Injury Prevention and Control

At least five million people die each year from injuries, and about half the deaths in the 10–24 years age group are accountable to them. This is a major health problem, for which a number of strategies for prevention and control can be developed.

This book presents a series of the plenary and state-of-the-art presentations from the 5th World Conference on Injury Prevention and Control. There is a focus on transportation, the workplace, sport and leisure, domestic sectors and violence. There is also an exploration of the legal, medical, environmental, safety and governmental issues which play a part in the subject.

The contributors have examined their themes from an international perspective and also suggested guidelines for the future. Practitioners and researchers in a variety of activities (including epidemiology and public health, occupational safety and health, ergonomics and product design, medicine, criminology, engineering and physical sciences, and the behavioural sciences) should find this a useful and challenging work.

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Injury Prevention and Control

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Preface

This book is being published on the occasion of the Fifth World Conference on Injury Prevention and Control to be held in the first year of the twenty-first century.

According to all estimates, non-communicable diseases will be a major cause of morbidity and mortality in all parts of the world in the next century. Intentional and unintentional injuries will be associated with a significant proportion of this burden of health. The control of this problem would depend on how much we can learn from each other, from different disciplines, from different income groups and different parts of the world.

Papers included in the volume reflect a wide variety of experiences, philosophies and ways of doing things. All except one will be presented at the Fifth World Conference as plenary or state-of-the-art lectures. We have included William Haddon’s paper because of his lasting and important contribution to the field of injury control.

Haddon insisted that injury is a public health problem and must be dealt with as such. Many societies, but not enough, have already recognized this and included injury control in their health policies. Such policies are already showing positive results. Other researchers have also stressed the role of societal and organizational structures in determining the level of safety in our world. It is clear that just blaming the individual or trying to reform him cannot solve the problem. To ensure a safer environment around us we need to pay much more attention to changing designs, structures and the relative power of different stakeholders in society.

Our objective in putting these papers together is to bring a broad understanding of the state-of-the-art knowledge in the field and to explore future directions. The chapters fall into three broad groupings: injury control and societal imperatives; survey of current knowledge and possibilities for future action; use of different theoretical techniques in injury control and the need for innovation in these techniques.

It is clear to us that injury control research needs to move beyond routine collection of data and analysis. All safety counter-measures have to be put in place by law makers and accepted by the people. This is why the interface between science, society and technology is critical in this endeavour. Obviously, this increases the complexity of our task. We hope that this volume helps professionals in meeting the challenges of injury control in the new millennium.

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INJURY CONTROL, SOCIETY AND ETHICS

Injury control, safety of individuals and societal arrangements are all interlinked. William Haddon wrote seminal pieces on the folly of focusing on ‘human error’ as the main cause in the occurrence of accidents (Haddon, 1968; 1970; 1972; 1973; 1974; 1980). He did not like the use of the word ‘accident’ as he thought that this leads to a feeling of inevitability in the occurrence of these incidents. Further, he was convinced that the term ‘accident prevention’ was too limiting and prevented the evolution of other safety counter-measures useful in limiting the severity of injury and in injury management after the event. Instead, he promoted the use of the phrase ‘injury control’ as being more neutral and scientific. But, he did not address the issues of ideology and the power of elites that societies are influenced by.

Perrow (1994, 1999) on the other hand, agrees with Haddon that individuals cannot always be held responsible for ‘human error’ under the system they operate in but provides a more sophisticated model of systemic imperatives: ‘I wish to point away from the basic and pervasive sin identified by those who casually examine organizational failures, that of operator error; this is given as the cause of about 80 per cent of the accidents in risky systems. I would put it at under 40 per cent. I will suggest that what is attributed to operator error stems primarily from the structure they operate in, and thus, stems from the actions of elites. Elite errors and elite interests stem from their class and historical power positions in society, and changes in these positions are glacial’ (Perrow, 1994).

Obviously, societal responsibility in the control of injuries becomes paramount when the problem is stated in these terms. Morbidity and mortality due to injuries have always existed in the past but their recognition as a public health problem is a phenomenon of the mid-twentieth century. Policy makers and safety professionals in every country find it very difficult to institute changes which actually result in a dramatic decrease in fatalities due to injuries. This is mainly because experience shows that individuals do not follow all the instructions given to them to promote safety. Attempts to educate people regarding safety are also not very effective and wide variations are found between people’s knowledge and their actual behaviour (Robertson, 1983). This is particularly true for those situations where we cannot select the people who will be involved in a particular activity. For example, almost everyone is involved in domestic chores, in road use and working in offices, factories or on farms. It is not possible to select people who will
always be careful in performing these activities. While some control can be exercised in licensing drivers of motor vehicles, almost no control is possible in selection of pedestrians and bicyclists. At the work place, only some very specialized jobs allow careful selection and monitoring. This makes it very difficult to promote safety by relying on improvements in individual behaviour and makes injury control a very complex process. This is illustrated by using road traffic as an example.

Almost all the persons in the school-going and working age groups have to be on the road at least twice a day in every country. This forces many individuals to use the road even when they are not adequately equipped to do so. These situations would include individuals with any of the following problems:

- Those who unable to concentrate on the road because they have suffered a personal tragedy recently, such as death of a loved one, loss of a job, failure in an important examination, monetary loss.
- Those who are disturbed because of problems in personal relationships with a spouse, parent, sibling or close friend.
- Persons taking medication or drugs which alter behaviour and perceptual abilities, or those who are under the influence of alcohol.
- Children whose cognitive and locomotor abilities make it difficult for them to understand or follow instructions given to them.
- Elderly people whose motor and cognitive functions are impaired.
- Disabled persons who have to be a part of regular traffic if they have to earn a living.
- All psychologically disturbed persons who may not be able to function as desired on the road but who cannot be singled out from participation in traffic.

Therefore, we have a societal and moral responsibility to design our products, environment and laws so that people find it easy and convenient to behave in a safe manner without sacrificing their needs to earn a living and fulfill their other societal obligations.

If we add up the total number of individuals who could be included in these categories on any given day it would amount to a significant proportion of people on the road (say, 20–30 per cent). These individuals cannot always be identified or prevented from using the road space. At the same time it is also a fact that their presence on the road is not out of choice, but a compulsion. In our modern ways of living we have to use products and do things at places and at times which are determined by someone else or by the society at large. The same holds true for activity at the work place or even at home. A large number of us have little choice in the design of the home we live in, the design of the tools we use, or the work place where we spend a major part of the day.

Therefore, we have a societal and moral responsibility to design our products, environment and laws so that people find it easy and convenient to behave in a safe manner without sacrificing their needs to earn a living and fulfill their other societal obligations. The systems must be such that they are safe not only for ‘normal’ people but also for those individuals who might belong to any of the groups of people having
problems. These kinds of designs, rules and regulations would reduce the probability of people hurting each other or themselves even when they make mistakes. Such systems are very often referred to as ‘forgiving’ systems.

Such systems cannot be put in place unless there is a societal and political understanding about the ethical and moral responsibility of the state and civil society to ensure the right to life of all its citizens. This right to life includes living in good health according to currently available knowledge and technology. A document prepared recently by safety professionals summarizes some of these issues as follows (Maurice et al., 1998):

- Safety is a fundamental human right.
- Safety is a state in which hazards and conditions leading to physical, psychological or material harm are controlled in order to preserve the health and well-being of individuals and the community. It is an essential resource for everyday life that an individual and a community need in order to realize their aspirations.
- There are two dimensions to safety: one is objective and assessed by behavioural and environmental objective parameters and the other is subjective and appreciated according to the feeling of safety of the population. Both dimensions can influence each other either positively or negatively. It is therefore necessary to consider these two dimensions to improve the safety of the population.
- Safety is a pre-requisite to the maintenance and improvement of the well-being and health of the population. It is the result of a dynamic balance that is established between the different components within a specific setting.

**INJURY CONTROL, PUBLIC HEALTH AND TECHNOLOGY**

Once we accept that injury control is a public health problem and that we have an ethical responsibility to arrange for the safety of individuals, then it follows that we also incorporate the lessons learned from our experience of the past few decades. We know that drinking water should be purified at its source; it is unreasonable to expect everyone to boil water before drinking it. Those societies which depend upon individuals to purify their own drinking water suffer from much higher rates of communicable diseases than those which purify water at source. Ironically, it is quite common to create a product or environment which is likely to cause injury, warn the user to be careful, and then blame the user if a mishap occurs. We would never tolerate a person who introduced cholera germs in the city water supply and then ‘educated’ every citizen to boil water before drinking it with the argument that those who knowingly do not do so would then be responsible for getting sick. This is the argument we all too often use when dealing with matters concerning safety. We put in place hazardous roads, vehicles and driving rules, and then expect road users to be safe by behaving in some ideal manner.

Once we are clear that injury control activities involve the same principles as any other public health problem, then we can institute policies and programmes for
institutionalizing safety promotion. However, most models of safety promotion and community action have their origins in the high income countries (HIC) and it is assumed that similar measures would work in the low income countries (LIC) also. Many of these policies are heavily dependent on introduction of expensive technologies and difficult regulation and legislation enforcement systems. Therefore, the transfer of ‘knowledge’ from HICs to LICs is sometimes almost impossible. However, we forget that many advances in public health in the control of communicable diseases took place before the invention of the modern definitive disease control drugs and vaccines.

Figure 1 Decrease in disease specific mortality rates in USA 1900–1980 (Data from Sathyamala et al., 1986)

Figure 1 shows the decrease in disease specific mortality rates in USA, 1900–1980. This data show that medical interventions for measles, scarlet fever, tuberculosis and poliomyelitis were introduced when the incidence rates had already declined considerably (Sathyamala et al., 1986). None of these death rates, except polio, show as marked a decline after the medical intervention as before. There is enough other evidence available to show that improvements in public health involve much more than just the introduction of new technologies and treatment methods. For example, in India the crude death rate declined from 47.2 per thousand per year in the decade of 1911–1921 to 27.4 for the decade 1941–1951 (Government of India, 1983). This 42 per cent reduction in death rates over three decades in India took place when most medical technologies were not available to a vast majority of the country’s population. These reductions took place because of improvements in environmental and other social conditions.

safety is a pre-requisite to the maintenance and improvement of the wellbeing and health of the population
Disease is the product of social, economic and technological environments that people live in. Within this environment the power to take decisions regarding choices available for one’s own well being and the power to influence other people’s lives plays an important role in what health benefits are available to the society as a whole. The same holds true for injury control and safety promotion.

Injury control activities will not be successful around the world unless we address these issues of social, economic and technological environments and the power available to people to influence decision making regarding their own well being. The lower the income of a society, the more important it becomes for injury control counter-measures to be instituted at the societal and system level. Many of the current approaches in injury control do not give enough importance to these aspects of the problem. They focus on control at the product or environmental design levels or in the establishment of safety standards without looking at the ability of a society to influence or sustain these activities. Success in promoting safety in LICs is further limited because LIC systems happen to be more complex than those obtaining in HICs. We cannot wait for all communities to become rich before they can avail of the same systems. The history of Public health shows that it should be possible for our lives to be safer in all communities before the introduction of new expensive technologies and expensive societal arrangements.

**Societal complexity and injury control**

The following factors played an important role in instituting safety programmes and policies in HICs:

- *Decline of mortality due to infections and contagious diseases.* This made the community more aware of injuries as a health problem and therefore gave support to injury control initiatives as a priority.
- *Development of a middle class society.* By the mid-eighties a significant majority of Europeans had incomes which would define them as ‘middle class’. At the same time an equalization process took place which made most professionals ‘equals’. This meant that policemen, school teachers, doctors, nurses, lawyers, university professors could sit around a table and actually communicate and respect each other as equals. Cooperation between various interest groups, law enforcers, policy makers and policy implementers then becomes more possible. These processes resulted in conglomerations of people which could be called ‘communities’ in a real sense. Most counter-measures for injury control benefit large proportions of the community. It can also be assumed that particular counter-measures would not harm some sections of the population since there are less conflicts of interest by different class categories.
- *Acquisition of decision making powers by local self governments.* Over time local communities have been able to acquire decision making powers over most aspects of community life, owing to national governments’ inclination to decentralize policies that relate closely to the citizens’ well being. This gives them the confidence to attempt changes.
• Establishment of institutions and organizations with high degree of expertise. This makes it possible for reasonably accurate and reliable data to be collected. These data can then be used for policy making purposes with support from most sections of society.

• Laws can be enforced. Because of the relative egalitarian structure of society it is assumed that most laws would affect most people in a similar manner. Since the law enforcers belong to the same social stratum as the general public it becomes possible to enforce laws more efficiently and more uniformly.

• Availability of safer technologies. Most technologies are developed and their designs controlled by the wider society where they are needed. Such technologies are more in tune with the needs of the community and can be changed if necessary.

• Safety standards can be enforced. Since most production is centralized, it is possible to make standards and enforce them.

In most LICs at present many of these conditions are not met. Some characteristics of LICs are as follows:

• Heterogeneity. The post-war period has witnessed the emergence of a very large number of independent nation-states in Africa and Asia. Most of these nation-states had never existed in the present form ever before in history. Many of these countries came into existence, most of them have very mixed population. These population may differ in religions, languages, common law, social customs and may not have shared values. The urban areas in these countries house people with very diverse backgrounds and so there may be very little homogeneity. In many cities in LICs people live in developments characterized by ethnic and religions bonds.

infections, contagious diseases, and other health problems due to malnutrition, air and water contamination, parasites, mosquitoes and unsafe work conditions, dominate the attention of the public and policy makers. Under such circumstances it becomes very difficult to arrive at a consensus to consider injuries as an important public health problem

• Inadequate public health facilities. Most LICs have not been able to institutionalize twentieth-century levels of hygiene and public health. Infant mortality and maternal mortality indices remain much higher than those in HICs. In addition, infections, contagious diseases, and other health problems due to malnutrition, air and water contamination, parasites, mosquitoes and unsafe work conditions, dominate the attention of the public and policy makers. Under such circumstances it becomes very difficult to arrive at a consensus to consider injuries as an important public health problem.

• Hierarchical societies. Most LICs have not been able to achieve high enough levels of economic growth over the past four decades. Low economic growth combined with nonegalitarian ideologies result in very low levels of upward mobility. The poorer sections of society remain dominant in terms of proportions of the population, but they have little influence on setting the policy
agenda. Within institutions the hierarchy also gets in the way of the dialogue needed for smooth functioning. Teachers, nurses, policemen occupy low social status as far as decision making is concerned. They hardly ever get to sit at the same table where bureaucrats and experts discuss policies and take decisions.

- **Inadequate control over technology.** Most LICs import almost all technological products and processes from HICs. Even aid projects ensure movement of technology from the donor to the receiver. Very often this technology is old or less expensive, and therefore, more hazardous. Local communities have almost no control over the choice of these technologies. For example, when a highway project is executed, the design and construction are done by people who belong to the metropolis of that country aided by experts from multilateral or bilateral international agencies and multinational corporations. The local community can hardly influence the execution of these projects except in the form of protests to halt the construction or change the location of the highway. Most of the time they do not have the expertise or the power to influence design. In addition, the local community may not possess the expertise to evaluate the hazards implicit in the designs of products or technologies being put in place.

- **Increase of complexity in social and technological systems.** Over the past few decades standardization of and homogenization of technologies has resulted in the reduction of complexity in many sectors in HICs. The roads have become identical in layout and design, vehicles have become similar, variety of vehicles has been reduced, school designs for most sections of the population are becoming similar, technologies used in houses are similar and the labour component in industry and farming has reduced. This reduction in complexity has made it somewhat easier to institute safety counter-measures.

On the other hand, in most LICs, both social structures and technologies include a great deal of variety which leads to more complex systems. The most modern vehicles share the same road space with non-motorized transport, modern gadgets are used in a traditional kitchen, inadequately trained labour is forced to handle high energy chemicals and equipment, and mechanized systems co-exist with labour intensive ways of living. These issues concerning increasing complexity in LICs is discussed in the following section.

**Consequences of increasingly complex systems in LICs**

Systems which have unfamiliar feedback loops, many potential interactions, indirect or inferential information sources, and limited understanding of some processes are considered to be more complex than those with the opposite characteristics (Perrow, 1999). These characteristics of LICs show that these countries tend to have more complex social and technological environments than those present in HICs. The most important issue to be understood regarding increasingly complex systems in LICs is that these societies face new problems which are different from those currently prevalent in HICs. They also have little precedence in the past of the HICs. It is not usually possible to find solutions from the past of HICs and transfer these old solutions to LICs today.
The complexity in the socio-political domain is a result of centralized decision making systems of nation-states and local government bodies not being able to accommodate the interests of the poorer sections of society. This happens because the individuals who take decisions are getting increasingly insulated from the daily lives and concerns of disadvantaged communities. Ease in international travel and instantaneous communication links between elite groups around the world tends unifies their interests and concerns. In earlier centuries and the first few decades of the present century there was greater conflict between the elite groups across nation-states than there exists today. This interaction and solidarity between richer sections of society in different communities and the conflicts between the poor sections within and across communities is at the expense of the interests of the poor.

The interests of poor communities can also be in direct conflict with the interests of the richer ones. Providing safety at the work place to prevent a small number of injuries and deaths may reduce the profits of the owner and the shareholders of the company. Slowing down traffic and providing a larger number of safer pedestrian crossings annoy car owners. Providing low-cost housing for low income groups takes away expensive land for making larger houses for the richer ones.

These problems are further compounded by the fact that the global information exchange makes poor people more aware of the latest happenings all over the world and raises their expectations for fair play. This results in more conflict in society making governance more difficult. Known counter-measures for safety demand the use of latest technologies which may or may not be suitable for the problem at hand. Innovative technologies need to be developed, but most LICs do not at present have the scientific pool of manpower or the institutional structure to develop these new technologies. A result of injury control work still not being perceived as an activity requiring sophisticated scientific and academic input. So communities end up trying out one unsuccessful ‘solution’ after another. This promotes a feeling of helplessness, powerlessness and lack of trust in policy makers. Not an ideal situation for ‘community’ action.

What needs to be understood is that the theoretical base of injury control counter-measures may have international applicability but the actual physical solutions may not. There is clearly a poverty of theory for work around the globe. For example, most road safety measures instituted in HICs have centred around the automobile and the automobile occupant. Road and intersection designs are based only on car, bus, and truck movement. Roads in LICs are dominated by motorcycles, human-powered vehicles, pedestrians carrying loads and locally-designed vehicles. No traffic flow models and computer programs are able to account for this mix. Even if all the solutions developed in HICs were put in place on the roads of LICs, the decrease in fatality rates would not be of the same magnitude as experienced in the HICs.

A good example of this is the role of expressways in inter-city travel. When an
expressway is built through the countryside it divides the landscape into separate zones. People from one side of the expressway cannot go to the other side of the expressway easily on foot or on a bicycle. In HICs this does not pose a serious problem as most people possess motorized transport. However, in LICs the countryside may be heavily populated on both sides of the expressway by people of low income who need to interact with each other. They need to cross the expressway carrying or pulling heavy loads. In such a situation they do not like to go long distances to cross the expressway at designated overbridges or underpasses. They end up breaking the fences and crossing the expressway at locations convenient for them. This makes the expressway much more hazardous for everyone concerned. The decision makers come from a different strata of society who are only concerned with increasing the flow of inter-city motor traffic and see the villagers as impediments to ‘progress’. This is just one example showing the inherent conflict among different ‘communities’ and the difficulties inherent in promoting a safer environment for everyone.

**SCIENTISTS, SOCIETY AND INJURY CONTROL**

The discussion in the previous section highlights the complex issues involved in dealing with public health problems at different income and organizational levels. A further complication is the role of scientists in dealing with issues concerning changes in technology and policy at the societal level. Accompanied by the ‘globalization’ of the economy is the globalization of the measure of scientific competence irrespective of the location where the professionals work. Pressures on scientists force them to try and maintain ‘high standards’ judged by the concerns of HICs. At times this works against the interests and the needs of the many in order to concentrate on the conditions of the few holding economic power. It will not be easy to change this state of affairs without understanding the changing role of scientists and their interaction with society.

Safety promotion requires a great deal of understanding between scientists, the public and policy makers they seek to address. A very large number of findings in the injury control area are counter-intuitive: limitations of education, lack of effectiveness of severe punishment for violators of safety norms, low correlation between attitude and behaviour of individuals, some safer technologies promoting riskier behaviour, etc. In this situation large doses of ‘science’, especially through the mass media, does not enable people to digest information adequately as experts disagree on many issues. Within this confusion, it is very convenient for vested interests to introduce political and business agenda in the guise of technical and cost-benefit analyses. The citizen is left with little except cynicism as she has no competence to examine competing claims. Discussing the problems inherent in the public understanding of science, Raina (1999) claims that, ‘The scientists’ understanding of science is a very limited aspect of a more complex web of understanding that weaves together science and society… We all grew up with the image of science as disinterested investigation. But this image of science has been bruised and science is now projected as serving vested interests… Studies on scientific controversies reveal that every time a controversy erupts, the reserves of trust available within the community of science are exposed, and there is a corresponding change in the social
authority of science… Thus both trust and judgement, central and enduring characteristics of academic science, are rendered suspect in practical circumstances.’

These concerns become particularly relevant for those involved in injury control and safety promotion because very few safety policies can be put in place without political support and public agreement. This necessitates the engagement of at least some scientists in the public domain. Traditional research activity, especially in universities, was confined to the academic world without frequent interaction with users of the knowledge. However, effective injury prevention and control work cannot be done in the confines of academia and needs the practitioner to engage professionals in other disciplines along with civil society. This mode of operation is relatively new and has been characterized by Gibbons et al. (1994) as ‘socially distributed knowledge’. The differences between ‘traditional knowledge generation’ and ‘socially distributed knowledge’ is shown in Table 1.

<table>
<thead>
<tr>
<th><strong>TRADITIONAL KNOWLEDGE GENERATION</strong></th>
<th><strong>SOCIALLY DISTRIBUTED KNOWLEDGE</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Production sites</strong></td>
<td>Problems set and solved by academic interests of a specific community</td>
</tr>
<tr>
<td><strong>Nature</strong></td>
<td>Disciplinary</td>
</tr>
<tr>
<td><strong>Characteristic</strong></td>
<td>Homogeneity</td>
</tr>
<tr>
<td><strong>Organization</strong></td>
<td>Hierarchical</td>
</tr>
<tr>
<td><strong>Social feedback</strong></td>
<td>Individualistic, emphasizes autonomy</td>
</tr>
<tr>
<td></td>
<td>Context of application</td>
</tr>
<tr>
<td></td>
<td>Transdisciplinary</td>
</tr>
<tr>
<td></td>
<td>Heterogeneity</td>
</tr>
<tr>
<td></td>
<td>Heterarchical and transient</td>
</tr>
<tr>
<td></td>
<td>More socially accountable and reflexive</td>
</tr>
</tbody>
</table>

Injury control scientists work on generation of socially distributed knowledge. Such knowledge is difficult to produce and even more difficult to disseminate in an effective manner. It is difficult to produce because of its transdisciplinary, heterogeneous, heterarchical and transient characteristics. The work requires not only people in different disciplines working together but also the integration of knowledge generated by professionals who have no personal contact with each other. The actual operation of research projects may involve individuals who are not controlled by a single authority figure. In addition these scientists could also be working under very different paradigms and who may also have very heterogenous working methods. Scientific work under such conditions does not have a long history and tradition and so the methods and approaches used are in a nascent stage of evolution.

Injury control research fits this description of socially distributed knowledge rather adequately. Such work needs very innovative working techniques and the same are being
evolved slowly. The present institutional structures, collaboration mechanisms for intradisciplinary research, peer recognition methods, information dissemination and sharing techniques, and structures for interaction between scientists and the public are still somewhat weak. The better structures and methodologies will become apparent only if we consciously evaluate experiences, successes and failures in widely different societies and settings and spread our net much wider than at present.

**THE WAY FORWARD**

This re-focusing of our efforts will not be easy. The international scientific community still does not view much of the work being done for injury control as ‘sophisticated’ enough. However, this view is likely to change as we become more adept at generating ‘socially distributed knowledge’ and our work leads to benefits for a larger proportion of the population around the world. Though most of the principles we discover will have universal applicability, many of the technologies and specific methods may not. Some critics may still not regard research work on many of these non-global technologies to be ‘modern’ or ‘scientific’ enough. However, the contrary is true. The issues surrounding these products are actually very modern. They are the products of the late twentieth century—combination of new socio-economic living patterns, instantaneous global communication, availability of sophisticated scientific knowledge and low per capita incomes. Work on these technologies will require very innovative thinking, familiarity with the latest scientific information, and packaging of products in ways which may require combination of technologies already available with those developed by locally in new settings. Unless we change our research and development activities in this direction we are likely to end up with very inefficient technological systems in our society. Our success in future will depend on how much we are willing to learn from each other and blending perspectives rather than working in our narrow confines of ‘science’.

Such changes will require much greater efforts to integrate theory with practice. Current trends in injury control are giving prime importance to data generation, surveillance and epidemiology. More and more sophisticated statistical methods are being used to analyse these data resulting in debates on micro-issues of methodology and definitions. Such work is also rewarded by journal editors and the scientific peer group in the form of published articles and recognition. However it need not result in deeper insight needed for socially generated knowledge. It is difficult to write a prescription for the future course of action, but the following guidelines may help us stumble onto the right path.

- A conscious effort to examine the theoretical directions in disciplines which do not have much involvement in injury control at present. Theories on complexity in physics, mathematics and computer science may help us
understand the behaviour of the system that we want to make safer. Work in evolution, biology and genetics may give us clues on how natural systems behave. Linguists and philosophers of science could lead us to a better understanding of the role of metaphors and symbols in the building of knowledge. This transdisciplinary work would need the development of arrangements for information exchange even when partners are not involved in work on the same problem.

- Development of a better understanding of the needs, aspirations, compulsions and operational mechanisms of people belonging to low income communities. Only then would it be possible to promote safety policies which are sustainable in such settings. Such communities form the majority of the world population and also exist in a minority in HICs. They are the norm rather than the exception.

- Institution of imaginative collaborative projects between researchers working in low and high income communities. Since safety counter-measures in LICs have to be low cost, such projects could provide to useful insight on reduction of safety expenditures in HICs with evolution of innovative ideas and products. Joint working in LICs and HICs would give a better understanding of the characteristics of ‘natural’ systems.

- Exploration of societal arrangements and technologies which ensure safer lives with minimum policing.

- Promotion of safety as a fundamental human right. Inclusion of the costs of safety in the basic design of products, infrastructure, roads, buildings and work places. These considerations would decide whether any of these items should be put in place or not.

REFERENCES


On the Escape of Tigers: An Ecological Note

William Haddon, Jr.

A major class of ecologic phenomena involves the transfer of energy in such ways and amounts, and at such rapid rates, that inanimate or animate structures are damaged. The harmful interactions with people and property of hurricanes, earthquakes, projectiles, moving vehicles, ionizing radiation, lightning, conflagrations, and the cuts and bruises of daily life illustrate this class.

TEN STRATEGIES FOR REDUCING THESE LOSSES

Several strategies, in one mix or another, are available for reducing the human and economic losses that make this class of phenomena of social concern. In their logical sequence, they are as follows:

The first strategy is to prevent the marshalling of the form of energy in the first place: preventing the generation of thermal, kinetic, or electrical energy, or ionizing radiation; the manufacture of gunpowder; the concentration of U-235; the build-up of hurricanes, tornadoes, or tectonic stresses; the accumulation of snow where avalanches are possible; the elevating of skiers; the raising of babies above the floor, as to cribs and chairs from which they may fall; the starting and movement of vehicles; and so on, in the richness and variety of ecologic circumstances.

The second strategy is to reduce the amount of energy marshalled: reducing the amounts and concentrations of high school chemistry reagents, the size of bombs or firecrackers, the height of divers above swimming pools, or the speed of vehicles.

The third strategy is to prevent the release of the energy: preventing the discharge of nuclear devices, armed crossbows, gunpowder, or electricity; the descent of skiers; the fall of elevators; the jumping of would-be suicides; the undermining of cliffs; or the escape of tigers. An Old Testament writer illustrated this strategy in the context both of the architecture of his area and of the moral imperatives of this entire field: ‘When you build a new house, you shall make a parapet for your roof, that you may not bring the guilt of blood upon your house, if any one fall from it’ (Deuteronomy 22:8). This biblical position, incidentally, is fundamentally at variance with that of those who, by conditioned reflex, regard harmful interactions between man and his environment as problems requiring reforming imperfect man rather than suitably modifying his environment.
The fourth strategy is to modify the rate or spatial distribution of release of the energy from its source: slowing the burning rate of explosives, reducing the slope of ski trails for beginners, and choosing the re-entry speed and trajectory of space capsules. The third strategy is the limiting case of such release reduction, but is identified separately because in the real world it commonly involves substantially different circumstances and tactics.

The fifth strategy is to separate, in space or time, the energy being released from the susceptible structure, whether living or inanimate: the evacuation of the Bikini islanders and test personnel, the use of sidewalks and the phasing of pedestrian and vehicular traffic, the elimination of vehicles and their pathways from community areas commonly used by children and adults, the use of lightning rods, and the placing of electric power lines out of reach. This strategy, in a sense also concerned with rate-of-release modification, has as its hallmark the elimination of intersections of energy and susceptible structure—a common and important approach.

There is no logical reason why the rank order…of loss-reduction counter-measures generally considered must parallel the sequence, or rank order, of causes contributing to the result of damaged people or property.

The very important sixth strategy uses not separation in time and space but separation by interposition of a material ‘barrier’: the use of electrical and thermal insulation, shoes, safety glasses, shin guards, helmets, shields, armour plate, torpedo nets, antiballistic missiles, lead aprons, buzz-saw guards, and boxing gloves. Note that some ‘barriers’, such as fire nets and other ‘impact barriers’ and ionizing radiation shields, attenuate or lessen but do not totally block the energy from reaching the structure to be protected. This strategy, although also a variety of rate-of-release modification, is separately identified because the tactics involved comprise a large, and usually clearly discrete, category.

The seventh strategy, into which the sixth blends, is also very important—to modify appropriately the contact surface, subsurface, or basic structure, as in eliminating, rounding, and softening corners, edges, and points with which people can, and therefore sooner or later do, come in contact. This strategy is widely overlooked in architecture with many minor and serious injuries the result. It is, however, increasingly reflected in automobile design and in such everyday measures as making lollipop sticks of cardboard and making some toys less harmful for children in impact. Despite the still only spotty application of such principles, the two basic requisites, large radius of curvature and softness, have been known since at least about 400 BC, when the author of the treatise on head injury attributed to Hippocrates wrote: ‘Of those who are wounded in the parts about the bone, or in the bone itself, by a fall, he who fails from a very high place upon a very hard and blunt object is in most danger of sustaining a fracture and contusion of the bone, and of having it depressed from its natural position; whereas he that fails upon more level ground, and upon a softer object, is likely to suffer less injury in the bone, or it may not be injured at all…’ (On Injuries of the Head, The Genuine Works of Hippocrates, trans. F. Adams [The Williams and Wilkins Co., Baltimore, 1939]).

The eighth strategy in reducing losses in people and property is to strengthen the structure, living or non-living, that might otherwise be damaged by the energy transfer.
Common tactics, often expensively under-applied, include tougher codes for earthquake, fire, and hurricane resistance, and for ship and motor vehicle impact resistance. The training of athletes and soldiers has a similar purpose, among others, as does the treatment of haemophiliacs to reduce the results of subsequent mechanical insults. A successful therapeutic approach to reduce the osteoporosis of many post-menopausal women would also illustrate this strategy, as would a drug to increase resistance to ionizing radiation in civilian or military experience. (Vaccines, such as those for polio, yellow fever, and smallpox, are analogous strategies in the closely parallel set to reduce losses from infectious agents.)

The ninth strategy in loss reduction applies to the damage not prevented by measures under the eight preceding—to move rapidly in detection and evaluation of damage that has occurred or is occurring, and to counter its continuation and extension. The generation of a signal that response is required; the signal’s transfer, receipt, and evaluation; the decision and follow-through, are all elements herewith whether the issue be an urban fire or wounds on the battlefield or highway. Sprinkler and other suppressor responses, fire doors, MAYDAY and SOS calls, fire alarms, emergency medical care, emergency transport, and related tactics all illustrate this counter-measure strategy. (Such tactics have close parallels in many earlier stages of the sequence discussed here, as, for example, storm and tsunami warnings.)

The tenth strategy encompasses all the measures between the emergency period following the damaging energy exchange and the final stabilization of the process after appropriate intermediate and long-term reparative and rehabilitative measures. These may involve return to the pre-event status or stabilization in structurally or functionally altered states.

**SEPARATION OF LOSS REDUCTION AND CAUSATION**

There are, of course, many real-world variations on the main theme. These include those unique to each particular form of energy and those determined by the geometry and other characteristics of the energy’s path and the point or area and characteristics of the structure on which it impinges—whether a BB hits the forehead or the centre of the cornea.

One point, however, is of overriding importance: subject to qualifications as noted subsequently, there is no logical reason why the rank order (or priority) of loss-reduction counter-measures generally considered must parallel the sequence, or rank order, of causes contributing to the result of damaged people or property. One can eliminate losses in broken teacups by packaging them properly (the sixth strategy), even though they be placed in motion in the hands of the postal service, vibrated, dropped, piled on, or otherwise abused. Similarly, a vehicle crash, per se, need necessitate no injury, nor a hurricane housing damage.

Failure to understand this point in the context of measures to reduce highway losses underlies the common statement: ‘if it’s the driver, why talk about the vehicle.’ This confuses the rank or sequence of causes, on the one hand, with that of loss-reduction counter-measures—in this case ‘crash packaging’—on the other.
There are, nonetheless, practical limits in physics, biology, and strategy potentials. One final limit is operative at the boundary between the objectives of the eighth and ninth strategies. Once appreciable injury to man or to other living structure occurs, complete elimination of undesirable end results is often impossible, though appreciable reduction is commonly achievable. (This is often also true for inanimate structures, for example, teacups.) When lethal damage has occurred, the subsequent strategies, except as far as the strictly secondary salvage of parts is concerned, have no application.

There is another fundamental constraint. Generally speaking, the larger the amounts of energy involved in relation to the resistance to damage of the structures at risk, the earlier in the counter-measure sequence must the strategy lie. In the ultimate case, that of a potential energy release of proportions that could not be countered to any satisfactory extent by any known means, the prevention of marshalling or of release, or both, becomes the only approach available. Furthermore, in such an ultimate case, if there is a finite probability of release, prevention of marshalling (and dismantling of stockpiles of energy already marshalled) becomes the only, and essential, strategy to assure that the undesirable end result cannot occur.

**FOR EACH STRATEGY AN ANALOGOUS OPPOSITE**

Although the concern here is the reduction of damage produced by energy transfer, it is noteworthy that to each strategy there is an opposite focused on increasing damage. The latter are most commonly seen in collective and individual violence—as in war, homicide, and arson. Various of them are also seen in manufacturing, mining, machining, hunting, and some medical and other activities in which structural damage often of a very specific nature is sought. (A medical illustration would be the destruction of the anterior pituitary with a beam of ionizing radiation as a measure to eliminate pathological hyperactivity.)

For example, a maker of motor vehicles or of aircraft landing-gear struts—a product predictably subject to energy insults—could make his product more delicate, both to increase labour and sales of parts and materials, and to shorten its average useful life by decreasing the age at which commonplace amounts of damage increasingly exceed in cost the depreciating value of the product in use. The manufacturer might also design for difficulty of repair by using complex exterior sheet metal surfaces, making components difficult to get at, and other means.

The type of categorization outlined here is similar to those useful for dealing systematically with other environmental problems and their ecology. In brief illustration, various species of toxic and environment-damaging atoms (such as lead), molecules (e.g. DDT), and mixtures (garbage and some air pollutants, among others) are marshalled, go through series of physical states and situations, interact with structures and systems of various characteristics, and produce damage in sequences leading to the final, stable results.
Similar comments can be made concerning the ecology of some of the viral, unicellular, and metazoan organisms that attack animate and inanimate structures; their hosts; and the types and stages of damage they produce.*

Sufficient differences among systems often exist, however—for example, the ecology of the agents of many arthropod-borne diseases is quite complex, and the life cycles of organisms such as schistosomes require two or more different host species in sequence—to preclude at this time many generalizations useful across the breadth of all environmental hazards and their damaging interactions with other organisms and structures.

A SYSTEMATIC ANALYSIS OF OPTIONS

It has not generally been customary for individuals and organizations that influence, or are influenced by, damage due to harmful transfers of energy to analyse systematically their options for loss reduction, the mix of strategies and tactics they might employ, and their cost. Yet, it is entirely feasible and not especially difficult to do so, although specific supporting data are still often lacking. In fact, unless such systematic analysis is done routinely and well, it is generally impossible to maximize the pay-offs both of loss-reduction planning and of resource allocations.

Such analysis is also needed to consider properly the problems inherent in the use of given strategies in specific situations. Different strategies to accomplish the same end commonly have different requirements; in kinds and numbers of people, in material resources, in capital investments, and in public and professional education, among others. In the case of some damage-reduction problems, particular strategies may require political and legislative action more than others. And, where the potential or actual hazard exists across national boundaries, correspondingly international action is commonly essential.

The types of concepts outlined in this note are basic to dealing with important aspects of the quality of life, and all of the professions concerned with the environment and with the public health need to understand and apply the principles.

*Actual and potential birth control and related strategies and tactics can be somewhat similarly categorized. Thus, in brief, beginning on the male line: preventing the marshalling of viable sperm (by castration or certain pharmacological agents); reducing the amount of sperm produced; preventing the release of semen (or of one of its necessary components, e.g. by vasectomy); modifying the rate or spatial distribution of release of semen (as in hypospadias, a usually developmental or traumatic condition in which the urethra opens on the underside of the penis, sometimes near its base); separating semen release in space or time from the susceptible ovum (e.g., continence, limiting intercourse to presumably non-fertile periods, coitus interruptus, and preventing a fertile ovum from being present when sperm arrive); separation by interposition of a material barrier (e.g. condoms, spermicidal creams, foams, jellies); increasing resistance of the ovum to penetration; making the ovum infertile, even if penetrated; prevention of implantation of the fertilized egg; abortion; and infanticide involved and not in the haphazard, spotty, and poorly conceptualized fashion now virtually universal. It is the purpose of this brief note to introduce the pathway along
On the escape of tigers

which this can be achieved

SUGGESTED READINGS


W. Haddon, Jr., 1970, Why the issue is loss reduction rather than only crash prevention, presented at the *Automotive Engineering Congress*, S.A.E., Detroit, Michigan, January 12, S.A.E. Preprint 700196.


W. Haddon, Jr., E. A. Suchman, and D. Klein, *Accident Research, Methods and Approaches*, Harper and Row, 1964. (See especially Chapters 9 and 10).
3
Where Have We Been and Where are We Going With Injury Control?

Susan P. Baker

INTRODUCTION

I would like to begin this paper by discussing where we have been as we have travelled the road to injury prevention. And although that is a fascinating story, I am even more interested in discussing where we are now: what are we doing right, what are we doing wrong? And, the most important part, where are we going? How can we best achieve freedom from preventable injury, disability, and death for people throughout the world?

WHERE HAVE WE BEEN?

The history of injury control goes back many thousands of years. Prehistoric man may not have understood the concepts of injury control, but he had an instinct for self-preservation that led him to design tools with which he could not only slaughter wild animals, but protect himself from being slaughtered in the process.

Somewhat later, people used amulets for self-protection. They may not have been effective, but they reflected the need for protection against hazards that people recognized yet could not prevent—lightning-induced forest fires, hurricanes, drought, famine.

When man moved out of caves and into buildings he created new hazards. Dr. William Haddon often pointed out that the Old Testament warns that there should be a parapet or railing around the edge of a roof so that people could not fall off. (In Nepal and many other places where animals are housed on the ground floor, children still play on roofs with no walls, and injuries from falls are not uncommon.) Later, Leonardo da Vinci was to advise that the floors of buildings should be strong enough to withstand the vibrations when a building was shaken by people dancing.

Stephen Bradwell, in his 1633 book *Helps for Suddain Accidents*, provided an early text of first-aid advice, somewhat limited by the knowledge of his day. He recommends, for example, that if a viper creeps into your stomach, the remedy is ‘the smoake of burnt old shooes received in at the mouth through a funnell’ (Bradwell, 1633).

Perhaps that sets the stage for looking at recent decades, during which we have begun to take a far more scientific approach to injury control, following Dr. William Haddon’s emphasis on not only the pre-event phase, that we used to call ‘accident prevention’, but also the ability to prevent injury during the event phase while crashes, falls and shootings
are actually occurring, and in the post-event phase when emergency services, acute care, and rehabilitation can save lives and minimize disability (Haddon, 1972). Table 1 provides examples of strategies related to each of the phases.

Table 1
Examples of Factors Related to Injury Prevention on the Highway, in the Three Phases

<table>
<thead>
<tr>
<th>PHASES</th>
<th>HUMAN</th>
<th>VEHICLE</th>
<th>PHYSICAL AND SOCIAL ENVIRONMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-crash</td>
<td>Alcohol intoxication</td>
<td>Speed capability</td>
<td>Signs, lighting</td>
</tr>
<tr>
<td></td>
<td>Fatigue</td>
<td>Brakes</td>
<td>Road design</td>
</tr>
<tr>
<td></td>
<td>Training, experience</td>
<td>Centre of gravity</td>
<td>Speed limits</td>
</tr>
<tr>
<td></td>
<td>Knowledge</td>
<td></td>
<td>Alcohol laws</td>
</tr>
<tr>
<td>Crash</td>
<td>Use of seat belts</td>
<td>Airbags</td>
<td>Median barriers</td>
</tr>
<tr>
<td></td>
<td>Helmet wearing</td>
<td>Crashworthy design</td>
<td>Guardrails</td>
</tr>
<tr>
<td></td>
<td>Bone fragility</td>
<td>Occupant containment</td>
<td>Recovery areas</td>
</tr>
<tr>
<td>Post-crash</td>
<td>Age</td>
<td>Fuel system design</td>
<td>EMS system</td>
</tr>
<tr>
<td></td>
<td>Physical condition</td>
<td>Telephone</td>
<td>Medical and rehabilita services</td>
</tr>
<tr>
<td></td>
<td>First-aid knowledge</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Haddon’s conceptual advances were important, but the greatest achievement of recent decades, in my opinion, is the widespread recognition of injuries as a health problem and the increasing numbers of health professionals who are dedicated to reducing this problem.

Epidemiologists too often overemphasize the personal risk factors that differentiate between injured and uninjured people

WHERE ARE WE NOW?

A recent report of the Institute of Medicine, *Reducing the Burden of injury* (1999) documents some of the current inadequacies of American efforts to control injuries. These include the need for:

- Developing surveillance systems with uniform coding of the external cause and nature of the injury
- Creating opportunities for training injury prevention researchers and practitioners
- Planning, implementing, and evaluating trauma systems.
Most of these inadequacies are prevalent in other countries, both developed and underdeveloped. Countries may differ markedly in their available resources; they certainly differ in the specific circumstances of injury (for example, do young children drown in swimming pools or irrigation ditches?). Countries also differ in the degree to which people are protected by regulations and their enforcement.

A major similarity among countries, however, is in the importance of the injury problem. Throughout the world, after early childhood the mortality from injuries dwarfs other major causes of death for children and young adults. In the United States, China and many other countries, injuries are the leading cause of death from about age 1 to after age 40, yet in many countries injuries cause a far greater proportion of all deaths among people age 15 or older than in the United States (Table 2).

Table 2

Number of injury deaths, and injuries as a percentage of deaths from all causes* in the population 15 years in various Asian and Latin American countries with other countries for comparison

<table>
<thead>
<tr>
<th></th>
<th>ALL INJURIES</th>
<th>YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of deaths</td>
<td>Percentage of all deaths</td>
<td></td>
</tr>
<tr>
<td>SOUTHEAST ASIA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>China, rural</td>
<td>32,973</td>
<td>11</td>
</tr>
<tr>
<td>China, urban</td>
<td>22,173</td>
<td>6</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>11,421</td>
<td>14</td>
</tr>
<tr>
<td>AMERICAS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guatemala</td>
<td>3,548</td>
<td>12</td>
</tr>
<tr>
<td>El Salvador</td>
<td>5,428</td>
<td>27</td>
</tr>
<tr>
<td>Colombia</td>
<td>39,612</td>
<td>28</td>
</tr>
<tr>
<td>Mexico</td>
<td>50,107</td>
<td>15</td>
</tr>
<tr>
<td>Honduras</td>
<td>1,823</td>
<td>16</td>
</tr>
<tr>
<td>Ecuador</td>
<td>5,309</td>
<td>14</td>
</tr>
<tr>
<td>Chile</td>
<td>7,571</td>
<td>11</td>
</tr>
<tr>
<td>Cuba</td>
<td>7,979</td>
<td>12</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>1,705</td>
<td>10</td>
</tr>
<tr>
<td>Uruguay</td>
<td>1,676</td>
<td>6</td>
</tr>
<tr>
<td>Argentina</td>
<td>14,391</td>
<td>6</td>
</tr>
<tr>
<td>Venezuela</td>
<td>9,816</td>
<td>15</td>
</tr>
<tr>
<td>COMPARISON</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
What are we doing right?

One important improvement in recent years is the growing recognition that intentional injuries, both assaultive and self-inflicted, are components of the injury problem and in many respects can be prevented through the same means as unintentional injuries. We know this in theory because the same gun that can be turned upon oneself or another person by a teenager, or that can fire inadvertently when children are playing with it, can be kept from harming anyone by a device that allows only the owner to fire it. There is also evidence of the fact that a single preventive measure can prevent both intentional and unintentional injuries: for example, there was a huge drop in both unintentional and suicidal poisoning when poisonous coal gas was replaced by natural gas in the United States (Baker et al., 1992). In England, it was shown that this advance almost eliminated suicidal poisoning by gas, without a corresponding increase in suicide by other means (Hassall and Trethowan, 1972). I emphasize the fact that a single approach can reduce both intentional and unintentional injury because in countries such as Sri Lanka and China, agricultural poisons are used as a means of suicide by many despondent woman, at the same time killing curious children. I am optimistic that a single solution will be found to address these huge problems. Larry Berger and Dinesh Mohan (1996) have pointed to the potential value of national and multinational regulations that control the manufacture and sale of pesticides to prevent both intentional and unintentional poisonings.

What else are we doing that is right? Certainly we have seen advances in many countries in:

- The designs of vehicles to make them more crashworthy with seat belts, for example,
- Safer toys that are less likely be choking hazards for children,
• Child proof fencing around swimming pools, which caused a nine-fold difference in the child drowning rates between Canberra, which required the fencing, and Brisbane, which did not.

We have made great advances in reducing alcohol-involved crashes with legal approaches such as increasing the legal drinking age and lowering the legal alcohol level for drivers, laws that in the United States have helped to substantially reduce teenage driver mortality rates.

WHAT ARE WE DOING WRONG?

First, epidemiologists too often overemphasize the personal risk factors that differentiate between injured and uninjured people. In a case-control study of back injuries in municipal workers, my colleagues and I matched injured cases and their controls on the basis of their departments and jobs, and then studied the differences between them in hundreds of variables (Myers et al., 1999). Because we matched on the job, which is the biggest determinant of back injury, we found that the greatest differences were in personal factors such as the ratio of weight to height, and the workers’ attitude towards their jobs. We purposely had not made it possible to analyse the relative importance of their department and job as risk factors, because we knew that the huge difference among departments in rates of back injury would overwhelm other risk factors. Unfortunately, because of a design that obscured the effect of exposure to jobs that placed great strain on the back, the results of our study placed great emphasis on personal risk factors rather than aspects of the jobs that could be changed—inordinately heavy tree trunks and moving equipment that had to be lifted on to trucks, uncomfortable stooping positions from which they had to move or raise a load, etc. For purposes of prevention, it would have been ideal to have placed greater emphasis on reducing the hazards.

Recently I talked with epidemiologists who were perplexed by their inability to find differences between injured and uninjured military trainees. It turned out that the young men in question had all been selected for an elite group of uniformly young, fit, intelligent males to be trained for especially hazardous and demanding tasks. The training programme was incredibly vigorous and had a high injury rate. But the search for personal risk factors that would predict which members of this homogenous group would be injured was doomed to failure, and distracted the investigators from performing a descriptive study of the circumstances of injury that would have had far greater potential for injury reduction. (A hypothetical example illustrating the same phenomenon would look at 100 identical siblings in a building that caught fire and killed half of them and then focus on personal risk factors rather than comparing injured vs. uninjured in terms of where they were when the fire broke out in relation to the point of origin of the fire and likely escape routes.)

Thus, we need to avoid the temptation to overemphasize personal risk factors when the environment and circumstances of injury dictate not only who is hurt but also the best means to prevent the injury.
WHAT ELSE ARE WE DOING THAT IS WRONG?

Too often, we design our physical environment for smart people who are highly motivated to prevent injury. Virtually everything—from roads to hand tools to stoves to poison containers—is designed with the assumption that people can and will read, follow directions, proceed with caution, take no risks. Yet who are the people at highest risks? Young children, teenage males, the elderly, the intoxicated—in other words, the people who are hardest to influence with information and educational approaches.

Tragically, we have ignored the pressures that cause people to take risks:

- Peer pressure, that leads teenage drivers to take more risks when they have passengers to distract or challenge them (Chen, 1999)
- The pressures of competition—you have all seen the risks taken by athletes in the Olympics
- Productivity pressures—farmers rushing to harvest the hay before it rains
- Economic pressures that cause a poor man to accept the risks that go with a hazardous job so he can feed his family
- The most important pressures are time pressures: no one likes to waste time. That is why you see pedestrians darting across traffic lanes and drivers running red lights; most people take the quickest way, even when it is not the safest way.

FUTURE DIRECTIONS

This leads me to my final question: where are we going with injury control?

First of all, I hope we are going to begin to design our environment and our tasks in a manner that recognizes that most people have some kind of limitation—none of us is perfect all of the time—and that most of us at one time or are under some form of pressure that can lead us to take risks. This means, for example, that we should redesign many of our jobs, so that workers have fewer incentives to work unsafely. When Swedish lumbermen were paid by the hour, rather than by how many trees they cut or how much lumber they sawed, their injury rate dropped dramatically (Sundstrom-Frisk, 1984). It means designing roads that can be crossed safely by pedestrians because the safest way has been made the easiest way, for example by raising the road slightly so that pedestrians can pass beneath it rather that requiring them to climb many stairs with their packages, bicycles, and children.

Second, I hope we are going to stop blaming the victim, finding fault with the injured person so that we fail to reproach other people who might have prevented the injury-designers, manufacturers, administrators, and other decision makers whose decisions can determine the likelihood of injury for thousands of people.

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people to take risks

Asking the injured person about injury prevention can provide useful information, if the question is asked the right way. If you ask an injured farmer how he could have kept from losing an arm in a corn picker, he is likely to say ‘I shouldn’t have been so stupid.’ But if you ask him how he might keep his best friend or his son from being hurt the same way, he is more likely to say ‘Find a way to get the corn stalks unstuck without his even having to get off the tractor!’

We took this approach with the back-injured municipal workers I mentioned earlier and found they had sound suggestions, often the same ideas as the ones provided by a trained ergonomist who evaluated the circumstances of injury. Some of the suggestions offered by the workers on the sanitation crews when they were asked how to prevent injuries to their friends were: ramps to help them load mowing machines onto trucks, waist-high shelves for storing heavy boxes, and rollers to help them slide heavy food trays.

Third, and finally, I hope we will continue to learn from one another, through meeting and conferences as well as through collegial communication year-in and year out. We each have much to share, to teach, and to learn. It is essential that we not only profit from one another’s achievements, but also that we learn from one another’s mistakes. An example of how we have failed to do that in the past is the tremendous toll taken by motorization, in one country after another, because we have not heeded the fact that wide, straight, undivided highways without reasonable and enforced speed limits invite the mayhem of high-speed crashes.

An example of a way in which we can profit from other countries’ achievements is through product safety regulation. Until each country adopts regulations that set standards for safe products and prohibit the sale of hazardous products, whether domestic or imported within its borders, its citizens will not be safe from many preventable injuries. In the United States, we experienced one example of this when we failed to set standards for infant pacifiers. In Maryland, our medical examiner determined that babies were choking to death on undersized pacifiers. Through his efforts, Maryland set a standard that prohibited the sale of pacifiers smaller than a certain size. Elsewhere in the United States, however, small pacifiers could legally be sold, and these cheap imports were popular. Tragically, despite petitions to the Consumer Product Safety Commission to set a national standard, we did not get a national standard until more babies had died in other states.

A type of product safety standard that might well be popular in any country is one that keeps young children from being burned. No one who has ever seen a burned child wants to see another. Most of you have seen cooking, heating, and lighting devices that are extremely hazardous to little children: stoves that can be tipped over or that are so low that children can easily reach them, for example, and unstable oil lamps that spill burning oil when a child pulls on a table cloth. The sale of these and other products can be regulated by the country in which they are sold, and is the kind of regulation most likely to be supported by many people.

I hope that all countries will protect children of all ages and adults from hazardous
products by adopting regulations that ensure the safety of products sold within their borders. If this gathering of injury prevention leaders were to focus on achieving a single needed preventive measure, this one would have my vote.

REFERENCES


Chen, L.H., 1999, Teenage Driver Crash Risk—The Effect of Passengers. (Baltimore, Maryland: The Johns Hopkins University, School of Public Health).


Reducing Injury Losses: What Private Insurers Can and Cannot Do

Brian O’Neill

INTRODUCTION

Injuries are a major public health problem worldwide and, increasingly, the focus of prevention efforts based on science. Resources available for injury prevention are minuscule. In USA about 150,000 injury deaths occur each year, but government activities and funding of injury prevention programmes/research, including motor vehicle crash injuries, are relatively insignificant when compared to those aimed at other major health problems (Institute of Medicine, 1999). The chronic problem of inadequate government commitment to injury prevention and control has led professionals to seek additional involvement and support from the private sector. One industry routinely identified as an obvious candidate is insurance, it is assumed that insurers pay for injury losses, therefore, benefit financially from loss reductions. This paper examines the validity of these assumptions and reviews some successful injury prevention activities by insurers. The focus is on private insurers, not insurance systems organized as government monopolies.

INSURANCE HISTORY

The basic concept of insurance, spreading risk of loss faced by an individual among a larger group exposed to similar risks, is very old. Earliest forms of insurance provided loans to fund risky businesses such as sending goods by caravan and ship, and loans were repaid with interest only if the goods arrived safely.

By the mid-fourteenth century, marine insurance was widely used in Europe to provide a mechanism for sharing risks associated with loss of ships and cargos. Lloyds of London started as a marine insurer in the seventeenth century, becoming one of the first modern insurers in the eighteenth century. To assess the risks it was considering, Lloyds collected as much information as possible on ship owners, captains, ships, routes, and cargos. Insurance premiums were adjusted to reflect anticipated risks.

In some cases, insurance was impossible to obtain because the risks were considered too high. If risks could be substantially lowered, more ships could be insured and the business could grow; so Lloyds began finding ways to prevent ships from colliding or running aground. The intent was to reduce property losses, but a clear additional benefit was to reduce the loss of life. Though a property insurer, in the early 1800s Lloyds
funded the development of shore-based lifeboats designed to rescue crew and others from shipwrecks. Lloyds also funded the deployment of these boats around the British Isles and some other countries (Grey, 1922).

Fire insurance began to develop in England after the London fire of 1666. The first US insurance company, formed in 1735, was a short-lived fire insurer. In 1752, Benjamin Franklin founded the first successful fire insurance company in the US, the Philadelphia Contributorship for the Insurance of Houses from Loss by Fire. Franklin campaigned to remove fire hazards from houses and grounds, developed the lightning rod to prevent fires. He designed the Franklin stove to provide more heat than an open fire at the same time, reducing the risk of home fires (O’Neill, 1987).

Modern life insurance dates to the eighteenth century, but there is no history of loss reduction activities by life insurers. Insurance against accidental injuries, which in some sense was an extension of life insurance, began with coverage for injuries in railway accidents but quickly extended to include all accidents. As with life insurance, these policies were issued to individuals; insurers did not work to make railroad travel safer.

government activities and funding of injury prevention programmes/ research, including motor vehicle crash injuries, are relatively insignificant when compared to activities and funds aimed at other major health problems

As this brief history indicates, insurance has taken many forms, and it still does. While the general public may tend to think of this industry as a single entity, in reality it is not; the many forms of insurance differ widely. Today the two principal categories of insurance are ‘life’ and ‘property and casualty’. In some countries such as USA, there also is general health insurance; this differs in many respects from traditional insurance in that, in addition to spreading the risks of significant losses, a component also serves, in effect, as prepayment for routine medical care.

The category of insurance that historically, and still today, has the most involvement in loss control efforts affecting the risk of death and injury is property and casualty insurance. Although this branch of insurance is primarily concerned with property losses, as we shall see reducing such losses also can reduce deaths and injuries.

**INSURANCE RISK AND LOSS REDUCTION**

Insurance allows organizations and/or individuals to assume otherwise unacceptable financial risks, which also may be related to injury risks. For example, the availability of marine insurance in the fourteenth century resulted in a dramatic growth of commercial shipping which, in turn, led to more shipwrecks because of greater exposure. This is one of the anomalies associated with insurance; it makes risk-taking more affordable, so the overall exposure to risk can be increased.

Recognition of this fact led insurers to focus beyond simply underwriting risks (i.e., charging an appropriate premium) to also finding ways to reduce risks. For example, it was not in the best business interest of Lloyds to reduce its risks simply by charging so much that it restricted the amount of shipping it insured. Instead its business could grow.
if it identified ways to make marine insurance more affordable by making it ‘safer’ so losses would be reduced.

Among the various types of property and casualty insurance, commercial property insurance provides many examples of loss reduction activities. Insurers of commercial buildings inspect boilers and other potential causes of loss and demand improvements when deficiencies are identified. They also require sprinkler systems for fire suppression. Although the focus of these kinds of activities is to reduce the risk of property damage to buildings, such programmes also reduce risks to occupants. In California, insurers of larger commercial properties work with building owners to ensure that buildings sustain less damage in earthquakes; this can involve structural remodelling to increase earthquake safety (Opferkuch and Frazier, 1987).

The fact that owners of larger commercial buildings can be pressured to make structures more earthquake resistant surely has contributed to the relatively small loss of life in recent US earthquakes, compared with those elsewhere involving the collapse of large buildings and loss of life. I do not wish to claim that without the loss reduction activities of US commercial insurers there would have been many more earthquake deaths. Government regulations, building inspections, etc., play obvious roles, but the contribution of insurers is not insignificant.

It is interesting to note that, in the case of individual homes and earthquake risks, the potential role of insurers in California is much more limited because state law requires insurers to offer earthquake coverage to all homeowners. Insurers cannot turn down poor risks such as homes built on hillsides, poor soil areas, etc. This legislated availability of earthquake insurance restricts the ability of home insurers to directly affect loss potential by requiring improvements as a condition of insurance.

Commercial earthquake insurance is an example of how insurers can help to reduce future losses by using the insurance pricing mechanism to directly influence risk. In addition to demanding safer buildings as a condition of insurance, insurers also can offer premium discounts for equipment that makes an insured home or product less risky, for example, discounts on homeowner’s insurance if smoke detectors are installed or reduced injury insurance premiums for cars equipped with airbags. Thus insurers can and do directly influence policyholders with financial incentives to choose features or devices that reduce their risks.

Much more limited is insurers’ ability to directly influence the behaviour of insured individuals through pricing. For example, although auto insurance discounts for injuries to motorists who promise to use safety belts all the time might seem attractive, this approach is limited by problems verifying that the commitment is being kept. Motorists in many European countries can earn sizable discounts on auto insurance if they file no claims for several years; the thinking might be that this promotes ‘safer’ driving, but it is likely that it encourages motorists not to file claims for crashes with relatively small losses. It has been suggested that insurers could make premiums prohibitively expensive for motorists with bad driving records, and although premium prices typically do reflect driver history, insurers often are legally prevented from charging appropriately high premiums for the poorest risks. In much of the US, special insurance pools with subsidized premiums are mandated by, or in some cases run by, state authorities to ensure that all licensed drivers have access to mandatory insurance coverage. The philosophy is
that if a motorist has a valid licence, affordable insurance should be available, regardless of risk; otherwise many high-risk motorists would be likely to drive uninsured.

Direct loss reduction using insurance pricing and/or discounts can be limited by government imposed regulations and complicated by the legal reparation system. The system for homeowners’ fire losses is relatively straightforward—if there is an unintentional loss the insured homeowner will be reimbursed—so insurers can use pricing discounts to encourage homeowners to reduce fire risks by installing smoke detectors without much complication. In contrast, automobile insurance typically involves a more complicated reparation system. In most developed countries motorists are required to purchase some form of liability insurance to provide reimbursement for injuries and property damage they cause to others (third parties). Insurance to reimburse a motorist for his or her own losses (first party) typically is not mandatory, although there are a few exceptions. Some government insurance systems, Quebec, Canada’s, reimburse insured motorists regardless of fault, and these are referred to as no-fault systems. To further complicate matters, the automobile insurance systems in some US states are called no-fault but, in reality, are only partial no-fault systems. In these jurisdictions, the intent is for many less serious injuries sustained in two vehicle crashes (soft tissue injuries) to be reimbursed by each motorist’s insurer without regard to fault. Liability insurance, the most commonly mandated coverage, requires determination of who is ‘at fault’ in two vehicle collisions. This, in turn, determines which of the two insurers (presuming both vehicles are insured) will reimburse the ‘innocent’ victim. The ‘at fault’ motorist may or not be reimbursed for his or her losses, depending on what kind of insurance was purchased.

there are both tangible and intangible benefits to insurers who embark on indirect loss reduction activities

These potentially different reimbursement sources for motor vehicle crash injuries influence insurers’ direct loss reduction possibilities. In USA, mandatory automobile liability insurance for injuries typically is much more expensive than optional first party injury insurance. This is partly because under the liability system, injured third parties can recover not only their economic losses (medical bills, etc.) but also additional costs for ‘pain and suffering’ associated with their injuries. In contrast, first party injury insurance has maximum reimbursement limits that typically are only a few thousand US dollars; there are no payments for ‘pain and suffering’. Thus, although US insurers offer discounts for cars equipped with airbags, they only can do so on first party insurance premiums, which are small in comparison with liability premiums. Another example is that in most front-to-rear collisions the driver of the striking car is considered ‘at fault’ this means his or her insurer will pay for injuries such as whiplash that might occur in the struck car (this would not be so under a few no-fault systems). If good head restraints in the struck car prevent an injury, the insurer who benefits directly is the insurer of the striking car, not the insurer of the car with the good safety equipment, so offering discounts for good head restraints is not economically justified.
INDIRECT LOSS REDUCTION BY INSURERS

Property and casualty insurers have long recognized the benefits of using the pricing mechanism to directly influence risk, but they also have a long tradition of indirect loss reduction that is, influencing risk by methods other than pricing. Ben Franklin worked to prevent fire hazards in eighteenth-century homes, and Lloyds funded lifeboats to rescue people from shipwrecks.

These two examples provide an interesting contrast: to the extent that Franklin succeeded in reducing home fire risks, his insurance company accrued direct benefits in reduced claims for fires. In the case of the lifeboats, however, Lloyds insured property, so it realized no direct benefits from the rescue of people from shipwrecks. It turns out that the Lloyds’ investment in lifeboats occurred about the time the British public had been shocked by a number of bad shipwrecks, including one involving an onshore crowd that watched a crew drown without being able to offer aid. It appears that reason why Lloyds funded lifeboats was a recognition that this would be good ‘public relations’. These examples suggest there are both tangible and intangible benefits to insurers who embark on indirect loss reduction activities.

Despite US fire insurance efforts, fire-related losses increased much more rapidly than the population through the latter part of the nineteenth century and the beginning of the twentieth. Major conflagrations were relatively rare, but fires, often related to newer products and processes, occurred frequently. At the end of the nineteenth century, fire insurers were increasingly dealing with electrical installations and products. This led to the establishment by Chicago insurers of electrical product testing by an organization called Underwriters Electrical Bureau, which became Underwriters Laboratories (UL) in 1894. Since then, UL has been involved in numerous evaluations of the safety of products including gasoline pumps, oil burners, auto safety glass, lightning rods, life vests, hair dryers (Bezane, 1994). Now UL laboratories worldwide examine how products are constructed, test and evaluate electrical and other products, and develop product safety standards. The most visible results are the ubiquitous UL certifications applied to more than 14 billion products each year.

Another example of US insurer commitment to loss control is the work by the Insurance Institute for Highway Safety (IIHS) and its affiliated organization, Highway Loss Data Institute (HLDI). IIHS dates to the sixties, and its research founder was Dr. William Haddon, Jr., a pioneer in scientific injury control. Their mission is to find out and communicate what works and just as important, what does not work to reduce motor vehicle crash losses. IIHS research focuses on potential counter-measures aimed at each major factor involved in motor vehicle crashes—human, vehicle, and physical/legal environment. Human factors research areas include graduated licensing systems for young beginner drivers, alcohol-impaired driving, truck driver fatigue and safety belt use.

Vehicle factors research focuses on crash avoidance and crashworthiness. IIHS began crash testing vehicles in 1969, evaluating the performance of bumpers in low-speed impacts. In the seventies, IIHS conducted high-speed tests to illustrate the vulnerability of fuel systems in rear impacts, the problem of cars under-riding trailers in rear-end crashes, the effect of vehicle size in collisions between large and small cars and the importance of
airbags and safety belts in occupant protection.

This work expanded in 1992 with the Vehicle Research Center in central Virginia. Frontal offset crash testing has become the focus of research at this world-class facility. Initiated in 1995, offset tests evaluate the performance of popular new passenger vehicles in 64.4 km/h frontal impacts into a deformable barrier to determine how well the vehicle structure performs to protect its occupants in crashes. These tests are shown to large audiences on national network television; the results are reported by print, broadcast, and electronic media outlets. Such wide coverage is prompting automakers to improve the crashworthiness of their passenger vehicles.

A brief list of other IIHS accomplishments:

• Research that provided the impetus to raise the legal minimum age for purchasing alcohol to 21 in all states (DuMouchel et al., 1987; Williams, 1986; Williams et al., 1983). This counter-measure alone has prevented thousands of teenage deaths related to alcohol.

• Research that documented the effectiveness of laws providing for quick administrative revocation of the licences of drivers who fail or refuse to take a breath test for alcohol (Zador et al., 1989). The findings of this study were released at a joint press conference with Mothers Against Drunk Drivers (MADD), which adopted administrative licence suspension laws as its top legislative priority. At the time of the press conference, only 23 US jurisdictions had such laws; now 43 do.

• Research on the teenage driving problem has culminated in recent years with the proliferation of graduated licensing laws, which are saving lives (see Insurance Institute for Highway Safety and Traffic Injury Research Foundation, 1999; Mayhew et al., 1998; Ulmer et al., 1999; Williams, 1997, 1999).

• Research on the benefits of motorcycle helmet use laws is repeatedly cited in states that are considering either adoption or repeal of such laws (see Kraus et al., 1976; Kraus et al., 1994; Kraus, Franti et al., 1975; Kraus, Riggins et al., 1975; Lund, 1990; Lund et al., 1991; Muelleman et al., 1992; Sakar et al., 1995; Watson et al., 1980, 1981).

Insurance companies are financial institutions subject to government regulations, and they are part of the legal reparation system. These and other factors sometimes can limit loss control efforts.

• A five-year programme to promote safety belt use in North Carolina through well-publicized enforcement of the state’s belt law now is cited by the US government as a model for increasing belt use (Foss et al., 1997). It is because of these efforts that the US belt use rate now is about 70 per cent, up from about 20 per cent in the mid-eighties.

• Research on urban crash problems, particularly at signalized intersections. Researchers have found ways to time light sequences better to reduce crashes (see Persaud et al., 1997; Retting, 1996; Retting and Greene, 1997; Retting et al., 1995). The use of red light cameras in USA has been increased to
apprehend—better yet de ter-flagrant red light runners. IIHS research reveals 40 per cent reductions in red light running in two communities using such cameras. Reductions occurred throughout the communities, not just at intersections where cameras were located (see Retting et al., 1999a,b).

Besides IIHS, auto insurers in many countries have established research and testing centres to reduce motor vehicle crash losses. Many of these centres belong to an international coalition, Research Council for Automobile Repairs (RCAR), which exists to reduce ‘insurance costs by improving motor vehicle damageability, repairability, safety, and security’. Although the focus is on reducing property damage losses, most also are involved in issues related to crash deaths and injuries.

A recent non-vehicle loss reduction initiative supported by US insurers is the Institute for Business and Home Safety (IBHS), its mission to ‘reduce deaths, injuries, property damage, economic losses, and human suffering caused by natural disasters’ Among its early initiatives, IBHS has developed a programme to retrofit community child care centres to protect against natural disasters. This organization also has designated showcase communities and states to demonstrate what can and should be done to reduce losses including deaths and injuries from hurricanes, tornadoes, floods, wildfires, earthquakes, etc.

As these examples indicate, insurers take many opportunities to expand their role beyond spreading risks and compensating people for losses. Insurers also work to reduce injury losses both directly and indirectly. This is not only good business for insurers but also a benefit to society; insurers’ financial interest in loss reduction directly parallels the public’s interest in fewer deaths and injuries. Insurers’ efforts worldwide have resulted in thousands of lives saved and injuries prevented. The world is undoubtedly safer and freer from risks because of programmes begun and financed by private insurers. But at the same time, insurance companies are financial institutions subject to government regulations, and they are part of the legal reparation system. These and other factors sometimes can limit loss control efforts.

REFERENCES


Accident Analysis and Prevention, in press.
Williams, A.F., 1986, Raising the legal purchase age in the United States: its effects on fatal motor vehicle crashes. Alcohol, Drugs, and Driving, 2, pp. 1–12.
INTRODUCTION

In most parts of the world, injuries are the leading cause of death and disability among young adults, adolescents and children. As infectious and degenerative diseases are better controlled, the importance of injuries in mortality and morbidity statistics has increased in developing countries. The study of the determinants of injuries is receiving increasing attention in most countries as the gravity of the problem is being faced.

The injury prevention and control research field can be considered to be a relatively new area of research in public health, when compared to the study of chronic diseases such as cardiovascular disease, cancer or infectious diseases such as tuberculosis, malaria. Researchers in every field have had to struggle with many methodological aspects in studying the particular disease, its aetiology and the impact of interventions. Particular interests are the quantification of the burden of the disease, identification of the causes of the disease, and evaluation of the impact of interventions to prevent and/or control the disease.

It is important that the specific characteristics of the disease process be taken into consideration when considering the appropriate methodology to use to address an issue in any field of research. The injury epidemiology field has progressed considerably in the last decade, by primarily ‘adopting increasingly sophisticated research methods from more established branches of epidemiology’ (Cummings et al., 1995), but still has a considerable way to go. It is time that the injury research community begins to address particular needs of injury data by developing appropriate methodology that takes into consideration the unique nature of the data. The study of diseases that are different in nature requires different paradigms.

The purpose of this paper is to identify some of the unique characteristics of injury data that must be addressed, to review some of the ways existing recent methodology has been applied often in novel ways in the injury field, and to challenge researchers to tackle unresolved problems. Only by doing so will the field of injury research mature methodologically.
UNIQUE ASPECTS OF INJURY DATA

Every field of public health has had to tackle issues of how best to describe the epidemiology of the disease, how to study the aetiology of the disease, and how to understand ways to prevent and/or control the disease. These are common issues shared across fields and many methodologies developed in one field are applicable in the study of others. However, there are unique aspects of each disease that challenge researchers to develop appropriately tailored methodologies if one wishes to address specific needs of the research.

Injuries are characterized by the unique feature that they occur in the context of a sudden and usually immediately apparent transfer of energy. This concept of energy transfer was not well understood until proposed by Haddon (1972) as a conceptual framework for motor vehicle injuries. This transfer of energy occurs during an event. Haddon divided the factors related to injuries into three phases: pre-event, event, and post-event. Thus, pre-event factors determine the occurrence of the event, event factors determine the occurrence and/or severity of the injury, and post-event factors determine the severity and/or outcome of the injury. Haddon created a nine-cell cross-classification matrix by adding another dimension that considers where the factors are operating, whether in the person, the injury producing vector, or in the environment. This matrix as a conceptual model has proven to be a successful tool for analysing injury producing events and recognizing factors important to their prevention. Recently, Runyan (1998) proposed a third dimension that considers its application in decision making. Thus, one of the unique features of studying the aetiology of injuries is the need to account for pre-event factors as well as event factors.

Second, like infectious diseases and unlike chronic degenerative diseases, injuries are characterized by the possibility of recurrence. Thus a given individual is at risk of re-injury if prior events are non-fatal and also not substantially disabling so as to remove the individual from exposures. A person can be involved in multiple motor vehicle crashes or suffer from repeated falls. Unlike many infectious diseases, like influenza, where immunity is not developed for all strains and one can argue that repeated events are stochastically independent, these repeated injury events are clearly not independent, as the likelihood for further events is related to the prior events and the injury outcome suffered. Once injured, an individual is likely to alter their behaviour and thus the risk for a second injury is no longer the same as it was for the first time. Thus, non-fatal injury data analyses need to address the repeated correlated nature of the data.

A more complicated characteristic of injury data is the likelihood of multiplicity on many fronts. Most diseases are affected by multiple factors and can be manifested in
several ways, but this is more complex in injuries due to multiple factors operating in the different cells of the Haddon matrix. An individual can be exposed to multiple competing risks just like for any other disease, but the term ‘injury’ encompasses a large variety of different times of trauma, from burns to fractures to asphyxiation, with a multiplicity of factors to consider for events as well as for injuries from these events. In addition, some injuries are manifested on multiple body sites, such as burns or fractures. Furthermore, the severity of the injuries may vary by site and type of trauma. A single event such as a motor vehicle crash can result in multiple types of injuries to multiple body sites with different severities. If we then add that in one event there can be multiple individuals involved, the complexity of the nature of the data is quite apparent. These complexities are important in deciding the unit of analysis—event, individual or vector.

For many chronic diseases, the exposure period is prolonged and is usually the entire lifespan of the individual. In most diseases, the individual is assumed to be exposed at all times, and that exposure levels may vary as one modifies one’s behaviour. In injuries, exposure to a particular injury is dependent on whether one is involved in a particular activity that is conducive to an event in which the energy transfer can occur. Thus one is not exposed to a motor vehicle injury if one is not near a motor vehicle and not exposed to drowning if away for water sources. This more immediate or acute relationship of exposure with outcome poses quantification problems that affects the design of studies, in particular case-control studies where exposure is measured retrospectively.

A major feature of injury data is the role that knowledge, attitudes and behaviours play in the aetiology of the disease. Clearly these considerations are really not unique to the injury field, as they also affect the epidemiology of other diseases. However, the role of these factors is often minimized in relation to more physiological factors when studying other diseases. Many of the various causes of chronic and infectious diseases are physical, chemical or biological factors that are distinct, identifiable and measurable, while for injuries, the more difficult to measure and operationalize factors of knowledge, beliefs and behaviour are more common (Petridou, 1997). The difficulty in assessing and quantifying these factors may be one reason that they have traditionally not been extensively incorporated in epidemiologic studies of other diseases, although recently there has been a trend for considering these more subjective factors. Given that exposure risks for injuries are more immediately dependent on the choice of engaging in a ‘risky’ behaviour, the more qualitative factors of knowledge, attitude and belief should be incorporated in analyses of the epidemiology of injuries alongside the more traditional demographic, physiologic, and environmental quantitative factors.

When considering the evaluation of the effectiveness of interventions to prevent or control injuries, the experimental designs available for injury research are ethically limited. For example, a randomized controlled trial (RCT), the accepted most rigorous experimental design to test the effectiveness of an intervention, requires that individuals be randomized to the interventions under consideration. It is not possible to use this methodology to test the effectiveness of vector or environmental factors since these do not operate at the individual level. It is often unethical or impractical to use an RCT to test the effectiveness of an individual level intervention, as in the case of protective devices such as seat belts in motor vehicles, or helmets or pads in sports activities. It is unethical to randomize individuals to undertake a ‘risky’ behaviour, some with and some
without a protective device. The experimental designs available are thus less rigorous, using quasi-experimental designs such as community intervention trials or before-after intervention studies.

Another unique feature of injury data is less a characteristic of the nature of the data, but more so of the methodology for obtaining data, and can be thought as due to the ‘identity crisis’ of injuries. Injury prevention and control as a research discipline is a very recent term, previously referred to as accidents. The term ‘accidents’ is still prevalent in many countries, especially due to the difficulty in translating the term ‘injury’ to have a similar connotation in other languages. The ‘random act of God’ implication of the term ‘accident’ relegated the documentation of injuries to legal and clinical requirements, not to research needs for understanding how to prevent and/or control their occurrence. So, while other diseases were viewed as preventable, thus information on relevant factors was collected, injuries were not as well documented and relevant factors on the circumstances that caused the injury were not routinely collected or considered relevant. This is a battle that all injury researchers face in every country. This feature affects the availability and quality of data and the feasibility of studies that rely on the use of existing data sources. Another major implication of this lack of completeness in injury data is the presence of missing data both cross-sectionally and longitudinally.

**CURRENT STATE OF THE LITERATURE OF INJURY ANALYSIS**

These unique features of injury data determine the possible methodologies that can be used. The complexities of the data are daunting and for many years, injury researchers focused on standard study designs well known in epidemiology and in standard descriptive and inferential statistical methods for analyses well known in many fields of application. The exception to this generalization is the field of motor vehicle injury research, which has a relatively longer existence, and is therefore methodologically more mature.

**most articles on injury topics were mainly descriptive and focused on primarily bivariate relationships with a few multivariate models**

A review of publications in epidemiology and public health journals for the last ten years showed that most articles on injury topics were mainly descriptive and focused on primarily bivariate relationships with a few multivariate models. Most of the complexities of the data arising from multiple dimensions, repeated measures, multiplicity of factors/sites/severities, and missing data, are often ignored or the problem simplified to satisfy requirements of less sophisticated methods, with the resulting loss of specificity and loss of information.

The major speciality journals in the injury field are few, with *Accident Analysis & Prevention* the oldest one (currently in volume 31) and *Injury Prevention* the relatively new kid on the block (currently in volume 5). A review of the last 12 years of *Accident Analysis & Prevention* shows the use of a variety of statistical analytic techniques, from the relatively simple analysis of variance, multiple linear regression and logistic
regression, to complex multinomial logit models, empirical Bayes methods, and various
time-series models. More recently techniques developed in the biomedical fields for
analysing clinical trial data such as meta-analysis and survival analysis have been used.

Injury Prevention in its publications contains a section in each issue entitled
‘Methodological Issues’ which varies from short reviews of well-known statistical or
epidemiologic procedures such as logistic regression and odds ratios (Platt, 1997) to more
complex issues such as the methodological issues in case-control studies (Roberts, 1995).

State-of-the-art methodologies applied to the study of injuries
There are many recent articles that have taken methods developed for other disciplines
and applied them to the injury field. To the extent that these methodologies adequately
account for the unique characteristics of injury data, they are appropriate and their use
should be encouraged. However, many require an adaptation of the data to the method
that may not be appropriate, and these methods must be used with caution.

This section briefly illustrates some of the novel applications of methods developed in
other fields. These are grouped into methods for quantifying the burden of injury, for
identifying causal factors of injury, and for evaluating the effectiveness of interventions.

Quantification of the burden of injury
Every field of public health has had to struggle with how to quantify the burden of their
disease, with problems of definition, classification or typology, and case ascertainment.
In addition, many fields struggle with issues of long-term effects (disability) of the
disease, and how best to quantify the financial burden represented by those with the
disease. The injury field is no different in having to face many of these same issues.

Cummings et al. (1995) identified many aspects in what they called the ‘numerator
problem’ or the ability to properly count injuries. These include definitional problems,
problems of classification, and of ascertainment. The problem of clear and unambiguous
case definitions is not unique to injuries. However, the need to consider near-cases of
injury such as near-drowning or near-fall is different from other diseases where these
considerations are not relevant.

In quantifying the burden of injuries, the proper denominator for estimating rates is
often not clear (Cummings et al., 1995). In calculating an area-specific rate, the
numerator and denominator must properly account for residency and transient status in
order to avoid erroneous estimations. In motor-vehicle related injuries, the choice of
denominator—population, registered vehicles or vehicle-miles—affects the resulting
interpretation of the magnitude of the problem (Bangdiwala et al., 1985). This is related
to the proper measure of exposure risk.

Many of the measurement problems in injury stem from the fact that the collection of
data is dependent on existing data sources or registries or that primary data collection is
either collected retrospectively from individuals, with the usual limitations of such data
such as recall bias, or collected soon after the occurrence of the injury. The latter is
problematic as the acute care of the injured individual takes precedent over data
collection, the researcher is not present at the moment of data collection, and that clinical
and legal issues may inhibit the data that is obtainable.

Given the practical difficulty of primary data collection at the time of the injury, a very common approach for data collection is to seek information at places where the injured do tend to go to seek care or compensation, emergency rooms, hospitals, private physician offices, police stations, insurance companies, rehabilitation centres. The advantages and disadvantages of these sources of subjects are the subject of discussions among researchers, with problems of undercount, access, quality of data, and completeness of information. An important effort in this regard is the International Collaborative Effort on Injury Statistics, which since 1994 has been directly addressing the priorities and issues in injury statistics from an international perspective, including international comparability issues on definitions, development and linkages of databases and classification systems.

many of the measurement problems in injury stem from the fact that the collection of data is dependent on existing data sources or registries, or that primary data collection is either collected retrospectively from individuals, with the usual limitations

In the injury field, a common approach is the use of surveillance systems. Surveillance, according to Buehler (1998), is ‘the continuous and systematic process of collection, analysis, interpretation, and dissemination of descriptive information for monitoring health problems’. Modern concepts of surveillance were shaped by programmes to combat infectious diseases, with the reporting of ‘notifiable’ diseases. However, the injury research field has recognized its utility and has adopted its methodology to monitor the occurrence of injury over time within specific populations.

The specific purposes of injury surveillance systems include:

• to provide descriptive epidemiology of injuries and possibly provide insight into aetiology
• to monitor trends, search for outbreaks or clusters in time and geography
• to provide indication of the success of interventions
• to permit identification of groups at highest risk
• to guide prevention activities to problem areas and anticipate future trends.

Since surveillance systems are usually dependent on someone besides the injury researcher as the primary data collector, they suffer from many potential limitations:

• Continuity, since they are not necessarily permanent and depend on the availability of continued funding
• Purpose, which usually is not research
• Completeness of information, since they are either retrospective or concurrent with the care of the injured
• Limited detail, which limits the ability to investigate more in-depth epidemiologic hypotheses
• Inadequate quality of the data, since usually out of the control of researchers
• Lack of relevance, since they seldom collect data useful for prevention, or
for fully understanding the circumstances of the injury or its severity.

This last point is illustrated by the recent trend in the injury research community to stimulate the inclusion of narrative data in surveillance records, since the rich information it contains is necessary for considering prevention; it is seldom collected, and if collected, not analysed.

Surveillance systems usually include only those with the disease, the injured, or the cases. They do not often provide a comparison group of individuals without the disease, the non-injured, thus limiting the ability of researchers to investigate aetiology.

Surveillance systems as a source for useful data for research and public health policy have been studied and evaluated for specific types of injuries or sub-populations (Lyons et al., 1995), for the sources of the data (Garrison et al., 1994, Runyan et al., 1992), and for their quality (Macarthur and Pless, 1999). They have many limitations including inadequate ascertainment and coverage of cases, incompleteness of data, poor quality of the data, and also that they often are designed as large investments of resources, are labour intensive, and often they are not evaluated. One of the reasons for the large costs is the effort to identify every case. Only recently has the well-known statistical technique of sampling been considered in injury surveillance systems. Another promising technique, the use of capture-recapture statistical methods, has only since 1993 been applied in the injury field (Chiu et al., 1993). It has been evaluated for ascertaining adolescent injuries in a school district of Pittsburgh, Pennsylvania (LaPorte et al., 1995), as well as for estimating deaths and injuries due to road traffic accidents in Karachi, Pakistan (Razzak and Luby, 1998). These methods, originally developed in wildlife and fisheries to estimate sizes of moving populations, utilize the information in the overlap of multiple sources of cases to estimate the number of missed cases and thus adjust the incidence rates appropriately. The benefit is that incidence rates can be calculated efficiently without every case being identified. ‘Capture-recapture analysis not only provided an approach to evaluate and adjust for undercount but also offered a formal means to evaluate the most efficient combination of the sources to maximize completeness while minimizing effort. The use of these techniques has the potential to evaluate and improve injury surveillance…’ (LaPorte et al., 1995). However, many practical and theoretical issues are yet to be adequately addressed.

**Identification of the causes of injury**

People who care directly for the injured and policy makers responsible for efforts to prevent and control injuries, are the individuals more interested in quantifying the burden of injuries. Researchers, on the other hand, are more involved in studying the causes of injuries in order to develop and evaluate counter-measures. This may explain why more sophisticated methodologies are applied to identifying the aetiology of injuries than to other areas of study.

In studying the relationship between potential explanatory or causal factors of injuries, the field draws from the existing designs in other fields of epidemiologic research. There are different types of study designs, each providing information that is relevant to the study of a particular disease and the factors associated with that disease. Studies can be
classified into observational or experimental, based on whether the investigator only records data or intervenes in some fashion with the subjects.

Observational studies include case series, cross-sectional or prevalence studies, retrospective studies such as case-control, and prospective studies such as cohort, incidence, and surveillance. Experimental studies include the so-called ‘natural experiments’, before-after studies, community and cluster trials, and randomized controlled trials.

Case series are descriptions of exposure characteristics in injured individuals, and are useful for detailed in-depth initial investigations of potential factors in injured subjects. Recently, Cummings and Weiss (1998) argue for the utility of case series and exposure series (descriptions of outcomes in exposed individuals) in providing information about the aetiology of injury when viewed as ‘primitive forms’ of case-control and cohort studies, respectively. Cross-sectional studies describe the burden of the disease in a given area and time period, provide prevalence rates, and permit the study of relationships between exposure factors and outcome measures that are evaluated simultaneously. They are thus limited in their ability to study causal relationships.

Case-control studies compare the occurrence of exposure factors in a sample of subjects with the disease or condition (cases) and the occurrence of exposure factors in a sample of subjects without the disease or condition (controls). They thus are able to quantify the strength of the relationship between the exposure factors and the outcome measures, estimate percentages of exposure in cases and controls, but given their retrospective design, also are not able to study causality. Nevertheless, they are very strong methodologically and widely used.

**an exciting new methodology for a research design is the case-crossover for quantifying the importance of transient effects on the risk of acute events**

Roberts (1995) addresses several methodological issues in case-control studies, from defining the study base from which cases and controls are to be drawn, to the importance of errors in the exposure measurement, and the potential for bias from combining unrelated injury outcomes. For most disease processes, incidence rates are expressed as the number of cases over a measure of person-time of exposure, which is person time ‘living’. For injuries, since these only can occur or be prevented when the person is engaged in a relevant activity, the denominator is more appropriately ‘person time exposed in a particular activity’. Marshall et al. (1998) illustrate potential biases from using inappropriate controls in bicycle helmet studies, while Cummings et al. (1998) study biases of selecting controls in an emergency department setting.

An exciting new methodology for a research design is the case-crossover for quantifying the importance of transient effects on the risk of acute events (Maclure, 1991). The methodology was developed for cardiovascular diseases but has been applied to child pedestrian injuries (Roberts et al., 1995), as it addresses the acute nature of the injury event.

Cohort studies measure the occurrence over time of a condition or an outcome measure in a sample of individuals initially free of the condition. They thus shed light on the natural or clinical evolution of the disease, estimate incidence rates, and permit the study
of causal relationships since temporally exposure precedes outcome. Cohort studies of
injuries are not much different in methodological issues from cohort studies of other
diseases. Issues of incomplete follow-up, missing data, duration and cost are shared.

The advantage of longitudinal data comes with the potential disadvantages of
incomplete follow-up thus missing information. Methodologically, they also are more
complex as one usually has repeated measurements in an individual over time, and the
correlation among these measurements must be accounted for in the analysis.

More often than not, these issues from multiplicity are simply ignored, which tends to
overestimate significance as it reduces the true variability of estimates. Another common
approach is to simplify the problem, by analysing the data using cross-sectional looks of
the data, looking at changes between two time points, and recently, by looking at simple
survival analysis of the time to the occurrence of the first outcome.

There are appropriate methodologies that do exploit the richness of the information in
longitudinal data, such as

- Time series analyses
- Survival analysis with time varying co-variates
- Repeated measures analytic methods:
  - Incidence density
  - Mixed random and fixed effects linear models
  - Latent class and hierarchical models
  - Generalized estimating equation models (GEE)

Williamson et al. (1996) illustrated various methods for analysing repeated measures data
when the outcome is binary (injured or not). They applied GEE models and survey
sample methodology to a cohort study of injuries in rugby players. This application did
provide interesting insight into relationships between exposure factors and the likelihood
of injuries that are not possible if the repeated measures design of the longitudinal data is
ignored or simplified.

A major problem faced by injury studies, which rely on existing data collection
systems or are by design longitudinal, is the presence of missing data. The analysis of
incomplete multivariate data has traditionally involved such drastic measures as case-
deletion or completing the missing information using some imputation technique. The
reason was to force the incomplete data set into a rectangular complete data format and
thus be able to use standard analytic techniques. Even if not done consciously, many
statistical software packages automatically delete observations with incomplete data in
multivariate procedures such as linear regression. Imputation can be a simple replacement
of the missing value with some reasonable observed mean of non-missing values or a
predicted value from a regression model. When the missing data is a small fraction
relative to the rest of the data, case deletion may be adequate. Ad hoc imputation
techniques do not account for the fact that there is uncertainty in the imputed value.
Recently, Schafer (1997) proposed iterative algorithms for simulating multiple
imputations of missing values in incomplete data sets, to account for the uncertainty in
the imputation.
Evaluation of the impact of interventions to prevent and/or control injuries

Observational studies are useful in providing information on strength of relationships among exposure factors and an outcome, but an experiment is necessary for evaluating the efficacy of an intervention in a controlled situation. There are many different types of experimental designs, which vary in the degree of control by the investigator over the factors that potentially affect the outcome. They all must comply with ethical considerations of intervening on human volunteers that have consented to participate in such studies. An experiment is the definite design that establishes the causal relationship of an exposure factor (the intervention) with the disease outcome.

The different types of experimental designs are

- **Natural experiments** where the factors occur differently in different communities, there is no control and should not really be considered as an experiment.
- **Before-after studies**, where individuals are their own comparison group, there is little control of factors and there is no randomization.
- **Community and cluster randomized trials**, where entire communities or clusters (groups of individuals such as church groups, neighbourhoods, factories, schools) are assigned randomly to interventions. The level of control of factors is at the group level, while the outcome measure is usually at the individual level.
- **Randomized controlled trials** where individuals are randomized to interventions, offering the maximum control over factors that potentially can affect the outcome measure.

Natural experiments arise from changes in a factor that is not controlled by the investigator, as in a new law, counter-measure for preventing injuries from motor vehicles or a comparison of two countries or communities with different policies. They are sometimes confused with before-after studies, that arise when some treatment has been deliberately implemented on a group or community and the task is to estimate its safety effect. Although randomization is not involved, before-after studies have a methodological advantage, which is that they have reduced variability since subjects are their own comparison group. Before-after studies are also very common in the injury field, as the political practice of evaluating policies is such a design. It is especially common in the field of road safety (Hauer, 1997). Many complex time series models are utilized in the analysis of trends in before-after studies.

Thus **randomized community trials or randomized controlled trials are the most sound study designs for evaluating the efficacy of an intervention**

The process of random assignment to intervention is considered as the most rigorous procedure methodologically thus randomized community trials or randomized controlled trials are the most sound study designs for evaluating the efficacy of an intervention. They are both prospective studies comparing the effect and value of one of more interventions against a control in human subjects with a given risk situation. They measure causality in terms of the effect of an intervention: if one alters the risk factor,
does one alter the occurrence of the event/injury?

Trials allow comparison of alternative treatments in a controlled experimental setting, to the extent that this is possible. The idea is to control the possible factors that may affect the outcome, vary one (the intervention) and evaluate the outcome. This ideal experimental setting is rarely achieved, since there are a multiplicity of factors that are difficult to control. Randomization at least will make comparable the distributions of these factors in the different groups, provided the study involves a large number of units of randomization. However, despite such statistical efforts, controlling human behaviour factors is often difficult and this is a primary concern in injury studies.

Cluster or group randomization occurs when we randomly allocate groups or communities to interventions and we study outcomes in a sample of its members. This is often called a quasi-experimental design. They arise from practical, ethical, and financial considerations. Such studies are very commonly used in injury research. For example, it may be difficult to randomly assign some individuals in a community to an intervention and others to not receive that intervention, especially when the intervention is an environmental countermeasure for road safety.

The analysis of community trials is somewhat more complex, since members within a cluster are statistically correlated, so that the needed assumptions of statistical independence of the data are not met. The effect of this correlation is to inflate the variance of the estimates of outcome rates. There are many alternatives for handling such correlated data. A common practice is to ignore the problem, thus overestimating the significance of the results. Another common approach is to avoid the problem by reducing the information to the cluster level, with the resulting loss of efficiency. The best alternative is to confront the problem using standard statistical methods like the variance inflation factor based on the intra-class correlation coefficient or using appropriate regression models for clustered data (Graubard and Korn, 1994).

**Challenge for the injury community**

Like most disease processes, injuries are caused by a multivariate set of variables. However, unlike the causes of cardiovascular or neoplastic diseases or of infectious diseases, where the event and the disease are the same, the risk factors for the occurrence of an event are not the same as those for the occurrence of an injury. This is exacerbated by the common research practice of considering broad categories of injuries as a single entity. However, since aetiologic mechanisms usually differ among the various types of injuries, causal associations between potential risk factors and injuries may be obscured.

The measurement of exposure is problematic. Promising developments focus on more reliable exposure ascertainment (Towner et al., 1994), or methods of quasi-induced exposure (Stamatiadis and Deacon, 1997; Hakamies-Blomqvist, 1998). The road safety field has been more active methodologically and many multivariate models have been proposed or adapted, as in using empirical Bayes procedures to predict accidents on main road with minor junctions (Mountain et al., 1996), and survival analysis to predict the probability of being involved in an accident given a vehicle’s non-accident status (Jovanis and Chang, 1989). The non-road safety field has used methodology from other fields, as in Poisson regression and time-series analysis for examining trends over time in
rates of child injury (Kuhn et al., 1994). However, many challenges remain, as the unique aspects of the field of injury need to be addressed. An important point of merging qualitative data with quantitative data has been promisingly discussed by Oppe (1992).

Despite a considerable body of research on interventions to prevent and/or control certain types of injuries, questions remain about the effectiveness of various intervention strategies. Often similar studies are replicated in different settings for different sub-populations. This effort is expensive, and often such studies are not completely comparable due to different circumstances and changes over time, culture and other factors. Many small studies are conducted due to limited financial resources, and the results may even be different. It is often impractical to conduct one large study. The recent methodological approach of systematic literature reviews and meta-analysis are appropriate tools for synthesizing the existing evidence form evaluation studies and to provide a basis for rational decision making. Such aggregate analyses benefit from the increased statistical power provided by the large combined sample size, and may often shed new light into the effectiveness of an intervention strategy. Sometimes they may show that interventions believed to be ineffective may be quite effective or vice versa. By demonstrating effectiveness with existing evidence, they can provide substantial savings by avoiding future unnecessary studies. Recently, an entire supplemental issue of the American Journal of Preventive Medicine illustrated the use of such methodology to evaluate a variety of strategies to prevent motor vehicle injuries such as the proper use of child occupant restraints for children, driver education programmes and alcohol laws and regulations (Rivara et al., 1999).

As we direct ourselves to the new millennium, we must consider advancing the field of injury prevention and injury control methodologically. In order to do this, as computer intensive methods are becoming the norm in cutting-edge statistical methods, we must familiarize ourselves with new techniques, such as:

**systematic literature reviews and meta-analysis are appropriate tools for synthesizing the existing evidence**

- Simulated imputation for addressing missing data
- Generalized estimating equations for multiplicity arising from longitudinal data
- Classification systems based on recursive partitioning
- Geographical positioning systems for spatial distribution.

There are also some well established statistical concepts that must be considered in the field of injury research:

- Combining qualitative with quantitative
- Combining event factors with injury factors using conditional probability
- Clustering for dealing with multiplicities
- Sampling techniques

Petridou (1997) clearly argued that epidemiology, as the basic science for public health, is the major ‘resource for identifying the underlying causes of injury, and eventually, for controlling them’. Injury epidemiology is a young discipline and as such it is
understandable that it borrows methodology from more established fields. However, it is imperative that it continues to explore alternatives, refinements and development of new methods that address its needs more adequately. ‘What is now needed is to develop epidemiologic methods that can effectively address the problems generated by the peculiar circumstances that increase the long term likelihood of an accident or, just as important, trigger it’ (Petridou 1997).

Methodology for analysing data should be appropriate to the needs of the subject matter. Thus one should use appropriate methods that fit the processes in which the data were generated (sampling), the nature of the data (continuous or discrete distribution) and the frequency measured (repeatedly or not). If appropriate methods do not exist, these need to be developed by competent researchers.

The potential for injury epidemiology is unrealized at present. The injury research community—working closely with methodologists that fully comprehend the specific issues in the nature of injury data—is challenged to continue tackling the important methodological issues in order to advance the field and to be able to deal more efficiently with limited resources with this grave problem affecting the entire world

REFERENCES


Assessing the Burden of Injury: Progress and Pitfalls

Ted R. Miller

INTRODUCTION

Only a systematic measurement of the burden that injury imposes on our society helps us fully understand the critical need to cure this pervasive killer and crippler (Rice et al., 1989). Cost is the Rosetta stone that makes burden estimates understandable. Cost estimates offers a major advantage over the measurement of incidence by reducing disparate outcomes—traumatic deaths, broken noses, burns, dog bites, even damaged motorcycles—to a single compact metric. Compactness eases comprehension. That makes cost data valuable for problem size and risk assessment, broad priority-setting, resource allocation modelling, health and safety advocacy, regulatory analysis, performance comparison, and programme evaluation. Cost data describe how injuries affect society and drive analyses of the potential to reduce injuries cost effectively.

Increasingly this basic health services research tool has become the focal point of debate and decision making. Cost is a powerful persuader. The press and politicians understand a savings of $9 per taxpayer in medical and work loss costs far better than a statistically significant 1 per cent reduction in injury deaths and hospital admissions.

From the perspective of a developing country, measuring injury burden can be a critical guide to health sector resource allocation. By 2020, the World Health Organization (Murray and Lopez, 1994) estimates that injury will rank ahead of all other causes except mental health as a contributor to disability adjusted life year (DALYs) loss in the developing world. Understanding burden size in a country and identifying the injury causes that contribute the greatest burden is critical when formulating cost-effective intervention projects. As donor organizations’ health sector interest shifts toward injury, so must the effort devoted to characterizing the problems and evaluating potential solutions.

COST CONCEPTS

Costs are estimated from a perspective. The US Panel on Cost-Effectiveness in Health and Medicine (PCEHM) (Gold et al., 1996), recommends always including a cost
When evaluating... laws that interfere with personal freedom, economists often focus on external costs... high external costs justify public intervention.

Estimate from society's perspective. That perspective embraces all costs associated with injuries—costs to victims, families, government, insurers and taxpayers. Costs to government, to insurers or to employers are frequently computed separately. When evaluating mandatory helmet use laws, driver blood alcohol limits and other laws that interfere with personal freedom, economists often focus on external costs—costs to people other than the person whose behaviour is constrained. High external costs justify public intervention.

Costs can be prevalence-or incidence-based. Prevalence-based costs measure all injury related expenses during one year, regardless of when the injury occurred. For example, the prevalence-based cost of head injuries in 1996 measures the total health care spending on head injuries during 1996, including spending on victims injured many years earlier. Prevalence-based costs are computed by summing all costs incurred during the year. They are used to project health care spending and evaluate cost controls.
Medical costs sum the lifetime costs that are expected to result from injuries that occur during a single year. For example, the incidence-based cost of head injuries in 1996 estimates present and future medical spending associated with all head injuries that occurred in 1996. Incidence-based costs are computed by multiplying the number of injury victims by lifetime cost per victim. They measure the savings that prevention can yield.

Investments earn interest. In incidence-based costing, therefore, future costs must be discounted to present value. This procedure shows the amount that would be invested today to pay future costs as they arise. The PCEHM (Gold et al., 1996) recommends that all cost savings analyses include an estimate at a 3 per cent discount rate to accommodate cross-study comparisons. Real rates of return on investment and discount rates that individuals apply when making health decisions suggest this discount rate is a conservative upper bound in the US (US Supreme Court, 1983; US Office of Management and Budget, 1994; Viscusi, 1995) and elsewhere (Murray and Lopez, 1994). Indeed, our group’s published work generally uses a 2.5 per cent discount rate. Worldwide, governments often require analyses of proposed government investments at discount rates of 7 per cent to 10 per cent. These high rates offset optimistic impact estimates, lowering total expected benefits. For example, a $1 million cost saving 20 years hence has a present value of $625,000 at a 2.5 per cent discount rate but only $275,000 at a 7 per cent discount rate.

**BURDEN CATEGORIES AND MEASUREMENT METHODS**

Injury burden falls into four categories: medical costs, other resource costs, work loss cost and quality of life.

Medical costs include emergency transport, medical, hospital, rehabilitation, mental health, pharmaceutical, ancillary, and related treatment costs, as well as funeral/coroner expenses for fatalities and administrative costs of processing medical payments to providers.

Other resource costs include police, fire, legal/court, and victim services (e.g., foster care, child protective services), plus the costs of property damage or loss in injury incidents.

Work loss costs value productivity losses. They include victims’ lost wages and the replacement cost of lost household work, as well as fringe benefits and the administrative costs of processing compensation for lost earnings through litigation, insurance, or public welfare programmes like food stamps and Supplemental Security Income. As well as victim work losses from death or permanent disability and from short-term disability, this category includes work losses by family and friends who care for sick children, travel delay for uninjured travellers that results from transportation crashes and the injuries they cause, and employer productivity losses caused by temporary or permanent worker absence (e.g. the cost of hiring and training replacement workers).

Quality of life includes the value of pain, suffering, and quality of life loss to victims and their families.

Some aspects of injury burden are readily measured in monetary terms. These include
medical costs, other direct or resource costs, and work losses. Together, they are called economic costs or human capital costs. Placing a monetary value on pain, suffering, and lost quality of life, however, is challenging and controversial. For this reason, it often is desirable to quantify this portion of burden with a non-monetary measure. Quality adjusted life years ((QALYs) and DALYs are popular non-monetary measures. The best approach may be to present both QALYs and monetized QALYs. Costs that include the value of pain and lost quality of life are called comprehensive costs or willingness-to-pay costs.

Medical Costs

Medical cost estimates are computed best bottom-up, by multiplying estimated medical spending per case or visit by diagnosis times corresponding estimated case or visit counts. Two coarser approaches are possible.

- Top-down. One can obtain total national medical spending, then apportion it according to hospital days by diagnosis group. This prevalence-based approach often is taken when comparing spending on injury and illness (Rice et al., 1985; Moore et al., 1997). We applied it to cost gunshot wounds in Canada (Miller, 1996) and occupational injuries and employer costs in the US (Miller and Galbraith, 1995a; Miller, 1997a).

- Factoring. One can adjust a national cost per case to local prices (and preferably local length of hospital stay), then multiply times a local case count to get local costs. We often use this method to make state or provincial cost estimates. It is inexpensive, yet yields reasonably credible numbers.

Work Loss Costs

*it is reasonable to assume parental work loss equals the loss that normally occurs when an adult suffers a comparable injury*

Work or productivity loss has two components: short-term losses during acute injury recovery and lifetime losses due to death or permanent work-related disability. The value of lost paid work includes both wages and fringe benefits. Employers or employees may bear these costs. On average, US workers lose housework on 90 per cent of the work days that they lose wage work. Thus household work days lost can be estimated from the days of paid work lost (Miller, 1993). These days typically are valued at the wages paid for comparable tasks (e.g., cooking, cleaning, child care).

Lifetime work loss costs value work losses in the current year plus the present value of probable work losses in future years if the individual dies or is permanently disabled. Children under age 15 will not lose work in the short-term. Thus, the lower bound on the cost of short-term work loss due to a child’s injury is none. When injured children are impaired sufficiently that they would not have been able to work if they had been employed, someone else generally will lose work while serving as a care giver. As an
upper bound, then, it is reasonable to assume parental work loss equals the loss that normally occurs when an adult suffers a comparable injury. For other age groups, the value of lost work depends on the work that someone of the victim’s age and sex normally would do and the amount they would earn.

**Quality of life**

A quality-adjusted life year or QALY is a health outcome measure that assigns a value of 1 to a year of perfect health and 0 to death (Gold et al., 1996). QALY loss is determined by the duration and severity of the health problem. To compute it, one estimates the fraction of perfect health lost during each year that a victim is recovering from a health problem or living with a residual disability, then sums these fractions. People killed lose a full QALY per life-year; this value may be adjusted for pre-existing conditions and the general decline in health as people age.

The most practical way to assess health-related quality of life losses from a community viewpoint is a two-step process. In the first step, one creates a set of scales for rating health states, i.e., physical and emotional health status. The general public then is polled to determine how they value the different health states relative to optimal health and to death. A good measure should allow people to rate some fates as worse than death.

In the second step, either patient survey/observation or expert physician judgement is used to estimate the temporal pattern of health status changes over time that result from a medical problem. The rating scale then is used to estimate lost utility (an economist’s measure of the relative value people place on different goods). What results is an estimate of the QALYs lost to the medical problem. Over time, refinements to this method have led to the recognition that death does not result in a full QALY of loss per year of life lost. Because no one is perfectly healthy every day, estimated QALY losses normally should be adjusted for major pre-existing health problems. US data now are available to support adjustment (Krueger and Ward, 1998).

A good QALY scale is segmented by dimensions of functioning. The range of functional dimensions varies in scope and detail. For example, the original Health Utility Index (Torrance, 1982) considers four dimensions: social-emotional function, role function, physical function, and health/sensory problems. Patrick and Erickson (1993) summarize the scale dimensions used in a wide range of QALY rating studies.

Each of the existing QALY scales has drawbacks. Furthermore, in a case study (Gold et al., 1996), the scales yielded widely varying estimates for the same disease. In part this was caused by the different domains covered by the different measures, in part it was a function of the underlying valuation task.

Primary considerations in selecting a baseline scale are: (1) how comprehensively the scale covers the range of health status dimensions, (2) how finely health status is assessed within dimension, (3) empirically, how credible the scale’s ratings are (measured by consistency with ratings from other scales and by the range/clustering of possible scale scores), (4) the representativeness of the population used in calibrating the ratings, (5) the technical soundness of the rating method used in calibration, (6) the length of interview required to rate current health status using the scale, and (7) importantly, what off-the-shelf ratings are available for specific medical conditions.
Here are preliminary assessments of some of the leading scales.

- The Health Utility Index (Torrance, 1982; Drummond et al., 1987) was calibrated primarily with a survey of 112 parents of school-age Canadian children. A broader HUI scale recently was calibrated with particular reference to disabling workplace injury (Torrance et al., 1992). A still more comprehensive HUI scale then was calibrated through a 500-person sample survey (Patrick et al., 1993). HUI scales are easily applied to a wide range of diagnoses. Miller et al. (1989) finds HUI-based estimates compare reasonably well with direct survey estimates of utility losses for selected conditions.

  The original HUI has been mapped into various US National Center for Health Statistics (NCHS) surveys including the National Medical Expenditure Survey, the National Health Interview Survey, and the National Health and Nutrition Examination Survey (Erickson et al., 1989, 1992), making it possible to compare the health status of people with varying medical conditions. Mapping yields a good measure of the population’s average quality of life. Since most people have a variety of medical conditions, however, it can be difficult to try to parse out the QALY impacts of a particular condition (Fryback et al., 1993).

- The Quality of Well-Being (QWB) Scale (Bush et al., 1973; Kaplan et al., 1976, Kaplan, 1982) is based on a San Diego survey in the early seventies. The QWB’s performance has a low maximum loss level; no fate is scaled anywhere near as bad as death. Although I am not overly fond of this scale, it has been very widely applied. Like the HUI, NCHS has mapped the QWB into its data sets (Erickson et al., 1989). Fryback et al. (1993) and those designing the Oregon Medicaid rationing effort (Office of Technology Assessment, 1992) also used it to calculate values for specific diagnoses. Oregon also recalibrated the scale (Patrick and Erickson, 1993). Thus, the QWB can readily be used for sensitivity analysis. I do not favour it, however, for base case analysis.

- The EuroQol scale (EuroQol Group, 1990; Brooks et al., 1991; Nord, 1991; Williams, 1995) has been calibrated with national sample surveys in Britain, Sweden, and the Netherlands, making its estimates more representative than any other scale developed to date. The scale only offers a total of 245 health states, meaning it is less detailed than the HUI. It may lack the sensitivity needed to differentiate between alternatives that create moderate improvements along one dimension of health status.

- The Injury Impairment Index (III) (Hirsch et al., 1983) was developed for physicians to use in rating the time-phased consequences of injury on six dimensions: cognitive, mobility, daily living, sensory, cosmetic, and pain. Following procedures similar to Erickson et al. (1992), Miller et al. (1991,1995) converted the functional ratings to utilities. Objective data were added on

injury cost per gun is $840 in Canada and $630 in the US. This finding strongly suggests controlling ready access to guns can reduce the toll
permanent work-related disability frequency. Weights were synthesized for each scale level within dimension and across dimensions from scores on HUI, QWB, and other scales, then combined across dimensions. Validation has been limited, however. This scale underlies virtually all of our group’s published estimates of willingness to pay to reduce the risk of non-fatal injuries.

- The Functional Capacity Index (FCI) (MacKenzie et al., 1996, Luchter, 1998) is the result of an ongoing major US National Highway Traffic Safety Administration investment. The work to date includes creating a 10-dimensional Functional Capacity Index, convening physician panels to rate average adult and paediatric functional losses by non-fatal injury diagnosis, validating the ratings, and converting the scores to QALY estimates through limited population surveys. The scales presently exclude impacts on pain and psychological function and do not allow fates worse than death.

Another popular measure, the World Bank’s disability adjusted life years (DALYs), is essentially QALYs where the importance of different aspects of functioning is based on analytic judgement rather than a survey of public preferences. Furthermore, impact is rated on a single 6-point disability scale with little supporting evidence for the ratings. DALY estimates are little grounded in data. They have not been validated. Promisingly, the Dutch are measuring DALYs with the EuroQol instrument, which will make them more objective and allow validation.

In cumulating future years saved, like with any benefit, one needs to discount. Numerous studies (Agee and Crocker, 1996; Cropper et al., 1991; 1992; 1994; Johannesson et al., 1997; Kashner, 1990; Moore and Viscusi, 1990a; 1990b; Olsen, 1993; Viscusi, 1995; Viscusi and Moore, 1989) find that discount rates for longevity are not dissimilar to discount rates for monetary decisions. Indeed, the PCEHM and WHO recommend discounting QALYs at the same rate as monetary losses (Gold et al., 1996; Murray and Lopez, 1994).

Should QALYs be monetized?

QALYs can simply be reported as a complementary measure to economic costs. Alternatively, they can be monetized. The strongest argument for monetizing is to permit comparisons between health sector investments and investments in other sectors. Such comparisons are especially important for multinational development banks and donor organizations.

Pain, suffering, and lost quality of life for fatalities are best valued in dollars using an approach economists call willingness-to-pay. This approach derives the value of pain and suffering by asking people what they are willing to pay (called contingent value surveys) or by studying what people actually pay for small changes in their chance of being killed or injured. The value of fatal risk reduction, aggregated over many people, yields the value of a statistical life. For example, suppose a study estimated that the average person spends $300 on optional auto safety features that reduce the chance of dying prematurely by 1 in 10,000. Dividing $300 by the 1 in 10,000 probability yields a $3 million value per statistical life. That value has two components: (1) the value of the future work that will
be foregone and (2) the value of the pain, suffering, grief, lost companionship, and lost quality of life. The value of lost future work is known. Subtracting it leaves the value of the intangibles (Arthur, 1981; Miller et al., 1989). Importantly, when this subtraction-based method is used to value lost quality of life, the total cost of an injury becomes insensitive to the work loss estimate.

The values for lost quality of life in our published studies use the estimated mean value of statistical life across 67 studies that Miller (1990, 1999) rated as technically sound. At present, value estimates exist for 12 countries. The estimated mean value of statistical life in the US, for example, is $3 million 1997 after-tax dollars with a coefficient of variation of 28.5 per cent. Miller (1990) modified many published values to remove inappropriate biases. Without these somewhat arbitrary adjustments, Viscusi (1993) recommends a value of $3–5 million. These values are for people averaging age 38, two-thirds of them males. Miller (1999) provides a formula for estimating values for other countries from their gross domestic product, but its validity for different cultures and less developed countries is uncertain.

For non-fatal injury, four methods can be used to place a dollar value on pain, suffering, and lost quality of life: (1) monetization of estimated QALY loss, (2) analysis of jury awards for non-economic damages in countries where juries make such awards without restrictions, (3) survey methods, although these are costly and often fail to yield credible estimates, and (4) multiplication of work losses by the average ratio of QALYs to work loss across all non-fatal injuries to get a low-cost order-of-magnitude estimate.

Monetizing QALYs is the most popular approach. Working from a general equilibrium model of the economy, Miller et al. (1989) show that the value of a statistical life times the percentage utility loss associated with a non-fatal outcome equals the willingness to pay to avoid that outcome. Most QALY systems are calibrated so that optimal health has a value of 1, death has a value of 0, and fates worse than death are allowed. Under those conditions, QALYs measure the desired utility loss. We have published more than a dozen studies using this approach. Beyond our work, other studies that monetize QALYs with willingness-to-pay values come from Australia (Fildes and Digges, 1998), Canada (Bein et al., 1994; Newman et al., 1994), New Zealand (Guria, 1991), the United Kingdom (Ball, 1998; Ives et al., 1993), and the US (French et al., 1996; Mauskopf and French, 1989).

The value of reducing risk by one QALY can be estimated readily from the value of statistical life by assuming the value per QALY does not vary with age or sex (Miller et al., 1989). Specifically, one subtracts lifetime work loss from the value of statistical life to avoid double counting, then divides the remainder by the expected years of life span saved per life saved (discounted to present value). Multiplying the discounted years of expected life lost for someone in a specific age group by the QALY value, and dividing by the mean discounted all-victim lifespan yields a value tailored by age and sex.

With our value of statistical life, the value per QALY at a 2.5 per cent discount rate is
$85,600 (in 1997 US dollars). Validation of this QALY value has been minimal. Miller et al. (1989) used it to accurately predict values of asthma risk reduction obtained in a subsequent survey. For assaults (Miller et al., 1996), consumer product injuries (Miller et al., 1998), and drunk driving (Smith, 1998), the pain and suffering component of jury verdicts can be predicted well from III-based QALY losses ($r^2 > 0.5$ in log-linear regressions), with juries valuing QALYs consistent with a value of statistical life of $1.7$ to $4$ million. Thus QALY costs measure real and tangible losses. For example, when a car strikes a bicyclist and a bicycle helmet prevents a severe brain injury, an auto insurer may avoid paying millions of dollars to compensate the family’s lost quality of life.

The jury verdict method also has quietly gained popularity. Its theoretical framework comes from Cohen (1988), Viscusi (1988) and Rodgers (1993). The basic notion is that pain and suffering to a survivor can be approximated by the difference between the amount of compensatory damages awarded by a jury minus the actual out-of-pocket charges associated with the injury. Miller, Cohen, and Wiersema (1996) estimates pain and suffering for physical assaults from log-linear jury verdict regressions, then compares the results with III-based QALY estimates by ICD9 diagnosis group (Miller et al., 1995). Some individual estimates vary fairly significantly, but the incidence weighted mean estimates from the two methods vary by only 5 per cent. Thus, in large numbers, US jury verdicts appear to be reasonably predictable.

Valuing quality of life may be unfamiliar or disquieting. Given the wide range for the value of a statistical life and the slim validation of the implied QALY value, it also is difficult and controversial. Nevertheless, the ease of dealing with a single burden measure and the ability to compare between health and other sectors make it a valuable supplement to economic cost and QALY loss estimates.
Recurring questions about costs

Audiences often ask eight questions about injury costs. This section answers them. In some cases, it adds technical details.

Question 1. Preventing injuries means physicians lose business! Is that a cost to society?
No. Physicians lose business, but jewellers and computer stores gain business, so it is a wash. At the end of the day, however, you take home a diamond ring rather than a leg cast. That means you benefit.

Question 2. Why are welfare payments not in the costs?
The issue here is perspective. Costs most often are computed from society’s perspective. Welfare payments mean that we pay part of the wage loss for your injury rather than you picking up the whole tab. If we counted both the work loss and the welfare payment, we would double count.

From government’s perspective, however, welfare payments count. They also count from an external cost perspective. This perspective is often used when analysing whether the public should interfere with individual freedom. It evaluates the cost to people other than an actor who bears some responsibility for the injury, for example, the costs to other people when someone rides a motorcycle without a helmet for a year or the costs that others pay when someone drives a kilometre drunk.

When an individual’s costs are estimated with willingness to pay, ignoring the value of pride and self-sufficiency, a rational individual will not be willing to pay anything to avoid costs reimbursed by the welfare system. To convert individual willingness to pay into societal willingness to pay requires adding the welfare payments. From a practical viewpoint, this means societal willingness to pay to prevent an injury equals the sum of resource costs, work loss costs, and individual willingness to pay to avoid pain, suffering, and lost quality of life (net of lost productivity).

Question 3. Can we compare the economic costs to the Gross National Product (GNP)? Do they describe injury’s impact on the GNP?
No, they are not comparable. The economic costs include household work loss. The GNP does not value housework.

Comparing economic costs minus housework to the GNP is a valid yardstick for the size of the injury problem. (For example, annual US highway crash costs are roughly comparable to the GNP reduction that results from a recession.) However, economic costs do not describe injury’s impact on the economy. For one thing, when you buy domestic medical care rather than an imported South African diamond or SONY television, that helps your country’s economy. Similarly, when someone dies, since we
are not at full employment, it means someone else gets a job. The victim’s wage loss is not a GNP loss. The GNP loss in wages is just the friction cost (Koopmanschap et al., 1995), essentially the costs of hiring and training plus the value of unique skills that are lost. To compute the impact of injury on the economy, we would need to use an input-output model to trace the effects of expenditure shifts.

**Question 4. When people die, we no longer have to pay to feed and clothe them. Why not subtract consumption from the wage loss?**

The purpose of society is to let people consume. Since the deceased was a member of society, his or her consumption losses are legitimate societal losses (Fein, 1958; Klarman, 1965; Rice, 1966; Rice and Cooper, 1967).

**Question 5. For deaths, especially deaths of older people, are reduced future medical costs a benefit?**

From society’s perspective, they are not. Medical care is just a good like food which people consume to maximize their quality of life. From a government or external cost perspective, reduced medical care generally is a benefit.

**Question 6. Why count earnings losses when unemployment is high? Someone else needs the dead person’s job.**

This is a difficult question. In a willingness to pay accounting framework, as discussed earlier, the value of statistical life values both earnings loss and quality of life. For this framework, economic theory dictates including earnings loss (Miller et al., 1989).

If one does not monetize QALY losses, the problem is more complex. QALYs typically include the value the victim places on losing the ability to work. Adding them to productivity losses would double-count. Friction costs (Koopmanschap et al., 1995) were designed specifically to measure the productivity cost to people other than the victim. They appear to be the appropriate productivity loss costs in a QALY accounting framework where the QALY measure includes work impacts.

The economic cost framework is theoretically justifiable only as a lower bound estimate of injury costs that excludes the impacts on quality of life. Miller et al. (1989) show that work loss is included in this lower bound estimate.

**Question 7. No dollars change hands when people lose quality of life. Are you adding quality of life costs just to inflate the losses? Can users of these numbers omit the quality of life costs?**

The costs value real losses. US tort liability lawsuits against people or companies that cause serious injuries yield pain and suffering awards comparable to our estimates, although a wide gap might exist in less litigious countries (Cohen and Miller, 1997; Miller et al., 1996; Smith, 1998). Suppose a big truck hits your car. Your baby is in a child seat so she avoids a severe brain injury. That means an insurer will not be paying millions of dollars to compensate your family for lost quality of life. We see those savings.

Nevertheless, for many purposes and audiences, it is perfectly acceptable to report just economic or medical costs. Problem size, for example, is best described to a hostile
audience with economic costs, possibly supplemented by non-monetized QALYs. Some audiences are only interested in medical or resource costs, and costs to government are especially relevant in political debates. Conversely, victims turned advocates often choose to use costs that include monetized QALYs. Politicians feel uncomfortable challenging the victims’ valuations for fear of seeming unsympathetic.

When analysing the cost savings of prevention, a cost per QALY saved or a benefit-cost ratio based on comprehensive costs generally is desirable. If the resource cost savings alone exceed intervention costs, however, it is reasonable to simply state that the intervention yields net cost savings. A large benefit-cost ratio based on economic cost savings also can be reasonable to report although it does not support sound comparison with alternatives.

Question 8. When a habitual drunk driver or violent offender is saved, (s)he may harm other people. Is that not a cost?

This is a difficult ethical question. It seems preferable to reduce benefits in such cases. Computationally, we lack the data needed to adjust.

RECOMMENDED BURDEN TABLES AND THEIR PURPOSES

This section suggests a preliminary set of injury cost tables for international comparisons. It also discusses additional tables that can be useful if the data is available. Miller and Blewden (1999) explains the utility of more detailed measures around one injury-related topic, impaired driving crashes and costs. Lack of incidence and outcome data constrains costing efforts internationally.

by comparison, a kilometre driven sober costs only $0.10. A kilometre driven drunk costs people other than the drinking driver $8.90, 1,400 times the $0.006 cost per sober kilometre

Practically speaking, it would be a major advance to have even a modest amount of comparable data on non-fatal injury. A reasonable medium-term goal would be to compare annual incidence, incidence rates and economic costs for all injuries combined—road crashes; occupational injuries, and interpersonal violence by gender and age group. Because different people often need different information, a cost breakdown is desirable into at least three cost categories: (1) medical and other resource costs, because these costs are of special interest to governments and insurers who typically pay them, (2) work loss costs, which yield insight into income tax and productivity losses, and (3) monetized or unmonetized quality of life losses, which provide the best measure of human burden.

Increasingly, countries collect injury incidence data that include International Classification of Diseases (ICD) diagnosis codes and external cause (e) codes. Ideally, these countries should tabulate incidence, costs, and QALY losses: (1) by gender and age group, accompanied by costs per resident, (2) by severity (fatal, hospital admitted, other medically treated), (3) by age group and external cause/intent group (e.g., road crash,
self-inflicted) classified following the recommendations of the International Collaborative Effort (ICE) on Injury Statistics, and (4) by age group and ICE diagnosis group. If incidence data exist, it also is desirable to tabulate the costs of occupational, consumer product, and sports injury. E codes do not identify these categories. Finally, a comparative assessment of injury and illness costs by age group can be very helpful in drawing attention to the major burden injury imposes.

Experience dictates not just reporting total annual costs, which tend to be billion dollar numbers. Legislators deal with such large numbers daily and understand them. Extensive survey and psychological research, however, shows most people cannot comprehend the difference between $10 billion and $100 billion; both numbers are simply enormous (Mitchell and Carson, 1989; Slovic et al., 1980; Soguel, 1995; Viscusi and Magat, 1987).

To aid public comprehension, billion-dollar annual costs should be supplemented with costs divided by denominators that make sense from a policy viewpoint. For example, firearm injuries cost $495 per US resident versus $180 per Canadian resident (in 12/93 US dollars) (Miller and Cohen, 1997). Does this mean Canadian handgun control works? Perhaps, but perhaps it merely means the US is a more violent country. A different divisor clarifies the picture. Injury cost per gun is $840 in Canada and $630 in the US. This finding strongly suggests controlling ready access to guns can reduce the toll.

As another example, three divisors seem particularly appropriate for alcohol-related crash costs. Cost per drink is relevant for debating and evaluating taxation and other consumption reduction efforts such as enforcing laws against serving intoxicated patrons. Cost per heavy drinker informs treatment, detention, ignition interlock, and other sanctioning analyses. Cost per kilometre driven under the influence supports evaluation of other harm reduction strategies. It also makes the riskiness of alcohol-involved driving and the need for public intervention clear. Consider that the crash cost per kilometre driven drunk in NZ approaches $18 (in 1997 NZ dollars) (Miller and Blewden, 1999). By comparison, a kilometre driven sober costs only $0.10. A kilometre driven drunk costs people other than the drinking driver $8.90, 1,400 times the $.006 cost per sober kilometre. Strong public intervention clearly is justified.

**PROGRESS IN MEASURING BURDEN**

Without doing an exhaustive search of the literature on injury costing worldwide, this section provides a partial report on costing practice and coverage by country. Transportation safety costs have been studied in most developed countries and some less developed countries. A partial overview of these studies is available in Elvik (1995), Schwab-Christe (1995), and Ryan and Dyke (1998). Further information can be found in the proceedings from the October 1994 conference *Valuing the Consequences of Road Accidents* organized by the Institute for Regional and Economic Research at the University of Neuchatel, Switzerland and the May 1998 conference on *Measuring the Burden of Injury* that. the European Consumer Safety Association (ECOSA) is editing.

In the US, our research group recently assessed economic costs and QALY losses (monetized and unmonetized) for injuries by age group, cause group, diagnosis group, and circumstance (e.g., occupational, consumer product). (See Miller, Romano and
Spicer, in press; Miller, Covington, and Jensen, in press; Miller et al., 1998; Miller et al., 1999). This work updates less complete estimates for 1985 (Rice et al., 1989). Increasingly, we are computing state-level cost breakdowns as well. Leigh et al. (1997) also estimates the economic costs of occupational injury.

Injury costs elsewhere in North America are less complete. We have estimated comprehensive costs for gunshot wounds by intent in Canada (Miller, 1995) and for road crash costs in Ontario (Vodden et al., 1993) and British Columbia (Bein et al., 1994). Nationally, economic costs of crashes are estimated periodically. Moore et al. (1997) uses a top-down approach to estimate Canadian economic costs for injury as a whole and compare them to illness costs. Angus et al. (1998) estimates Canadian economic costs for unintentional injury, with separate breakdowns into 10 cause categories and severity. (This report also reviews the world literature on injury costs, as does Koffijberg et al., 1998.) Kerr and McLean (1996) and Day (1995) estimate the economic costs of violence against women in Canada. Mexico began assessing its road crash costs at one time but I am unsure if this effort was completed.

Most European countries have estimated the costs of road crashes periodically (OECD, 1988; Elvik, 1995). Several countries (Austria, Denmark, France, Norway, Sweden, Switzerland, and the United Kingdom) use willingness-to-pay values of statistical life from contingent valuation survey data. The remainder include only economic costs. The United Kingdom also has made QALY-based estimates for crash injuries and has roughly estimated comprehensive costs of occupational and consumer product injuries (Ball, 1998).

An on-going multinational effort coordinated by the European Consumer Safety Association (ECOSA) is developing uniform methods for costing consumer product injuries in Europe. The Netherlands has assessed its medical costs using the agreed methods and has estimated the economic costs of injury (van Beeck et al., 1997). They also have assessed the QALYs lost to injury versus illness as part of a EuroQol-based assessment of national DALY loss by health condition. Austria has estimated economic costs for injuries, as has a Swedish municipality (Lindqvist and Brodin, 1996). Norway also has current injury medical cost estimates (Kopjar et al., 1996) and is estimating work losses.

Australia periodically evaluates the economic costs of transportation injury (Cook et al., 1992). They are experimenting with ways to incorporate quality of life losses. Victoria estimated economic costs of injury (Watson and Ozanne-Smith, 1997); Moller (1998) used their cost factors to estimate national injury costs by age group and sex for 13 cause groups.

New Zealand used a contingent valuation survey to cost injury deaths and hospital admissions, then supplemented their estimates with medical cost data. Although their work has focused primarily on road crashes, it could easily be applied to cost other unintentional injury. They also have estimated all-cause injury medical costs (Phillips et al., 1993).
In Central and South America, the Pan American Health Organization and InterAmerican Development Bank are studying violence costs. Japan, Malaysia, Taiwan, and Hong Kong all estimate road crash costs. With expert judgement, Japan also has assessed QALY loss to crash injuries. Hsueh and Wang (1987) and Liu and Smith (1996) have estimated the value of statistical life in Taiwan.

WHERE WE NEED TO GO

International collaborative efforts have been instrumental in developing a worldwide picture of injury incidence. Outcome measurement scales like the Functional Capacity Index (MacKenzie et al., 1994) are being developed and validated through multinational efforts. These scales are valuable cost building blocks. It would be desirable for the worldwide injury community to adopt one QALY scale as a standard for base case analysis in cost-utility and benefit-cost analyses. Uniformity allows comparison of results across studies. Sensitivity analysis with other scales or supplemental direct survey assessments then can be added as appropriate.

It also is time to try stretching beyond national boundaries in developing other injury cost factors. Especially if we standardize on a QALY scale, the obvious question is whether countries need to collect their own QALY levels (i.e., utility loss estimates) by functional capacity loss category. Surveys of 100 to 400 people in half a dozen countries could answer questions like whether people trade off mobility against cognitive function comparably. If they do, several modest survey investments could yield a large calibration data set. I am particularly tempted by the idea of adopting Torrance’s latest HUI scale and accompanying scaling, or possibly the FCI.

Other injury cost factors also may be comparable internationally. It may be possible to develop temporary and permanent work-related disability probabilities and temporary disability durations by diagnosis code that apply across developed countries. We need to see if patterns between ICD diagnosis codes in length of stay, medical resource intensity/cost, and percentage of medical spending in the acute care phase persist across countries (e.g., how does the US ratio of 7.5:6.1 for lengths of stay for admitted tibia/fibula fractures (ICD 823) versus humerus fractures (ICD 812) compare with other countries’ ratios).

Another valuation issue where a worldwide approach seems credible is willingness to pay for fatal risk reduction. Miller (1999) suggests values are reasonably transportable across developed countries, but that finding needs validation, especially for different cultures and less developed countries.

PROGRESS IN MEASURING COST SAVINGS OF PREVENTION

One particularly important area of progress in estimating injury burden is in application for evaluation and resource allocation. We recently completed a meta-analysis of studies examining the cost-savings of non-occupational injury prevention and treatment system organization measures in the US (Miller and Levy, 1999). We identified 84 credible cost
savings estimates published between 1987 and 1999. The large majority of the estimates addressed impaired driving, substance abuse, road crashes, or interpersonal violence. None addressed suicide, drowning, poisoning, scald, cutting/piercing, childhood fall, or unintentional firearm injury prevention. The lack of well-designed outcome evaluations for effective preventive measures imposes a major barrier to filling the holes.

Many preventive measures, including more than half the road safety measures, offered resource cost savings exceeding their implementation and operational costs. In health care, interventions rarely are this cost-effective (Tengs et al., 1995). High benefit-cost ratios and low costs per QALY saved suggest many injury prevention efforts should be widely implemented. Cost effective road and vehicle safety efforts have been implemented, as have child safety measures. Interventions that constrain adult behaviour, however, have often met political resistance. Indeed, the US repealed two measures with proven benefits—national interstate speed limits and Federal incentives for states to mandate that motorcyclists wear helmets—in 1996. Promises of cost savings can help to swing the political wheel. They are, however, only an advocacy aid. Political will is the key to safety.

Each year brings greater knowledge of the worldwide burden of injury and ways to reduce it cost-effectively. We still have much to learn. Costs and QALY losses are critical public information and investment management tools. They can be assessed at reasonably modest cost. It is time we accelerated the process.

REFERENCES

Cohen, M.A. and Miller, T.R., 1997, Willingness to award nonmonetary damages and the
implied value of life from jury awards. Working paper, Vanderbilt University, Nashville, TN.


Hauer, E., 1994, Can one estimate the value of life or is it better to be dead than stuck in traffic ? *Transportation Research, A 28A,* pp. 109–118.


In Discussion Paper 8801. (Taiwan: Chung Hua Institution for Economic Research).


INTRODUCTION

Knowledge of fundamental traffic flow characteristics—speed, volume and density—and associated analytical techniques are essential requirements in planning, design, and operation of transportation systems. The fundamental characteristics have been studied at microscopic and macroscopic levels. Existing traffic flow models are based on time headway, flow, time-space projectory, speed, distance headway and density. These have lead to the development of a range of analytical techniques: demand-supply analysis, capacity and level of service analysis, traffic stream modelling, shock wave analysis, queuing analysis and simulation modelling. The focus of this research has been homogenous traffic conditions—traffic which consists primarily of cars or motorized vehicles of similar characteristics. We are now faced with a situation where more than half of the world’s population is living in megacities in the developing region. Large differences in income levels and social disparities have lead to the development of ‘cities within cities’. Each level of the city, with its own level of technology and land-use patterns, exists in close geographical proximity with other cities of different patterns. This is reflected in the travel and traffic patterns existing in this region. The same road space gets used by cars and buses, along with locally developed vehicles for public transport such as three-wheeled scooter taxis, scooters and motorcycles, bicycles, tricycle rickshaws, animal and human drawn carts. Infrastructure which is designed on the basis of homogeneous traffic models has failed to fulfill the mobility and safety needs of this traffic. Despite low levels of car ownership, accidents and congestion continue to plague this region. This is the right time to question the applicability of models which have been developed for a very different situation.

Traffic Flow and Safety

Two basic parameters of traffic flow which influence the safety of road users are traffic volume or flow measured in terms of number of vehicles per unit time and traffic speed. The amount of traffic, often called traffic flow or more general exposure, is often treated as a matter of routine. Relationship between accidents and flow is, therefore, often assumed to be a simple (linear) relationship. One major reason could be that it seems obvious that an increase in flow leads to an increase in the number of accidents. If we have a system without road users it is obvious that it cannot produce any traffic accidents.
And if the number of road users increases this will then obviously lead to increased probability for an accident. Most modelling work has used flow as one major explanatory variable. The most used model structure is the exponential (Ekman, 1996).

\[ E(A) = k \times \text{exposure}^y \] (Kulmala, 1995).

This approach fulfils some basic ideas about traffic and traffic safety: it starts at the origin, zero flow creates no accident. Furthermore, it is monotonically increasing with increasing flow, as long as \( y \) is positive. However, this assumption is not completely supported either by basic traffic theory or modern behaviour adaptation theories. The results from estimations based on empirical data is often that \( y \) is slightly less than 1. This means that accidents increase by increasing exposure less than a linear approach would have given. This makes intuitive sense also considering the relationship between flow, speed and fatalities.

**Flow, speed and fatalities**

The standard traffic flow model assumes a parabolic curve between speed and flow as shown in Figure 1.

![Figure 1 Speed flow relationship (May, 1990)](image)

Depending on the degree of heterogeneity in the traffic mix, fatalities and injuries may decrease even if the exposure of vulnerable road users increases.

As number of vehicles increase on a network, speed remains constant as long as the flow is below a certain value. This condition is defined as level of service A. Speed reduces
gradually until the flow reaches capacity. Consider this relationship with the relationship of speed and fatalities and injuries shown in Figure 2. The estimates for probability of pedestrian deaths at different impact velocities are: 5–8 per cent at 30 kph, 25 per cent at 40 kph, 45–80 per cent at 50 kph, and more than 85 per cent at 60 kph (European Transport Safety Council, 1995; University of Zurich and Swiss Federal Institute of Technology, 1986.) For car occupants in crashes at 80 kph the likelihood of death is 20 times more than at 32 kph (IIHS, 1987). Clearly, increase in speed is associated with disproportionate increase in number of fatalities. Also, the safe speed for car occupants is much higher than for the pedestrian and bicyclists.

Speed influences energy consumption, pollution, noise, vehicle and road maintenance costs, stress on road users and safety. In general, higher speeds have an adverse influence on all these factors. The safety of road users is influenced both by the absolute speed of vehicles and by the variation in speeds among vehicles on the road (Noguchi, 19**). Other factors remaining constant, higher speeds increase the probability of a crash taking place and the severity of injury in a crash, whereas a greater variations in speeds of vehicles only increases the probability of the event. As illustrated in Figure 2, small reductions in travelling speed result in large reductions in injuries and fatalities in both urban and rural areas. This is because the stopping distance of a vehicle under braking is proportional to the square of the original velocity and the damage to human beings is related to the square of the impact velocity. Lower initial speeds means that the driver has better control on the vehicle and the vehicle can stop much earlier and reduce the probability of a crash. In the event of a crash the injuries are less severe at lower impact velocities.

![Figure 2 Speed and pedestrian fatalities](image)

The relationship between flow, speed and fatalities requires further consideration in the case of mixed traffic and vulnerable road users. A heterogenous traffic mix has an effect on traffic safety, specially traffic fatalities. Figure 3 shows the distribution of the percentage of non-motorized vehicles (NMV) fatalities versus the percentage of motorized vehicles (MV) trips comprising the location’s modal split (Fazio and Tiwari,
Theoretically, no NMV fatalities can result from a striking MV at the origin on the graph because no MVs exist in the traffic stream at this point. When MVs account for 100 per cent of the trips, no NMV fatalities occur because of the absence of NMVs in the traffic. Presence of NMVs also has a calming effect on traffic speed. Data from Delhi also show that as NMV flow increases, the average speed difference between MVs and NMVs decrease specially on roads where mixing of MV and NMV takes place (high conflict between MV and NMV). As the speed difference or initial speed reduces, number of fatalities and injuries reduce. Therefore, depending on the degree of heterogeneity in the traffic mix, fatalities and injuries may decrease even if the exposure of vulnerable road users increases.

Models which predict number of fatalities, injuries and accidents based on a linear relationship with motorization or flow are inappropriate if they do not include speed implications. Rate of fatalities would depend on how the increased flow affects mean speed of the traffic stream as well variation of speed of the traffic stream. The modal diversity present in mixed traffic (primarily in less motorized countries) makes the effect of speed even more critical because the vulnerable road users (VRUs)—people outside cars and buses constitute majority of the victims.

![Figure 3 Degree of traffic homogeneity](image)

**Heterogeneous traffic Flow: present and future**

Nearly 60 per cent of world population lives in developing regions-Africa, Asia and South America (Figure 4).
models which predict number of fatalities, injuries and accidents based on a linear relationship with motorization or flow are inappropriate if they do not include speed implications

These regions are characterized by dominance of large cities—more than 60 per cent of the urban population resides in million-plus cities. Of the 100 largest cities 62 are in this region. A large proportion of the population residing in these cities lives below the poverty line, 29–60 per cent (Figure 5). Therefore, the demand for non-motorized modes and pedestrians on highways and urban areas is inevitable.

Urban areas in developing countries experience such extremes of wealth and poverty that they can be characterized as having dual economies. One serving the needs of the affluent and featuring modern technologies, formal markets, and outward appearance of developed countries. The other serves disadvantaged groups and is marked by traditional technologies, informal markets and moderate to severe levels of economic and political deprivation (Dimitrou, 1990).

Urban poverty, characterized by unemployment, dependence on the informal sector, low wages and insecure jobs, has a direct bearing on travel and transport demand of a large segment of the population residing in urban areas. Their dependence on transport which enables them access to job markets becomes essential for survival. This need is more critical for them than for those with high income and secure jobs. However, this segment of population is also transport poor. Even a subsidized public transport remains cost prohibitive for them.
Cities in developing countries are characterized by heterogeneous traffic (mix of non-motorized and motorized modes) and mixed land-use patterns. Non-motorized vehicles are owned and used by a large section of the population (Figure 6).
Car ownership rates in Asian countries are low compared to North America and OECD countries. In 1993, it was 29 cars per 1000 residents in East Asian countries compared to 561 cars per 1000 residents in North America, 366 in OECD countries (AAMA, 1995). Although the greatest growth rate in the number of motor vehicles is expected in many Asian countries, most of these increases in absolute numbers of vehicle fleets will result from increases in the numbers of motorized two-wheelers (MTWs) and three-wheelers (World Resources Institute, 1996). In Thailand, Malaysia, Indonesia and Taiwan, two- and three-wheelers account for more than 50 per cent of all motor vehicles.

30 per cent of the world population living in urban poverty in cities of developing countries is transport poor… A sustainable transport system must meet the demand of this captive ridership of non-motorized transport existing in the cities of the South.

Non-motorized transport (NMT) constitutes a significant share of the total traffic in many Asian cities. Shanghai, Hanoi, Kanpur and Tokyo all have a relatively high rate of bicycle ownership and a high proportion of bicycle traffic (Figure 7). In Indian cities, the share of NMT at peak hour varies from 30–70 per cent. The proportion of trips undertaken by bicycles range between 15 and 35 per cent, the share tending to be higher in medium and small sized cities. The patterns of NMT use changes with growth in city size. In most NMT-dependent low-income cities, bicycles are used for entire trips (e.g., commuting, shopping). In Kenya, despite several constraints, the NMT including walking are still the prevalent modes that provide more than 45 per cent of all the personal transport in urban centres. In a high-income city like Tokyo, bicycles are increasingly used as a feeder mode to rail stations as well as for shopping and other purposes (World Bank, 1995). Every motorized public transport trip involves access trips by NMT at each end. Thus, NMT including walking continues to play a very important role in meeting the travel demand in cities in developing countries.

Table 1 gives selected indicators for a few Indian cities. Regardless of city size, it shows that nearly 40–60 per cent of households have monthly incomes of approximately US $50–60. In large cities like Mumbai, Delhi, Chennai, more than 60 per cent of people are employed in the informal sector. For this population walking and bicycling to work is the only mode of transport available. Assuming a minimum of 4 trips per household per day at the cost of Rs 2 (US$ 0.05) per trip by public transport, a household would need to spend Rs.320 (US$ 8) per month on transport. For low-income people living in the outskirts of the city, the cost per trip may be two or three times this amount depending on the number of transfers. On an average, low-income households cannot spend more than 10 per cent of its income on transport. This implies that a household’s income must be at least Rs.3200 (US$ 80) to be able to use the public transport system at minimum rates. According to a survey (ORG, 1994), approximately 28 per cent of households in Delhi have a monthly household income of less than Rs.2000(US$ 50).
Table 1

Indian city indicators

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>MUMBAI</th>
<th>DELHI</th>
<th>MADRAS</th>
<th>BANGALORE</th>
<th>LUCKNOW</th>
<th>VARANSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (million)</td>
<td>10.26</td>
<td>8.96</td>
<td>5.65</td>
<td>4.47</td>
<td>1.8</td>
<td>1.08</td>
</tr>
<tr>
<td>Household Income Distribution (Quintile Boundaries US $)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I (poorest 20%)</td>
<td>374</td>
<td>290</td>
<td>347</td>
<td>385</td>
<td>291</td>
<td>268</td>
</tr>
<tr>
<td>V (richest 20%)</td>
<td>2497</td>
<td>3292</td>
<td>2781</td>
<td>2487</td>
<td>2181</td>
<td>2084</td>
</tr>
<tr>
<td>Informal Employment (%)</td>
<td>68</td>
<td>66</td>
<td>60</td>
<td>32</td>
<td>48</td>
<td>49</td>
</tr>
<tr>
<td>Motorized Vehicles (per 1000 pop.)</td>
<td>51</td>
<td>205</td>
<td>102</td>
<td>130</td>
<td>130</td>
<td>85</td>
</tr>
</tbody>
</table>

Data from: Society for Development Studies, Delhi
Survey results show that nearly 60 per cent of respondents find the minimum cost of work trips by public transport (less than Rs.2 per trip) unacceptable (CRRI, 1988). Even at minimum costs, public transport trips account for 20 to 30 per cent of family income for nearly 50 per cent of people living in unauthorized settlements. This segment is very sensitive to the slightest variation in the cost of public transport trips.

The data above show that an estimated 30 per cent of the world population living in urban poverty in cities of developing countries is transport poor. In this segment it is harder for individuals and households to save and build up assets, and reduce their vulnerability to sudden changes/loss in income. Low incomes also make it difficult for households to ‘invest’ in social assets such as education that can help reduce their vulnerability in the future. Therefore, access to affordable transport is necessary for survival. A sustainable transport system must meet the demand of this captive ridership of non-motorized transport existing in the cities of the South.

**URBAN TRANSPORT AND LAND-USE PATTERNS**

Heterogeneous traffic is likely to continue in less motorized countries (LMCs) because of the socio-economic realities and compulsions. Many cities in LMCs experience such extremes of wealth and poverty that they can be characterized as having dual economies—one for the affluent and the other for the disadvantaged. Very often formal plans address the needs of one set of city residents, failing to recognize the existence of the other set who very often form the majority.

This traffic is characterized by lack of any effective channelization, mode segregation or control of speeds. To the formally trained planner it looks like chaos moving towards total gridlock. Yet people and goods keep getting through. And may, by some measures actually be doing better than in some controlled conditions.

The planning framework as adopted in the preparation of master plans in many Asian cities has been completely divorced from resource assessment. The process also does not invoke any procedures for involving community and bringing about consensus on contentious issues. The net effect of the inadequacies of the planning process has been that majority of urban growth has long taken place outside the formal planning tools. Informal residential and business premises and developments increasingly dominate new urban areas. Even in our megacities where half or more of a city’s population and many of its economic activities are located in illegal or informal settlements, urban planners still rely on traditional master-planning approaches with their role restricted to servicing the minority, high income residents. Few weak attempts have been made to bring some coordination of development and ‘services’ to informal areas through slum improvement schemes.

Unlike traffic in cities in high income countries (HICs), bicycles, pedestrians and other non-motorized modes are present in significant numbers on arterial roads and intercity highways. Their presence persists despite the fact that engineers designed these highway
facilities for fast moving uninterrupted flow of motorized vehicle.

Increase in the level of congestion has been a major concern for planners and policy makers in metropolitan cities. In Delhi average speeds during peak hour range from 10–15 kph in central areas and 25–40 kph on arterial streets (CRRI, 1992). Compared to Delhi, average speeds in other mega cities are less. In 1993, Delhi’s traffic fatalities were more than double that of all other major Indian cities combined (Indian Express, 1994). Clearly, criteria for recommending optimal speeds and congestion reduction does not include desired level of safety, pollution and land-use patterns.

There is ample evidence to illustrate the mismatch between the careful planning and growing transportation problems. Unless we understand the basic nature of problems faced by our mega cities, the adverse impact of growing mobility on the environment and safety would continue to multiply in future.

The existence of an active informal sector introduces a high degree of heterogeneity in the socio-economic and land-use system. This is assumed to add to our problems of congestion and pollution. However, the informal sector is an integral part of the urban landscape providing a variety of services at low costs, at locations with high demand for these services. Many view hawkers, pavement shops, cycle and motor vehicle repair and spareparts shops as unauthorized developments along the road that reduce the capacity of the planned network. However, since the market demands these services, they continue to exist and grow along arterial roads as well. It is quite clear that long term land-use transport plans must address the needs of the informal sector.

Understanding Heterogeneous traffic flow in developing country cities

Most developing country cities have been classified as ‘low cost strategy’ cities (Thomson, 1977). In comparison with cities in the West, these cities consume less transport energy. High densities, intensely mixed land-use, short trip distances, and high share of walking and non-motorized transport characterize these urban centres (Newman and Kenworthy, 1989).

Heterogenous traffic flow consists of modes of varying dynamic and static characteristics sharing the same road space. Underlying concepts of traffic flow theory in the US, Europe, and Australia are formed by motorized four-wheel road way traffic dominating in those areas, i.e., homogenous traffic. All car following, lane changing logic and system’s measure of effectiveness used in microscopic simulation programmes ultimately use field data from these countries for calibration.

In LMC cities, the road network is used by at least seven categories of motorized and non-motorized vehicles. Vehicles ranging in width from 60 to 2.6 m, and capable of maximum speeds ranging from 15 to 100 kph, share the same road space. All these vehicles which have varied dynamic and static characteristics share the same carriageway. This traffic is characterized by lack of any effective channelization, mode segregation or control of speeds. To the formally trained planner it looks like chaos moving towards total gridlock. Yet people and goods keep getting through. And may, by some measures actually be doing better than in some controlled conditions.

In Delhi different traffic modes are not segregated and there is minimal enforcement of speed limits. In this situation flow patterns result in a natural optimization of road use due
to self organization by road users. Though aggregate conflict data do not correlate with fatalities, our data show that Delhi has high number of VRU fatalities. Therefore, segregation and traffic calming techniques developed for Delhi conditions with special reference to motorized two-wheelers are desirable. Techniques developed in HMCs do not address the high volume of motorized two-wheelers and large variations in traffic composition from site to site.

The peak hour motor vehicle flows in traffic with mix of MVs—cars, buses, two-wheeler scooters, three-wheeler scooter—have been observed to be very high compared to homogenous traffic sites of similar street width (Fazio et al., 1998). Having vehicles of narrow widths in the traffic stream greatly increases the capacity of streets. Narrow vehicles fill-in the lateral and longitudinal gaps between wide vehicles; heterogenous traffic uses on-street space more efficiently than homogenous traffic (Figures 8, 9 and 10). Homogeneous traffic flow is modeled on the basis of lane discipline logic. An ideal lane capacity is estimated of only passenger cars by using passenger car units or equivalents.

For heterogenous traffic, having an ideal capacity by lane is mis-conceptual because lane discipline is very loose. Vehicles have varying static and dynamic characteristics. These share the same road space and move by sharing the lateral as well as the linear gaps. For example, a motorcycle rider judges whether the lateral distance (width) between a motor scooter and bus is acceptable to progress on the roadway. Another motorcycle rider in the same situation would have a different critical width acceptance. If the width is unacceptable, then an entity is constrained by preceding entities. Critical width acceptance depends on three items. First, the travel speed of the vehicle/entity itself. The next item is the physical width of the vehicle. Distribution of the width acceptances of specific entity groups is the third item, i.e., driver/rider/pedestrian behaviour. Each vehicle/entity group has its own critical width acceptance.

Heterogeneous traffic can have many motorized two-wheelers, motorized three-wheelers, bicycles, non-motorized three-wheelers, cars, buses, trucks, animal-drawn carts, and human-powered push and pull carts. Additionally, if sidewalk facilities are inadequate or lacking, this diverse mixture contains significant on-road pedestrian traffic. In homogeneous traffic, traffic entities form one-dimensional queues (Figure 8); in heterogeneous traffic, mass queues develop. These queues grow lengthwise as well as laterally.

Lane discipline is deficient in heterogenous traffic not because driver behaviour is significantly different, but because heterogeneous traffic consists of entities of various widths and varying dynamic characteristics

The ‘car following’ notion used in homogeneous traffic flow models is not applicable in heterogenous traffic (Figure 9). Since cars do not comprise most of the traffic mixture, ‘car following’ is an incorrect term for heterogenous traffic. Secondly, since width of entities vary greatly in heterogenous traffic, figuring out which leading entity/vehicle it is following is difficult. Leading entities may run parallel or staggered.
Professionals have extensively derived models and algorithms from the ‘lane changing’ notion of homogeneous traffic (Figure 10). Microscopic studies of this traffic shows that the time headway between vehicles is an important flow characteristic that affects safety, level of service, driver behaviour and capacity of a transportation system. A minimum time headway must always be present to provide safety in the event that the lead vehicle suddenly decelerates. The percentage of time that the following vehicle must follow the vehicle ahead is one indication of level or quality of service. The distribution of time headways determines the requirement and the opportunity for passing, merging, and crossing. The capacity of the system is governed primarily by the minimum time headway and the time headway distribution under capacity-flow conditions.

Clearly, underlying these concepts is the notion of lane discipline or lack of it. Lane discipline is deficient in heterogenous traffic not because driver behaviour is significantly different, but because heterogeneous traffic consists of entities of various widths and varying dynamic characteristics. With homogeneous traffic, the width range is approximately 2.1 m for cars to 2.6 m for trucks and buses. Homogeneous traffic drivers find it optimal and advantageous to adopt lane discipline to traverse the roadway space given the narrowness of the width range. For heterogeneous traffic, the width range is approximately 6 m for pedestrians to 4.9 m for overburdened truck trailers. Drivers,
pedestrians, riders and animals find it optimal to advance by accepting lateral gaps (widths) between preceding entities. Heterogeneous traffic uses road space more efficiently than homogenous traffic. For this traffic, models based on width acceptance can ultimately produce a good estimate of roadway capacity and assessments of operations and safety of various facility designs.

Figure 10 Lane changing

This specific characteristic of heterogeneous traffic highlights the limitations of conflict technique which has been developed for homogeneous traffic (Tiwari G et al., 1998). There are very few detailed studies on traffic patterns and their influence on accidents in LMCs. We use here a study conducted in Delhi which involved conflict analysis for prediction of fatal crash locations. Peak hour traffic at fourteen selected locations were videotaped. Trained observers recorded traffic compositions at mid-block, average space, mean speeds by mode and conflicts by type, reactor mode and cause mode. The study showed a weak crash-conflict association. Definitions of conflict developed in HMCs where motorized vehicles are the dominant modes are inadequate in heterogeneous traffic situations like Delhi. In heterogeneous traffic streams, bicyclists, motorized two-wheelers and motorized three-wheelers have the freedom of moving laterally as well. These manoeuvres at low speeds need not necessarily lead to fatal crashes. Kouabenan (1996) and Salimen et al. (1992) have also reported that fatal accidents generally differ in causation from non-fatal injuries. The 3.5 metre wide lanes designed to fit four-wheeled motorized vehicles, such as cars, trucks, and buses can fit at least two lanes of two wheelers. These space sharing manoeuvres of heterogeneous traffic are also recorded as conflicts. These manoeuvres at low speeds need not necessarily lead to fatal crashes. For mixed traffic, we need to develop better understanding of conflicts to differentiate between conflicts that are a part of normal driving cycle and the ones that are potential crashes.

These issues convince us that LMCs are experiencing a new phenomenon in road traffic patterns and accidents for which there is little precedence. These patterns are new and they need to be understood through careful scientific research.
Safety in Heterogeneous traffic

The proportion of road users killed in various modes of transport as a percentage of all fatalities in different countries is shown in Figure 11. The data show that non-car occupants constitute almost 75 per cent or more of all fatalities in most developing countries. This flows logically from the fact that this class constitutes the majority of road users however, roads and other transport infrastructure designs address the need of motorized vehicles only. In addition, because VRUs are not protected by metallic or energy absorbing materials, they sustain relatively more serious injuries even at low velocity crashes.

![Figure 11 Proportion of road users killed in different countries](image)

In many LMCs highways run through rural areas with high density populations where most people do not have access to motor vehicles.

It is possible that wherever the proportion of VRUs is high as a proportion of all road users similar crash rates will be experienced as in India. However, some less motorized countries (LMCs) do not have bicycle use rates as high as those of countries like India, China and Vietnam, and these countries have lower involvement of bicycle fatalities (Tiwari and Saraf, 1997). In these countries where bicycle use rates are lower, it appears that MTW and pedestrian fatality rates are proportionately higher. Data show that in most developing countries, the urban poor who are heavily dependent on NMVs, are the victims of road traffic crashes.

Almost 80 per cent of all cars are owned by 15 per cent of the world’s population
residing in North America, western Europe and Japan. On the other hand, in LMCs like India and China, less than one in a hundred families owns a car. Car ownership levels in LMCs are so low that even at a reasonable economic growth rate (say 7–10 per cent per year) for the next few decades, most families in LMCs are not likely to own a car in the next quarter of a century. A comparison of per capita levels of vehicle registration and proportions of cars and motorcycles in a few countries is given in Table 2. These ownership patterns show that total vehicles registered per capita, and car and motorcycle ownership levels differ greatly in HMCs and LMCs. These different ownership levels influence traffic behaviour patterns and composition of traffic fatalities.

Table 2

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>GNP PER CAPITA (us$)</th>
<th>TOTAL NUMBER OF VEHICLES / 1,000 PERSONS</th>
<th>MTWs AS % OF TOTAL VEHICLES</th>
<th>CARS AS % OF TOTAL VEHICLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>34630</td>
<td>640</td>
<td>20</td>
<td>58</td>
</tr>
<tr>
<td>USA</td>
<td>24780</td>
<td>740</td>
<td>2</td>
<td>88</td>
</tr>
<tr>
<td>Germany</td>
<td>23980</td>
<td>570</td>
<td>9</td>
<td>89</td>
</tr>
<tr>
<td>France</td>
<td>23420</td>
<td>520</td>
<td>10</td>
<td>87</td>
</tr>
<tr>
<td>UK</td>
<td>18 340</td>
<td>410</td>
<td>3</td>
<td>86</td>
</tr>
<tr>
<td>Australia</td>
<td>18000</td>
<td>610</td>
<td>3</td>
<td>76</td>
</tr>
<tr>
<td>Republic of Korea</td>
<td>8260</td>
<td>206</td>
<td>24</td>
<td>33</td>
</tr>
<tr>
<td>Malaysia</td>
<td>3 140</td>
<td>340</td>
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<td>34</td>
</tr>
<tr>
<td>Thailand</td>
<td>2410</td>
<td>190</td>
<td>66</td>
<td>16</td>
</tr>
<tr>
<td>Philippines</td>
<td>950</td>
<td>32</td>
<td>26</td>
<td>28</td>
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<tr>
<td>Indonesia</td>
<td>810</td>
<td>58</td>
<td>69</td>
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<tr>
<td>Sri Lanka</td>
<td>600</td>
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<td>60</td>
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<tr>
<td>China</td>
<td>530</td>
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<td>India</td>
<td>320</td>
<td>30</td>
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<tr>
<td>Vietnam</td>
<td>210</td>
<td>27</td>
<td>91</td>
<td>9</td>
</tr>
</tbody>
</table>

These figures suggest two different phenomena that are relevant to road safety policies. It appears that total vehicle registration levels remain below 100 per thousand persons in countries that have per capita incomes of less than US $ 1,000 and that motorcycle registrations decrease below 20 per cent of the total vehicle fleet only when per capita
incomes are much greater than US $ 8,000. The only exceptions are countries like China where MTW production or availability has been controlled by government policy. Even at per capita income levels of US $ 3,000 car ownership levels remain low and the proportion of MTWs can be more than 50 per cent. Most LMCs, including India and China, will not reach per capita income levels of US $ 3,000 in the next decade. As incomes increase, the poorest people in countries like India and China will be able to own bicycles and those who own bicycles today may opt to buy motorcycles when they become richer. As the number of poor and lower middle class people in these countries is larger than that belonging to the upper class, we are likely to witness greater increases in absolute numbers of bicycles and motorcycles than cars in the next decade or so. Road safety policies and countermeasures that are based on societies where car fleets constitute about 80 per cent of the vehicle fleet will not be adequate for most LMCs where MTWs comprise more than 40–50 per cent of the total number of vehicles.

**future traffic models must account for the users of different transport modes having conflicting requirements... Highway planning standards provide for services needed by motorized vehicle users. However, there are no standards for providing services needed by NMT**

The prevalent high rates of pedestrian, bicycle and motorcycle traffic in LMCs (proportions do differ from country to country) result in VRU fatalities constituting 60–80 per cent of all traffic fatalities (Mohan, 1992). These patterns of traffic and accident in LMCs are not only different from those that are prevalent in HMCs today, but are also different from the experiences of HMCs in the past. The HMCs have never experienced road traffic that includes such a high proportion of motorcycles, buses and trucks sharing the same road space with pedestrians and bicyclists. In addition, in the earlier part of this century when the present HMCs had low per capita incomes, motor vehicles (including motorcycles) were relatively more expensive and not capable of high velocities and accelerations. Therefore, speeds were lower and number of vehicles using roads was less than that seen today. In a sense, motor-vehicle technology, roadway quality and social systems were more compatible. On the other hand, LMCs now have to plan for use of technologically advanced vehicles using relatively ‘less advanced’ roadways and enforcement systems.

Because bicyclists and pedestrians continue to share road space in the absence of infrastructure specifically designed for NMVs, they are exposed to higher risks of being involved in a road traffic accident by sharing the road space with high speed modes. Unlike cities in the West, pedestrians, bicyclists and MTWs constitute 75 per cent of total fatalities in road traffic crashes. Buses and trucks are involved in more than 60 per cent of fatal crashes. Buses are often very crowded inside and significant proportion of passengers who die are those who fall from footboards of buses. In addition, many indigenously designed vehicles (IDVs) such as tempos, jugar are present on roads of Indian cities because of the absence of efficient and comfortable public transport services. These IDVs operate as paratransit modes thus serving a useful role in the context of existing social system (Tiwari, 1994).

In HMCs a very large proportion of the population owns motorized vehicles. In
addition, these countries can afford to have roads parallel to expressways to be used by local traffic and vehicles not allowed on expressways. In many LMCs highways run through rural areas with high density populations where most people do not have access to motor vehicles. Also, many expressways in LMCs do not have parallel road links for slow and non-motorized traffic. This forces slow and non-motorized traffic to use expressways and to cross them illegally where that majority of the victims of road accidents on intercity highways are the vulnerable road users.

**FUTURE DIRECTIONS**

Various road users have different and often, conflicting requirements. Motorized vehicles need clear pavements and shoulders, while bicyclists and pedestrians need shaded trees along the pavement to protect them from the summer sun. Owners of private transport modes like MTW and automobiles prefer uninterrupted flow, fewer stops and minimum delays at intersections, whereas public transport buses require frequent stops for picking and discharging passengers. Motorized four-wheeled vehicles like cars, buses, etc., perform better if they move in queues with minimum braking and acceleration. Since our infrastructure design does not account for the existing conflicting requirements of different modes, all modes have to share the road space and operate in sub-optimal conditions.

Experience of past decades of long-term integrated land-use transport plan exercise suggests that the existence of informal sector and their travel needs must be recognized for preparing effective plans. This should encourage mixed land-use patterns and transport infrastructure especially designed for bicycles and other non-motorized modes.

Future traffic models must account for the users of different transport modes having conflicting requirements. These models must account for the needs of motorized vehicles for clear roads for uninterrupted traffic flow, at the same time they must address the needs of bicyclists and pedestrians for shady trees, kiosks for drinks, food and bicycle repair shops, etc., at shorter distances. Highway planning standards provide for services needed by motorized vehicle users. However, there are no standards for providing services needed by NMT. These services mushroom along urban or inter-city highways to fulfill the demand of road users, however their existence is viewed as ‘illegal encroachment’ on the designed road space.

Motorized vehicles are designed to operate at much higher speeds for better fuel economy and emission levels. Roads are also designed to increase throughput of motorised vehicles only. These measures decrease safety of NMV occupants and pedestrians sharing the same road space. Therefore, safe facilities—segregated lanes, convenient crossing opportunities from the point of view of NMV users should form an integral part of the road designs. At present these facilities are viewed as cost increasing measures which many developing countries cannot afford due to resource crunch.

Urban streets passing through the commercial development and highways passing through small towns serve multiple purposes. They carry through traffic. However, the adjacent land-use generates cross-traffic and demands multiple space usage, for example, space for parking vehicles, space for hawkers and informal shopping, etc. The existing
design standards do not account for conflicting demand between local traffic and through traffic resulting in sub-optimal conditions, i.e., long delays for through traffic and safety hazards for local traffic specially at off peak hours, for both kinds of traffic.

We have to accept the fact that safety has to be promoted in most LMCs within existing conditions. These include low per-capita incomes, presence of mixed traffic, low capacity for capital intensive infrastructure and different law enforcement capabilities. This approach will be important for most LMCs as they are not likely to experience economic growth rates which puts them at par with HMCs within the next couple of decades. This implies that pedestrians, bicyclists and motorized two-wheeler (MTW) riders will remain dominant on LMC roads for many decades. This group of road users will be called the vulnerable road users (VRUs).

Such traffic systems are very complex and will need new understanding. Therefore traffic flow and safety models need to developed for this complex traffic to meet their specific requirements not found in homogenous traffic conditions.

there is a need to accommodate the conflicting requirements of NMV occupants and pedestrians, and motorized traffic on our urban and inter-city highways

A major shift is required in design principles itself to promote safety in LMCs. If a large number of users are pedestrians, bicyclists and other slow moving vehicles then road designs have to address their needs in addition to the needs of motorized vehicles. Motorized vehicles can use a longer route and over-bridges, however, a pedestrian or bicyclist would prefer not to use an underpass or over-bridge just because it is safer to do so. For this group of users convenience is an overriding priority.

There is a need to accommodate the conflicting requirements of NMV occupants and pedestrians, and motorized traffic on our urban and inter-city highways. This includes redesigning the road cross section setting more exclusive space for pedestrians and NMVs, and giving pedestrians and bicyclists priority over cars at certain places.

Speed control is perhaps the most important measure for reducing road traffic crashes in LMCs. Methods to control speed in urban and residential areas should be given the highest priority. Currently we do not have a good understanding of how this can be done at low policing levels in the traffic mix seen in LMC urban areas. For rural roads there are no good designs for non-expressway safety with high VRU participation.

The quality of roads issue has to be addressed in terms of providing better facilities to non-motorized road users, developing suitable designs for heterogenous traffic and those for slowing traffic in residential areas. In many LMCs even on national highways, majority of people killed are pedestrians, bicyclists, those using two-wheelers or involved in crashes with tractors/bullock carts. Therefore, unless these issues are addressed and methods developed for area wide safety improvements we will not be gaining much by concentrating on blackspot treatment.

REFERENCES

Central Road Research Institute, Mobility Levels and Transport Problems of Various Population Groups, CRRI, Mathura Road, New Delhi, India, 1988, p32.
CRRI, 1992, Development of Traffic and transport Flow Data Base for Road System in Delhi Urban Area (New Delhi: Central Road Research Institute)
Folklore and Science in Traffic Safety: Some New Directions

Murray Mackay

INTRODUCTION

Today there are approximately 700 million passenger cars, trucks and buses and 300 million motorcycles and mopeds (motorized two-wheelers) worldwide. Nobody really knows how many bicycles there are. Of passenger cars 80 per cent are owned by 15 per cent of the world’s population living in North America, western Europe and Japan. Along with food, shelter, security and health, individual mobility is a basic human need; one on which our other basic needs are in part dependant. Indeed historically, development has been almost synonymous with improvements in transport from the trans-Asian Silk Route of Marco Polo to the farm-to-market roads in early United States to the trans-European motorway network aiming to link west Europe more firmly to East Europe.

A major side effect of increased mobility is increasing exposure to injury in traffic crashes. Using the measure of Disability adjusted life years (DALYs) Murray and Lopez (1996) predicted that death and disability resulting from road accidents (in comparison with other diseases) will rise from 9th to 3rd rank between 1990 and 2020. Road accidents as cause of death and disability would rank below heart disease and clinical depression, and ahead of stroke and all infectious diseases (see Figure 1).

What is clear from even the most superficial view of the epidemiology of road accidents is that the characteristics of this form of injury vary enormously between country and region. It is therefore wrong to describe these phenomena as an unified subject with well defined characteristics and a universally applicable array of counter-measures. Conventional wisdom on the subject has evolved in western Europe and North America in the context of fifty years of modest growth rates and currently very high levels of car ownership and use in comparison to the rest of the world. At present, neither conditions pertain in most countries. This paper argues that a fundamental review is required of the nature of traffic injury in low income countries (LICs) and new strategies need to be developed to diminish traffic injuries in LICs. For too long consultants have been applying western counter-measures to traffic accident problems of LICs. New knowledge, thus new strategies need to be developed within the political and cultural framework of each country, which are more appropriate for the real traffic accident problems faced by most of the world.
developed within the political and cultural framework of each country, which are more appropriate for the real traffic problems accident faced by most of the world.

**Figure 1** Change in rank order of disease burden for 15 leading causes 1990–2020

**BACKGROUND**

At the macro level traffic-related deaths are the only variable which are recorded worldwide, and even deaths are likely to be seriously under-reported in many LICs (Mackay, 1984). Sample studies suggest that the following ratios for survivors occur in most traffic environments:

| Fatality | 1 |
| Major Permanent Disability | 3 |
These ratios are of course influenced by the quality of care available, reporting procedure and precise definitions of the categories described. Table 1 indicates current trends of fatalities in the 15 member countries of the European Union and the United States.

<table>
<thead>
<tr>
<th></th>
<th>1990</th>
<th>2000</th>
<th>2010</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU</td>
<td>55K</td>
<td>40K</td>
<td>30K</td>
<td>25K</td>
</tr>
<tr>
<td>USA</td>
<td>45K</td>
<td>42K</td>
<td>40K</td>
<td>38K</td>
</tr>
</tbody>
</table>

*Data from: Various national and EU reports*

Within the European Union there is a six-fold variation in fatality risk between the best and worst countries, in terms of fatalities per motor vehicle kilometres travelled (FERSI, 1997). It is likely that these variations will diminish over the next two decades, the general trend in terms of fatalities is likely to be downward in the industrialized countries of Europe, North America, Japan and Australia.

This is not the case in low income and middle income countries. By 1990 these countries (described, using the United Nations’ collective euphemism, as ‘developing’) accounted for 70 per cent of the world’s traffic fatalities. Currently that proportion is 84 per cent and by 2010 it is likely be over 90 per cent, as shown in Table 2.

<table>
<thead>
<tr>
<th></th>
<th>1990</th>
<th>2000</th>
<th>2010</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrialized</td>
<td>150K</td>
<td>About the same or little less</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Developing</td>
<td>350K</td>
<td>800K</td>
<td>1.3M</td>
<td>1.9M</td>
</tr>
<tr>
<td>Total</td>
<td>500K</td>
<td>950K</td>
<td>1.4M</td>
<td>2M</td>
</tr>
</tbody>
</table>

*Data from: Various national and UN reports*
These projections are partly determined by growth in motor vehicle ownership. Table 3 gives a consensus of projection for a selection of motorized and developing countries. Clearly a number of LICs are in the process of doubling their number of cars over a period of about 10 years. Such projections however, fail to give a realistic picture of either the nature of traffic in LICs, or the nature of traffic accidents or the trends in traffic casualties for the future, because they do not include the most commonly used vehicles in the country/region.

Table 3
Forecast of car populations 1995–2005

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>1995</th>
<th>2005</th>
<th>PERCENTAGE CHANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(in thousands)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>13,850</td>
<td>15,000</td>
<td>8.3</td>
</tr>
<tr>
<td>USA</td>
<td>148,200</td>
<td>156,000</td>
<td>5.4</td>
</tr>
<tr>
<td>Germany</td>
<td>40,500</td>
<td>44,000</td>
<td>9.8</td>
</tr>
<tr>
<td>Italy</td>
<td>30,000</td>
<td>32,000</td>
<td>6.7</td>
</tr>
<tr>
<td>UK</td>
<td>24,960</td>
<td>27,500</td>
<td>10.2</td>
</tr>
<tr>
<td>Japan</td>
<td>44,680</td>
<td>55,880</td>
<td>25.0</td>
</tr>
<tr>
<td>Mexico</td>
<td>8,060</td>
<td>10,900</td>
<td>35.2</td>
</tr>
<tr>
<td>Brazil</td>
<td>12,500</td>
<td>15,800</td>
<td>26.4</td>
</tr>
<tr>
<td>Poland</td>
<td>7,340</td>
<td>11,160</td>
<td>52.0</td>
</tr>
<tr>
<td>Malaysia</td>
<td>2,500</td>
<td>4,930</td>
<td>97.2</td>
</tr>
<tr>
<td>China</td>
<td>2,700</td>
<td>7,850</td>
<td>190.7</td>
</tr>
<tr>
<td>India</td>
<td>3,630</td>
<td>8,120</td>
<td>124.0</td>
</tr>
</tbody>
</table>

Data from: National reports, AAMA annual reports

TWO WHEELED VEHICLES

The number of cars, trucks and buses around the world is reasonably well documented, although even with such vehicles there are serious uncertainties for some countries. Vehicle registration data at the national level is often incomplete in some LICs, the age of motor vehicles is undoubtedly much longer in LICs than in motorized countries, often around 20 years, and thus projections based on annual new registrations, a technique used in some countries for estimating the vehicle fleet are very uncertain.

When you attempt to quantity the population of two-wheeled vehicles even rough estimates become very uncertain. No good figures exist as to the working life of a
motorcycle, registration data in many countries is fragmentary, under reporting being commonplace. Contrary to popular belief the highest volume motor vehicle ever made is not the Volkswagen Beetle, but the Honda Super Cub in its various national versions, which has had a production volume of 24 million, over 50 per cent more than that of the Beetle, and the Honda machine is still produced in significant quantities.

prediction of future injury trends in LICs based on car, truck and bus populations are unlikely to be accurate, as their role, both in traffic and in accidents, is relatively small

Table 4 illustrates the importance of the motorized two-wheeler in various countries. These data are taken from Mohan and Tiwari (1998) and they illustrate the minor importance of the passenger car in terms of the total vehicle fleet in LICs. Hence prediction of future injury trends in LICs based on car, truck and bus populations are unlikely to be accurate, as their role, both in traffic and in accidents, is relatively small. Predictions of growth in two-wheeled vehicle use and particularly the transition from foot to bicycle to motorcycle, as countries progress along the mobility spectrum, are problematic. However as Mohan and Tiwari note, the data in Table 4 suggest that motorcycle registration decrease to less than 20 per cent only when per capita income exceeds US $8,000. China is an exception, but that is because motorcycle use is specifically controlled by government policy. Even at income levels of US $33,000 per capita the motorcycle part of the vehicle fleet can be greater than 50 per cent. Hence, it seems likely that in many LICs over the next two decades we will see greater increase in the use of bicycles and motorcycles than cars and trucks.

This is likely to be especially true in the growing megacities in low motorized countries (LMCs). In such cities as Shanghai, Beijing, Delhi, Bangkok and Manila the road infrastructure is already totally inadequate for the current traffic volumes and this leads to a natural preference for two-wheeled vehicles as the only way of minimizing delays from congestion. The development of a motorcycle taxi service in Bangkok is just a sign of adaptation to those demands.

Table 4
Vehicle ownership in different countries

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>GNP PER CAPITA (US $)</th>
<th>TOTAL NUMBER OF VEHICLES PER 1000 PERSONS</th>
<th>MTWs AS % OF TOTAL VEHICLES</th>
<th>CARS AS % OF TOTAL VEHICLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>34,630</td>
<td>640</td>
<td>20</td>
<td>8</td>
</tr>
<tr>
<td>USA</td>
<td>24,780</td>
<td>740</td>
<td>2</td>
<td>88</td>
</tr>
<tr>
<td>Germany</td>
<td>23,980</td>
<td>570</td>
<td>9</td>
<td>89</td>
</tr>
<tr>
<td>France</td>
<td>23,420</td>
<td>520</td>
<td>10</td>
<td>87</td>
</tr>
</tbody>
</table>
Beyond the motorcycle, non-motorized traffic constitutes a very significant share of urban travel in many Asian cities. Mohan and Tiwari note that in Indian cities the proportion of trips undertaken by bicycles ranges from 15 to 35 per cent. Even in high income cities like Tokyo the bicycle is significant as a travel mode for shopping and as feeder at each end of a railway journey for commuters. This contrast with HICs are reflected in the varying characteristics of road fatalities. Table 5 gives the relative proportions of the various categories of road users for a selection of cities and countries.

Table 5

Road fatality categories as proportion of all road fatalities

<table>
<thead>
<tr>
<th>Country</th>
<th>PEDS</th>
<th>CYCLISTS</th>
<th>MTWs</th>
<th>4-WHEELERS</th>
<th>OTHERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>18,340</td>
<td>410</td>
<td>3</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>18,000</td>
<td>610</td>
<td>3</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td>Korea</td>
<td>8,260</td>
<td>206</td>
<td>24</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>Malaysia</td>
<td>3,140</td>
<td>340</td>
<td>56</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>Thailand</td>
<td>2,140</td>
<td>190</td>
<td>66</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Philippines</td>
<td>950</td>
<td>32</td>
<td>26</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Indonesia</td>
<td>810</td>
<td>58</td>
<td>69</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>600</td>
<td>50</td>
<td>60</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>530</td>
<td>21</td>
<td>40</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>320</td>
<td>30</td>
<td>67</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Vietnam</td>
<td>210</td>
<td>27</td>
<td>91</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

Data from: Statistics are taken from country reports, international agency publications and conference papers, year range 1992–1995, (Mohan and Tiwari, 1998)
These examples reflect the great preponderance of that collective group, the vulnerable road users, pedestrians, cyclists and motorcyclists—together being numerically far more important in LMCs than vehicle occupants. Even in highly motorized countries however, these vulnerable road users constitutes 20 to 46 per cent of all road fatalities.

**ACCIDENT RATES**

Fatality and accident rates of various types are used to assess changes over time, make comparison between different countries and to described relative risks, often inappropriately and drawing incorrect conclusions.

Two main rates are most useful in assessing traffic safety and personal safety. Traffic safety is a measure of how safely the road transport system is performing. It is commonly measured in terms of death per number of registered motor vehicles, or somewhat better, using deaths per number of vehicle kilometers travelled. This latter indicator is a good measure of how the road system is functioning, but in most parts of the world such exposure data is not available. Even when it is available it is often based on sale of fuel with consequent uncertainties as to how that variable relates to actual mileage covered.

The benefits of behavioural change programmes have often been over stated and inadequately evaluated. This has resulted in wasted resources and neglect of other more successful scientific strategies

The second rate often used is an assessment of individual risk on personal safety, and is the number of road deaths per unit population. It follows that:

\[
\text{Personal Safety} = \text{Traffic safety} \times \text{Motorization}
\]

Where motorization is the number of motor vehicles per head of population.

Table 6 lists these various rates for a selection of countries. Many intriguing comparison can be drawn. Clearly as motorization increase, deaths per vehicle decline and the traffic system as it develops becomes safer. Even on that measure however, there are interesting differences; for example deaths per number of motor vehicles registered in the USA is significantly higher than for a number of EU countries (e.g., Britain) and Japan. Traffic safety politicians in the United States argue that a better parameter is to use deaths per hundred million kilometres travelled, that fatality rate for the United States in 1996 being 1.06. That number compares very favourably with the EU average of 1.8 (see Figure 2), with only Sweden and the UK having a lower rate. However, in terms of personal safety, the United States has over twice the death rate of India, 50 per cent
higher than Kenya and on par with France. This arises because of the higher levels of exposure in the USA because of the enormous amount of road travel which occurs. The idea of exposure control, as a traffic safety strategy in North America, clearly finds little favour.

Table 6

Fatality rates, traffic safety and personal safety

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>VEHICLES PER 1000 PEOPLE</th>
<th>DEATHS PER 1000 MVs</th>
<th>DEATHS PER MILLION POP.</th>
<th>DEATHS PER YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA (1996)</td>
<td>760</td>
<td>0.21</td>
<td>158</td>
<td>41,907</td>
</tr>
<tr>
<td>Australia (1998)</td>
<td>647</td>
<td>0.13</td>
<td>85</td>
<td>10,805</td>
</tr>
<tr>
<td>Great Britain (1997)</td>
<td>481</td>
<td>0.13</td>
<td>64</td>
<td>3,599</td>
</tr>
<tr>
<td>France (1994)</td>
<td>568</td>
<td>0.26</td>
<td>148</td>
<td>8,533</td>
</tr>
<tr>
<td>Thailand (1994)</td>
<td>219</td>
<td>1.17</td>
<td>257</td>
<td>15,176</td>
</tr>
<tr>
<td>Saudi Arabia (1994)</td>
<td>167</td>
<td>1.44</td>
<td>241</td>
<td>4,077</td>
</tr>
<tr>
<td>India (1993)</td>
<td>25</td>
<td>2.75</td>
<td>67</td>
<td>59,300</td>
</tr>
<tr>
<td>China (1993)</td>
<td>19</td>
<td>2.72</td>
<td>53</td>
<td>63,508</td>
</tr>
<tr>
<td>Ethiopia (1990)</td>
<td>1</td>
<td>17.2</td>
<td>23</td>
<td>1,169</td>
</tr>
</tbody>
</table>

Mohan and Tiwari (1998) make the point that all such comparisons are questionable when great differences in the mix of the vehicle fleet are present. To illustrate the point they calculate road user specific fatality rates, shown in Table 7.

These rates show that the car occupant fatality rate is 30 per cent more in Delhi than in the USA, but the motorcycle rate is 50 per cent less. The pedestrian death rate in Delhi is 3.5 times that of the United States, but if the exposure of the walking population is much greater, which clearly is, then that high rate does not necessarily translate into a high individual risk. Clearly without more accurate measures of exposure, comparisons between countries with very disparate traffic patterns do little to illuminate genuine differences and, particularly if deaths per number of motor vehicles is the sole measure of comparison, can lead to profoundly wrong conclusions.
The fact of gross under reporting of surviving casualties from road accidents is a worldwide problem. In Britain about a third of slightly injures pedestrians and motorcyclists, and about 50 per cent of cyclists who are treated by emergency room personnel do not feature in police reported data. In LICs the problem of under reporting...
of casualties in police data is likely to be profound. A comparison of ratios of fatal: serious: slight casualties between Nigeria and Britain gave the following results.

<table>
<thead>
<tr>
<th></th>
<th>NIGERIA</th>
<th>BRITAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrians</td>
<td>1:2:3</td>
<td>1:8:22</td>
</tr>
<tr>
<td>Cyclists</td>
<td>1:4:3</td>
<td>1:16:61</td>
</tr>
<tr>
<td>Motorcyclists</td>
<td>1:3:2</td>
<td>1:17:42</td>
</tr>
<tr>
<td>Vehicle Occupants</td>
<td>1:2:2</td>
<td>1:13:50</td>
</tr>
</tbody>
</table>

Clearly the outcomes of road accidents in Nigeria cannot be as different as these ratios imply, and hence major under reporting of surviving casualties must be the appropriate conclusion.

Fatalities are different in kind from injury producing accidents and do not follow the same trends. Figure 3 illustrates for Japan how fatalities have declined markedly during the last 7 years, but in contrast, injuries have continued to climb. The same is true of Great Britain over the last decade.

![Figure 3 Traffic accident changes in Japan Data from: Traffic Accidents In Japan, Ministry or Transport, Tokyo, 1999](image)

The health sector has neglected traffic injury, although it is manifestly a major public health problem

Thus in the context of LICs the absence of agreed definitions of injury severity and pervasive under reporting of casualties in police-collected data sources mean that the true dimensions of the traffic injury problem are poorly documented and understood.
A FRAMEWORK FOR EFFECTIVE POLICIES

Fundamental to developing an effective response to road traffic death and injury is to recognize that road accidents are capable of being studied and documented like any other disease and that appropriate counter-measure can be successfully applied. The epidemiology of traffic injury is very incomplete, and particularly because of the profound differences between countries at various levels of motorization, the characteristics of traffic crashes vary profoundly from country to country.

What is most apparent is that vulnerable road users, pedestrians, cyclists and motorcyclists on a global basis are far more numerous as traffic casualties than vehicle occupants. Particularly in LICs where traffic is much more mixed, where formal rules are not applied, but informal rules develop between different road users, the counter-measures traditionally applied in HICs may not be appropriate and may well not work.

The benefits of behavioural change programmes have often been over stated and inadequately evaluated. This has resulted in wasted resources and neglect of other more successful scientific strategies. This does not mean that behavioural programmes should not be introduced. It does mean however, that they must be targeted, realistic and always evaluated for effectiveness. In the long run behavioural change must be the way towards greater safety on the world’s roads. Those behaviours which prove to be successful in one country may well not be successful in other environments and cultures.

Historically traffic safety has been perceived largely as a public sector undertaking, centred in departments of transport. The health sector has neglected traffic injury, although it is manifestly a major public health problem, and generally the focus of government, reflecting the perceptions of politicians and the community, has been to leave traffic safety as a public sector activity, dominated by traffic engineering and behavioural control counter-measures.

Until relatively recently the professions and the private sector have not been prominent in developing initiatives in traffic safety. The training of doctors, automotive engineers and indeed traffic engineers hardly addresses the issues of traffic accidents and injuries. Few universities have any teaching or research activity in traffic safety. Such private sector ventures as do occur are usually focused on specific local problems or campaigns.

Haddon in 1964 applied the host, agent, environment framework of classical epidemiology to motor vehicles crashes acting on the pre-crash, crash and post-crash aspects of an accident. Although that nine-phase structure provides almost useful way of thinking about counter-measures, and forced a fundamental rethink of the nature of causation, it lacks a specific recognition of the importance of exposure control as an overt strategy. Perhaps a more inclusive framework is the five strategies outlined by the GTST (1988):

- Exposure control
- Crash Prevention
- Behaviour Modification
- Injury Control
- Post-Crash Injury Management
Bounding these five strategies are the necessary accident and control data delineate and quantify the problem. Furthermore, the introduction of any counter-measures should always be accompanied by evaluation of any changes, which actually occur in deaths and morbidity.

ultimately succesful programmes will be those which develop locally and at the national level. They cannot be imported from outside

Because of the profoundly different characteristics of traffic injuries between low motorized and highly motorized countries and the great preponderance of vulnerable road user casualties in LMCs, the actual counter-measures developed, their relative priorities, and the nature of infrastructure investment should be very different from the routes followed historically in HMCs. The first stage is to develop a greater understanding of traffic and accident epidemiology specifically in LMCs.

Necessary to that process is to encourage a more scientific approach by both national governers and national safety councils with political recognition of the importance of traffic injury control. International agencies are limited in what they can offer in this area. Long-term effective solutions are likely to be home grown and dependent more on professional expertise developed at the national level. Global professional training in the various dimensions of injury control is vital, but so is a recognition of the great difference between countries in terms of the characteristics of crashes and the effectiveness of various counter-measures. Ultimately succesful programmes will be those which develop locally and at the national level. They cannot be imported from outside.

REFERENCES


INTRODUCTION

The proportion of pedestrian fatalities relative to all road user fatalities has been recently estimated by Mackay (1997) as being in the range of 16 to 36 per cent for motorized countries in Europe and USA.

Each year in the European Union, approximately 7,000 pedestrians and 2,000 cyclists are killed as a result of being struck by a motor vehicle, accounting for about 20 per cent of total road traffic deaths (ETSC, 1999). In addition, each year an estimated 400,000 pedestrians and cyclists are injured by vehicle impact. The majority of pedestrian accident casualties are the very young and the very old, and injuries are sustained as a result of impact by a passenger car front. The European Commission is considering recommendations for pedestrian test procedures that will define performance targets aimed at reducing these pedestrian casualties in Europe. The total number of cars sold in the European Community market is 12 million per year, so this legislation may result in significant benefits.

In the past, much research has been done in Europe, USA and Japan investigating causes of pedestrian injuries and the biomechanics of pedestrian impact. In Europe, a test procedure was developed by the European Experimental Vehicles Committee (EEVC, 1994). This work has been co-ordinated by research institutes representing the government and car industry in the EEVC Working Group 10 with a view to creating a legislative standard for passenger cars and their commercial vehicle derivatives (Ref. 203). This standard, which consists of a number of component tests simulates three common mechanisms of injury: a) Lower leg/knee joint impact against the bumper b) Upper leg/hip joint impact against the bonnet leading edge, and c) Head impact (child and adult) against the bonnet and wing tops.

These tests and the associated injury criteria, have been written into a draft European directive, and are proposed as a requirement for new vehicles models. This draft standardizes test procedures simulating a 40 km/h collision between a motor vehicle and pedestrian.

Annual benefits that will be gained in terms of reduced fatal and serious injuries experienced by pedestrian and cyclist accidents based on such test regulation has been predicted by several institutes, i.e. MIRA (1997) has estimated a number between 3,795 and 14,914 injured persons. Total additional benefit gained across Europe for this 15 year
The European Transport Safety Council believes that the introduction of legislation requiring new cars to pass EEVC tests is one of the most important actions that the EU could take to improve road safety (ETSC, 1998). Using up-to-date casualty information from International Road Traffic Accidents Database (IRTAD), ETSC estimates that if all cars on the road today provided such protection then 655 to 2,226 fatalities and 21,548 to 24,944 serious pedestrian and cyclist casualties could be prevented annually, resulting in an annual cost reduction of ECU 3.7 billion to ECU 5.1 billion, respectively.

**CURRENT DRAFT EUROPEAN PEDESTRIAN DIRECTIVE**

The directive stipulates three types of component test for vehicles in M1 and N1 categories. These are outlined in Figure 1.

![Figure 1 Pedestrian protection test methods proposed by EEVC WG 10](image)

Each year in the European Union, approximately 7000 pedestrians and 2000 cyclists are killed as a result of being struck by a motor vehicle.

**Legform to bumper impact**

A minimum of three tests must be carried out at points judged most likely to cause injury, on each test type. This is carried out by striking the front of the vehicle, or a
representative section of the vehicle, in a longitudinal direction with an impact device representing the upper and lower leg two rigid tubular segments and the knee joint at a fixed impact velocity of 11.1 m/s (40 km/h). These are connected by a replaceable, deformable element which allows relative shear and bending displacement between segments under impact conditions. The legform with a total weight of 13.4 kg is enclosed in a soft foam covering with rubber skin.

The relative bending and shear displacements between the rigid segments are measured, and an accelerometer near the top of the lower leg segment is measuring the acceleration in the impact direction. During the test, the maximum dynamic angular displacement measured between the upper and lower leg segments must not exceed 15°, and their maximum dynamic shear displacement must not exceed 6 mm. At the same time, the acceleration at the upper end of the lower leg must not exceed 150 g.

**Upper legform to bonnet leading edge impact**

The device consists of a rigid cylindrical segment carrying an impact element in the form of a simply supported beam on its front face. The beam’s two supports incorporate transducers to measure the force exerted at the interface, and the beam itself is strain gauged to measure the bending moment exerted in it. The beam is covered by a layer of foam with a rubber skin. The rear segment of the upper legform, reacting through the force transducers to the forward cylindrical beam, incorporates attachments for ballast weights by which the mass of the device can be varied.

The weight of the device and its impact velocity (up to 40 km/h) are determined according to the geometry of the front of the vehicle, in accordance with a set of curves published in the directive.

During the test, the sum of the forces exerted between the beam and the rigid segment must not exceed 4 kN, and the bending moment in the beam must not exceed 200 Nm.

**Headform to bonnet top impacts**

These are carried out by striking points on the bonnet and top of the wings with either a child headform (2.5 kg) or adult headform (4.8 kg) at a velocity of 40 km/h in free flight at impact.

The two headforms are made of semi-rigid polymer material, covered with an elastomeric skin. A metal insert in the centre of the sphere carries three accelerometers measuring the load for the impact direction and also to the other two principal axes.

A minimum of nine tests must be carried out with each type of head impactor, within areas marked out on the top of the bonnet defined according to a wrap-around distance, starting from the ground plane below the bumper. This wrap-around distance is between 1000 mm and 1500 mm for the child headform and between 1500 and 2100 mm for the adult. If the lower edge of the windscreen lies within the child or adult warp-around distances, this will limit the extent of the head impact zone.

In order to pass the test, the Head Performance Criterion measured by the headform must not exceed 1000 mm.
REVIEW OF CURRENT STATUS

Recent accident studies have been analysed, showing among other findings a decline in the proportion of injuries caused by the bonnet leading edge of modern streamlined passenger cars. Moreover, it is found that the windscreen and the A-pillars of cars are also important injury areas, but these are not covered by EEVC test methods (Otte, 1999). The need for more research in the future is recommended by many scientific authors.

EEVC working group 17 was created in 1998 for analysing the current situation on new accident data, biomechanics and test specifications in the test method. Modifications were made on the test procedure concerning optimised material conditions for decreasing special vehicle designs, but the windscreen impact at higher speed levels has not been included. A modified procedure based on the final version of the report will be available by mid–1999 (EEVC WG 17, 1998).

In general it is difficult to estimate the exact cost benefit of such test procedures, because changes in car design resulting from these test requirements will not be known in advance. The spectrum of injury occurrence and injury patterns depend on the shape, stiffness and localization of impacted area on the vehicle front and are also influenced by the energy of impact, and biomechanical limits of the bony structures of the human body. These are also likely to change with the introduction of the standard.

Another aspect of the proposed regulation is that it is based on analyses of pedestrian accidents only. There is no mention of bicycles with their specific impact points on the car front in the reported statements for the regulation.

In this paper an overview of the current injury situation is given on the basis of in-depth investigations carried out by Accident Research Unit at the Medical University Hannover ARU-MUH, Germany. This work (Otte, 1994) has been financed by the German Federal Highway Research Institute (BAST) for more than 25 years. The results of pedestrian accidents analyses have also been integrated into the studies by EEVC. With such an ongoing project a comprehensive investigation of the accident situation can be conducted by comparing different time histories, including old and new car designs.

The accident documentation was compiled according to a statistical random sampling procedure, using a weighting procedure, that can be considered as representative for the area under investigation, namely the city and county of Hanover.

In order to gain an initial overview of the situation of pedestrians, the relationship between the collision speed of the cars and the total degree of severity of injury—Maximum Abbreviated Injury Scale, MAIS—to the pedestrian was recorded (American Association for Automotive Medicine, 1990).

Importance of car shape areas with bumper and bonnet leading edge
In order to demonstrate those injuries to pedestrians which are influenced by the design of the front edge of the car bonnet, the latter were investigated in the context of its frequency as cause of injury; the team had in each case linked the injury to the impacting part of the vehicle respectively the road.

For comparison of the temporal development of the vehicles, cars involved in accidents were differentiated by model of car, i.e. the year when the model was introduced in the market, the actual year of construction of the car was not taken into consideration (Otte, 1998). The vehicle groups were defined as follows:

- cars released in the market before 1990, so called ‘old vehicle’ n=615
- cars released in the market in 1990 or later, so called ‘new vehicle’ n=80

It can be established, that there were fewer impacts with the front edge of car bonnets in the case of new vehicles. Injuries due to impact with the bonnet in ‘new vehicles’ were recorded at 4.4 per cent, while in older vehicles the figure was 19.7 per cent. It should, however, be borne in mind at this point that an impact was only recorded if it led to injury.

The frequency of this kind of injury proved to be relatively independent of the height of the pedestrian. Impacts with the bonnet mainly causes injuries to lower extremities of the body of persons above the height of 120 cm, while shorter persons frequently sustain injuries to the thorax and arms. The influence of the speed of impact can be clearly ascertained, 30.3 per cent of collisions at speeds of over 40 km/h involving older vehicles and 13.9 per cent involving modern vehicles resulted in injury.

The relationship between the collision speed and the severity of injury sustained by the pedestrian according to the Abbreviated Injury Scale is shown in Figure 2.

![Figure 2 Injury severity grade MAIS for different groups of collision speed](image-url)
It was established that at impact speeds of less than 40 km/h there was hardly any risk of the pedestrian sustaining extremely serious injuries (MAIS 5/6). At an impact speed between 41 and 60 km/h there was a spread of 30 per cent minor injuries (MAIS 1), 64.7 per cent severe injuries (MAIS 2–4) and 5.3 per cent extremely severe or fatal injuries (MAIS 5–6). At a speed above 60 km/h, 24.2 per cent of the pedestrians sustained extremely serious injuries or were killed.

In a traffic scene 82.6 per cent of impact speeds can be established below 40 km/h and only 17.4 per cent above 40 km/h (Figure 3).

However, 66.3 per cent of pedestrians with severe head injuries AIS 2 and above (AIS 2+) suffered these injuries at impact speeds of up to 40 km/h (Figure 4); 33.7 per cent received these injuries at impact speeds above that level.

![Figure 3 Cumulative frequency of collision speed (100 per cent all vehicles)](image)

Accident Research Unit Hanover

However, it was established that at impact speeds of less than 40 km/h there was hardly any risk of the pedestrian sustaining extremely serious injuries.

There proved to be a lower incidence of injury to the head, thorax and legs in post-1990 models (Table 1); the incidence of injury to the pelvis was slightly lower at 15.3 per cent compared to 19 per cent in pre-1990 models. However, the percentage of injuries to the neck, 3.5 per cent, was remarkably higher for new cars compared to 2.6 per cent for old cars.
Figure 4 Cumulative frequency of collision speed (100 per cent all vehicles collided with pedestrians AIS$_{\text{head}}$ 2 and above) Accident Research Unit Hanover

Table 1

Frequencies of injured body regions for new and old cars (100% all pedestrians each vehicle group)

<table>
<thead>
<tr>
<th>INCIDENCE OF INJURY ACCORDING TO AREA OF BODY</th>
<th>INTRODUCTION OF CAR MODEL IN THE MARKET</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-1990</td>
</tr>
<tr>
<td>Total number</td>
<td>615</td>
</tr>
<tr>
<td>Head</td>
<td>60.7%</td>
</tr>
<tr>
<td>Neck</td>
<td>2.6%</td>
</tr>
<tr>
<td>Thorax</td>
<td>23.6%</td>
</tr>
<tr>
<td>Arms</td>
<td>44.8%</td>
</tr>
<tr>
<td>Abdomen</td>
<td>8.6%</td>
</tr>
<tr>
<td>Pelvis</td>
<td>19%</td>
</tr>
<tr>
<td>Legs</td>
<td>77%</td>
</tr>
</tbody>
</table>
When looking to accidents at collision speed of up to 40 km/h (n=386 pre-1990 models and n=49 post-1990 models), similar situation can be recognized (Table 2), injuries to the thorax and legs occur less frequently and neck injuries occur with a higher frequency in post-1990 models.

Table 2

Frequencies of injured body regions for new and old cars (100% all pedestrians each vehicle group) for collision speed of up to 40 km/h

<table>
<thead>
<tr>
<th>INCIDENCE OF INJURY ACCORDING TO AREA OF BODY</th>
<th>INTRODUCTION OF CAR MODEL IN THE MARKET</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-1990</td>
</tr>
<tr>
<td>Total number</td>
<td>386</td>
</tr>
<tr>
<td>Head</td>
<td>55.2%</td>
</tr>
<tr>
<td>Neck</td>
<td>1.9%</td>
</tr>
<tr>
<td>Thorax</td>
<td>19.6%</td>
</tr>
<tr>
<td>Arms</td>
<td>42.6%</td>
</tr>
<tr>
<td>Abdomen</td>
<td>5.9%</td>
</tr>
<tr>
<td>Pelvis</td>
<td>17.9%</td>
</tr>
<tr>
<td>Legs</td>
<td>75.3%</td>
</tr>
<tr>
<td>Bonnet leading edge as cause of injury</td>
<td>16.8%</td>
</tr>
</tbody>
</table>

Accidents at speeds of more than 40 km/h show a clearly higher incidence of injuries for all body regions (Table 3). At speeds of more than 40 km/h there were head injuries over 80 per cent of cases, compared with accidents at lower impact speeds in nearly 60 per cent (Table 2). The head has the highest injury frequency, especially for newer car models. Injuries to the pelvis are, however, less frequent in post-1990 cars. Proportion of injuries caused by the front edge of the bonnet for new cars was 4.5 per cent, clearly lower than that for older vehicles (16.8 per cent) (see Table 2).

Table 3

Frequencies of injured body regions for new and old cars (100 per cent all pedestrians each vehicle group) for collision speeds of above 40 km/h

<table>
<thead>
<tr>
<th>INCIDENCE OF INJURY ACCORDING TO AREA OF BODY</th>
<th>INTRODUCTION OF CAR MODEL IN THE MARKET</th>
</tr>
</thead>
</table>

Demands to vehicle design and test procedures 111
The incidence of injury through impact with the bonnet leading edge increases at higher speeds (Table 3). In the case of pre-1990 cars 30.3 per cent of pedestrians were injured on impact with the bonnet at speeds above 40 km/h.

Figure 5 is shows the frequency of impacts with the vehicle front and the road and the resultant injuries. This was analysed within each case at different speed ranges.

In general it can be seen that higher impact speeds result in more severe injuries due to impact with the car. For collision speeds of up to 40 km/h nearly in 40 per cent of most severe injuries were due to impact with car, and for speeds ranging from 41 to 60 km/h this proportion was 80 per cent.

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<table>
<thead>
<tr>
<th></th>
<th>Pre-1990</th>
<th>Post-1990</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number</td>
<td>134</td>
<td>15</td>
</tr>
<tr>
<td>Head</td>
<td>81.9%</td>
<td>100%</td>
</tr>
<tr>
<td>Neck</td>
<td>7.7%</td>
<td>12.4%</td>
</tr>
<tr>
<td>Thorax</td>
<td>40.7%</td>
<td>34%</td>
</tr>
<tr>
<td>Arms</td>
<td>63.1%</td>
<td>70%</td>
</tr>
<tr>
<td>Abdomen</td>
<td>17.8%</td>
<td>12.8%</td>
</tr>
<tr>
<td>Pelvis</td>
<td>27.5%</td>
<td>18.6%</td>
</tr>
<tr>
<td>Legs</td>
<td>85.9%</td>
<td>69.3%</td>
</tr>
<tr>
<td>Bonnet leading edge</td>
<td>30.3%</td>
<td>13.9%</td>
</tr>
</tbody>
</table>

as cause of injury
it is remarkable that in newer cars in collision speeds up to 20 km/h almost no head injuries were registered.

**Impacts to the windscreen region**

Results of 762 car to pedestrian collisions (Otte, 1999) were used to analyse for the detailed injury situation of the head impacted the area of the windscreen. The characteristic deformation pattern of the glass and frame was studied compared to the injury pattern of the head. Within the framework of the study the investigated vehicles were categorized as ‘old cars’ (if production was pre-1990) and ‘new cars’ (cars produced after 1990). It can be stated that in newer vehicles 11.6 per cent of head injuries occur by impact with the windscreen pane and 9.3 per cent are caused by front hood impact.

**Head injuries and collision speed**

Two-thirds of all head injuries were soft-tissue lesions, including abrasions, kceration-contusion injuries as well as cuts of the skin (severity degree AIS 1) for 91.5 per cent of all pedestrians. Of them, 51.1 per cent suffered injuries by road impact, 16.9 per cent of soft-tissue injuries on the car were caused by the hood and 19.8 per cent by the windscreen. Fractures of the skull are frequent to the vault of the cranium and the middle face. Fractures of the skull base are rare. Another frequent injury type is concussion. This type of injury is received by 7.9 per cent pedestrians by an impact to the pane. It was observed that the windscreen quite often causes injuries and is also responsible for
fractures of the vault of the cranium, the skull base, the middle face and the skull-brain trauma (Table 4)

Table 4

Different types of head injuries and their impact location (100% all pedestrians)

<table>
<thead>
<tr>
<th>PEDESTRIAN WITH HEAD INJURIES</th>
<th>TOTAL STREET LOCALIZATION OF IMPACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>n=543 (100%)</td>
<td>car</td>
</tr>
<tr>
<td></td>
<td>front</td>
</tr>
<tr>
<td>soft tissue</td>
<td>91.5</td>
</tr>
<tr>
<td>fracture of face</td>
<td>5.7</td>
</tr>
<tr>
<td>skull fracture</td>
<td>5.2</td>
</tr>
<tr>
<td>fracture of skull base</td>
<td>1.9</td>
</tr>
<tr>
<td>concussion</td>
<td>28.8</td>
</tr>
<tr>
<td>brain injury</td>
<td>9.0</td>
</tr>
</tbody>
</table>

The probability of occurrence of different injuries definitely depends on the collision speed of the car (Figure 6).

Figure 6: Cumulative frequency of different types of injuries in relation to the impact speed of car
Of all soft-tissue injuries 80 per cent were sustained in collision speeds up to 40 km/h (Figure 7), 60 per cent of the fractures and 40 per cent of serious skull-brain traumas, the so-called contusion were registered. The cumulative frequency reveal that for old as well as for new cars approximately 75 per cent of all established collision speeds were exceeding 25 km/h, while in comparison for all pedestrian collisions 80 per cent were registered in speeds up to 45 km/h (Figure 8). The correlation between head injury severity and impact speed is pointed out in Figure 6, 74 per cent of all head injuries occurred at speed ranges of up to 40 km/h, while 34 per cent happened at speeds above 60 per cent. Here 28 per cent were severe injuries of the brain.

![Figure 7](image_url)  
**Figure 7** Frequency of types of head injuries in head impacts to the windscreen (100% head injuries of pedestrians per car impact speed range)

the probability for the head to hit the front pane or the lateral cross-beam the so-called A-pillar is visibly increasing with higher collision speeds

It is remarkable that in newer cars in collision speeds up to 20 km/h almost no head injuries were registered. The severity of head injuries also determines the injury severity of the entire body.
The probability for the head to hit the front pane or the lateral cross-beam the so called A-pillar is visibly increasing with higher collision speeds (Figure 9). In collision speeds up to 30 km/h a frequency of windscreen contacts below 10 per cent is established. In speeds of 31 to 40 km/h already 38.4 per cent of pedestrian accidents with head impact to the front pane or the A-pillar occurred. Injuries were incurred to 26 per cent. With speeds
of 51 to 60 km/h already 60.4 per cent of pedestrian accidents occurred and with speeds of more than 70 km/h 90 per cent were registered with head impact to the front pane region or the A-pillar. Not all contacts to the front pane region lead to injuries. This is apparent when comparing the different frequency curves for contacts and injuries of the head and serious head injuries of AIS 3+ as illustrated in Figure 9. It also demonstrates that with increasing collision speed serious head injuries are more frequent. Head injuries of severity degree AIS 3+ occurred only in speeds above 30 km/h and those severity grades significantly started more frequently above 50 km/h.

All documented and measured impact points on the glass of the windscreen pane or the lateral windscreen frames and the A-pillar respectively were analysed in each case and transferred to a standardised drawing in Figure 8.

The results from these investigations lead to the conclusion that real world conditions have not been considered for EEVC test regulations for pedestrian impacts.

As far as the frequency of all impact points is concerned Figure 10 illustrates impact patterns showing remarkably many points on the lower half part of the windscreen pane. This reveals a rotation of the entire body within the impact kinematic. During the ladling-up phase the head experiences a downward directed movement. An impact to the lateral...
A-pillar is with 5.1 per cent quite rare, and it doesn’t show a high injury severity in most cases. Children quite often, and in this study especially, contact of the front hood, compared to this adults, however contact the hood surface is quite rarely.

The detailed analysis of the head impact points shows that serious head injuries do not only occurring on the border region of the pane to frame but very frequently on the pane surface. The dominating influential parameter for the windscreen impact is the collision speed of the car. Only in speeds of more than 40 km/h are impacts of the hood often found on the pane surface and here regions also found in the centre of the pane and, therefore, are the cause for serious head injuries.

It could be established, that up to impact speeds of 40 km/h exclusively soft tissue lesions (74.1 per cent) and the concussion (20.5 per cent) and fracture of the skull happened in 2.8 per cent only. Compared to this in the speed range of more than 40 km/h fractures could be registered with higher frequency. With speeds above 60 km/h 7.9 per cent of the head injuries were fractures of the skull, 7.3 per cent skull base fractures and very often a severe head brain trauma could be observed.

Figure 10 True to scale head impact location on the front shape by detailed case analysis on standardized front shape
QUANTIFICATION OF THE INFLUENCE OF DIFFERENT IMPACT AREAS FOR INJURY PATTERN

For showing the influences of injuries of different body regions to the resultant severity of the body MAIS in the frame of an ongoing study a virtual MAIS was calculated. It was asked for the avoidance of injuries of the specific body region caused by a forgiven impact area at the car (Table 5) and assessed for the resulted injury pattern of the whole body. Therefore in the data file the AIS of each injury of the specific body region and impact point of car, i.e. the head to windscreen, was set to zero and for that person the new so called virtual MAIS was evaluated as maximum of all AIS grades of body region except the specific region and impact area, i.e. the head at windscreen. Only those cases were selected for this calculation with a maximum of 40 km/h for the impact speed of the car, which is the most often observed impact speed in pedestrian accidents and is the defined speed range for EEVC test procedure.

Table 5
Pedestrians colliding with car front of car up to 40 km/h (as percentage)

<table>
<thead>
<tr>
<th>AGE OF PEDESTRIAN</th>
<th>EXISTING CASE</th>
<th>VIRTUAL SITUATION AVOIDING INJURIES OF</th>
<th>MAXIMUM INJURY SEVERITY GRADE NOT INJURED</th>
</tr>
</thead>
<tbody>
<tr>
<td>UP TO 12 YEARS n=155</td>
<td></td>
<td>head</td>
<td>upper leg</td>
</tr>
<tr>
<td>maximum injury severity</td>
<td>—</td>
<td>—</td>
<td>1.9</td>
</tr>
<tr>
<td>MAIS 1</td>
<td>76.8</td>
<td>76.8</td>
<td>78</td>
</tr>
<tr>
<td>MAIS 2–4</td>
<td>23.2</td>
<td>23.2</td>
<td>20.1</td>
</tr>
<tr>
<td>MAIS 5/6</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AGE OF PEDESTRIAN</th>
<th>EXISTING CASE</th>
<th>VIRTUAL SITUATION AVOIDING INJURIES OF</th>
<th>MAXIMUM INJURY SEVERITY GRADE NOT INJURED</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;12 YEARS n=333</td>
<td></td>
<td>head</td>
<td>upper leg</td>
</tr>
<tr>
<td>maximum injury severity</td>
<td>—</td>
<td>2.9</td>
<td>3.5</td>
</tr>
</tbody>
</table>
For selected impact speed range of up to 40 km/h very severe injuries of MAIS 5/6 are very rare. For pedestrians up to 12 years no child suffered such severity and 0.5 per cent of the adults. Avoiding the impact of the head to the bonnet the best effectiveness can be found (real world 23.2 per cent MAIS 2–4 compare to virtual situation of 20.1 per cent MAIS 2–4). For pedestrians older than 12 years the reduction of the impact of the lower leg and knee region to the bumper area is found as a high effectiveness (39 per cent MAIS 2–4 in existing cases to 31.7 per cent MAIS 2–4 in virtual situation). There will be an increase of uninjured and minor injury severity grades if all measures are taken into account together, resulting in 12.3 per cent uninjured children and 18.5 per cent adults.

**CONCLUSION**

Safety for pedestrians in impacts with cars has clearly improved within the past few years. More than one third of pedestrians, however, suffered serious injuries. The head is regarded as the most seriously injured body region—60 per cent of all pedestrians suffer head injuries and 70 per cent of all collision occur at speeds up to 40 km/h. Up to this speed level 60 per cent of pedestrians are affected with head injuries. Most of the serious injuries are registered in this speed range. It could be established, that with higher speed levels, above 40 km/h, a still higher injury frequency with a probability for head injuries of more than 80 per cent occur, linked with often severe head injuries.

For cars introduced to the market since 1990, so-called new cars, 93.6 per cent of pedestrians were registered with head injuries if the impact speed was above 40 km/h. With impact speeds up to 40 km/h injuries caused by the windscreen region are relatively rare (4.7 per cent). With speeds exceeding 40 km/h for newer cars, the windscreen region is very frequently associated with (63.8 per cent) injury causation. This may be due to the low number of cases in this speed range. On the other hand, it could be due to a shorter front hood, which is often found in newer compact cars.

The study clearly shows that the head impact often occurs to the lower half of the windscreen. Serious injuries of AIS 2+ are caused just as frequently in the lower and lateral edge region of the windscreen. The head of an adult pedestrian is mostly impacting the lower half of the windscreen and that this region is therefore responsible for severe head fractures and brain trauma (AIS 2+ injuries). The lateral frame of the windscreen, the so called ‘upper A-pillar’ is an area seldom impacted by the head and no higher injury severity could be established than for the glass pane surface. Severe head injuries AIS 2+ exclusively happen with speeds of more than 40 km/h, while up to 40

<table>
<thead>
<tr>
<th>MAIS 1</th>
<th>60.5</th>
<th>60</th>
<th>58</th>
<th>59</th>
<th>59.7</th>
<th>57.3</th>
<th>55.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAIS 2–4</td>
<td>39</td>
<td>36.6</td>
<td>38</td>
<td>36</td>
<td>37.2</td>
<td>31.7</td>
<td>25.7</td>
</tr>
<tr>
<td>MAIS 5/6</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
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Safety for pedestrians in impacts with cars has clearly improved within the past few years.
km/h minor injuries such as soft tissue lesions and concussions are frequent.

The bonnet leading edge is responsible for 4.5 per cent of injuries up to 40 km/h for new cars compared to 16.8 per cent for old cars. But it is not quiet right to say that injuries caused by the front leading edge are very rare. For the impact speed range above 40 km/h a higher incidence of injury causation was observed—13.9 per cent.

The results from these investigations lead to the conclusion that real world conditions have not been considered for EEVC test regulations for pedestrian impacts. Impact speeds of up to 40 km/h are not responsible for the severity of the head impact to the windscreen. The collision speed is the main indicator for the injury severity. The causation for serious injuries must be seen in view of the fact that severity of head injuries often determine the overall grade of the trauma. Patients with poly-traumatic symptoms, who suffered injuries to at least three different parts of the body with injury severity degree MAIS 2+ nearly always suffer head injuries. The proportion of pedestrians with poly-traumatic symptoms amounts to only 4.7 per cent of all injured pedestrians, but 61.4 per cent of pedestrians suffered an impact to the windscreen. Beside the fact that chances of survival for these patients are quite limited, there exists, on the other hand, a high probability of long-term consequences. From the medical-traumatic point of view, measures are required for modification of the windscreen region, especially the pane itself. The head impact at least should be integrated in the EEVC test rules.

It must be taken into account, that 12.4 per cent of all bicycles colliding with cars suffered head injuries from impact against the windscreen. The study shows, that most impact points are located on the lower half of the pane. Concerning to this result an area of approximately 20 cm beneath the lateral frame and the border to lower metal parts of the bonnet should be used as point for a head impactor. The head impactor should impact with his lateral forehead region to the pane surface under an angle of 45 degrees of the body length axis related to a horizontal line. An accident-conform impact speed, diverging from defined test criteria does not seem to be convincingly necessary.

On the other hand, the analysis of different studies, discussed in this paper, acknowledged the existing impact areas on the car, used as test points by EEVC.

Furthermore the study clearly shows the following demands for future developments:

- An energy absorbing attachment of the pane in the anchorage system of the frame should be developed, a more elastically material of the glass compound system could be used for such a purpose.
- An optimizing of the angle of the windscreen pane could help to reduce the head impact speed in connection with the kinematics of the ladling-up movement of the pedestrian body.
- An impact within the glass region of the windscreen there is not high risk for severe injuries to the head, admittedly the impact to the frame region is very severe.

The results of this study should help for further development of car designs and finding measures. Some more in-depth research activities are needed for this purpose.
REFERENCES

American Association for Automotive Medicine, 1990, The Abbreviated Injury Scale AIS; Revision. (Illinois: USA).


ETSC briefing, January 1998.


Otte, D., 1994, Road accident research by the Medizinische Hochschule Hannover as an example of the significance and usefulness of a scientific team working at the scenes of accidents. Brandschutz, Deutsche Feuerwehr Zeitung, 6, pp 370–377.

Otte, D., 1998, Pedestrian impact at front end of car, Paper for EEVC WG 17 doc. 10 rev., Accident Research Unit; Medical University Hannover.

Otte, D. 1999, Severity and mechanisms of head impacts in car to pedestrian accidents, proc. IRCOBI, (Barcelona, Spain).
You are the proud owner of a new car. Perhaps it just came from the factory and you are the first owner; perhaps you acquired it second-hand or third-hand. But it is new to you. And one of its unfamiliar features is an air bag—a device in the steering column that will inflate during a crash and reduce the forces that may injure you. You may be well aware of the air bag—you may like it or you may fear it. Or you may not even know that it is there.

Question: Will your driving change because of the air bag? Will you drive faster or more recklessly, because you believe you will be safer in a crash?

You are a logger. You earn your living cutting down trees with a chain saw. It is a dangerous occupation: injuries from falling trees or from the chain saw are common. To reduce these injuries, your employer or the government requires that you use safety equipment: a hard hat, safety goggles, gloves, steel-toed shoes. You are very aware of this equipment every time you work: it is hotter with a hat, the goggles can steam up, the gloves protect your hands from snapping branches.

Question: Will your work practices change because of the safety equipment? Will you work more quickly and less carefully because you believe you are safer?

These are typical risk compensation questions. Stated more broadly: will your behaviour change in response to features or rules intended to improve safety? Do individuals compensate for their increased safety; do they in some way trade this safety for increased performance?

This paper provides an overview of risk compensation, reviews its history, discusses its theoretical foundations, outlines evidence for and against its claims, provides the author’s own views, and gives a brief annotated bibliography for further reading. It concludes with practical advice: what relevance, if any, does risk compensation have for injury prevention workers who seek to reduce unintentional injuries and their consequences?
THE SETTING: INJURY PREVENTION STRATEGIES AND RISK COMPENSATION

The discipline of injury prevention began when injuries were understood to be both predictable and preventable rather than unavoidable accidents or behavioural problems. Injuries are the unintended consequences of individual behaviour within a risky environment. This understanding led to three fundamental injury strategies to prevent injuries, as described in the comprehensive report *Injury in America* (Committee on Trauma Research, 1985):

- persuade persons at risk to change their behaviour
- require behaviour change by law or administrative rule
- provide automatic protection through product and environmental design.

Injury prevention policymakers and workers agreed that it usually was easier to change objects than people. Consequently, as *Injury in America* reports: ‘Each of these general strategies has a role in any comprehensive injury-control program; however a basic finding from research is that the second strategy—requiring behaviour change—will generally be more effective than the first, and that the third—providing automatic protection—will be the most effective’.

In the United States, injury prevention and control methods were first used on a national scale in 1966 when Congress established the organization that soon became the National Highway Traffic Safety Administration (NHTSA) and appointed William Haddon as its first administrator. The NHTSA was directed it to reduce traffic injuries and fatalities. The Consumer Product Safety Commission (CPSC) followed in 1972. While NHTSA employed all three strategies, it emphasized the latter two: safe behaviour through laws (such as mandatory motorcycle helmet use) and safer vehicles through required safety features (such as shatterproof windshields). CPSC relies almost exclusively on the third strategy, safe product design.

injuries are the unintended consequences of individual behaviour within a risky environment

The favoured strategies implicitly assume that people will not react to safety laws or safer products in unexpected ways. But this assumption may not be correct. If you are required to wear a seat belt or cycle helmet while on the road or to wear padding and a helmet while playing ice hockey, it is possible that you may change your driving or skating behaviour. If your ski boots now have quick-release bindings to prevent ankle injury, you may possibly ski more aggressively. If your medicine bottles now have ‘child-resistant’ caps, you may possibly be more careless in leaving them near children. If your behaviour does change, the safety gains expected from the safety laws or safer products may not be realized.

This potential behaviour change in response to safety rules, safer products or safer environments has been called many things. In this paper, ‘behavioural adaptation’
describes all behavioural change in response to our perceived changes in risk and ‘risk compensation’ describes the special case of behaviour change in response to laws and regulations. The distinction becomes murky at times. For example, if a new safety feature appears on all chain saws, our behavioural reaction will not depend on whether the feature is required by government regulation or adopted voluntarily by all manufacturers. But our risk compensation definition focuses on the injury prevention strategies of greatest interest, where the government attempts to require us to be safer.

These strategies have also generated the greatest controversy regarding risk compensation. Its adherents maintain that safety measures imposed on us cannot succeed. The debate has produced several books and over 200 journal articles over the past 25 years, many of which contain rather strong views from risk compensation proponents and opponents.

Scientific risk compensation studies are based in economics, psychology, decision theory, and mathematical statistics. But on a practical level we all are risk compensation experts as we live our everyday lives. I invite each reader to think about risk compensation from at least two perspectives: as an injury prevention and control specialist whose goal is to reduce injuries across society, and as an individual subject to safety laws and using products designed to reduce injury.

A BRIEF HISTORY OF RISK COMPENSATION

It is perfectly obvious that we change our behaviour in response to changes in perceived injury risk. Most obviously, we take additional precautions if we believe our risk has increased. For example, when roads and sidewalks are icy, we walk more carefully for fear of falling and we drive more slowly to be sure that we can stop safely.

Note that we can react only to what we perceive or know. There is an experience shared by almost everyone who has driven a car in snowy conditions. You ‘know’ that the road may be slippery; you may or may not drive more slowly or allow more distance to brake. But one time when you apply the brakes, the car skids. If you are lucky, you correct the skid or come to a stop without consequence. If you are not, your skid may produce a damaged fender or worse. And afterwards, at least for a time, you drive even more slowly and apply the brakes more cautiously. Actual risk has not changed, but your perception of risk has, and your actions change as a result.

Early behavioural adaptation thoughts in road safety

Some observers raised the possibility of behavioural adaptation and risk compensation shortly after features or regulations were implemented to reduce injury. The early literature deals with road safety, for several reasons. In motorized countries, traffic crashes are the largest cause of accidental injury and death. As a result, extensive safety regulations were implemented—traffic laws, traffic police to enforce these laws, required safety features for vehicles and roadways—which affect almost everyone in these countries every day. Consequently, road safety provided the best opportunity to examine any behavioural reaction to these safety regulations. More recently, risk compensation
has been discussed in response to regulations affecting consumer products and workplace safety.

A letter from the early days of motoring notes quite colourfully that road safety measures may produce behavioural adaptation (Adams, 1995):

Letter to *The Times*, 13 July 1908

Dear Sir,

Before any of your readers may be induced to cut their hedges as suggested by the secretary of the Motor Union they may like to know my experience of having done so.

Four years ago I cut down the hedges and shrubs to a height of 4ft for 30 yards back from the dangerous crossing in this hamlet. The results were twofold: the following summer my garden was smothered with dust caused by fast-driven cars, and the average pace of the passing cars was considerably increased. This was bad enough, but when the culprits secured by the police pleaded that ‘it was perfectly safe to go fast’ because ‘they could see well at the corner’, I realized that I had made a mistake. Since then I have let my hedges and shrubs grow, and by planting roses and hops have raised a screen 8ft to 10ft high, by which means the garden is sheltered to some degree from the dust and the speed of many passing cars sensibly diminished. For it is perfectly plain that there are many motorists who can only be induced to go at a reasonable speed at crossroads by consideration for their own personal safety.

Hence the advantage to the public of automatically fostering this spirit as I am now doing. To cut hedges is a direct encouragement to reckless driving.

Your obedient servant,

Willoughby Verne

Forty years later, Smeed (1949) noted in a widely-quoted observation: ‘It is frequently argued that it is a waste of energy to take many of these steps to reduce accidents. There is a body of opinion that holds that the provision of better roads, for example, or the increase in sight lines merely enables the motorist to drive faster, and the result is the same number of accidents as previously. I think there will nearly always be a tendency of this sort, but I see no reason why this regressive tendency should always result in exactly the same number of accidents as would have occurred in the absence of active measures for accident reduction. Some measures are likely to cause more accidents and others less, and we should always choose the measures that cause less.’

Academics also began thinking and writing about these ideas. But they attracted little public attention and certainly had little influence on injury prevention programmes and policy.

**behavioural adaptation describes all behavioural change in response to our perceived changes in risk and risk compensation describes the special case of behaviour change in response to laws and regulations**
Risk compensation and economics: Sam Peltzman’s evaluation of motor vehicle safety standards

Risk compensation in response to government actions became a public issue with Sam Peltzman’s 1975 paper—‘The effects of automobile safety regulation’—in the Journal of Political Economy. Nine years earlier, in 1966, the United States Congress established NHTSA’s predecessor and directed it to set motor vehicle safety standards—to make vehicles safer by regulation. Prior to this, road safety concentrated on regulating individual behaviour, through traffic laws and developing a safe road environment. These strategies affected individual drivers, cyclists, and pedestrians on the one hand and involved public expenditures for developing infrastructure on the other but did not directly affect private industry. NHTSA moved quickly to comply with its directive, issuing 20 Federal Motor Vehicle Safety Standards (FMVSS) in January 1967 that applied to all new motor vehicles. Nine more standards followed by the end of 1968. Some FMVSS sought to prevent crashes by setting standards for brakes, tires, and mirrors; the majority sought to reduce crash injuries by requiring features such as seat belts, shatterproof windshields and energy-absorbing steering columns.

As product regulations affected business, the FMVSS attracted the attention of economists. Some economists believe that markets for goods and services usually function best when left alone; that government regulation or control, even with the best of intentions, distorts prices and quantities of goods and influences both producers and consumers to act in ways not in society’s best interests. The FMVSS ran directly counter to this point of view.

Peltzman evaluated the effects of the FMVSS: had they in fact improved safety as their advocates had predicted? He began with the assumption that individuals are rational economic consumers who will act in their own best interests. If you have more of something than you want, you will (if you can) exchange it for something else that you lack or desire. Each day involves many decisions to trade your time, your money, or your goods for other goods or money or time, to improve your overall well-being.

Peltzman considers safety (or risk) an economic good that you will trade with other goods in the same way. If you do not have as much as you wish, you will acquire more. You will spend more time and walk more slowly if icy sidewalks are too risky. You will buy gloves if pulling thistles without them is likely to injure your fingers. And if you have more safety than you want, and are able to trade some of it for something else you desire, you will. On the road, if your car is safer than you want it to be, then Peltzman presumes you will drive faster, trading safety for time. In his words, you will trade safety for ‘driving intensity’ to achieve the balance that you find best.

Peltzman then proceeded to test his idea with an econometric (statistical) analysis of FMVSS effects. He concluded that the standards were ineffective (Peltzman, 1975): ‘The main conclusion is that safety regulation has had no effect on the highway death toll. There is some evidence that regulation may have increased the share of this toll borne by pedestrians and increased the total number of accidents.’

This conclusion, from a University of Chicago economist, based on an analysis using standard econometric methods, startled the road safety community. Peltzman not only claimed that the FMVSS had not performed as predicted, he also said that they may have
reduced safety for pedestrians. His analysis was based on classical economic theory. And, of course, it challenged the role of government in attempting to improve safety through regulation. In Peltzman’s view, NHTSA was useless and perhaps even counter-productive.

Peltzman’s paper prompted a lively debate over the next 20 years, with criticism and support from Joksch (1976a, 1976b), Robertson (1977a, 1977b, 1977c, 1981, 1984, 1996), Crandall and Graham (1984), Graham and Garber (1984), Orr (1984), Zlatoper (1984), Garbacz (1990), Chirinko and Harper (1993), and Peltzman himself (1976, 1977), among others. The debate concentrated on Peltzman’s statistical analysis. Typical issues included the variable used to measure FMVSS effects (traffic fatalities, fatalities per mile of travel or fatalities per crash), the time period analysed (Peltzman used data from 1947–1972), the regression equation’s functional form (linear or logarithmic), what other factors should be included in the model as controls and how they are best measured (changes in drunk driving, rural-urban travel mix, speed limits and gas shortages, the number of young drivers, etc.), and how to account for motorcycles, trucks and other vehicles not regulated in the same way as passenger vehicles. Each choice may affect the results substantially. As just one example, Graham and Garber (1984) chose to recalculate Peltzman’s regression estimates, changing the functional form. We did this merely using data on the absolute levels of death rates, average speeds, and so on, rather than their logarithms. This change alone casts serious doubt on Peltzman’s conclusions: The resulting estimates suggest that regulation averted roughly 5,000 fatalities between 1966 and 1972, rather than causing about 10,000 deaths as Peltzman’s estimates suggest.’

Blomquist (1988) reviewed 11 studies from 1975 to 1986, some with multiple analyses. He summarized the key conclusions reported by all 11 as follows: due to the FMVSS, passenger car occupants are safer, non-occupants are less safe, overall road travel is safer, and occupants probably are less safe than engineering studies had predicted. In a recent critical review, Levy and Miller (1999) agree that the FMVSS improved occupant safety but find only weak support for any effect on non-occupants.

** behavioural adaptation generally does not eliminate the safety gains from programmes, but tends to reduce the size of the expected effects **

Peltzman moved on to other economic issues. After replying to his initial critics he did not write on risk compensation again. The FMVSS remained in force, without serious challenge (indeed, manufacturers had adopted many of the FMVSS voluntarily before they were required by regulation). But Peltzman had introduced risk compensation into the road safety debate. His 1975 paper probably is cited more frequently than any other risk compensation study.

** Risk compensation and psychology: G.J.S.Wilde’s risk homeostasis theory **

G.J.S.Wilde, Professor of Psychology at Queen’s University in Ontario, had been thinking and writing about behavioural adaptation and risk compensation since the early seventies. He set forth the fundamentals of a theory in several papers leading to *The Risk Compensation Theory of Accident Causation and Its Practical Consequences* in 1976.

In Wilde’s view, risk is an inherent part of our human psychological makeup. Not only can we not escape risk, we need risk. Indeed, Wilde hypothesizes that we each have a ‘target level of risk’. We each measure risk on our own ‘risk thermostat’. If the perceived risk of a situation exceeds our target level, we will act to reduce it. And if the perceived risk is less than our target level, we will increase our risk back to our target level through more dangerous actions.

Wilde’s name for this process is risk homeostasis, by analogy with the self-regulatory and unconscious manner in which we maintain our body’s temperature. Risk homeostasis is then an extreme form of behavioural adaptation: not only do we modify our behaviour in response to external changes designed to make us more or less safe, but we seek to counteract these changes completely and return to our desired risk level. Because the risk in our environment constantly changes, we are constantly forced away from our target risk level, but we always move back toward it, always countering external influences (such as injury prevention measures) that attempt to decrease or increase our risk.

Wilde (1982) developed a mathematical formulation of risk homeostasis in road safety: the ‘accident rate per time unity of driver exposure is invariant regardless of road geometry’ (or, for that matter, regardless of anything else). In other words, your accident rate per hour of travel on a high-speed divided motorway is the same as your rate per hour on a low-speed neighborhood street. Wilde also described his theory in catchy language: ‘the sum of the sins is constant’. Others have called it even more picturesquely ‘the law of conservation of misery’. Wilde (1994) also extended risk homeostasis beyond road safety to other injury prevention (and in fact disease prevention) arenas. ‘Risk homeostasis may thus apply not only to road use, but also to industrial safety, sports, making love, smoking, drinking, doing home repairs, climbing ladders, physical exercise, investing money, gambling, and who knows how many other activities.’

Risk homeostasis challenges the very foundations of injury prevention strategy. It holds that the only effective safety measures are those that alter your desired risk level. Anything that merely modifies the environment or that regulates your behaviour without affecting your target risk level is useless. It is as far removed as possible from Haddon’s recommended strategies.

Wilde’s risk homeostasis theory was challenged by Leonard Evans, Frank McKenna, and others. Wilde published extensively over the next 10 years, engaging his critics in running debates (see Evans, 1986a; 1986b and Wilde, 1986; McKenna 1982; 1985a; 1985b; 1987; 1988; 1990 and Wilde, 1984; 1985; 1989. Wilde summarized his views in popular form in his 1994 book *Target Risk*.

### Risk compensation and public policy: John Adams’ campaign against seat belt use laws

John Adams, a geographer at University College, London, began investigating the effects of seat belt use laws in his work on transportation planning, where he was strongly critical of policies that favoured continual increases in the number of private cars. He
concluded that seat belt laws were not effective. In fact, as Peltzman concluded for the FMVSS, Adams believed that belt laws reduced risk for passenger car occupants but increased risk for pedestrians and cyclists.

Adams generalized his observations across most standard road safety measures: when they have any effect at all, they merely redistribute risk from vehicle occupants to cyclists and pedestrians. He adopted much of Wilde’s risk homeostasis as the behavioural basis for his findings.

Adams’ motivation was to influence public policy. He took on the issue of seat belt laws while it was being debated in the British Parliament. He opposed belt use laws in newspapers and in letters to the government as well as in formal papers. His primary analytic method for estimating belt law effects was to compare overall road fatality trends in countries with and without belt laws. His results were easy to show on a chart and easily understood by newspaper readers and politicians alike. He emphasized the idea of individual liberties, that belt use laws infringe on our freedom to act as we wish as long as we do not interfere with others. And he also could state his thoughts clearly, succinctly and controversially: ‘protecting motorists from the consequences of bad driving encourages bad driving’ (Adams, 1985b). His 1995 book Risk, John Adams summarizes and extends his ideas to a broad discussion of risk in society.

Adams’ views and analyses on belt law effectiveness were countered forcefully by many, notably Murray Mackay. His critics argued that Adams’ methods were suspect. In particular, overall road fatality trends are affected by many factors and a detailed statistical analysis with good data and appropriate controls is needed to evaluate belt law effects.

After extensive debate, Parliament voted to adopt a belt use law effective in January 1983 which would lapse after three years unless Parliament voted again to continue it. This provided the opportunity for a careful and detailed evaluation under favourable conditions: a rapid increase in belt use from about 40 per cent to over 90 per cent, a large population affected at the same time (over 16 million cars in 1983), and a good records system for recording crashes, injuries and fatalities. The results were quite consistent. A simple comparison of casualties for the 11 months before and 11 months after the law showed fatalities dropped by 23 per cent and serious injuries by 26 per cent (Mackay, 1985a). A more sophisticated time series analysis by British Department of Transport statisticians reported fatality and serious injury reductions of about 20 per cent for drivers and 30 per cent for front-seat passengers (Department of Transport, 1985). Finally, an independent evaluation by Durbin and Harvey, distinguished statisticians from the London School of Economics, reported that serious injuries and fatalities had dropped 23 per cent for car drivers and 30 per cent for front-seat passengers but had risen 3 per cent for rear-seat passengers, dropped 0.5 per cent for pedestrians, and risen 5 per cent for cyclists, with the last three results not statistically significant (Department of Transport,
1985). Adams (1995) countered by claiming that the observed decrease was due to a well-established downward trend in casualties and to a simultaneous campaign to reduce drunk driving.

In 1986, Parliament voted to retain the seat belt use law. Irwin (1987) provides a thoughtful view of scientific and political issues throughout the British seat belt law debate. Adams (1985a) and Mackay (1985) give contemporary views from both sides. Evans (1991) and Adams (1995) analyse the issues and evaluate the results from a longer perspective.

**Risk compensation in 2000**


In terms of ideas and controversy, though, little has changed in the past decade. An excellent, thorough, and dispassionate summary of risk compensation theories and evidence is found in the OECD (1990) report *Behavioural Adaptations to Changes in the Road Transport System*, prepared by a working group with representatives from 16 European and North American countries. The report’s key conclusion is that: ‘…behavioural adaptation to road safety programmes does occur although not consistently. …behavioural adaptation generally does not eliminate the safety gains from programmes, but tends to reduce the size of the expected effects’.

The extreme views of risk homeostasis have attracted little support. For example, the editors of a safety journal (Stanton and Glendon, 1996) noted that: ‘One of our reviewers requested that we send him no more papers on RHT [risk homeostasis], adding that “when an enterprise is built on sand there is not much likelihood of a future and repeating old arguments is no substitute for progress”.’

**EVIDENCE FOR AND AGAINST RISK COMPENSATION**

To summarize so far: risk compensation occurs if we change our behaviour in response
to a law or regulation designed to increase our safety. Risk homeostasis theory predicts that we will attempt to compensate exactly, over the long run, to restore the prior level of risk. The two broad reasons why we might change our behaviour are economic and psychological. As economic beings we can exchange safety for other things in order to maximize our overall well-being. As psychological beings we may have an inherent desire for risk that leads us to compensate for unwanted external attempts to reduce it.

If we change our behaviour, we can do so in several ways. We may change how we perform a specific task, we may change the task, or we may add or eliminate the task altogether. If my car is required to have antilock brakes, I may drive faster on some roads and I may drive instead of taking public transit when roads are icy. If my local children’s playground has been required to replace its concrete with softer surfaces, I may now allow my children to perform more dangerous tricks, I may allow them to go to the playground unsupervised, or I may allow them to use the previously ‘off-limits’ playground.

Our behavioural changes may have system effects: consequences beyond the current act or to others. If we drive faster because of better brakes, we may endanger others. If we now permit our children to play at the safer playground, they may have to cross a dangerous street to get there.

With this broad framework, let us examine the evidence supporting and opposing risk compensation. The evidence falls into three broad categories: evaluations, experiments, and theory. We consider each in turn.

Evaluations

**Risk compensation is relevant only if a safety measure produces behaviour change which in turn increases risk**

Risk compensation occurs if people react to a safety law or regulation by acting less safely. To see if this has occurred, we either can examine individuals to see if their actions have changed, or we can examine aggregate data to see if the law or regulation has had its intended effect.

Both evaluation types must deal with the ‘noticeable difference’ issue. A change so small that it cannot be detected may be interesting theoretically but has no practical value. The question is not whether risk compensation occurs or not, but rather whether we can detect a noticeable difference in behaviour or aggregate effects that can be attributed to it.

**Individual action:** Was explicit compensating behaviour observed? This is a logical way to evaluate risk compensation, but for two reasons it is virtually impossible to carry out satisfactorily in practice. First, risk compensation predicts that behaviour will change but does not predict how it will change, so we do not know what to observe. Behaviour may change in a way that is not at all obvious. Wilde (1994) suggests that measures to reduce drunk driving may in fact have an overall road safety benefit but may cause those who would have driven drunk to act in more risky ways when not on the road. Or, compensating behaviour may take place well after the fact. Adams (1988) suggests that
laws requiring traffic to stop when children are boarding or getting off a school bus, reinforced by flashing lights and signals on the buses themselves, may teach children not to be careful when getting off any bus, so that in later years they are in danger when boarding or exiting a transit bus. No study can examine all possible ways in which compensating behaviour might occur.

Second, behaviour change is difficult to measure. We may be able to measure large changes such as performing the task more quickly but usually cannot measure more subtle changes such as increased carelessness. If we attempt to observe changes in specific individuals we probably will not have enough observations to draw meaningful conclusions. If we instead observe groups, either before and after or with and without a safety measure, we must control for all other factors that may influence behaviour.

A few studies have looked for driving behaviour changes following various road safety measures. They typically find no effects for measures to protect occupants in the event of a crash (such as seat belts) but may find effects for measures that attempt to prevent crashes by improving vehicle performance (such as better brakes or tires). For example, O’Neill et al. (1984) report on studies in Canada and England after seat belt use laws were implemented. They examined travel speeds and following headways and reported no evidence of riskier behaviour due to the belt use laws. Sagberg et al. (1997) observed travel speeds and following headways for Oslo taxi drivers with and without air bags and anti-lock brakes. They reported shorter headways for cars with anti-lock brakes but no significant difference for cars with air bags.

Most important, even if evaluations show that behaviour has changed, the changes may have no effect on accidents or injuries. Faster driving may not necessarily lead to increased crash risk; different methods of sawing wood may not lead to increased injuries. Risk compensation is relevant only if a safety measure produces behaviour change which in turn increases risk. This must be evaluated with aggregate data.

**Aggregate data:** Did the measure reduce injuries as intended? Did the motor vehicle safety standards reduce traffic injuries and fatalities? Did child-resistant medicine caps reduce accidental poisoning? These questions require all the standards of a good evaluation: a sound experimental design, good data, good controls for other factors, and appropriate statistical analyses. Even competent researchers often have difficulty meeting these standards. While overall injury counts are high, individual injuries typically are rare events. Data on which to base an evaluation frequently are inaccurate or imprecise. Effects may be small: most traffic measures do well to reduce casualties by 10 per cent. Injury control measures seldom are implemented in controlled experimental conditions but are put in place in the real world, where many other changing factors can affect the results.

The literature contains tens of thousands of studies evaluating injury prevention measures. For example, a literature search produced 54,078 abstracts or titles that might be relevant to nine motor vehicle injury prevention strategies (Rivara et al., 1999). I suspect that most evaluations concluded that injuries were reduced. But good studies are rare. For instance, a meta-analysis of drunk driving prevention and control literature from 1960 through 1991 identified 6,500 documents, of which only 125 passed minimal standards of scientific rigour and quality (Wagenaar, 1999). To test for risk compensation, though, a high-quality study must do two additional things. First, it should
compare the effect with what was predicted, with what would have happened had there been no behavioural change as a result of the measure. Predictions are of course imprecise, and predictions made by advocates may well oversell the expected benefits. However, results falling far short of predictions may suggest risk compensation. Second, the study should examine system effects. Safety measure evaluations frequently fail to look beyond the population directly affected by the measure: for example, seat belt evaluations often consider consequences only to vehicle occupants.

Evans (1985, 1991) provides a good sampling of actual and predicted effects. He examined 24 studies from the road safety literature and compared the effects predicted and actually realized. For measures designed to increase safety he found examples where safety increased even more than expected, about as expected, less than expected, where the measure was ineffective (safety did not change at all), and where the measure actually decreased safety—a perverse effect. Similarly, for measures expected to decrease safety, he found the same range of effects, from a decrease greater than expected to an actual increase in safety—an equally perverse effect. Evans concluded that behavioural adaptation to traffic safety measures is widespread, that the effects can vary widely, and that there is no evidence for the complete compensation predicted by risk homeostasis.

However, many of Evans’ measures are not laws or regulations, so his conclusions on behavioural adaptation cannot be applied immediately to risk compensation. His studies also do not report on any system effects. To examine both issues, let us consider three road safety areas where risk compensation issues have been raised frequently: vehicle safety standards, seat belt laws, and motorcycle helmet laws.

a meta-analysis of drunk driving prevention and control literature from 1960 through 1991 identified 6,500 documents, of which only 125 passed minimal standards of scientific rigor and quality

- **Vehicle safety standards:** The evaluations discussed previously address both issues. They typically examine data on all road fatalities, thus including all plausible system effects. Several evaluations also compare results with predictions. Blomquist’s summary (1988) suggests that the FMVSS did make occupants safer, but less than expected; that they may have increased risk for non-occupants; and that they increased overall road safety: in short, they may have produced some risk compensation, but their overall effect was positive. Note, though, that these FMVSS analyses were far from consistent, as they reported effects on total road fatalities ranging from a decrease of 60 per cent to an increase of 5 per cent.

- **Seat belt use laws:** The British seat belt law studies discussed previously consider system effects on all road users. The results also are consistent with the well-established protective benefits of belts in a crash and with the observed increases in belt use resulting from the law (Evans, 1991). As noted earlier, Adams (1995) challenges these findings. Evans (1991) compares United States seat belt law results with predictions. He finds observed fatality reductions close to, but typically less than, predicted reductions. He attributes this to two factors:
that belted drivers are generally safer drivers than unbelted, and that belt use rates are lower at night than during the day (when belt use observations typically are taken).

Many other belt use law evaluations have been published with far less conclusive results. Typically they attempt to measure fatality reductions in relatively small populations resulting from laws that have not increased belt use substantially. Evans (1991) maintains that these situations do not permit fatality reductions to be measured directly. The studies usually report fatality reductions lower than had been predicted and usually do not consider effects on other road users (Levy and Miller, 1999, review a few studies that do examine possible risk compensation).

- **Motorcycle helmet use laws.** These laws in the United States provide an excellent test of risk compensation for several reasons. Helmets clearly reduce head injury in a crash, and head injury is the leading cause of death for motorcyclists.

  Motorcyclists are very aware of the protection offered by a helmet, but some motorcyclists dislike helmets for various reasons. The potential risk compensation mechanism is obvious: a motorcyclist who would not choose to wear a helmet may drive more recklessly if helmet use is required by law. Helmet use depends strongly on the presence of a law: about half of all motorcyclists wear helmets if there is no law but almost all wear helmets if there is a law. States have enacted, repealed, and re-enacted helmet laws many times over the past 35 years, providing many opportunities to measure law effects. Finally, system effects of helmet use laws are negligible: motorcycle crashes very rarely cause serious injury to anyone other than motorcyclists themselves.

  At the request of Congress, in 1991 the United States General Accounting Office reviewed all available studies of helmet law effectiveness (GAO, 1991). It summarized information from 46 studies and concluded that helmet laws reduced motorcyclist fatalities by 20 to 40 per cent, a result in reasonable agreement with helmet effectiveness in a crash. Evans (1991) compares predicted and observed reductions and reaches similar conclusions. Motorcycle helmet laws have produced no detectable risk compensation.

**Summary.** This brief review indicates that risk compensation may have occurred in response to some safety measures but not in response to others. The review also illustrates the difficulty of conclusively establishing or refuting risk compensation, as its proponents acknowledge. Adams (1995): ‘…the multi-dimensionality of risk and all the problems of measuring it discussed earlier, preclude the possibility of devising any conclusive statistical tests of the [risk compensation] hypothesis.’

### Experiments

Controlled experiments in laboratory settings eliminate much of the messiness and variability of real world evaluation. These experimental studies of risk compensation take a variety of forms. Subjects typically perform some task for a reward that depends on
their performance. They also face penalties for an ‘accident’. The experimenter varies the reward and the accident risk and observes changes in the subject’s performance.

Two examples give a flavour of these laboratory experiments. For a summary of many experimental studies on risk compensation, see Glendon et al. (1996).

Jackson and Blackman (1994) report on a study in which subjects ‘drove’ a driving simulator through a predetermined route of city blocks with traffic lights and pedestrian traffic. Subjects received a monetary reward for completing the route more quickly than the average subject. They were penalized monetarily for ‘accidents’ (striking solid objects, crossing the curb line, running red lights, etc.) or for being caught speeding (exceeding the speed limit while passing through a randomly-located speed check). Various speed and vehicle control measures were recorded. The speed limit, speeding costs, and accident costs were varied. The authors found that, ‘consistent with risk homeostasis theory, increased speed limit and reduced speeding fine significantly increased driving speed but had no effect on accident frequency. Moreover, increased accident cost caused large and significant reductions in accident frequency but no change in speed choice.’

G.J.S. Wilde reports on several experiments in Target Risk (1994). Wilde’s experiments seek to estimate whether a person takes too much or too little risk compared to his or her skill level when the goal is to maximize net benefit. In the basic experiment, a subject is seated at a computer screen. At random times, a large square appears in the center of the screen. The subject’s objective is to press a button as close to but no sooner than 1.5 seconds after the square appears. The subject’s reward increases the closer the response is to 1.5 seconds. Responses sooner than 1.5 seconds receive no reward and may impose a penalty. Wilde calls these ‘brinksmanship’ experiments: your reward increases the closer you come to the brink of disaster. In many replications of these and similar experiments Wilde finds, for example, that as the penalty for responding too quickly increases, response times also increase so that the number of responses drawing penalties decreases.

**behavioural adaptation to traffic safety measures is widespread, that the effects can vary widely, and that there is no evidence for the complete compensation predicted by risk homeostasis**

These experiments show clearly that people will modify their behaviour in response to the reward and penalty structure of their environment. This is hardly news: behavioural change in response to reward and risk has been observed in decisions to invest, to buy insurance, to gamble at the casino, and in hosts of other ways. But this is far from relevant to injury prevention. Laboratory experiments carry no risk of injury or death. Performance in the laboratory likely has little or no relation to risk compensation. Even risk compensation proponents recognize this: ‘Many of the central questions of risk homeostasis theory, such as the effect of legislation on seat belts or crash helmets, are not well suited to study within a simulated environment’ (Glendon et al., 1996).

‘Resorting to laboratory and simulation studies may be methodologically pleasing (and morally innocuous), but it is doubtful that the theory in question [risk compensation] can ever be cogently tested under such contrived conditions…. In other words: simulation of risk, like a sham duplicating the real thing, is a contradiction in terms’(Wilde, 1982b).
‘Risk, by definition, cannot be simulated’ (Wilde, 1994).

**Theory**

Theory provides the only alternative to the difficulties of testing risk compensation in either experimental or real-world settings. We are, or we are not, economic beings who constantly balance costs and benefits in deciding whether to speed up a bit on this road (knowing that our air bag will protect us if worst comes to worst). We are, or we are not, motivated by an inherent desire for physical risk. Both common sense and the evidence briefly reviewed earlier suggest kernels of truth in both propositions, but something far short of complete acceptance. Further, theory is useful when it can make predictions about real-world behaviour that are testable. This leads right back to evaluation.

On a personal level, we all know that we sometimes change our behaviour in response to changes in our environment that appear to increase or decrease our risk. We also know of and welcome many changes in our environment that have made us safer. On a professional level, we know that many safety measures have not produced the benefits we had expected. We also know of many that have indeed reduced injuries substantially. With these thoughts as incentive to read further, I will give you my views.

**A PERSONAL VIEW OF RISK COMPENSATION**

First, my disclaimer (or, to understand where I stand, you should know where I sit). I am not a professional economist or psychologist or decision theory professional. I am not an academic (though I was one once). Instead, I have worked in road safety for 24 years, developing and implementing many measures that risk compensation proponents find useless or worse (such as belt use laws, air bags, and various drunk driving counter-measures).

I believe it is quite clear that from both common sense and formal studies that behavioural adaptation and risk compensation can occur in some situations. We are humans, not machines; we react to changed conditions; we are famous for not always doing as we are told or as is expected of us. On the other hand, the evidence is overwhelming that risk compensation does not always occur and that risk homeostasis cannot be justified on any basis short of metaphysics.

Thus the issue becomes not yes or no, but when and how much. When may compensation occur in response to a safety measure? How likely is it to occur? What are the possible consequences, both specific and on the system at large?

I suggest that four factors influence compensation in response to a safety measure. Each factor has several aspects, and the factors interact with each other. None is original. Many authors have proposed some of them. OECD (1990) suggests that five similar factors influence risk compensation in response to changes to motor vehicles. These four factors lead to overall guidance and to principles for action.
Visibility

How obvious is the change produced by the safety measure? Do I even know there has been a change?

Some changes are very obvious, especially if they affect performance through direct feedback: brakes, studded tires, and other vehicle handling characteristics, child-resistant caps on medicine bottles, protective equipment for athletes or workers. Other changes are apparent if I look for them but easily can be overlooked. I ‘know’ there’s a smoke detector outside my study, but I think about it only when I replace its battery. Finally, some changes may be completely or psychologically invisible. The only way I can tell it is there is from information in the media or in product information. Many features to reduce or prevent injuries to vehicle occupants, such as side door beams or penetration-resistant windshields, are invisible for all practical purposes.

Laws and regulations restricting my behaviour can be very obvious, if advertised and enforced vigorously. On the other hand, they too can be invisible, as we all know.

Evans (1991) takes a strong position: ‘Technical changes that are readily apparent to the driver are very likely to induce user responses’—brakes, handling, tires, etc. On the other hand, ‘… there is no case of a safety change invisible to road users which has generated a measurable user response’.

Rule 1: If you do not know it is there, you will not compensate for a safety measure.

Effect

How does the change affect me, both physically and mentally?

This factor has several dimensions. First, how does the change affect my physical performance of the task, through direct sensory feedback or otherwise? Is it annoying, like child-resistant medicine caps that too often are adult-resistant as well? Is it physically uncomfortable, as helmets are for some motorcyclists or seat belts for some vehicle occupants? Does it make the task easier, like improved vehicle handling or brakes? Or more difficult, like the lawnmower deadman switch that requires me to hold the handle constantly?

Second, how does the change affect my attitude? Does it annoy me, like a requirement to wear seat belts may for a libertarian? Or do I welcome it, like a guardrail added to a dangerous curve? These two dimensions clearly interact, as changes affecting my performance may also affect my attitude.

Finally, how does the change affect my perception of risk? Do I feel safer because I am wearing a bicycle helmet? Do I feel that it has eliminated all risk, as the Titanic’s passengers and crew may have believed? Or do I think it has little or no effect on my risk, because I felt there was no risk in the first place, because I believe the measure is ineffective, or because I don’t know that anything has changed?

Rule 2: If it does not affect you, you will not compensate for a safety measure.
Motivation

What influences my behaviour? What is my motivation in doing the task? What is my economic utility function? What are my psychological needs?

This factor is key in most risk compensation theory discussions. Economists hold that my only influence is my pursuit of fairly well understood economic goals. If I am driving, they believe my goal is to be transported in the shortest time and to avoid the economic costs of crashes and injuries. So if my car becomes safer, either because it is less likely to crash or less likely to injure me if it does, and if the additional safety is not useful to me, then I will drive faster. The same reasoning applies if I am required to use safety equipment such as seat belts or cycle helmets. In the workplace, especially if my salary depends on my output, my goal is to maximize my production while keeping my injury risk below an acceptable level.

Risk homeostasis theorists, on the other hand, hold that my basic goal is to maintain my desired risk level: ‘It is primarily risk to self that governs behaviour on the road’ (Adams, 1995).

Both views are simplistic. We are motivated by many factors, both economic and behavioural. On the road we want to get from here to there while avoiding both personal injury and crashes. We may or may not care about saving time: while late for a business appointment, we may cherish every second; on a casual trip, we may decide to take a longer and slower route because the drive is prettier.

We also are motivated by habit and by our desire to simplify decisions. While we may make more or less rational decisions in an unfamiliar situation, we quickly fall into habits and put many daily operations on ‘automatic pilot’. So we do not think each time about how fast we drive down our neighborhood street, we do it just as we always have done. Once accustomed to wearing a seat belt or a bicycle helmet, many of us do it every time without thinking about it. In fact, after seat belt wearing has become a habit, we feel uncomfortable if a belt is not available. The first few times we wear a hard hat on a construction site we notice it, but it soon becomes second nature; again, we may feel uncomfortable without it.

These factors all influence our motivation to compensate for safety changes. If I am motivated to change behaviour, and if the safety change allows me to do so and still maintain my previous risk level, I may well compensate. But if there is no motivation for behaviour change, I will not. As Fuller (1994) states quite vividly in the setting of road safety: ‘Except where speed increases are rewarding, only very special road users, such as homicidal maniacs, putative suicides and demolition engineers ever intentionally opt for a greater chance of collision with obstacles in front of them. The rest of humanity sets out by and large with a distinct preference for self-preservation and a marked dislike of visits to the albeit friendly but expensive hospital and vehicle repair shop’.

Rule 3: If you have no reason to change your behaviour, you will not compensate for a safety measure.

Control

How much do I control the situation? Can I change my actions even if I want to?
Workplace situations frequently are tightly controlled by rules, supervisors, and the physical environment, so may allow little opportunity for compensation. Piecework settings provide more flexibility and freedom. Driving allows considerable freedom: traffic laws provide nominal control, but since most laws are not enforced rigorously, individual drivers have considerable latitude for their actions. Household settings allow virtually complete control.

Sports provides interesting examples of the interplay between injury prevention, compensation, and control. In many sports, players are required to wear protective equipment. Ice hockey and American football are prime examples. Some players have compensated by acting more violently within the confines of the rules. In some instances this has led to rules changes to control player actions more tightly and prohibit some violent actions.

Rule 4: If your behaviour is tightly controlled, you will not compensate for a safety measure.

A compensation index

Each of these four factors—visibility, effect, motivation, and control—is far more complex than this simple discussion suggests. But together they provide a useful framework for considering potential risk compensation in response to a safety measure: a highly imprecise Compensation Index. Assess each factor subjectively, from ‘no, not at all, zero’ to ‘maybe, moderate, some’ to ‘yes, strong, a lot’. As a first approximation:

prefer measures that are invisible to people, or that do not affect their actions or attitudes, or for which they have no motivation or freedom to change behaviour

• Compensation is unlikely if any of the four is zero: the measure is invisible, does not affect me, or I have no motivation or no freedom to change my behaviour.
  • As all factors reach moderate levels, the likelihood of compensation increases.
  • If each is high, behavioural compensation is likely: the measure is highly visible, affects me substantially, I have good reasons to change behaviour and I have the freedom to do so. Then I will consume at least some of my increased safety as performance. And even then it’s unclear whether the overall effect will be to compensate partially, completely, or more than completely for the safety measure.

Let us apply the Index to a few of the examples considered previously.

• FMVSS: The crash-prevention standards such as better brakes and tires that improve vehicle performance rate moderate to high on each factor: compensation is likely (although, as noted previously, many crash-prevention FMVSS merely codified existing industry practices). The injury-prevention standards such as improved side door structure are essentially invisible: no
compensation is expected.

- Seat belt use laws: Belt use is quite visible and affects belt users (though the effect may be ignored as belt use becomes habitual). However, there is little or no motivation for more risky driving because belts do not affect the risk of a crash. Thus compensation is unlikely.

- Safety equipment for chain saw operators: The equipment is very visible and allows me to work faster with lower injury risk. If I am paid by the quantity produced, I am highly motivated to increase my output and likely will compensate substantially. If I am paid by the hour and my working practices are constrained by rules, I likely will not compensate.

These predictions are in reasonable agreement with the best evidence on risk compensation in these situations. As a mental experiment, consider several injury prevention measures that you know well. Does the Index predict compensating behaviour or not? Is this prediction accurate?

**WHY SHOULD YOU CARE ABOUT RISK COMPENSATION?**

Injury prevention and control professionals seek to do something, right now if possible, to reduce unintentional injuries. Academic discussions matter only if they have practical consequences. With this in mind, it is appropriate to summarize this discussion of risk compensation with a short list of Things to Think About and Actions to Take in planning and implementing injury prevention and control measures.

Risk compensation can occur—people are not machines

We all change our behaviour in response to changes in our environment. Our behaviour is determined by a complex set of rational and behavioural factors. Safety measures change our environment, so we may change our behaviour in response to them. Never assume blindly that behaviour will not change.

Four factors influence risk compensation—visibility, effect, motivation, and control

Risk compensation occurs only in certain circumstances. The four factors and the Compensation Index help you think through the circumstances of an injury prevention measure to estimate whether risk compensation is likely or not.

To reduce or eliminate risk compensation, use measures rating low on at least one factor

Prefer measures that are invisible to people, or that do not affect their actions or attitudes, or for which they have no motivation or freedom to change behaviour.
Consider system effects

Injury prevention measures may have effects beyond the individual actions they influence directly. These effects may be harmful or helpful. Think about them before acting.

Do not over-predict benefits

Many injury prevention measures promise more benefits than they deliver, due to bad science, political pressures, or failure to consider risk compensation or system effects. While calm and realistic benefit estimates are difficult to produce in the heat of battle, unduly optimistic predictions will hamper injury prevention efforts in the long run.

Trading safety for performance is not all bad

Safety is not our only goal. All action produces risk; there is no risk-free life. As society and as individuals we constantly change our balance of performance and risk (in many dimensions of each). If some safety benefits predicted for an injury prevention measure become performance improvements instead, we should be pleased with contributions to society in both areas.

FOR FURTHER INFORMATION

Key papers


• Gerald Wilde’s *Risk Analysis* paper (1982a), four commentaries (Slovic and Fischhoff, Graham, Orr, and Cole and Withey), and Wilde’s response (1982b) begin the debate on risk homeostasis. To follow it further, see McKenna (1982), Wilde (1984), McKenna (1985a), Wilde (1985), McKenna (1985b), McKenna (1987), Wilde (1988), McKenna (1988), Wilde (1989), and McKenna (1990); also Evans (1986a), Wilde (1986), and Evans (1986b).

• John Adams’ early work is not in easily-accessible literature, but his views
are rebuttal. Leonard Evans’ 1985 Human Factors paper discusses 26 traffic safety studies presented clearly and at some length in his 1985 paper. Mackay (1985) offers a that illustrate all varieties of risk compensation.

Books

• The OECD report *Behavioural adaptations to Changes in the Road Transport System* (1990) gives an excellent, thorough, and dispassionate summary of risk compensation theories and evidence in road safety.
  • Gerald Wilde’s *Target Risk* (1996) summarizes his views, again concentrating on road safety, provides numerous examples from the literature, and discusses some of his experimental work.
  • Edward Tenner’s *Why Things Bite Back: Technology and the Revenge of Unintended Consequences* (1996) takes a broad view of why things don’t necessarily work out the way we had expected. The sections on sport speak directly to behaviour change in response to equipment change intended to improve safety and performance.

Collections

The literature on risk compensation is spread across many disciplines and journals (in preparing this paper I reviewed papers in over 60 different journals). For quick access to several points of view on risk compensation issues, I recommend two books and five special journal issues (in chronological order).

  • *Accident Analysis and Prevention* vol. 18, no. 5 (1986) is a special issue on risk, with seven papers.
  • *Ergonomics* vol. 31 no. 4 (1988) is a special issue on ‘Risky decision-making in transport operations’ containing 21 papers from a 1986 workshop on risk compensation on the road and in the workplace.

- Safety Science vol. 22, no. 1–3 (1996) is a special issue on risk homeostasis and risk assessment, with 13 papers.
- Managerial and Decision Economics vol. 17, no. 5 (1996) is a special issue on product safety and managerial decisions with three papers on risk compensation considerations regarding cigarette lighters, bicycle helmets, and lawn mowers.

REFERENCES


GAO, 1991, Highway Safety: Motorcycle Helmet Laws Save lives and Reduce Costs to
McKenna F.P., 1988, What role should the concept of risk play in theories of accident involvement? *Ergonomics* 31, 469–484.


INTRODUCTION

Research on ageing and traffic safety has a history dating to the thirties. In an early paper (DeSilva, 1938), concern was expressed at the steadily increasing proportion of drivers over 40 years of age. During the beginnings of traffic gerontological research, which was dominated by research teams in the US, ageing of drivers was considered the main issue. Since late sixties, empirical evidence on different aspects of ageing and driving has accumulated, and mainstream older driver research has shifted focus a few times. The scope of research also has widened from drivers to other road users, and from treating older road users mainly as a safety problem to also encompass mobility and quality of life related issues.

This paper describes the main trends in gerontological traffic safety research during the last three decades, with focus on research on private car accidents, since this has been the most active area of traffic gerontology. The scope of the report makes it impossible to present an exhaustive review of all relevant research; rather, the aim is to illustrate certain paradigmatic shifts with a few examples of representative studies. For sake of clarity, this report is organized chronologically by decade; the author apologises for the unavoidable geometrical oversimplification.

THE SEVENTIES: IS THERE AN OLDER DRIVER PROBLEM?

The ‘older driver problem’ first became established as a result of a wave of intensive research activities on older drivers by the end of the sixties, mainly, in the US. As a result of these efforts (for an overview, see Grow, 1972), general trends in accident rates and exposure characteristics were established. Thus, it was found that older drivers had less accidents per capita but more per mileage and that they in general drove less than did middle-aged drivers (Finesilver, 1969; McFarland, 1964; Planek, 1972). The importance of different aspects of vision for safe driving was thoroughly studied by Hills and Burg (1977).

At the North Carolina Symposium on Highway Safety in 1972, Planek (1972) summarized the status quo in a critical review the focus of which he defined in the following manner: ‘In studying the effect of the ageing process on driving, we shall be primarily interested in drivers over 55 years of age, although some age-associated change in driving activity itself may start as early as 50. This discussion will focus on defining the deficiencies of ageing drivers and examining them in relation to driving performance
research. Hopefully, from such a review, we can begin to assess the impact of the ageing driver in today’s traffic both quantitatively and qualitatively.’

According to Planek, deficiencies of the summarizing the findings available, ageing driver seemed to fall into the two overlapping categories: those due to the ageing process itself and those due to some medical disability. The age-related deficiencies were delineated along three general areas: sensory reception, neural processing and transmission, and motor response.

Planke’s views reflected the Zeitgeist in research on ageing drivers in two ways. First, in harmony with the concurrent interest in accident proneness (Echterhoff, 1990), the driver’s ‘deficiencies’ were seen exclusively as the cause of all problems, and the characteristics of the traffic system were taken largely for granted. Second, the concepts used for the driver’s internal faculties clearly date from a period before the ‘cognitive revolution’; the lack of an information-processing viewpoint and cognitive terminology is flagrant for a modern reader. Another analysis presented by Mann (1972) at the same meeting reflects similar thinking. Although discussion about the importance of decision making processes and about possible safety-related changes in the traffic system soon emerged (Planek and Overend, 1973), the general recommendations made by the US National Conference on the Ageing Driver (National Conference on the Ageing Driver (NCAD, 1974) were dominantly oriented towards screening drivers and eliminating those with higher risk from the driver population.

It can only be speculated whether the impact of this first wave of interest on future older-driver research and traffic planning might have been different had a more system-oriented view of the human operator already prevailed. As it was, the problem became established in terms of decreased safety of deficient drivers and the need to do something about them.

older drivers are ‘good insurance risk’ but have more accidents per distance driven

In Europe, interest in ageing and driving seems to have emerged later, although some valuable work was done as early as the fifties (Häkkinen, 1954). In some European countries, age-related controls or restrictions to driver licensing were stipulated in early seventies, but generally speaking the issue did not get much attention before the eighties (Hakamies-Blomqvist, 1996).

THE EIGHTIES: WHAT IS THE NATURE OF THE OLDER DRIVER PROBLEM?

Once it had been settled that there was, or would be, an ‘older driver problem’, research in the eighties was directed toward a more thorough understanding of the general traits of this problem. Early findings on accidents were supported and complemented by later studies. Thus, it was shown that older drivers are ‘good insurance risk’ (Cooper, 1990; Wiener, 1972) but have more accidents per distance driven (Brorsson, 1989; Cerelli, 1989; Evans, 1987; Evans, 1988; Graca, 1986). When involved in an accident, older
drivers were found to be more often than not the legally responsible party, i.e., the party at fault (Knoflacher, 1979; McKelvey and Stamatiadies, 1989; Partyka, 1983; Verhaegen et al., 1988; Viano et al., 1990). Older drivers were shown to be over-represented in accidents occurring at intersections and other complex traffic situations (Broughton, 1988; Cerelli, 1989; Hauer, 1988; OECD, 1985; Partyka, 1983; Stamatiadis et al., 1991; Viano et al., 1990; Yanik, 1985). Older drivers were also found to be convicted more often for corresponding violations in traffic (McKelvey and Stamatiadis, 1989; Rothe, 1990). On the other hand, they turned out to have less single-vehicle accidents (Campbell, 1966; Cerelli, 1989; Moore et al., 1982). It was also established that accidents of older drivers occurred mostly in the daytime (Broughton, 1988; Campbell, 1966; Cerelli, 1989; Hauer, 1988) and that accident-involved older drivers were less often alcohol-intoxicated than accident involved young or middle-aged drivers (Berghaus et al., 1983).

While the results of the research papers of this period usually are neat and straightforward, the discussion in these papers tend to be disappointing. Attempts to explain the emerging accident picture of older drivers were mostly based on an ad hoc combination of elements belonging to knowledge bases: (1) a task analysis of car driving, now mostly described in information processing terms (e.g., flow charts), (2) gerontological data about age-related changes in different aspects of human performance, and (3) accident statistics. From these three database, hypothetical explanations were generated by matching the information about which faculties are necessary for safe driving, which functions change with age, and which kinds of accidents occur. The elements chosen to explain the accident picture were mostly picked on the basis of their face value. Thus, since (1) vision certainly is one of the necessary faculties for safe driving, and (2) several visual functions deteriorate with age, and (3) older drivers were over-represented in intersection accidents where they failed to see their collision partners in time, age-related changes in vision often were blamed for their accidents.

A central weakness of such an approach was that though empirical evidence of the nature of the accidents accumulated, insight into their causation did not, since the same speculations were expressed again and again with little or no effort towards deepening the understanding of the behavioural mechanisms mediating the effects of functional deficits via driving behaviour to accident statistics.

A definite improvement, however, compared to earlier research, was a shift of focus towards higher cognitive functions in search of factors explaining the age-related accident risk. During the seventies, sensory and motor phenomena were the focus; during the eighties, critical deficiencies were described in referring to speed. Neural conduction time was mercifully forgotten as a major factor explaining accidents.

The success story of the UFOV research (Useful Field of View), a dynamic measure of the functionally available field of view, is a good example of the power of a more cognitive approach. In an early study, Burg and Hills had tried to establish statistical relations between, basic visual functions accident risk (Burg, 1967; Burg, 1968; Hills and Burg, 1977). Despite a sample of over 17,500 drivers, their findings were modest. Discussing their failure to achieve stronger predicting power, Hills and Burg claimed that perceptual rather than sensory measures would be useful in predicting accidents; for instance ‘useful visual field’ instead of total visual field was proposed as a tool for future
researchers. Ten years later, such a measure was developed. In a retrospective accident study, in combination with a measure of cognitive performance, UFOV explained 29 percent of the variance in older drivers’ prior 5-year rates of accidents at intersections (Owsley et al., 1991).

While the adaptation of a cognitive frame of thinking was a major improvement, the main weakness of ‘modern’ flow chart models of driver behaviour was their ahistorical nature. Such models only presented a snapshot and failed to take into account the nature of driving as a skilled performance with a long learning history. Conceptualizing driving as skilled behaviour rather than, or in addition to its being a complex information processing task has become increasingly popular in the nineties; in the beginning of the nineties, some important advances also were made in the study of ageing of cognitive skills (Bosman, 1993). This approach certainly shows promise toward a deeper understanding of the weaknesses, strengths and compensatory strategies of older drivers.

One of the corner stones of the definition of the older driver problem, the claim concerning their higher accident rates, was contested in the eighties when it was pointed out that a higher risk of injury leads to sampling bias in accident data bases. As demonstrated by Evans (1991) on the basis of several earlier studies, the greater physical frailty of older individuals explains an important part of their higher rates of injury and fatal accidents. Challenging the traditional problem definition, Evans concluded that for older drivers, accident risk in fact was a minor issue, and limitations in mobility, due to self-imposed compensatory restrictions in driving exposure, were the real problem. In the eighties, many European countries felt the need of conducting a national state-of-the-art review on older road users. Depending on the actors involved, these different national papers have somewhat different focuses and levels of discussion.

older drivers were shown to be over-represented in accidents occurring in intersections and other complex traffic situation

In 1989, a report by the European Conference of Ministers of Transport summarized the situation in Europe regarding population and licensing trends, accidents, and implementation of safety measures focusing on older road users. The general findings and conclusions were largely in harmony with an earlier OECD report (OECD, 1985).

From the beginning, the European discourse on ageing and driving has had a somewhat different orientation than the North American one. Characteristic for the European approach is a system perspective: issues like factors affecting modal choice and safety as unprotected road user have higher priority in Europe than in the US where the focus is more on private car use. In Europe there is also an explicit attempt to design traffic facilities ‘for all’; groups with special needs are not primarily seen as targets for specific solutions but rather as criterion users guiding the design toward solutions beneficial for all users.
THE NINETIES: WHOSE PROBLEM IS THE ‘OLDER DRIVER PROBLEM’?

Arguably the most important change of direction in older driver accident research is the recent shift of focus from a general approach toward a differential one. Research efforts in the eighties had attempted to describe the general nature of the older driver problem. However, it was, at the same time, increasingly recognized that the problem may not be a general one. Gerontological research had long since shown that inter-individual variance increases with age. Clinical experience pointed out certain sub-groups of older patients having illnesses that could affect abilities essential for safe driving as a major source of safety concern, more than ‘normal ageing’. Thus, while earlier research mostly was guided by the question ‘Why do older drivers have higher accident risk?’ the alternative question ‘Which older drivers have higher accident risk?’ has gained momentum in the nineties (Hakamies-Blomqvist, 1998).

Of risk-increasing illnesses, dementia of Alzheimer type has received most attention. The scientific and political discussion about dementia as risk factor for car driving started with a study by Friedland et al. (1988) claiming that older drivers with dementia had 4.7 times the accident risk of healthy older drivers. The authors recommended on the basis of these findings that a diagnosis of dementia (in their case Dementia of Alzheimer Type, DAT) should always lead to a revocation of driver licence. Similar findings and conclusions were presented by Lucas-Blaustein later the same year (Lucas-Blaustein et al., 1988). Serious protests were, however, immediately presented against this recommendation which was claimed to be premature and to have negative consequences (Drachman, 1998). While most studies showed a substantial risk increase due to dementia (Carr et al., 1990; Drachman et al. 1993; Dubinsky et al., 1992; Fitten et al., 1995; Gilley et al., 1991; Logsdon and Larson, 1992; Lucas-Blaustein et al., 1988; O’Neill et al., 1992; Trobe et al., 1996; Tuokko et al., 1995), it was also shown that the risk does not necessary increase in the beginning of the illness, and that many patients with DAT diagnosis have intact driving ability (Hunt et al., 1997). In 1994, an international consensus conference was organized (documented in Lundberg et al., 1997) concerning dementia and driving. The conclusion was that patients with beginning or mild dementia should be allowed to drive but there should be a periodical follow-up in order to monitor changes in performance.

Although it has been convincingly demonstrated that dementia increases a driver’s accident risk it does not necessarily follow that dementia is a major factor in older drivers’ accident statistics; demented drivers may limit their exposure or stop driving entirely. Several studies have shown that between 20 and 30 per cent of drivers affected by dementia continue driving (Gilley et al., 1991, Carr et al., 1990, Logsdon and Larson, 1992). In a Swedish-Finnish collaborative study, Johansson et al. (1997) addressed the question of how big a share all older drivers’ accidents could actually be attributed to drivers suffering from dementia. They used micropathological methods to study certain parts of the brain of aged drivers killed in traffic accidents, and concluded that those with neuropathological changes in their brains, indicating possible or probable DAT (dementia of Alzheimer type), were clearly over-represented, around 50 per cent of the killed.
drivers.

If demented drivers turn out to be heavily over-represented among accident-involved older drivers, as indicated by Johansson’s study, then it follows that non-demented drivers have a smaller share of the accidents than has been generally believed. The distribution of individual accident risk among the elderly may indeed be bimodal rather than normal: in virtue of their cautious driving style and self critical attitude, normally, or ‘successfully’ ageing older drivers may be extremely safe drivers whereas illnesses causing dementia may lead to a dramatic increase of risk—which brings up the old concept of ‘accident proneness’ again in a fresh shape. In harmony with this thinking, periodic medical controls for older drivers are often suggested as safety measure when discussing illness-related risk increase. Those studies in which existing systems have been evaluated have, however, failed to show beneficial effects of medical screening of older drivers (Hakamies-Blomqvist, 1996; Hull, 1991), except for small safety benefits for regular vision controls (Levy et al., 1995; Shipp, 1998).

while earlier research mostly was guided by the question ‘Why do older drivers have higher accident risk?’ the alternative question ‘which older drivers have higher accident risk?’ has gained momentum in the nineties

The realization of the importance of cognitive decline in accident causation has stimulated interest in driver diagnostics and related research. Generally speaking, research on diagnostic testing of older drivers, while flourishing in the US, is still young in Europe, and there are several problematic issues. First, there is the ‘eternal’ problem of accidents as outcome measure. Since accidents are rare multi-determined events it is difficult to achieve sufficient statistical power using accident data as outcome variable. However, the validity of any surrogate measures remains to be demonstrated. Second, it is not always clear whether the aim of the diagnostic studies is in reality to find methods sensitive for safety decrements, or rather, to find methods sensitive for early dementia, since signs of beginning dementia or other cognitive decline tend to correlate strongly with any surrogate measures of increased risk. In the latter case, the research done in a traffic context risks to duplicate more powerful research addressing the same issues within a medical context.

The concept of risk has continued to intrigue traffic gerontologists in the nineties. Janke (1991) demonstrated in a pertinent review paper how comparisons based on accidents per mileage exaggerate the risk of driver groups with small yearly mileage as compared to those driving more. Maycock (1997) analysed European accident statistics with respect to the frailty effect and concluded that half of the increased fatality risk of drivers aged 75 years or more, compared to drivers aged 30 years, might be due to the enhanced susceptibility of the older drivers to be killed in the accidents in which they are involved, rather than to their higher accident rates. Hakamies-Blomqvist (1994, 1998) pointed out that the finding that older drivers tend to be legally responsible parties in their collision accidents can be equally well stated as that older drivers are very hard to hit as innocent parties because of their cautious and defensive driving style. Hence, surrogate measures of induced exposure relying on the ratio of at-fault to not-at-fault tend to exaggerate the risk of older drivers. Finally, in a number of studies an attempt has been
made to dissect the effects of age, cohort, and period on older drivers' accident picture. The overall findings indicate that typical age-related findings emerge at a later age in cohorts born later as compared to those born earlier (Evans, 1993; Stutts and Martell, 1992; Hakamies-Blomqvist and Henriksson, in press).

There has been an impressive amount of research on different aspects of driving behaviour during the nineties, which it is not possible to review here. Suffice it to mention a few topical areas: trends and changes in travel behaviour, actual driving behaviour such as merging decisions at intersections, compensatory strategies such as limiting one’s driving exposure, and reasons of driving cessation.

FUTURE DIRECTIONS

In harmony with the redefinition of the older driver problem, recent traffic gerontological research seems to have adopted a wider scope than earlier. Travel behaviour is more often studied in the whole context of everyday life. Aspects other than safety are often in focus, and an increasing interest in a phenomenological point of view is evident. Another recent trend is the emergence of older female drivers as a special group. Integrative research efforts containing a ‘user perspective’ can be expected in future, as well as a growing interest in ‘life after licence’.

REFERENCES


Cooper, P.J., 1990, Differences in accidents characteristics among elderly drivers and


Evans, L., 1993, How safe were today’s older drivers when they were younger? In Transportation Research Board, 72nd Annual Meeting. Washington, DC.


Hakamies-Blomqvist, L. and Hensriksson, P., in press, Cohort effects in older drivers, accident type distribution: Are older drivers as old as they used to be? *Transportation Research Part F, Traffic Psychology and Behavior*.


Häkkinen, S., 1954, Sambandet mellan alder och trafikolyckor (Relation between age and...


Hills, B.L. and Burg, A., 1977, A re-analysis of California driver vision data: General findings. *TRRL Laboratory Report 768*. (Crowthorne, UK: Transport and Road Research Laboratory).


Adolescents’ Risk-taking Behaviour, Myth or Reality: Evidence from International Data

Anne Tursz

INTRODUCTION

Professionals working in the area of adolescent health generally agree that adolescence is a period characterized by a high frequency of risk-taking behaviour. This consensus has been possible especially since Jessor and Jessor (1977) defined the psychological and social utility of risk for this age group, Zuckerman (1971, 1979) showed that the ‘sensation-seeking’ curve reaches its apogee at the end of adolescence (16–19 years of age), and Holinger (1981) compared adolescent risk-taking behaviour with a tendency for self-destructiveness. Recently, several articles and books (Tonkin, 1987; Special issue of the Journal of Adolescent Health, 1991; Tursz et al., 1993; Jonah, 1997) and publications from surveillance systems (Kann et al., 1998) have reviewed the state of knowledge about these behaviours, and the possibility of preventing them (Dryfoos, 1991).

Agreement within clinical and public health circles on the issue of risk as a characteristic of adolescence is based primarily on conclusions of a statistical nature. Mortality and morbidity linked to certain risk-taking behaviours seem particularly high at that age. Epidemiological studies on risk-taking during adolescence investigate risk-taking behaviours per se such as, consumption of alcohol, tobacco, illegal drugs, dangerous driving, unprotected sex, suicide attempts, violence as well as their negative consequences-intentional or unintentional violent deaths, accidents, mortality related to drug abuse, unwanted pregnancies, sexually transmitted diseases, including AIDS.

As a matter of fact, in most countries, definitely in industrialized countries (IC), no peak in frequency is observed among adolescents for these causes of morbidity and mortality, except in the case of accidents (Tursz, 1997). Accidents are the primary cause of death among children and adolescents, with a peak in mortality for the 15 to 24 age group in most IC (WHO, 1995).

The age limits of adolescence vary from one study to another. Data presented in this article cover different age groups but most are between 11 and 19 years of age. However, mortality figures concern subjects between 15 and 24 years (adolescents and young adults).

Bibliographical research of recent studies on adolescents’ risk-taking behaviour produce many more references on sexual behaviour, STDs and AIDS, than on behavioural causes of unintentional injuries. Questioning scientific data bases on the specific issue of adolescents’ accidents leads to the identification of a large number of articles reporting the results of studies conducted in ICs (mainly on traffic accidents in
USA), but very few on accidents in developing countries (DC), and almost none on risk-taking behaviour in DCs. Nevertheless, it was recently estimated that 4 out of 5 young people live in DCs (Friedman, 1989), unintentional injuries (mainly road traffic accidents) are a growing problem in DCs (Smith and Barss, 1991), with nearly three-quarters of road deaths in the world occurring in DCs (Odero et al., 1997), and increasing population density being associated with a proportionately greater number of traffic related deaths among the youth (Söderlund and Zwi, 1995).

In this paper, the intention therefore is to present data on adolescents’ accidents, when possible, from both ICs and DCs. Epidemiological data analysed in this article deal with both, mortality and morbidity related to risk-taking behaviours and with the behaviours themselves. Mortality and morbidity figures relate only to unintentional injuries and accidents, since they constitute a health problem internationally recognized as specific to adolescence, whereas suicide rates, for example, increase with progression of age in most countries (WHO, yearly publication). Regarding risk-taking behaviour and protective behaviour, examples will be presented and discussed from various areas, such as drug consumption or sexual behaviour. This review of epidemiological data does not presume to be exhaustive but rather aims at presenting and analysing relevant examples. It also aims at identifying some methodological problems in study design and data collection which sometimes make the interpretation of figures difficult, especially at an international level.

some risks may even be rewarded. This is the case with risk in sports, sports being one of the few ways violence may repeatedly be expressed with the agreement of Western society

Analysis of epidemiological data leads to a consideration of what really is specific about adolescence. Indeed, looking at figures, rates and percentages of the consumption of toxic substances, of sexual partners, raises numerous questions. Are these figures high, average or low? In comparison to what or to what standard? The standard for figures found among adults, for example? Or are they being compared to some theoretical standard linked to the level of social acceptance of the negative consequences of risk-taking by an adolescent (the enormous economic, social and psychological cost of traffic accidents, for example)? The level of social acceptance of risk varies, with different societies and cultures selecting different acceptable and unacceptable risks. Some risks may even be rewarded. This is the case with risk in sports, sports being one of the few ways violence may repeatedly be expressed with the agreement of Western society.

A social definition of risk, including ideas of negotiation in terms of social norms, of consensus, is far from the epidemiological definition used in public health (probability of an event occurring, that an individual will die or fall sick during a given period). This definition, with its very negative connotation and statistical data gathered in epidemiological studies, serve as the basis for planning prevention strategies. One may very well question the narrowness of this definition as well as its implications for rejecting any notion of benefit associated with risk. Taking into account the utility of risk-taking, and the cultural and social value of certain risks is necessary for planning prevention programmes with credibility among those we wish to communicate with—
MORTALITY AND MORBIDITY FROM UNINTENTIONAL INJURIES

Accidental mortality is principally caused by traffic accidents, 77 per cent of all accidental deaths in the EU (WHO, 1995). Accidental mortality shows a peak for adolescents and young adults between 15 and 24 years of age in most ICs (see Table 1, rates are higher for males in the age group 25–34 years only in Finland and Spain). This high mortality is attested to by the place occupied by this pathology among all causes of death in the age group 15–24 years in EU countries—38 to 70 per cent of all causes of death according to country and gender (WHO, 1995). However, in countries where driving licenses can be obtained at 18, the rates are much higher among young adults (especially males) from 20 to 24 years than among adolescents from 15 to 19 years. In France, in 1996, rates of fatal accidents among males were 35.3 per 100,000 among 15 to 19 year olds and 58.4 per 100,000 among 20 to 24 year olds, while for females it was 11 and 13.5 respectively (INSERM, 1996). Mortality rate for this age group is higher than that for adults older than 25 years of age, and in the United States, the curve of the number of fatal traffic accidents in relation to the distance travelled annually shows an evident peak for 16 to 19 year olds, with rates four times higher than those for adults 30 to 34 years old (Williams and Carsten, 1989). In USA, 73 per cent of all deaths among the 10–24 year olds result from three causes: unintentional injuries, homicides and suicides (Kann et al., 1998). There is a very constant pattern for adolescent and youths accidental mortality in ICs. Table 1 shows a dramatic increase in rates after the age of 15 and the considerable male overmortality (sex ratio from 3.0 to 5.2).

Table 1

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>YEAR</th>
<th>5–14 YEARS</th>
<th>15–24 YEARS</th>
<th>25–34 YEARS</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>F</td>
<td>M</td>
</tr>
<tr>
<td>Austria</td>
<td>1994</td>
<td>9.7</td>
<td>3.1</td>
<td>75.4</td>
</tr>
<tr>
<td>Belgium</td>
<td>1989</td>
<td>9.0</td>
<td>8.8</td>
<td>69.9</td>
</tr>
<tr>
<td>Denmark</td>
<td>1993</td>
<td>8.4</td>
<td>6.9</td>
<td>32.9</td>
</tr>
<tr>
<td>Finland</td>
<td>1994</td>
<td>10.0</td>
<td>5.1</td>
<td>35.3</td>
</tr>
<tr>
<td>France</td>
<td>1993</td>
<td>7.3</td>
<td>4.6</td>
<td>55.1</td>
</tr>
<tr>
<td>Germany</td>
<td>1994</td>
<td>7.4</td>
<td>4.3</td>
<td>47.0</td>
</tr>
<tr>
<td>Greece</td>
<td>1994</td>
<td>7.3</td>
<td>5.8</td>
<td>70.5</td>
</tr>
<tr>
<td>Ireland</td>
<td>1992</td>
<td>10.3</td>
<td>2.8</td>
<td>51.0</td>
</tr>
</tbody>
</table>
Accidental morbidity also shows a peak between 15 and 24 years of age in ICs (Fife et al., 1984; Williams and Carsten, 1989; Tiret et al., 1989).

In DCs, the mortality peak at 15–24 year olds is not observed in all countries (Smith and Barss, 1991), and in many of them mortality rates (especially traffic death rates) increase after the age of 25. Nevertheless some recent studies show the importance of accidents among adolescents. A study conducted in two districts of Algiers in 1986 indicates that higher traffic accident rates were observed in the 20–24 years age group for both sexes and in the 15–24 age group for males (Bezzaoucha, 1988). In 1991 in a South African township, the highest injury rate was found among adolescents aged 15–19 years, with two major causes: traffic accidents and violence (Zwi et al., 1995). In this study, adolescents’ injuries were found to be more severe than those of subjects of other ages. Adolescents’ injuries in DCs are often related to causes which are rare in ICs, such as occupational accidents, as noted in India, where in 1983, it was estimated that 44 million 12–18 year olds were industrial or rural workers (Chaudhuri, 1990). If it has been estimated that middle-income countries appear to have, on average, the largest road traffic mortality burden, after adjusting for motor vehicle numbers, the poorest countries show the highest road traffic-related mortality rates (Söderlund and Zwi, 1995). This is to be compared with the relationship observed between socio-economic status and the type of accident in adolescents in ICs (Williams et al., 1996).

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>% Male</th>
<th>% Female</th>
<th>% Other</th>
<th>% Other</th>
<th>% Traffic</th>
<th>% Violence</th>
<th>% Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Italy</td>
<td>1992</td>
<td>8.1</td>
<td>3.7</td>
<td>59.9</td>
<td>12.4</td>
<td>40.9</td>
<td>8.7</td>
<td></td>
</tr>
<tr>
<td>Netherlands</td>
<td>1994</td>
<td>6.3</td>
<td>4.0</td>
<td>24.1</td>
<td>8.0</td>
<td>19.1</td>
<td>4.9</td>
<td></td>
</tr>
<tr>
<td>Portugal</td>
<td>1994</td>
<td>14.8</td>
<td>8.7</td>
<td>69.7</td>
<td>13.7</td>
<td>64.7</td>
<td>9.8</td>
<td></td>
</tr>
<tr>
<td>Spain</td>
<td>1992</td>
<td>9.4</td>
<td>6.1</td>
<td>68.3</td>
<td>16.7</td>
<td>70.6</td>
<td>13.2</td>
<td></td>
</tr>
<tr>
<td>Sweden</td>
<td>1993</td>
<td>6.3</td>
<td>2.8</td>
<td>25.4</td>
<td>8.5</td>
<td>19.4</td>
<td>5.7</td>
<td></td>
</tr>
<tr>
<td>United Kingdom</td>
<td>1992</td>
<td>7.2</td>
<td>3.4</td>
<td>31.3</td>
<td>8.9</td>
<td>23.9</td>
<td>5.3</td>
<td></td>
</tr>
</tbody>
</table>

*: Rates from Luxembourg are not calculated due to too small numbers of deaths

Data from: World Health Statistics Annual, 1995

...taking into account the utility of risk-taking, and the cultural and social value of certain risks is necessary for planning prevention programmes with credibility among those we wish to communicate with—adolescents...

Important differences observed in all countries between males and females for mortality as well as morbidity rates favour an explanation in terms of the role of behaviour, since these differences cannot be fully explained by differences in risk exposure and as risk and protective behaviours varies notably in traffic according to gender.
RISK BEHAVIOURS

Risk-taking

Some nation-wide surveys address all types of risk-taking behaviours, such as the national school-based American Youth Risk Behaviour Surveillance System (YRBSS) (Kann et al., 1998), or the French national study Adolescents, conducted in 1993, in schools, among subjects aged 11 to 19 years (Choquet and Ledoux, 1994). Other studies are more specific and we shall emphasize those addressing the problem of behaviours leading to injuries, mainly traffic accident related injuries. Research on risk behaviour come almost exclusively from ICs.

The data from the 1997 YRBSS and the French ‘Adolescents’ study show marked differences as concerns the level of risk-taking. In the American study, 36.4 per cent of high school students had smoked cigarettes during the 30 days preceding the survey; 50.8 per cent had drunk alcohol, and 26.2 per cent had used marijuana; 2.1 per cent had ever injected an illegal drug; 7.7 per cent had attempted suicide during the previous 12 months; 48.4 per cent had ever had sexual intercourse (Kann et al., 1998). In the 1993 French study, 14.5 per cent of subjects smoked regularly; 39.8 per cent reported drinking alcohol occasionally and 3.3 per cent reported drinking regularly and had been inebriated 3 or more times in the past year; 12 per cent had smoked hashish but only 0.9 per cent had tried heroin at least once (0.2 per cent had tried it 10 or more times); 6.5 per cent had already attempted suicide; 31.3 per cent of the boys and 22.4 per cent of the girls had ever had sexual intercourse (Choquet and Ledoux, 1994).

These different risk-taking behaviours are by and large more frequent among males than females, whether this concerns the consumption of alcohol or drugs. On the other hand, studies carried out in France on tobacco consumption show tobacco use among girls identical to that among boys (Choquet and Ledoux, 1994), and even higher among girls aged 16 years and older (Sasco et al., 1993). In fact, not all types of risks are the subject of studies and it is probable that females may take more risks than young males when the risk is associated with values judged relevant for their sex, which is doubtless the case for tobacco consumption and may be becoming so in the case of operating two- and four-wheeled motor vehicles. Perhaps conforming to a masculine model is socially worthwhile in the eyes of some girls. In all studies, changes with age are in the direction of a regular increase in the frequency of risk-taking behaviours.

In DCs risk-taking behaviour by adolescents and young people is seldom studied and may be addressed in a quite theoretical manner, risk-taking behaviour being described as a component of the ‘rebellion’ specific to this age (Chaudhuri, 1990). One explanation might be that, in DCs, environmental hazards as a cause of injuries (poor road infrastructures, occupational hazards) may appear as much more problematic than that of inappropriate behaviour.

In the area of traffic violations, young drivers have certain specific risk behaviours (Assailly, 1992) associated with sensation seeking (Jonah, 1997) and possibly leading to single vehicle collision (Zhang et al., 1998) in particular, speeding and following too closely (Jonah, 1997; Zhang et al., 1998) especially when driving at night (Zhang et al., 1998).
1998), and risky decision making at intersections (Chiron et al., 1994). The latter problem has been identified in a recent study carried out among 980 high school students who use motorbikes in the Rhone region of France (Chiron et al., 1994), this study showing that 20 per cent of boys and 8.5 per cent of girls never signal for turns and only 25 per cent of boys and 38 per cent of girls always do so.

Indeed, in the area of dangerous driving and traffic violations, gender differences are quite significant. A study of risk for driving while intoxicated (DWI), conducted among an American white suburban population, addressed the perception of car and driving according to gender (Farrow and Brissing, 1990). Males scored higher on a sensation-seeking scale, used more alcohol, perceived (for themselves) greater driving skills in risky situations and tended to use automobile to enhance self efficacy. Females seemed more realistic and more responsible in the assessment of a dangerous drinking situation. Nevertheless, when young women were driving while intoxicated, they were, more often than males, given warnings rather than cited for traffic violation; this, of course, introduces a bias in the reliability on the statistics of DWI by gender.

Dangerous driving tends to increase with age, especially DWI, as shown in a study of 2250 Iowa high school students (Schootman et al., 1993).

The accumulation of risks

Several studies show the frequency of association of different risk behaviours in the same subject (Friedman, 1989). Thus, in the French national study on adolescents (Choquet and Ledoux, 1994), the percentage of those having used drugs 10 or more times during their lifetime is 25 per cent among daily smokers and 1 per cent among non-smokers, 28 per cent among regular drinkers and 1 per cent among non-consumers of alcohol. Ninety-four percent of non-smokers and 96 per cent of non-drinkers have never used drugs. A longitudinal study carried out recently among 2,480 students in the county of San Diego (USA) showed that the use of marijuana and the consumption of alcohol were predictors of later tobacco use (Eckardt et al., 1994). In a study of a large sample of Dutch secondary school students aged 16 to 19 years, strong statistical associations were found between suicide attempts and, hard drug abuse and use of sedatives among girls, cigarette smoking and use of sedatives among boys (Garnefski and de Wilde, 1998). These results suggest that suicidal behaviour and addiction-risk behaviours should both be regarded as part of a complex interaction of multiple behavioural problems.

Protective behaviours

A number of converging phenomena are apparent from a comparison of the previously cited studies which concern risk behaviours and the rates of utilization of the different systems of protection in risky situations.

In most of the studies, the rate for use of seat belts is low (Litt and Steinerman, 1981; Preusser, 1987; Centers for Disease Control, 1994); it was 32.5 per cent (‘safety belts used “always” when riding in a car or a truck as a passenger’) in the 1992 Youth Risk Behaviour Survey (Centers for Disease Control, 1994). In the same study, regular wearing of a motorcycle helmet was more frequent, at 43.6 per cent.
Comparisons of percentages for condom use in various studies from ICs are often made somewhat difficult because of age group differences and the definitions used for variables associated with condom use. The percentage of utilization was 58.3 per cent in the 1992 Youth Risk Behaviour Survey (Centers for Disease Control, 1994) and 56.8 per cent in the 1997 YRBSS (Kann et al., 1998) reported use during most recent sexual intercourse, subjects aged 14 to 19 years; in the French national study on adolescents (Choquet and Ledoux, 1994) subjects aged 11 to 19 years), percentages were 41 per cent during established heterosexual relationships and 71 per cent during occasional heterosexual relationships; and, in the 1991–1992 national study on the sexual behaviour of the French (Spira, Bajos et le groupe ACSF, 1993), 74.8 per cent in the case of relationships with a single partner and 90.9 per cent in the case of relationships with multiple partners (reported condom use by men during heterosexual relationships during the past 12 months, subjects aged 18–19 years). In the French study carried out in 1994 among 15–18 year olds (Lagrange and Lhomond, 1995), the percentage use of a condom during the first sexual relationship was 78.9 per cent for boys and 74.4 per cent for girls, and 72.5 per cent and 51.1 per cent, respectively, during the most recent intercourse.

As concerns sex differences in the use of safety devices, boys are less likely than girls to wear back seat belts and moped helmets, and seat belt and helmet use decreases dramatically with age (Schootman et al., 1993).

The analysis of changes in preventive behaviours with age is complex. As concerns condom use, study data converge: condom use uniformly diminishes with age. One might attribute this phenomenon to the establishment of stable and faithful sexual relationships, but this is an insufficient explanation as attested to by the decrease in use, not only among people with a single partner, but also among those citing several (Spira, Bajos et le groupe ACSF, 1993).

**Factors influencing risk-taking and protective behaviours**

Studies have been carried out on the relationship between socio-economic status and behaviours that can compromise health. A Finnish study on alcohol and tobacco consumption and nutritional habits of 16–18 year olds indicates that social mobility and achieved social position (in terms of schooling) are more important than original social class (Karvonen et al., 1999). Two studies, one on factors in childhood and youth predicting alcohol abuse in Swedish women (Spak et al., 1997) and one on drinking behaviour of adolescents in Scotland (Schucksmith et al., 1997) found no relationship with social class. In the area of injuries, a survey of health behaviour of 4,710 school children aged 11, 13, and 15 years (Williams et al., 1996), identified no relationship between the occupation of the father and a score of family welfare on the one hand, and the incidence and severity of injuries on the other. However differences were found as concerns circumstances of accidents and behaviours: children from low economic status groups had more road accidents and engaged with friends in risky activities (crossing
busy streets, skateboarding, drinking), whereas children from high economic status groups had more sports injuries, and presented more protective behaviours (notably use of bicycle helmets).

Psychological factors seem to be more important than socio-economic factors: in the two studies previously quoted (Spak et al., 1997; Schucksmith et al., 1997) on drinking behaviour, family factors were strongly associated with alcohol consumption. In the Scottish study, a supportive family environment was associated with lowered prevalence of alcohol use (Schucksmith et al., 1997) and sexual abuse in childhood was the strongest predictor of alcohol abuse in young Swedish women (Spak et al., 1997). Suicide and suicide attempts are also known to be more frequent among adolescents with prior physical or mental abuse (Alvin, 1993; Choquet and Ledoux, 1994) and violent adolescents have frequently had a personal experience with violence in their childhood (Choquet and Ledoux, 1994). Personal factors such as high self-esteem have been shown to be associated with few dangerous behaviours (Friedman, 1989); conversely, school drop-outs are over-represented among those with suicidal thoughts (Berg Kelly, 1991).

**Time trends in risk taking and protective behaviours**

Adolescents’ knowledge about situations of risk changes, as does their preventive behaviour. Thus in France, a recent summary of research carried out between 1985 and 1992 on youths and AIDS showed an improvement in the state of knowledge about protective measures and a moderate increase in the percentage of condom users (Beltzer et al., 1994), but more recently this percentage decreased due to an unjustified overconfidence in new treatments for AIDS.

Both the 1997 YRBSS (Kann et al., 1998) and data from the Fatality Analysis Reporting System, from the CDC in Atlanta, show an increase in the use of seat belts by young people. In 1988, 39.6 per cent of young drivers involved in fatal motor vehicle crashes were using restraints, but by 1995, this percentage reached 54 per cent (Phebo and Dellinger, 1998). In the 1997 YRBSS, 19.3 per cent of high school students had rarely or never worn a seat belt, in 1992 (Centers for Disease Control, 1994), 67.5 per cent did not use ‘always’ a seat belt (data which are indeed not easy to compare). On the other hand, comparisons between YRBSS 1992 and 1997 data show an increase in consumption of alcohol, tobacco and marijuana (Centers for Disease Control, 1994; Kann et al., 1998).

**METHODOLOGICAL PROBLEMS**

The data on risk behaviours and their consequences are essentially of two kinds: 1) statistical data furnished by health services (e.g. accidental morbidity) or by administrative services (national mortality statistics, police accident reports, data from the legal system on drug use); 2) data on behaviour, usually self-reported during answers to questionnaires (generally closed-ended questions filled out by the respondents), or, rarely, recorded during observations.
These data are gathered in often non-representative populations. Only data gathering directly in the homes of adolescents guarantees representativeness (for non-institutionalized populations) as long as the parents are not present during the interview. Many studies, including those at the national level, are carried out in school settings (Choquet and Ledoux, 1994; Kann et al., 1998). Even though the vast majority of adolescents attend schools, this approach may introduce serious selection bias by excluding those young people who may be most at risk because they are school dropouts, unemployed, or frankly marginal. Special methods should be used for including these young people in studies, as was done in the 1992–1993 Swiss national study (Narring et al., 1994) where access was had to adolescents through social workers, firms who employ adolescents, care or helping institutions, and detention centres for minors. Analysis of the results in this study shows clearly the important differences which exist between youths from these settings and those attending schools, especially as concerns consumption of tobacco and illegal drugs.

Studies on risk behaviours carried out among adolescents in health services cannot make a claim to being representative. In addition, they often have the disadvantage of giving health professionals a vision of the general adolescent population which is biased by observations made among their clientele in clinical settings.

The quality of information sources and statistical data is uneven and interpretations should be made with care, especially when crude routine data are concerned. Thus in France (Tursz, 1995), accidental mortality studies generally use national statistics based on death certificate data. These do not allow the determination of whether an adolescent who died in a traffic accident was a driver or a passenger, whether responsible or not for the accident, or whether the adolescent died in an accident caused by an adult. Data gathered in police departments and courts are usually deficient to a greater or lesser degree because of under-reporting. In France, traffic accidents are recorded by police departments and classified according to the category of the user (driver, passenger, pedestrian), type of vehicle (two or four-wheeled), age, the circumstances of the accident, the seriousness of the injuries. While under-reporting is very low for fatal cases, it becomes proportionally higher as the seriousness of the injury decreases.

Self-reported behaviours on questionnaires also pose problems of reliability. A study recently carried out in Maryland on the consistency of answers about sexual behaviour (Alexander et al., 1993) and which followed a cohort during several years, shows that this consistency is sometimes weak and varies according to the ethnic origins of the subjects, the type of behaviour studied, and the questions asked (variables used for measuring sexual activities included: the existence or not of sexual relations, number of times, age at first experience). For example, by repeating questions to subjects each year, it was observed that 67 per cent of answers were inconsistent concerning age at the time of first sexual experience. In addition, self-administered questionnaires may be inappropriate because they are too rigid or incomprehensible for young marginal subjects. One solution is to replace them with interviews, as in the Swiss study (Delbos et al.,
1995).

Some retrospective studies cover a long recall period and may therefore be biased. For example, this could be the case for the study of predictive factors for alcohol dependence and abuse in young Swedish women (Spak et al., 1997); alcohol-dependent women may have given more precise answers on their childhood and adolescence than the non-dependent ones.

Some types of behaviour may be systematically underdeclared, notably by specific groups (e.g. ethnic groups), as shown in a study of the declaration of alcohol consumption by Hispanic and Black drivers in the USA (Ross et al., 1991).

As has already been noted, the comparison of several studies often leads to identifying different phenomena, and these differences between studies may be difficult to explain, particularly because of differing definitions of risks, behaviours and age groups, but also because detailed data are rarely available on the cultural context. Numerous studies compare risk behaviours of adolescents from different ethnic backgrounds. These are usually epidemiological studies which are unable to deal in any but a superficial manner with the problem of the relative importance of ethnic and socio-economic factors in the observed differences. Epidemiological studies identify target groups for prevention programmes (African-American adolescents for example) without elucidating the basic mechanisms associated with risk-taking which would clarify the most appropriate prevention strategies. Only an anthropological approach would permit an evaluation of the true role of cultural factors and elucidate the fact that answers to questionnaires have social and cultural value which varies according to the study population.

The importance of comparing research results, particularly at an international level, lies in the role these comparisons have in suggesting guidelines for prevention. They illuminate the varied cultural, socio-economic, legislative and regulatory frameworks (legislation on firearms in Europe and United States, for example) within which risk-taking behaviours and their consequences are imbedded. For example, the considerable differences in the rates of adolescent pregnancies noted between Europe and the US-American figures are more than 10 times higher (Tursz, 1997) suggest the need for carrying out in-depth research among pregnant young girls on the local context in which they live, their motivations and the meaning of their pregnancy for them. It is only with this kind of knowledge in hand that it will be possible to identify those groups to which information and prevention messages should be directed and to adapt the nature of prevention strategies (contraception, among others).

**RISK-TAKING BEHAVIOURS: SPECIFIC TO ADOLESCENTS?**

**self-administered questionnaires may be inappropriate because they are too rigid or incomprehensible for young marginal subjects**

Are these risk-taking behaviours rare or even non-existent, among adults? Are they of comparable frequency regardless of age, the difference being mainly their negative consequences for health, which are more frequent during adolescence? The answer to these questions is not clear, except for accidental pathologies which show characteristic
peaks of mortality, morbidity, seriousness and lethality at that age. It has not been clearly demonstrated that subjects less than 20 years old have greater frequency of chronic alcoholism, STDs or severe consequences related to illegal drug use (Tursz, 1997).

When demonstrating the specificity of adolescent risk-taking behaviour, one comes up against a methodological problem: the rarity of studies permitting the comparison of two age groups (adults and adolescents). And this is the case whether the studies include subjects of all ages, or are done on adults and adolescents separately but using comparable methodologies.

National studies in USA (Department of Health and Human Services, 1992) and France (Haut Comité d’Etude et d’Information sur l’Alcoolisme, 1985), and measuring blood alcohol levels of all subjects involved in traffic accidents, show clearly that levels are lower among subjects under 21 years of age than among their elders; highest levels being found among subjects aged 21 to 34 years in the American study (Table 2), and among those 41 to 60 years old in the French study.

Table 2

<table>
<thead>
<tr>
<th>AGE IN YEARS</th>
<th>NUMBER OF DRIVERS</th>
<th>BLOOD ALCOHOL CONCENTRATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0.0 %</td>
</tr>
<tr>
<td>15–20</td>
<td>1,639</td>
<td>71.4</td>
</tr>
<tr>
<td>21–24</td>
<td>1,358</td>
<td>57.3</td>
</tr>
<tr>
<td>25–34</td>
<td>3,014</td>
<td>60.6</td>
</tr>
<tr>
<td>35–64</td>
<td>3,958</td>
<td>74.0</td>
</tr>
<tr>
<td>≥65</td>
<td>1,175</td>
<td>88.7</td>
</tr>
</tbody>
</table>

Data from: US Department of Health and Human Services

As for illegal drug use, one may note its beginnings among teenagers and increase among young adults. The National Household Survey on Drug Abuse showed that in 1984 in USA, 18–25 year-olds were most involved, with percentages for hashish and marijuana consumption 2 times higher than among 12–17 year-olds, and 3.5 times higher for heroin (NIDA, 1986).

A study of fatal acute reactions to opiates or cocaine in 6 large Spanish cities between 1983 and 1991 (Sanchez et al., 1995) indicates the rarity of the phenomenon before the age of 19, the highest frequency among subjects aged 25–29 years, and an increase in the average age of death from this cause from 25.1 in 1983 to 28 years in 1991 (Table 3).
This study did not depend on routine mortality statistics, rather used autopsy reports and a system of information for recording drug addiction. It is therefore unlikely there were differences in the identification and recording of cases as a function of age.

Some preventive behaviours are more frequent among adolescents than among adults, in particular, the use of the condom. In the study on the sexual behaviour of the French (Spira, Bajos et le groupe ACS F, 1993), the percentage of condom users among men with only one partner falls from 74.8 per cent among 18 to 19 year olds to 42 per cent among 20 to 24 year olds, and from 90.9 per cent to 74.5 per cent respectively among those with several partners (Table 4). Changes in the percentage of users in the case of a single partner may be related to the establishment of a permanent relationship, but it is interesting to note that, within the context of risk behaviour (multiple partners), the youngest subjects are more careful than their elders.

Table 3

<table>
<thead>
<tr>
<th>YEAR</th>
<th>&lt;15</th>
<th>15–19</th>
<th>20–24</th>
<th>25–29</th>
<th>30–34</th>
<th>All ages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1983</td>
<td>0.0</td>
<td>2.0</td>
<td>5.4</td>
<td>4.9</td>
<td>1.8</td>
<td>1.2</td>
</tr>
<tr>
<td>1987</td>
<td>0.2</td>
<td>3.7</td>
<td>12.5</td>
<td>14.4</td>
<td>7.5</td>
<td>3.3</td>
</tr>
<tr>
<td>1991</td>
<td>0.2</td>
<td>2.6</td>
<td>22.6</td>
<td>35.3</td>
<td>27.7</td>
<td>8.2</td>
</tr>
<tr>
<td>Annual average rate</td>
<td>0.0</td>
<td>2.8</td>
<td>14.1</td>
<td>19.6</td>
<td>11.5</td>
<td>4.1</td>
</tr>
</tbody>
</table>

Rates ratio

\[
\frac{1991}{1983} \times \frac{2.6}{1.3} = 2.6* \\
\frac{1991}{1983} \times \frac{4.2}{1.3} = 3.3 \\
\frac{1991}{1983} \times \frac{7.2}{1.3} = 5.6 \\
\frac{1991}{1983} \times \frac{15.2}{1.3} = 11.8 \\
\frac{1991}{1983} \times \frac{7.1}{1.3} = 5.6 \\
\]

Rates difference

\[
\frac{1991}{1983} \times \frac{0.2}{1.3} = 0.2 \\
\frac{1991}{1983} \times \frac{0.6}{1.3} = 0.6 \\
\frac{1991}{1983} \times \frac{17.2}{1.3} = 13.7 \\
\frac{1991}{1983} \times \frac{30.4}{1.3} = 23.5 \\
\frac{1991}{1983} \times \frac{25.9}{1.3} = 19.7 \\
\frac{1991}{1983} \times \frac{7.0}{1.3} = 5.4 \\
\]

* Rates ratio 1991/1984, because the mortality rate was 0 in 1983.


Table 4

<table>
<thead>
<tr>
<th>AGE</th>
<th>TYPE OF SEXUAL ACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Condom utilization by men in heterosexual intercourse during the 12 last months, according to age (National survey on sexual behaviour in France, 1991–1992)
In France, all of the recent studies on the attitudes of young people vis-à-vis AIDS (Beltzer et al., 1994) show they are quite knowledgeable about the mechanisms of transmission and the modes of prevention of the disease. Adolescents also take care of their health and, in some countries, consult physicians, as shown in the French ‘Adolescents’ study (Choquet and Ledoux, 1994) and in a study of self-reported health status of 3500 Swedish adolescents aged 13 to 16 years who reported an average of 5.5 medical appointments per year (Berg Kelly et al., 1991). A national study on ‘young people and their health’ (Health Barometer, 1992) indicates that 69.3 per cent of subjects questioned about their fears concerning their health cited traffic accidents as the most important problem (Baudier et al., 1994). Furthermore, the French national study on ‘Adolescents’ (Choquet and Ledoux, 1994) shows that they want information (particularly on AIDS, for 62.8 per cent of them). A recent American study, comparing three groups of subjects on their perception of risks (adults, their adolescent children and ‘high risk’ institutionalized adolescents) found that the feeling of ‘invulnerability’ is no more developed among adolescents than among adults. In addition, one finds the same tendency to deny personal risk in the three populations, social distance playing a more important role in perception of vulnerability than does age—more socially distant people are perceived as being more at risk (Quadrel et al., 1993).

These adolescents, who seem to be quite knowledgeable about health problems which may affect them, who have an appropriate perception of risk and who engage perhaps in no more risky behaviours than do adults, are, nevertheless, more often victims of serious accidents than are adults. Explanations for this apparently paradoxical situation are to be looked for in the conditions in which they take risks, for example in the area of risks related to driving, conditions which are different from those encountered by adults, as noted previously (Assailly, 1992; Chiron et al., 1994; Jonah, 1997; Zhang et al., 1998). Thus, in spite of a general exposure to risk which is lower than for adults (fewer number of kilometres travelled yearly, lower average alcohol consumption), adolescent automobile drivers or passengers are exposed to particularly dangerous conditions:

<table>
<thead>
<tr>
<th></th>
<th>One partner</th>
<th>Multiple partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>18–19</td>
<td>74.8</td>
<td>90.9</td>
</tr>
<tr>
<td>20–24</td>
<td>42.0</td>
<td>74.5</td>
</tr>
<tr>
<td>25–34</td>
<td>25.8</td>
<td>69.0</td>
</tr>
<tr>
<td>35–44</td>
<td>26.6</td>
<td>59.7</td>
</tr>
<tr>
<td>45–54</td>
<td>13.4</td>
<td>44.2</td>
</tr>
<tr>
<td>55–59</td>
<td>15.5</td>
<td>40.7</td>
</tr>
</tbody>
</table>

Data from: Spira and Bajos, La Documentation Française, 1993

Epidemiological studies identify target groups for prevention programmes … without elucidating the basic mechanisms associated with risk-taking which would clarify the most appropriate prevention strategies.

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driving at night after having spent the evening with friends, automobiles overloaded with teenage passengers (Preusser et al., 1998), automobiles in poor operating condition, acute alcohol use. Furthermore, it has been widely demonstrated that sensitivity to alcohol is higher at that age and that, with equivalent levels of alcohol, adolescents have a much higher probability of having an accident than do adults (Zylman, 1973).

Finally, the role of experience is important. Adults often react out of habit, and, through trial and error, they have acquired effective responses to problems which arise in risky situations. Adolescents suffer more from inexperience than from ignorance. It should be noted, however, that opinions diverge on the respective roles of age and experience. For some authors, research indicates that youth plays a much greater role than inexperience and accidents of young motorcyclists are associated with a particular pattern of behaviour (a willingness to violate the rules of safe riding) (Rutter et al., 1996), driving experience appearing to have very minor, if any, influence (Levy et al., 1990). This comes out clearly in the debate over the ideal age for gaining access to driving an automobile. For some, it should be advanced because young drivers have a higher rate of accidents than do adults with the same experience (first year of driving). For others, the age should be lowered since the frequency of accidents, traffic violations and dangerous behaviour diminishes with experience, and therefore learning to drive should begin early (with a long period of driving accompanied by an adult before the examination for the driver’s license) (Assailly, 1992).

In the final analysis, prospective longitudinal studies are lacking which would allow follow-up into adulthood of risk behaviours begun in adolescence, or for identifying behaviours which begin in adulthood. Due to the methodological issues and the cost of these studies, there are very few of them, but they tend to show that risky behaviours of adults are often initiated in adolescence, if not in early childhood, and that predicting factors can be identified. According to a study conducted in Quebec, aggressiveness and anti-social behaviours in kindergarten children are associated with violence in adolescence and delinquency at adulthood (Tremblay, 1996). Based on the Dunedin (New Zealand) birth cohort, a study showed that motorcycle riding by young males, which is a significant cause of serious injuries, had strong predictors, such as below average reading skills and fighting in a public place at age 15 (Reeder et al., 1997).

**FUTURE DIRECTIONS: SOME REFLECTIONS ON PREVENTION**

Disseminating information on risks is the appropriate response if we assume that adolescents do not know or do not understand risks. However, as has been abundantly noted above, it seems rather that adolescents know about risks and decide to take them because the benefits are greater than the negative consequences. Several solutions are therefore possible. One could limit the freedom of adolescents who, by taking risks, do not subscribe to adult values (for example, by raising the age for drivers’ permits or by curfews which prevent night driving). Above all, a larger range of choices could be made available to adolescents so that they do not find themselves inextricably confronted with risks. Indeed, external constraints, principally socio-economic ones, frequently force adolescents to take risks (poor vehicle maintenance or defective motorcycle helmet, both
due to financial reasons; poor safety of the traffic environment in DCs). To the extent possible, it is important to offer protective systems to adolescents which are financially accessible. However, one should not try to hide the fact that adolescents from the most disadvantaged social classes will remain most at risk.

The roles played by the modification of the environment, in the sense of increasing its safety, and by safety standards for products, need no further demonstration (the situation of DCs and the low mortality rates observed in the countries known to have developed traffic safety, such as Sweden or the Netherlands [Table 1] speak for themselves). In the area of traffic accidents, there are numerous examples, including recent safety measures such as helmets for cyclists. Thus, in Australia, it was possible to demonstrate on the one hand that wearing a helmet considerably reduced the number of head injuries, and on the other hand, that the passing of a law could bring about a massive increase in the rate of utilization of helmets (Rogmans, 1993).

The feeling of ‘invulnerability’ is no more developed among adolescents than among adults.

While working to improve the material environment for adolescents, it is nonetheless necessary to continue to provide them with pertinent information, especially since this is their wish, as noted above. It is therefore necessary to reflect on what are the best channels for communicating this information. In some countries, health personnel can continue to play an important role, as noted in the French national study on adolescents (Choquet and Ledoux, 1994). School physicians can notably contribute to the identification of predictive factors such as child abuse or school drop out. The family can also play a very important role, since, according to several studies, adolescents consider their parents as the persons they discuss things with most. Thus, in the French study (Choquet and Ledoux, 1994), 64.6 per cent of adolescents prefer to talk to their parents about health matters, and 68 per cent about school difficulties.

Society can play an important role by way of publicity. Adolescent beauty, youth and innocence have been used, and are still used in some countries, for vaunting the merits of speed in automobiles or the consumption of alcoholic beverages and cigarettes. A study carried out in 1986 among 602 high school students in the United States showed that adolescents who were exposed to advertising for cigarettes were more likely to smoke than others (Botvin et al., 1993), and a 1993–4994 British study indicates that onset of smoking is largely influenced by cigarette advertising among girls (While et al., 1996).

Focusing on adolescent risk behaviours appears to be justified because adolescence is the time when these behaviours are initiated, and therefore potentially the time for modifying or even preventing them, since they continue into adulthood. There is a risk, however, of constructing programmes which give adolescents a negative image of themselves, which deny similarities with adulthood, and deny a positive aspect of risk behaviours at this age: an attempt to gain independence. Such programmes may be totally counterproductive in the same way as would programmes conceived for particular cultural or ethnic groups which fail to recognize the meaning and utility of certain risks for these groups. More generally, preventive strategies should take into account the social value of risk (Douglas, 1986), the place of adolescents in society, and the role played by
adults and society in adolescent risk behaviour.

REFERENCES


Williams, J.M., Currie, C.E., Wright, P., Elton, R.A. and Beattie, T.F., 1996,


INTRODUCTION

It is in relatively recent times that the community has afforded children some formal protection. It is again relatively recently that Western societies have recognized children as being different from adults. There is no cause to be complacent about their safety and welfare, as children continue to be injured, intentionally or unintentionally, across all cultures.

What is not universal, however, are perceptions of childhood, injury and the potential to prevent injury. There is also limited political or economic capacity to foster change in these areas. The purpose of this paper is to examine injury prevention from the perspective of the child’s right to safety.

I argue that advocacy for a safer environment for children may lead to a recognition that safety measures are enforceable, thus ascribing a measure of right. This paper examines the development of rights to safety for children through the view of my Western eyes. I trace developments in children’s rights in a Western tradition, based for the most part on English practices. Some may see this as so narrow an approach it is bound to give a jaundiced view. My purpose is to give an outline of what has worked in some Western communities and to view that from a rights perspective. This approach is not universally applicable. However, if there are lessons from history and experience that might benefit children anywhere, then there would be progress towards universal rights for children.

Advances for children have followed changes from agrarian to industrial and post-industrial forms of society. Many of these had their origins in England, and in that context there are some lessons to be learned. Children exist universally but approaches to childhood are not universal. Children live in a social, cultural and economic context. Western interpretations of childhood or rights cannot be claimed to be universal nor even agreeable to all Western eyes. Again, my purpose is to give recognition to the view that children require protection in particular areas where adults do not, and, therefore, should be treated as a special case.

CHILDREN ARE A SPECIAL CASE

There has been a move over the past century towards protecting children from harm and exploitation. Indeed, there is now recognition in some quarters that children have rights independently of parents and adults. Nations are now moving to modify laws to ensure
that children’s rights are adequately incorporated therein. Change in the way we perceive children has been slow. The challenge for the future is to maintain this pressure for change. Children continue to be hurt both seriously and unnecessarily in an adult oriented world. Advocacy is one of the best means to stimulate change.

Throughout history, children were killed, abandoned, terrorized and sexually abused. Society afforded children a low priority and paid no attention to their special needs.

**WHAT ARE RIGHTS?**

This paper does not argue the theories of how rights might develop or be justified, or about the moral or ethical fundamentals that drive and shape rights. The paper recognizes that certain rights for children have already been specified in some jurisdictions. Further, an ideal specification for children’s rights has been proposed and accepted by most countries of the world. Two have not yet acceded. Rights for children are no longer speculative, they are possible.

The questions to be explored are: ‘How have these rights come about?’ and, ‘How can the United Nations Convention on the Rights of the Child, which by its existence and widespread support has merit, be used to advance children’s safety and maximize its potential for good?’

**Fundamentals of rights**

*children require protection in particular areas where adults do not, and, therefore, should be treated as a special case*

Alston *et al.* (1992) edited the work of 15 authors who have expressed disparate views of children’s rights. The following short summary serves not to condense their positions but to highlight different approaches to justification of children’s rights.

Rights may be based on a moral obligation to children or conversely on fundamental moral rights of children. Each approach has implications for the consequences of any regulations framed from those positions. Another position is to argue that rights exist to protect the interests of children. Yet another argument is that they exist to give the subject of the rights, the child, the freedom to waive or enforce their will. However, if rights are recognized for children, how can they practically enforce their will when they do not have the resources, experience or the power to do so?

A further approach to rights argues that the moral justification for rights lies in equality and autonomy. If this is so, how can young children exercise the autonomy required to benefit from the right. On the other hand if rights have roots in autonomy a young child or a toddler might require that certain conditions be maintained in order to grow and develop to adulthood, thus benefit from the right.

The question of similarities and differences between adults and children will colour how, and whether, a society will protect children’s interests specifically. It also determines what adult obligations are to children or whether adults make decisions for
children.

These questions overlay the fundamental approach to children’s rights, embodied in the United Nations Convention—that matters affecting children, should comply with the best interests of the child. Interpretation of the best interests of the child will, of course, differ from one person, court or nation to another and has the potential, as has recognition of rights for children, to create difficulties between the state, the family and the child.

The complexities of the philosophical arguments have been summarized by Parker (1992). He suggested that differing approaches to children’s rights frequently require a measure of assertion in order to proceed.

Rights cannot be discussed without consideration of obligations or of claims to rights. Parker points out that a claim to rights can be ascribed by others and not necessarily by the claimant who, as a child, may not be able to do so. Thus, advancing injury prevention measures, through advocacy for change in laws or community norms, specifically for children, is to recognize children’s rights. One function of children’s rights is to protect the interests of children. Children do not vote or control much of the world’s resources. It requires individuals or organized advocates to speak out for children’s safety issues and to be advocates on children’s behalf.

**Recognition of rights for children**

The Magna Carta provided the first documentation of rights in the English speaking world when King John traded rights for lords in exchange for peace. Not universal rights, but it was a beginning. Magna Carta, however, did not directly advance the cause for children’s rights. The theme of children not being considered until later is a theme which recurs in the development of rights and the development of a safer environment. A recent example of this time lag was exhibited in the development of the airbag for motor vehicles. It was apparently designed, tested, and implemented with adults as focus. The unsuitability for children was discovered only after fatalities occurred with its use on the roads.

Other documents have defined rights for citizens. Habeas Corpus enshrines the right for detainees to have the legality of their detention tested in court. Another document to define rights was The Bill of Rights in the United States. It was introduced as ten original amendments to the USA Constitution in force on the 15th December, 1791. The amendments preserve and define freedom of religion, speech, the press, peaceable assembly, and the right to petition the government; the right to bear arms; limited use of military by the state; controls over policing powers such as search and seizure; right to due process of law, the courts and trial by jury; freedom from excessive, cruel or unusual punishments; and rights assigned to the individual states. As no specific prerogatives for children are mentioned, the question is whether children are adequately protected.

An early attempt at defining acceptable standards for children occurred in the United Kingdom in 1908. The Children’s Act had the aim of protecting children from harm, tobacco and alcohol among other things. One purpose of the act was to prevent exploitation. However, ironically it limited freedom in order to achieve that.

Eglantyne Jebb, founder of the Save the Children Fund, drafted the five item document known as The Declaration of Geneva in 1922. This document was recognition that
‘mankind owes the child the best that it has to give...above all considerations of race, nationality or creed.’

This declaration was adopted by the General Council of the Save the Children International Union in February 1923. It was adopted by the Assembly of the League of Nations in 1924 and reaffirmed in 1934. This document was the forerunner of the Declaration of the Rights of the Child, proclaimed by the General Assembly of the United Nations on 20 November, 1959. The Declaration of the Rights of the Child was accepted by 78 member states of the United Nations. Table 1 shows a chronology of some of the milestones in the development of rights for children.

Table 1

Chronology of milestones towards codification of rights for children

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1922</td>
<td>The Declaration of Geneva</td>
</tr>
<tr>
<td>1924</td>
<td>The Geneva Convention</td>
</tr>
<tr>
<td>1948</td>
<td>Universal Declaration of Human Rights</td>
</tr>
<tr>
<td>1959</td>
<td>Declaration of the Rights of the Child</td>
</tr>
<tr>
<td>1978</td>
<td>Move to prepare a Convention on the Rights of the Child</td>
</tr>
<tr>
<td>1979</td>
<td>The International Year of the Child</td>
</tr>
<tr>
<td>1989</td>
<td>Consensus in the General Assembly for the Convention</td>
</tr>
<tr>
<td>1992</td>
<td>The Convention ratified by 16 nations on the first day if its release</td>
</tr>
<tr>
<td>1999</td>
<td>Only 2 nations yet to ratify the Convention</td>
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Children have not been recognized as having particular rights in the drafting of any of the documents defining rights for adults. It was only some 200 years ago that children were recognized as being different and having different needs from adults.

Children have been afforded some rights in other resolutions, declarations and conventions including special protection for children in foster placement and adoption, (resolution 41/25 of the General Assembly of 3 December 1985). However, the Convention on the Rights of the Child has gained the most support in less time than any other United Nations convention.

The Universal Declaration of Human Rights, adopted by the United Nations in 1948 agreed that everyone is entitled to the rights and freedom set out in the Declaration without distinction of any kind. These include race, colour, sex, language, religion, political or other opinion of national or social origin, property, birth or other status. The Universal Declaration of Human Rights also proclaims that childhood is entitled to special care and assistance. The groundwork was set for the further development and codification of rights for children in the Declaration of the Rights of the Child and the acceptance of these through the United Nations General Assembly and the Convention on
the Rights of the Child. As stated, The United Nations Convention on the Rights of the Child has been supported like no previous United Nations convention. The Convention was ratified by a record number of countries on the first day. One hundred and seven countries ratified and a further 35 countries signed the convention in just over one year. It has been ratified by all but two countries (more than any other convention), and more quickly than any other United Nations convention. Such a display may indicate widespread support, or the alternative cynical view, that being seen to do good things for children is good politics.

The United Nations Convention does not confer a solution to the question of children’s right to safety, but rather presents a strong advocacy that the vulnerabilities of children should be considered in decision making.

In summary children have not been recognized as having particular rights in the drafting of any of the documents defining rights for adults. It was only some 200 years ago that children were recognized as being different and having different needs from adults. Codification of rights for children has developed relatively recently. The development of rights for children has lagged many years behind the development of human rights generally.

**Rights and protection of children**

Provision for the physical protection of children has been a slow process. It is one issue that individuals have defended strongly, despite derision and opposition from colleagues. This advocacy to recognize and deal with ‘child abuse’ has been strongest over the past 30 years. The pace of change in community attitudes in England highlights some of the difficulties in recognition of children in that community.

In sixteenth century England some interest in children occurred. This was a time when it was thought children might be useful to the future of Cromwell’s Commonwealth. The first Poor Law, enacted in 1531, gave some protection to the care of children. However, rights of children were limited and not widely recognized. Thirty-three years later, in 1564, the first English slave trader, Sir John Hawkins, began plying his trade. He did not discriminate against children. He captured and traded them as easily as he did adults.

Legislation regarding children over the next few centuries was mainly involved with law and order, rather than individual safety or protection of children. Some apprenticeship laws protecting against ill treatment at work were passed.

**Recognition of children’s right to protection**

In England in 1839 the Infants’ Custody Act (2&3 Vict c54) was the first legislation in the United Kingdom to acknowledge that children had a right to protection. This act gave the court the power to determine custody of children. It was the first statutory intervention into the common law rights of the father. Previously illegitimate children were in the custody of the mother while legitimate children were in the custody of the father. A mother could not petition for custody of her own legitimate children. Today, decisions about custody of children, take into account the child’s development, in some cases the child’s wishes, and, in general, consider the interests of the child to be
paramount.

Child welfare acts have always recognized the need to protect children from alcohol and tobacco. However, legislative prohibition is as ineffective a means of social control for children as it is for adults.

At the turn of the century England was one of very few nations that

- allowed children of any age to buy beer and spirits for off premises consumption
- allowed children of 13 years and older to drink beer on the premises
- allowed children of 16 years to drink spirits on the premises
- provided a penalty of only 20 shillings on the licensee

The ‘Anti-sipping act’ was introduced in England in 1901. The age limit of 13 years was changed to 14 years and liquor was required to be sold in sealed vessels. It had been called the anti sipping act as children, sent to collect liquor for parents, would sip on the way home.

The 1908 Children Act in England was the first recognition of an obligation by the state to provide general protection for children. This legislation drew together piecemeal laws and amendments of previous decades. At the one time it controlled the sale of tobacco and prohibited children in brothels, bars and street corners from begging. The attempt was to provide a minimum level of care for children. This act prohibited children under 14 years entering licensed premises and prohibited giving liquor to a child under five years of age.

Rights to protection from abuse and maltreatment have been developing since the beginning of the twentieth century. However, it is only since the sixties and early seventies that these rights have been made more explicit, and mechanisms have been put in place to detect abuse and enforce protection.

Punishment and rights

It is a commonly held belief that physical punishment is an acceptable form of discipline—‘spare the rod and spoil the child’. Attitudes toward physical punishment, by both the state and individuals, have been slow to change in countries with a western tradition.

many psychological punishments such as threatening, scaring or ostracising are as detrimental to a child as beating

In the early eighteenth century (1718) the English courts were authorized by parliament to order transportation as a direct punishment. Juveniles still were not recognized as being different from adults, and were therefore also liable for transportation, and indeed, were transported.

Later in the second half of the eighteenth century, there seemed to be some softening towards punishment of offenders. In 1768 English judges were empowered to substitute transportation for capital convictions.
The nineteenth century has been called ‘the century of the child’. Real inroads began to be made into changing attitudes towards children’s care, welfare and health needs. More and more books were written about children and for children. Some, such as Charles Dickens’s works, exposed the social injustices toward children and no doubt prompted philanthropic movements on children’s behalf.

Pickpocketing was a common crime among destitute boys in the early 1800s and in 1808 the English Parliament agreed to transportation instead of death for pickpocketing. This show of soft-heartedness towards pickpockets was not extended to children who stole. Four years later, in 1814, on one February day at the Old Bailey, five children were condemned to death for stealing and burglary. Their ages 8, 9, 11, 12, and 12 years, respectively.

Corporal punishment has been an accepted means of discipline in western tradition. It has been progressively abandoned in state run institutions. In many countries it has remained part of private school culture. Abandonment of corporal punishment has been taken one step further in Sweden where in 1979 the Swedish Parliament gave support (almost without opposition) to legislation, which reads:

‘A child may not be subject to physical punishment or other injurious or humiliating treatment.’ Assault has always been a punishable offence. The effect of this law was to sweep aside any confusion or ambiguity which was present in Swedish law (and is still so in Australian law) about the difference between physical chastisement and assault. The law went a little further. It recognized that many psychological punishments such as threatening, scaring or ostracising are as detrimental to a child as beating. Under this law these could be considered to be injurious and humiliating treatment and were forbidden.

The physical abuse of children has been recognized in our community for many years. In the forties, spiral fractures of long bones in children were linked to abuse. It took until the sixties for this to have widespread acceptance and to be consistently acted upon. However, child abuse is still not accepted as a possibility in some countries. In addition, it is still not accepted by some responsible adults, that parents are denied the right to deal with their children as they please.

The Convention on the Rights of the Child is clear that children should be protected from such intentional injury.

SAFETY IN THE WORKPLACE

Galen, in his treatise ‘de Sanitate Tuenda’ epitomized the attitudes of AD 157 when he wrote, ‘the life of many men is involved in the business of their occupation and it is inevitable that they should be harmed by what they do…and it is impossible to change it.’

In the case of workplace health and safety in factories the needs of children have been addressed ahead of those of adults. Exclusion of children from factories in England was not popular and took years many to accomplish.

The view that injury could not be prevented has been a widely held view. This sentiment prevailed for the 100 years that it took to introduce the ‘Plimsoll line’ or safe load line on ships. It prevailed for the 100 years that it took the English Parliament to prevent sending children into chimneys to clean them. It also prevailed well into the
twenty-first century until workers’ unions fought for safer conditions on the job, and when Ralph Nader began to advocate for safer vehicles on the roads and for safer consumer products in the home. Rights do not come easily and cannot be assumed. For every advocate for a right there will be an individual or group with an interest in opposing change and the possibility of loss in the face of gain by others.

Associated with the industrial revolution in England (c.1750–1870) were the inequities of the workhouse system namely indifference, neglect and cruelty. The exploitation of child labour in the 18th Century led to reform in the early 19th century. One example of this was the Health and Morals of Apprentices Act passed in 1802 which led to the limitation of children’s working hours to 12 hours a day.

By 1815 no child under ten years of age was to work in mills. In spite of this prohibition, in the same year, the parliamentary transaction report, Hansard, reported a speech where a Lancashire mill owner agreed with a London parish to take one idiot with every 20 sound children supplied from the poor houses—so children of non-specified ages were still being recruited.

The greatest changes in the workplace have taken place over the past three decades. The International Covenant on Economic Social and Cultural Rights, ratified by more than 90 countries, provides in Article 7(b) for ‘safe and healthy working conditions’. While the level of safety might vary between workplaces, standards exist. The level of safety required continues to rise and does so at a quicker rate than it took the English Parliament to recognize the plight of sailors going to sea in dangerously overloaded vessels, or to recognize the level of injury and death to children used in the chimney cleaning trade.

Safety for workers on the job is widely recognized in the West, as are their rights to a safe working environment. Ironically children in the workplace are often less protected than their adult counterparts because of the vulnerability associated with their age.

Western societies may like to think that they are enlightened about children in the workplace. Consider this report from a factory inspector in the United Kingdom, reported in 1984 of a boy of 14 years of age found assembling electronic boards. He was working in a room 8 feet by 5 feet by 9 feet. There was a diesel motor in the room giving off copious amounts of fumes. The boy had a tube to breathe through one end of which was passed through the window.

CHILDRen AND SAFETY

Ironically children in the workplace are often less protected than their adult counterparts

Safety matters, like so many matters in this world, are considered for children after they are considered for adults. Advocacy has the potential to change attitudes and practices with long term improvement where protection of children is concerned. The advocacy, which led to the abandonment of the use of boy chimney sweeps in England, is especially important as an injury prevention strategy.

Reports from the 1750s indicated that the practice of using young, small children to
sweep chimneys was widespread in England. The effects of this practice on the children were injury from falls, burns from having fires lit under them to force them up the chimney, *Sweepers Cancer*. This was a pioneering work in identifying an occupational hazard leading to disease.

In 1788, David Porter petitioned parliament to restrict the use of boys under eight years of age as sweeps. No change occurred and it has been recorded that in 1795 Thomas Allen aged three and a half years was indentured as a chimney sweep. The first legislative change occurred in 1834 (49 years later) when parliament forbade the binding of any boy less than 10 years of age to a sweeper.

Europe had not used children in chimneys for many years. Design changes had been incorporated into European chimneys to give access from the outside rather than by travelling the length of the chimney. Europe also made use of alternative mechanical devices to do the job which continued to be undertaken by children in England until 1875. This was 100 years after Dr Potts reported on the chimney sweepers cancer, and 87 years after David Porter first petitioned parliament about the use of children as sweeps.

**WHAT THE UNITED NATIONS CONVENTION SAYS ABOUT CHILDREN AND SAFETY**

Following are some of the articles from the United Nations Convention which have some bearing on developing rights for children to a safe environment.

**Article 3.3**

States parties shall ensure that the institutions, services and facilities responsible for the care and protection of children shall conform with the standards established by competent authorities, particularly in the areas of safety, health, in the number and suitability of their staff, as well as competent supervision.

**Article 4**

States parties shall undertake all appropriate legislative, administrative, and other measures for the implementation of the rights recognized in the present convention. With regard to economic, social and cultural rights, states parties shall undertake such measures to the maximum extent of their available resources and, where needed, within the framework of international co-operation.

**Article 5**

States parties shall respect the responsibilities, rights and duties of parents or, where applicable, the members of the extended family or community as provided for by local custom, legal guardians or other persons legally responsible for the child, to provide, in a manner consistent with the evolving capacities of the child, appropriate direction and guidance in the exercise by the child of the rights recognized in the present convention.
**Article 6**

1. States parties recognize that every child has the inherent right to life.
2. States parties shall ensure to the maximum extent possible the survival and development of the child.

**Article 24**

1. States parties recognize the right of the child to the enjoyment of the highest attainable standard of health and to facilities for the treatment of illness and rehabilitation of health. States parties shall strive to ensure that no child is deprived of his or her right of access to such health care services.
2. States parties shall pursue full implementation of this right and, in particular shall take appropriate measures.
   A to diminish child and infant mortality; B to ensure the provision of all necessary medical assistance and health care with emphasis on the development of primary health care; E to ensure that all segments of society, in particular parents and children, are informed, have access to education and are supported in the use of basic knowledge of child health and nutrition, the advantages of breast feeding, hygiene and environmental sanitation and the prevention of accidents.
3. States parties shall take all effective and appropriate measures with a view to abolishing traditional practices prejudicial to the health of children.

**UNITED NATIONS CONVENTION AND INJURY PREVENTION**

Article 6 recognizes that children have an inherent right to life and that states should, to the maximum extent possible ensure the survival and development of the child. This provides a rationale to set priorities to deal with life threatening injury. In most parts of the world motor vehicle injury will be a top priority.

The framework provides specifically for a safe environment for children in the care of institutions and other agencies (Article 3.3) and in Article 24.2 identifies a right to the highest attainable standard of health care, including the provision of information about primary health care and the prevention of accidents.

To achieve this states should work to diminish child and infant mortality and ensure health care is available with an emphasis on primary health care. The question of a right to an injury free environment is not canvassed as an issue of rights. The question is whether an injury free world is attainable or desirable.

**the question of a right to an injury free environment is not canvassed as an issue of rights. The question is whether an injury free world is attainable or desirable**

There are many areas of injury prevention activity which cause unresolved debate among the injury prevention community. Some examples where there is not consensus include
approaches to home use of trampolines, safety of playground equipment in public parks and schools and use of baby walkers. A rights approach does nothing to inform that debate. In fact a rights framework may lead to a dilemma about conflicting rights, for example, the right to safety versus the right to developmental experiences, or risk taking or a civil right.

THREE CASES OF INJURY PREVENTION: IS A RIGHTS FRAMEWORK USEFUL?

Three cases are presented for consideration of the potential ambiguities in a rights approach to injury prevention.

Swimming pool fencing

Safety legislation was introduced in Queensland, Australia in 1990. This legislation required new domestic swimming pools to be fenced on all four sides and for the fence to have a self-closing, self-latching gate. In spite of numerous letters to the editor in newspapers about children drowning in fenced pools, on investigation all of these children had gained access through a gate which had been left propped open or was not functional.

The achievement of pool fencing legislation in Queensland came about almost 20 years after the problem was first recognized. The drowning rate for children 0–3 years, was among the highest recorded in the world. An ordinance was first introduced into the Queensland Capital City in 1978. This ordinance required all pools to be fenced on four sides. The ordinance was vetoed by the State Government following political intervention. The power of veto over local government had been used by the state only on one previous occasion. This time the veto affected the lives of children.

The current legislation is more far reaching than the original local government city wide legislation in that it is state legislation and the safety measure is now in place across all local government areas.

The process of change was not without vigorous debate and persuasion of public opinion. The public debate throughout the fencing campaign included phases in which the threat was defined, a solution was publicized, the arguments were debated by interest groups, opposition was identified, public opinion was surveyed and the legislation was introduced and evaluated.

An addendum to the fencing legislation has been reported recently in the press in Queensland. A set of apartments, many of which were rented out, had a swimming pool with a faulty or missing lock on the access gate. The local authority served a notice on the ‘body corporate’, the body of owners responsible for the property, giving a period in which the lock should be replaced. In the mean, time a child of three years of age entered the pool enclosure and drowned.

This case involves elements of law (the pool was required to be fenced with a self
latching gate), ethics (the latch had not been repaired or replaced when it was known to be faulty or missing by the ‘body corporate’ and rights (the child’s right to safety, defined by the existence of the law). The resolution of this case could serve to establish the child’s right to protection from this recognized community hazard.

In the case of pool fencing the target of the prevention strategy is children aged three years and under. These children do not have the developmental proficiency to discriminate, or negotiate with confidence, hazards such as unguarded pools in their close environment. The problem was also at a level where child deaths were involved at a rate higher than anywhere in the world. Advocacy for the rights to life of this group were part of the community debate. Arguments against fencing included the cost to the home owner and to the property value, that pools were on private property, that parents should supervise children, and the aesthetic of having a pool with no fence. When the debate was lost in 1978 and the state vetoed the local government ordinance, those arguments held more weight than those of protecting life. By 1990 community perception had changed and the right was established. Continued energetic advocacy will be required to keep the protection in place. hand over hand, have been identified as producing the majority of injuries. Of these injuries fractures to the upper limb predominate. Some of these fractures are serious enough to affect long term function. Observation studies of children in playgrounds suggest that children are five times more likely to play on a horizontal ladder than the next most popular piece of equipment.

Removal of monkey bars will undoubtedly reduce injuries to children in playgrounds, but at what cost. Children will be denied the most popular piece of equipment, and one of the few pieces of equipment available to enhance upper body development.

What is the obligation of the injury prevention community? Is it to advocate for removal and thereby injury reduction? Should injury prevention advocates entertain the alternative arguments of enhancing child development or arguments of preferences for particular equipment? Should injury research inform on the risks and avoid the public debate? Public parks administrators in some places have removed play equipment to avoid legal liability. Information about improving the safety of the equipment through lowering or improving the surface is not yet available, and therefore not likely to be used as an alternative to removal. The point here is that action may ensue instead of community debate.

Does the responsibility of the injury prevention community go beyond identifying the problem and educating parents? Should alternative solutions come from them or from play leaders, or child development specialists who have an alternate interest to injury prevention advocates. What of the preferences of the children? Should they be taken into account?

**Consumer safety**

Children live in a world surrounded by an environment and products built by, and to a scale for, adults. Consumer safety has been a relatively recent movement. The idea of producing products to standards based on function and performance rather than on engineering principals is still not widespread.
does the responsibility of the injury prevention community go beyond identifying the problem and educating parents?

Safety of trampolines for home use has been discussed recently among subscribers to the International Society for Child and Adolescent Injury Prevention. Home use trampolines have been identified in a number of studies as posing significant threat to children. That is, of the numerous injuries reported 15 per cent were assessed as severe while 12 per cent were spinal injuries including fractures and paraplegia (Furnival et al., 1999). The American Paediatric Association has recognized the hazard since 1981 and in 1999, reconfirmed the view that they be banned.

Proponents of the trampoline cite the many hours of fun had by children using trampolines, the aspect of development of coordination and the need for children to learn to handle risk. Is the level of risk a consideration from a rights perspective? If the risk paediatric association has recognized the hazard since 1981 and in 1999, reconfirmed the view that they be banned.

Proponents of the trampoline cite the many hours of fun had by children using trampolines, the aspect of development of coordination and the need for children to learn to handle risk. Is the level of risk a consideration from a rights perspective? If the risk is for death, then certainly rights are a consideration. The insurance industry had an influence over objections to pool fencing in Queensland, when it declared that with legislation in place, a pool owner who did not comply would void their public safety insurance. The insurance industry has influenced the ban on trampoline use in some schools through increased premiums, also reflecting the risk.

FUTURE DIRECTIONS

The future of children’s rights to safety is unassailable. The language of rights is currently being used for adult safety in the workplace and on roads. It is only a matter of time before children are included more generally in the rubric.

Because children constitute a ‘special case’ it will be some time before there is clarity about the theoretical basis of rights for children. This debate will continue and progress the cause of children’s rights.

On a practical front, it is clear from the United Nations Convention that the child’s right to life is paramount consideration and this will be used successfully to promote some aspects of injury prevention. It seems to be stating the obvious to suggest that in setting priorities for injury prevention, fatal injury should be considered prior to non-life threatening injury. However, fatal injury does not reduce health costs, but reducing the impact of non-fatal injury is of greater economic benefit to a community. The focus in some programmes seems to be towards reducing injuries as a means of reducing health costs. Taking a rights perspective injury prevention professionals should advocate to address fatal injury and for community resources be placed to address the most pressing fatal injury causes.

Such advocacy can lead to changes in public policy backed by the strength of
legislation. However, legislation can be changed at the stroke of a pen. Helmet wearing legislation for motor cyclists has been enacted and rescinded in some states of the United States of America. Pedal cycle helmet laws have been threatened in some States of Australia and pool fencing legislation was introduced and rescinded in New South Wales, Australia. In a future where children’s rights are established parallel to those of adults, children will have the same right to organize and challenge safety legislation, say, to ban cycle helmet wearing or to challenge bans on trampolines or baby walkers. Alternatively, children might recognize the damage to their own class, caused through the interests of adults, and move to enforce bans where the interests of adults have thwarted them.

Advocacy in Australia has been effective in establishing that toddler aged children have a right to protection from unfenced swimming pools. Twenty years of advocacy by scores of people led to the introduction of legislation requiring domestic swimming pools to be fenced. A rights framework for non-fatal injury prevention is more of a problem. Arguments for reducing non-fatal injury to children using a rights framework are likely to lead to debate about conflicting rights within the injury prevention community and the broader community. The injury prevention community must focus on reducing injury effectively, and not be diverted by the interests of others. The community will decide, but injury prevention must advocate its position as actively as any other interest group.

In injury prevention there is a constant balance between opposing vested interests—political, economic or social. Thus for many issues, especially those involving children, it has been possible to stonewall change. The lesson for us is that injury prevention or public health practitioners have a vested interest and must learn the skills associated with winning in the political, economic and social ventures of life.

**in a future where children’s rights are established parallel to those of adults, children will have the same right to organize and challenge safety legislation**

It took almost 100 years in England from the time opposition was mounted to stop the practice of putting small children up chimneys as sweeps. The introduction of compulsory fencing of swimming pools in the State of Queensland, Australia took 18 years of campaigning. While the time taken to implement change is long, the best measure of the delays is in the number of deaths and suffering that might have been prevented.

The frequently seen example of an adult cycling without a helmet followed by a child cycling with a helmet, in spite of legislation requiring helmet use, illustrates the dilemma of considering rights in the context of safety. While neither has the right to flout the law, the adult considers the freedom to express his will and not use a helmet as a right. Should community provided health services be withheld or a premium paid to provide services in the case of injury to the adult? Does the position change if the child is injured? There are currently no correct answers as far as rights for children are concerned. Advocacy for injury prevention and children’s rights must take account of the balance between social, political and economic forces to provide the most effective preventive solutions to injury problems.

Laws confirming rights can and do change. The future of the debate on rights and injury prevention depends very much on continued advocacy and involvement in that
debate. Through public debate of safety measures support and opposition for safety measures may come from unexpected quarters. Advocates for the kidney foundation in California have been heard to argue strongly in favour of rescinding helmet laws in that state.

The future will see advocates liaising with odd partners in order to progress the cause of preventing injury to children.

FURTHER READING


Evidence-based Injury Prevention and Safety Promotion: State-of-the-art
Leif Svanström

INTRODUCTION

Concepts and definitions

Generally speaking there is the same contradiction between the concepts of injury prevention and safety promotion as between disease prevention and health promotion. The starting point of injury prevention is an outcome of a process where the medical view decides the prevention activities in the same way as in disease and disease prevention. However, safety as well as health is a much broader concept and safety promotion is based in the society and community and how the individual or populations understand the concept of safety and what measures need to be taken. Such actions might lead to prevention of injuries or might not.

Because health and safety is a fundamental right of human beings, safety is also a prerequisite to the maintenance and improvement of the health and welfare of a population. It is a fundamental need of human beings.

Safety can be defined as a state or situation characterized by an adequate control of physical, material or moral threats and which contributes to a perception of being sheltered from danger (Andersson and Svanström, 1998).

Thus safety cannot be defined in absolute terms. Safety is a dynamic state. Safety is not merely the absence of injuries or threats. Safety promotion should not be narrowed down to injury prevention.

Safety promotion can be defined as a process that aims to provide populations the means to ensure the presence and maintain the conditions that are necessary to reach and sustain an optimal level of safety.

Safety promotion is all organized efforts by individuals, organisations and communities to achieve that ultimate goal. Structural as well as attitudinal and behavioural changes all aim at creating sustained supportive environments for safety.

By environment we mean not only the physical but also the social, cultural, technological, politic, economic and organisational environment. Changing attitudes and behaviours of man is not a goal in itself but merely a means to achieve an environment and social structure where safety is built in.

In practice, on the road to achieve that goal, man has used a combination of efforts like safety promotion, injury prevention, treatment and rehabilitation. The choice of one approach over the other is important. Structural and environmental change demands a
democratic work, both participatory and representative, and can be more demanding than the choice of organising treatment and rehabilitation after lack of real safety leading to injury or environmental or machine damages.

The idea of an evidence-based safety promotion is based on the closeness between the concepts of injury prevention and safety promotion. Evidence-based safety is always related to a defined outcome. We have not been able to identify any studies of scientific character where the outcome is a feeling of safety among individuals or populations. Most outcomes are defined as injuries or lack of injuries or change of injury incidents. Some examples of evidence-based findings are given here. The majority is from the areas of safety promotion for children and elderly.

**CHILD SAFETY PROMOTION**

**Safety promotion in the traffic environment**

*Safety can be defined as a state or situation characterized by an adequate control of physical, material or moral threats and which contributes to a perception of being sheltered from danger*

“There is good evidence that the use of cycle helmets and child car seat restraints can reduce serious injury to children involved in road traffic accidents. Urban road safety measures such as a provision of crossing patrollers, measures to re-distribute traffic and improve the safety of individuals can reduce the rate and severity of childhood accidents.” (Effective Health Care, 1996).

In an urban safety project the effect of measures to redistribute traffic and improve the safety of individual roads was assessed in five English towns compared to match control areas (Lynam et al., 1988). There was an overall accident reduction of 13 per cent attributable to the schemes but there were great variations between schemes. Slight injuries declined proportionately more than serious ones. Measures that were particularly successful were those which protected two-wheeled vehicles (such as right turn prohibition and central road dividers) and there was a general reduction in child cyclist casualties. Each scheme cost about 250,000 Pounds and first year rates of return indicated considerable accident costs savings.

The speed at which a car is driven affects the severity of pedestrian injuries (20 mph leads to 5 per cent death; 30 mph-45 per cent; 40 mph-85 per cent). Therefore transport policies aiming at reducing excessive car speeds maybe effective. However, there is very little evaluation of such interventions.

‘There is little reliable evidence to suggest that children can be successfully trained to avoid injury on the roads’ (Effective Health Care, 1996). Controlled trials indicate that teaching children road crossing skills, however, can change reported behaviour and that instruction in the classroom can be as effective as the road sign. “Educational programs by themselves appear to have little effect. However, a number of community programs, which involve local participation, and use of broad range of interventions have been
effective at reducing childhood injuries from a wide variety of causes. These need to be based on accurate data derived from surveillance systems.” (Effective Health Care 1996).

Some studies show no evidence that children’s knowledge of road safety (e.g. Traffic Clubs) had been improved. The Streetwise Kids Club was introduced in London, but membership was low, particularly in lower social class groups (Downing, 1987). An evaluation of the ‘Eastern Region Traffic Club’ showed increased participation and a positive effect on aspects of behaviour and a 20 per cent reduction in casualties involving children emerging from behind a vehicle (Bryan-Brown, 1995).

Renaud et al. (1989) has evaluated simulation games promoting traffic safety for children. Using a simulation game designed to teach children to obey certain traffic safety rules, an experimental study was conducted with 136 five-year-old children in four Quebec schools. Within each classroom, subjects were randomly divided into four groups: three intervention groups and one control group. Each of the experimental groups was subjected to a different intervention with outcome measured using three instruments related to attitudes, behaviour and transfer of learning of pedestrian traffic safety. Results suggest that simulation games including role-playing/group dynamics and modelling/training can change attitudes and modify behaviour in the area of pedestrian traffic safety and children of this age.

Several surveys and epidemiological studies have reported that cyclists who wear helmets have a reduced risk of severe head injuries (Graitcer et al., 1995). In the past decade there have been a variety of educational approaches used to promote the use of bicycle helmets. These programs have included classroom curricula, programs that subsidize the purchase of helmets, and programs that provide helmets in a health care setting. None of these individual educational strategies has been shown to have any significant impact in increasing helmet use. Only helmet promotion programs that are organized by community-wide coalitions and use a variety of educational and publicity strategies have been shown to be effective. The most successful of these programmes—the Seattle Children’s Bicycle Helmet Campaign organized by Harborview Injury Prevention and Research Center—used multiple strategies. These included classroom education, discount purchase programmes, bike rodeos, distribution of printed material through a variety of venues, and intensive promotional efforts by sports leaders, bicycle clubs, and the media to increase children’s helmet use (Bergman et al., 1990). Using this broad based approach, the Harborview program has been able to increase helmet wearing rates among children to more than 40 per cent (Rivara et al., 1994). No information is available on the direct and indirect cost of these promotional efforts. The relative difficulty in implementing educational programs to promote helmet use, their potentially grate costs, and their success in greatly increasing helmet use, have led to the introduction of mandatory helmet wearing laws as a principle strategy of many governmental jurisdictions. Studies from the introduction of legislation on helmets in Victoria, Australia, showed that during the period 1975–1980 less than 5 per cent of all Victorian bicyclists wore helmets. In March 1991, approximately 9 months after implementation of the law, the average use rate for Victoria bicyclist was 75.2 per cent. A special survey, conducted in May 1992, indicated that this rate increased further to 83 per cent (Cameron et al., 1994). The number of head injuries decreased by 48 per cent during the first year and an additional decline to 70 per cent of the pre-law levels was noted in 1991/2.
One major evaluation of the effect of community wide programs to promote the wearing of cycle helmets showed a significant reduction in the rate and severity of casualties. In 1990, following ten years of cycle helmet promotion campaigns, the state of Victoria in Australia introduced the first law in the world requiring cyclists to wear helmets. The increase of helmet wearing rates from 31 per cent immediately before to 75 per cent in the year following legislation was associated with a 48 per cent reduction in head injury admissions or death between 1989/90 and 1990/91 and a reduction of 70 per cent over the two year period 1989/90–1991/92. As with seat belt legislation, the experience in Victoria has shown that legislation following education campaigns can increase use. In a recently published study (Ekman et al., 1997) shows for some intervention areas of Sweden, for children under 15, an average annual decrease in all bicycle-related injuries of 3.1 per cent, equivalent to a decrease of 48 per cent over the study period, 1978–93 (for head injuries, 59 per cent). Sweden as a whole showed a reduction of 32 per cent in bicycle-related injuries (head injuries, 43 per cent). In Skaraborg, children have been the targets of helmet-wearing programs at local and regional levels since 1982 and at national level since 1987.

There is considerable evidence that child car seat restraints (for young children) when properly used, reduce car occupant injuries (Agran et al., 1989). In the United States Child passenger restraint use and motor vehicle related fatalities among children (MMWR, 1991). In 1990, child safety seats were used for an estimated 83 per cent of infants and 84 per cent of toddlers, compared with 60 per cent and 38 per cent, respectively, in 1983. Use of child safety seats reduced the likelihood of fatal injury by an estimated 69 per cent for infants and 47 per cent for toddlers. Adult safety belts used for toddlers reduced the likelihood of fatal injury by 36 per cent.

**Safety promotion in the home environment**

There is little reliable evidence to suggest that children can be successfully trained to avoid injury on the roads

General home injuries are more common in households with poor social circumstances. Rather than focusing on individual parenting behaviour it has been suggested that increasing financial and social support to deprived households with young children would have a beneficial effect on injury rates. However, no relevant evaluation has been identified. A programme targeting poor, unmarried or teenage mothers of pre-school children in the USA indicated that homes which had several visits from a nurse home visitor had fewer home hazards than those which had not been visited (Olds et al., 1994). The use of safety devices in the home such as smoke detectors, child resistant containers and thermostat control for tap water can reduce the risks of home injuries. Targeting of households at higher risk combined with home visits, education and the free distribution of devices is likely to make the most impact.

A variety of protective safety devices have been tested under experimental and field conditions and have been shown to reduce the risks of home injuries.

These include smoke detectors and child resistant container closures. Others are also
associated with reduced risk such as fireguards, stair-gates, safety catches for cupboards, coiled kettle flexes, safety harnesses, safety film for interior glazing and thermostat control of tap water (Department of Trade and Industry, 1991).

Programs aimed at raising awareness of home hazards encouraging parents and children to reduce or avoid these risks have met with varying success. Home visits to people in poorer areas with specific advice on hazards, combined with health education and media campaigns resulted in around 50 per cent more households making changes to the home environment (Colver et al., 1982).

**Burns, scalds and smoke detectors.**

There have been a series of evaluations of programs designed to increase the use of smoke detectors. In one program, smoke detectors were given away free and 81 per cent were operational 8–12 months after the campaign (German et al., 1985). One study showed a small reduction in fatalities due to fires in a community where smoke detectors were required by law in all homes. However, compliance was low (McLoughlin et al., 1985).

**Tap water temperature reduction.**

One study showed that provision of a free thermometer when combined with physician counselling was more effective than counselling by itself at reducing scalds (Katcher et al., 1989).

Erdmann et al. (1991) point to the importance of legislation. Five years after a 1983 Washington State law required new water heaters to be pre-set at 49 °C, 77 per cent of homes had tap water temperatures of less than 54 °C. In 1977, 80 per cent of homes had tap water temperatures greater than 54 °C. The period of July 1979 through May 1988 showed an average admission rate of 2.4 per year, compared with 5.5 per year in the seventies.

**Poisoning**

Clarke et al. (1979) points to the effectiveness of child-resistant closures, required under the Poison Prevention Packaging Act of 1970, in reducing the incidence of accidental ingestion of aspirin and aspirin-containing products among children less than 5 years of age has been investigated. For baby aspirin, it is estimated that safety packaging has reduced the incidence of ingestion 45 per cent to 55 per cent. For non-baby aspirin products, the reduction has been 40 per cent to 45 per cent.

A controlled trial of children resistant containers for paraffin showed a 47 per cent drop in paraffin ingestion compared to no change in the control area. Walton (1982) reported on a study involving regulated substances like aspirin, acetaminophen, prescription drugs and household chemicals. The ingestion rates for all substances that require child resistant closures has declined from 5.7 per 1000 children 1973 to 3.4 per 1,000 children in 1978. It is estimated that child resistant closures have prevented nearly 200,000 accidental ingestion since 1973 in the USA. The death rate due to poisoning of
children has declined from 2.0 per 100 000 children to 0.5 per 100,000.

**Safety promotion in the play and sport environment.**

In the review over child injury prevention (Effective Health Care 1996) no good quality studies were identified which evaluated the effectiveness of injury interventions associated with sports. Similarly there has been little evaluation of playground layout, equipment and surfacing in terms of achieving injury reduction; no evaluated studies of training schemes for adults or children were identified.

A recent review suggests that a number of safety measures such as rule changes and use of safety equipment may be effective at reducing injuries as a result of organized sports in the 15–24 year age group (Coleman et al., 1996).

**Organisation-based interventions**

One study showed that provision of a free thermometer when combined with physician counselling was more effective than counselling by itself at reducing scalds

Especially the role of primary health care organisations has been investigated (Bass et al., 1993). Twenty articles met the criteria for inclusion. Of these, 18 showed positive effects of injury prevention counselling including 5 randomized/controlled, 10 non-randomized/controlled, 2 multiple-time series and 1 descriptive study. In 15 of the positive studies, physicians performed the counselling. Positive outcomes as measured by increased knowledge, improved behaviour, or decreased injury occurrence were reported for both motor vehicle and non-motor vehicle injuries. The literature review supports the recommendation of the AAP to include injury prevention counselling as part of routine health supervision.

Miller et al. (1995) has evaluated the role of the paediatrician. The authors have estimated the savings achievable with comprehensive childhood injury prevention counselling organized around the three Framingham Safety Surveys used in The Injury Prevention Program (TIPP) developed by the American Academy of Paediatrics. TIPP paediatrician injury counselling sessions between the ages of 0–4 years can achieve estimated savings of US$ 880 per child or US$ 80 per visit. If all 19.2 million children ages 0–4 years completed TIPP, they estimated that US$ 230 million would be saved annually in medical spending, and injury costs would decline US$ 3.4 billion. Each dollar spent on TIPP childhood injury prevention targeting children 0–4 years returns nearly US$ 13. TIPP encompasses up to 11 visits between the ages 0–4 years. Topics covered include child safety seat and smoke detector use, crib safety, water safety, firearm safety, pedestrian safety, play equipment safety, fall prevention, burn prevention, choking and suffocation prevention and poisoning prevention.

Bablouzian et al. (1997) has evaluated how high risk pregnant women, who were enrolled in home visiting program that augments existing health and human services received initial home safety assessments. Clients received education about injury
prevention practices, in addition to receiving selected home safety supplies.

Results showed a significantly larger proportion of homes were assessed as safe at discharge compared with the initial assessment. That was true for the following hazards: children riding unbuckled in all auto travel, Massachusetts Poison Centre sticker on the telephone, outlet plugs in all unused electrical outlets, safety latches on cabinets and drawers, and syrup of ipecac in the home. Thus four home hazards were significantly reduced for which safety supplies were provided. Education and promotion of the proper use of child restraint systems in automobiles significantly reduced a fifth hazard children riding unbuckled in auto travel.

Community-based interventions

The Falköping Program in Sweden included establishment of an extensive network of people interested in injury prevention, education of policy makers and health workers, raising a public awareness, and provision of a local shop selling child safety products. The intervention area experienced a reduction of 27 per cent in home accidents and 28 per cent in occupational accidents (Schelp, 1987).

In the ‘State-wide’ Child Injury Prevention Program (SCIPP) USA (Guyer et al., 1989) nine intervention communities and five control communities were selected in Massachusetts. Interventions targeted burns, poisoning, falls, suffocation and passenger traffic accidents. Households in the intervention communities had greater safety knowledge and higher behaviour scores than controls. There was a significant reduction of motor vehicle passenger injuries in the intervention communities. No evidence was found for the reduction of other target injuries.

The ‘Safe Block Project’, in Philadelphia, U S (Schwarz et al., 1993) targeted a poor inner-city African-American community, using community workers and recruiting black representatives from the local community. This method of “cascade training” was successful in getting households involved. The intervention included an educational program, home visits and the provision of safety equipment. The intervention was partially effective for those home hazards requiring minimal or moderate effort to correct. No information was provided on baseline comparability of the areas and no data were collected on accident rates.

In a community intervention study Svanström et al. (1995) report on a programme focusing childhood safety. The Lidköping Accident Prevention Program was compared with four bordering municipalities and to the whole of Skaraborg County and included five elements: surveillance, provision of information, training, supervision and environmental improvements. In Lidköping there was an on average annual decrease in injuries leading to hospital admissions from 1983 to 1991 of 2.4 per cent for boys and 2.1 per cent for girls compared with an smaller increase in one comparison area and a decline in the other. (Four border municipalities: girls +2.2 per cent, boys +0.6 per cent; Skaraborg county −0.3 per cent for girls and −1.0 for boys.)

Conclusion on prevention of childhood unintentional injuries

In a review made by Dowswell et al. (1996) it is concluded that examples of
Interventions that have been effective in reducing injury include bicycle helmet legislation, area wide traffic calming measures, child safety restraint legislation, child resistant containers to prevent poisoning, and window bars to prevent falls. Interventions effective in changing behaviour include bicycle helmet education and legislation, child restraint legislation, child restraint loan schemes, child restraint educational campaigns, pedestrian education aimed at the child/parent, provision of smoke detectors, and parent education on home hazard reduction. For the community based campaigns, the key to success has been the sustained use of surveillance systems, the commitment of inter-agency co-operation and the time needed to develop networks and implement a range of interventions. Education, environmental modification and legislation all have a part to play and their effect in combination is important.

Educational programmes by themselves appear to have little effect. However, a number of community programmes, which involve local participation, and use of a broad range of interventions have been effective at reducing childhood injuries from a wide variety of causes

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PROMOTING SAFETY FOR ADOLESCENTS

Literature has been reviewed under the standard setting headings of road, work, home, and sports and leisure (Munro et al., 1995). The most effective measures appear to be legislative and regulatory controls in road, sport and workplace settings. Environmental engineering measures on the road and in sports have relatively low implementation costs and result in fewer injuries at all ages. There is little evidence that purely educational measures reduced injuries in the short term. Community based approaches may be effective in all age groups, and incentives to encourage safer behaviour hold promise but require further evaluation. The potential of multi-factorial approaches seems greater than narrowly based linear approaches. The conclusion is however that few interventions to reduce injury in adolescents have been rigorously evaluated. There were no studies identified relating to 15–24 year olds in domestic settings. Studies, however demonstrating the effectiveness of smoke detector programs are clearly relevant to this age group.

Alcohol being a major risk problem has led to a number of studies on prevention, as in a by Foxcroft et al. (1992). 33 studies of which 24 were randomized controlled trials or had well matched controls were evaluated. Assessment of the quality of the studies showed that only 10 of the 33 studies included met four core methodological criteria, indicating the poor quality of the studies. Overall, no prevention program was convincingly effective. Of the 29 studies of prevention programs with short-term follow-up, 16 were partially effective, 11 were ineffective and 5 had negative effects (increased
alcohol consumption). There were 12 prevention programs with medium-term follow-up. Of these five were partially effective, five ineffective and two had negative effects. Only two prevention programs had long-term follow-up, one was effective and one ineffective.

SAFETY PROMOTION IN THE WORK ENVIRONMENT

Prevention work designed to reduce the number of occupational injuries can be undertaken at a national or regional level and can also take place locally at the level of the organisation and the individual (Menckel, 1990). Near accident reporting has been used. A review of available literature produced 24 research reports in the of near accident reporting. This had been completed between 1968 and 1982 and had been conducted at the local level. The review demonstrated that large quantities of information of near accidents, which otherwise would not have been recorded, were gathered by verbal means while written reporting provided relatively little information. No clear-cut conclusions with respect to the effects on near accident reporting could be drawn, above all because of limitations to the documentation of the near accident reporting that had taken place. Some of the studies pointed to an increase in the level of safety activities following a period of near accident reporting while such an increase could not be detected with certainties in others (Carter and Menckel, 1985). Field experiments involved occupational health nurses and safety engineers from occupational health services and those with local responsibility for safety and production. Improvements were detected in accident and prevention work with quicker accident investigation, an increase in the number of counter measures proposed and a certain reduction in the number of accidents in the number of days per accident.

An example of a very successful intervention has been reported by Springfeldt (1996) Serious occupational injuries cause by rollover tractors can be prevented by fitting Rollover Protection Structures (ROPS). In some countries authorities have required such protection on tractors for many years. Others have recommendations or no rules at all. In a survey of tractor rollover injuries and protective measures, the developments in twelve countries are described. Sweden and New Zealand were first to develop ROPS in the fifties Mandatory regulations for new tractors were introduced in Sweden 1959, Denmark 1967, Finland 1969, West Germany, Great Britain and New Zealand in 1970, the United States 1972, Spain 1975, Norway 1977 and in Switzerland 1978. In Canada and Australia federal authorities have no regulations at all concerning ROPS and tractors.

In Sweden the frequency of fatal rollovers by 100,000 tractors per year has been reduced from 17 to 0.3 since mandatory regulations were introduced. In Norway the frequency has decreased from 24 to 4 between the periods 1961–1969 and 1979–1986 and in Finland from 16 to 9 from 1980–1987. From 1961–1986 a West German rate has been reduced from 6.7 to 1.3. In New Zealand the risk has decreased from 37 to 30 from the period 1949–1958 to the period 1969–1974. In countries that introduced mandatory regulations long ago an evident decrease in the number of rollover injuries is reported, especially when retrofitting of ROPS on old tractors is required (Springfeldt, 1993).
PREVENTING FALLS AND SUBSEQUENT INJURY IN OLDER PEOPLE

The risk of falls increases with age. Falls in older people often result in injury and death. Such injuries, frequently fractures, are a common and costly cause of hospital admission.

General overview of interventions preventing injuries to the elderly

There is a recently published review on the evidence-base of this area (Effective Health Care, 1996). They conclude:

• There is some evidence to suggest that exercise, such as balance training, is effective in reducing the risk of falls in older people. Access to such interventions should be offered and ways of promoting uptake should be investigated. New programs should be part of controlled evaluations.
  • Home visits and surveillance to assess and where appropriate, modify environmental and personal risk factors can be effective in reducing falls. This can be carried out by nurses, health visitors, occupational therapists or trained volunteers.
  • Soft hip protector pads have been shown to dramatically reduce hip fractures in frail older people in residential care. Their effect and acceptability in the community needs further research.
  • High dose Vitamin D supplementation with or without calcium appears to be effective in reducing fractures. Research is needed to identify the most cost-effective strategy.”

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Sackett et al. (1991) identified thirty-six trials which evaluated interventions to prevent falls (exercise (23), home assessment (9), type of shoe (1), interventions in institutional settings (3), nutritional supplementation (1) and hip protectors (1), two studies examined interventions covering more than one area. Pooling the results of these studies showed that people assigned to an exercise group had an estimated 10 per cent lower risk of falling than controls. Pooling the results of studies evaluating a balance training only intervention showed a reduction in the risk of falling of 25 per cent. In one trial people offered the balancing exercise Tai Chi, had 37 per cent lower risk of falling than the non-intervention group (Wolf et al., 1993)

The review also covered studies involved visiting older people at home, an assessment of the safety of the home environment, and a range of interventions such as safety checks, safety modifications, referral to care, and recommendations for exercise. In a study of over 2,000 people, Hornbrook et al. (1994) found that those offered a home intervention to remove and repair safety hazards showed a reduction in falls compared with controls.
Similarly Carpenter and Demopoulos (1990) found that older people visited at home by trained volunteers reported one-third of the number of falls as did controls.

Six trials were identified which evaluated the effectiveness of interventions other than exercise and assessment in people who live in institutions. Frail people are at particularly high risk of falling when getting out of bed. The use of a bed alarm, which alerts an assistant when a person to get out of the bed, was evaluated in a small trial. This showed a reduction in falls, which was not statistically significant (Tideiksaai et al., 1993).

Significant protection against falling was apparent from interventions which targeted multiple, identified, risk factors in individual patients, and from interventions which focused on behavioural interventions targeting environmental hazards plus other risk factors.

Medical interventions preventing injuries for elderly

Recently a systematic review of RCTS (Randomized Clinical Trials), completed within the Cochran Collaboration, looked at the effectiveness of Vitamin D and calcium supplementation in reducing fractures (Gillespie et al., 1996). However, the so far most extensive review has been made byINAHTA (Hailey et al.,1996) Bone Density Measuring is poor at determining present fracture risk since it cannot distinguish clearly between patients with fracture and those without. ‘It is estimated, under realistic assumption, that a bone screening program would lead to the prevention of only 2 per cent of fractures in menopausal women (screening uptake of 50 per cent, sensitivity of 38 per cent, reduced fracture risk of 30 per cent with Hormone Replacement Therapy (HRT), lifetime compliance with HRT of 30 per cent.) fracture risk with ever and never users of HRT’. Consequently 393 women would need to be invited for screening in order to avoid one fracture.

Technology interventions preventing injuries for elderly

In a study from Denmark on the effect of hip protectors (Lauritzen et al., 1993) 10 of the 28 wards in the nursing home were randomized to receive external hip protectors; thus 167 women and 80 men were given protectors and 277 and 141 men no protectors. A fall register was set up for 2 treatment wards and 2 control wards. There were 8 hip and 15 non-hip fractures in the hip-protector group and 31 hip and 27 non-hip fractures in the control group. The relative risk of hip fractures among women and men in the intervention group was 0.44. None of the 8 residents in the intervention group who had a hip fracture was wearing the device at the time of the fracture. The study indicates that external hip protectors can prevent hip fractures in nursing home residents.

Organizational interventions preventing injuries to the elderly

A randomized controlled trial (Rubenstein et al., 1990) from a long-term residential care facilities for elderly persons included an intervention group of 79 people and a control group of 81. The assessment included a detailed physical examination and environmental assessment by a nurse practitioner, laboratory tests, electrocardiogram and 24-hour Holter
monitoring. At the end of the two-year follow-up period, the intervention group had 26 per cent fewer hospitalizations and a 52 per cent reduction in hospital days compared with controls. Patients in the intervention group had 9 per cent fewer falls and 17 per cent fewer deaths than controls by two years.

**Community interventions preventing injuries to the elderly**

Tinetti *et al.* (1994) studied 301 men and women living in the community who were at least 70 years of age were given either a combination of adjustment in their medications, behavioural instructions, and exercise programmes aimed at modifying the risk factors or usual health care plus social visits. During one year of follow-up, 35 per cent of the intervention group fell as compared with 47 per cent on the control group—a significant reduction.

Svanström *et al.* (1996) have shown similar results for a whole community in a quasi-experimental design. The incidence of femoral fractures in Lidköping—the study area-shows a significantly declining trend for females (6.6 per cent per year) and (a 5.4 per cent decline for males during the study period of 1987–1992. The control area of Skaraborg County showed a minor decrease and Sweden as a whole showed an increasing trend during the same period.

**people assigned to an exercise group had an estimated 10 per cent lower risk of falling than controls**

Ray *et al.* (1997) give support through a randomized controlled trial with randomization of nursing homes. Seven pairs of middle Tennessee nursing homes with one facility in each pair randomly assigned to the intervention. Facilities had 482 (261 control, 221 intervention) residents who qualified for the study. The mean proportion of recurrent fallers in intervention facilities was 19.1 per cent lower than that in control facilities. Intervention targeted four specific safety domains: environmental and personal safety, wheelchairs, psychotropic drugs and transferring and ambulation.

Plautz *et al.* (1996) has reported on the trial established by the Department of Public health, City and County of San Francisco—the Community and Home Injury Prevention Program for Seniors (CHIPPS) to reduce the rate of unintentional injuries among elderly residents. The objective was to reduce rates of falls, scalds and burns. Reported falls were reduced by 60 per cent after the intervention, from 0.81 to 0.33 falls per person year. Scalds were reduced from 9 to 0 and burns from 7 to 0 during the six-month periods before and after the intervention.

**SAFETY PROMOTION AT THE LOCAL LEVEL—SAFE COMMUNITY INTERVENTIONS**

Community interventions may be distinguished by their shift away from the focus on individual responsibility and towards multi-faceted community wide interventions, which ensure that everyone in a community is aware or involved.
As far as we know, The Falköping Accident Prevention Program (FAPP) is the first evaluated comprehensive programme aiming at promoting safety and preventing injuries at the local community level. The idea behind is to address all kinds of safety and prevent injuries in all areas, addressing all ages, environments and situation and involving non-governmental as well as governmental community sectors. FAPP is based in Skaraborg County, Sweden. An injury register was started in 1978 and intervention began in 1979. Three years later the total rate of injuries had fallen by 23 per cent. In Falköping home injuries decreased by 26.7 per cent, occupational injuries by 27.6 per cent, traffic injuries by 27.7 per cent and other injuries by 0.8 per cent (Schelp, 1987). A corresponding decrease in the number of other emergency visits, i.e. non-accident related, has not been noticeable during the same period of time. The incidence of home injuries in the study area decreased from 26 per 1,000 per year in 1978 to 17 per 1,000 per year in 1981/2 (Schelp L & Svanström L 1986). In 1978 there were 49 occupational injuries per 1,000 gainfully employed persons per year whereas the corresponding figure for 1981/2 was 34 occupational accidents per 1,000 gainfully employed persons/year (Schelp and Svanström, 1986).

The program has then been followed over the period from 1978–1991 (Svanström et al., 1996), using indicators of processes as well as outcome. Since 1983 the outpatient injury rate has levelled off and the inpatient rate shows an average annual increase of 8.7 per cent for females and 4.9 per cent for males, which is significantly higher than the increase for Sweden, which is 2.3 per cent for females and 0.5 per cent for males.

For injuries seen in either ambulatory or hospital settings, it seems that the effect of the early phase of the program was the lasting one, but for injuries admitted to hospital the effect was temporary. The onset of the increase by the end of 1982 coincides with the break-up of the cross-sectoral organization originally set up to run FAPP.

In the beginning of eighties the programme was followed by others in Norway like Vaeroy and Harstad and Sweden, like Lidköping and Motala.

In the program implemented in Motala municipality in the western part of Östergötland County in Sweden. The incidence on non-trivial injuries treated in health care decreased by 41 per cent, while the trivial injuries increased by 16 per cent (Timpka et al., 1998). The incidence of health care treated injuries had decreased by 13 per cent from 119 (per 1,000 population years) to 104. In the control area, corresponding injury incidences were 104 and 106. The hospital-treated injuries decreased by 15 per cent from 19 per 1,000 population years to 16, while in the control area the incidences remained at 13 per 1,000 population years (Lindqvist et al., 1998). The larger decrease of non-trivial injuries was observed in all ages and injury event environments.

The best-evaluated programme in Norway is in Harstad (Ytterstad B 1995).

In a quasi-experimental study (Ytterstad and Wasmuth, 1995), hospital-treated traffic accident injuries were recorded prospectively for seven and a half years in two Norwegian cities, Harstad and Trondheim. Traffic safety was promoted in a comprehensive community program in Harstad, with Trondheim as a control. A 27 per cent overall reduction of traffic injury rates was found in Harstad from period 1 to period 3 (each period 30 months duration), whereas a correspondent significant increase was found in the comparison city. Promotion of bicyclist helmet use and pedestrian safe behaviour was implemented by activating public and voluntary organisations and media.
(Ytterstad, 1995). Significant rate reductions were observed below the age of 16 for both bicyclists (37 per cent) and pedestrians (54 per cent). For bicyclists this reduction was larger among males (43 per cent) than females (23 per cent). Head injury rates decreased for bicyclist children below 10 years of age but increased for those 10–15 years old.

Accident analyses based on the local database revealed coffee to be the most frequent liquid causing scalds, which mostly occurred in the kitchen (Ytterstad and Søgaard, 1995). Sixty-six per cent of the injured were boys and two-thirds were below two years of age. From the first to the second of the three periods the mean burn injury rate decreased 53 per cent, from 53 to 25 per 10,000 person years. In the Control City located 1,000 km away, the rates increased from 62 per cent to 68 per 10,000 person years.

Sports injuries account for considerable morbidity and expenditure of resources (Ytterstad, 1995). It accounted for 17 per cent of recorded unintentional injuries in Harstad. Post-intervention injury rates for downhill skiing was reduced by 15 per cent when adjusting for exposure.

**older people visited at home by trained volunteers reported one-third of the number of falls as did controls**

Outside the Nordic countries the Safe Community Model has been especially popular in Australia. Jeffs *et al.* (1993) reports on the Illawarra area of New South Wales. Reductions of 17 per cent in attendance by children for injuries and a 14 per cent fall in accident-related hospital admissions of children have been observed over the course of the four year period, 1987–1991 before and after the intervention.

The evaluation of the Latrobe Valley Better Health Injury Prevention Program, a community-based intervention in south east Victoria, Australia (Day *et al.*, 1997) showed that the age standardized rate per 100,000 persons for emergency department presentations for all targeted injury fell from 6594 in the first program year to 4821 in 1995/96. There were significant decreases in the presentation rates for home injuries among all age groups except for those 65 years and over, playground injuries among 5–14, 15–24 and 25–64 years old and sport injury among 15–24 year olds only. The direct program cost per injury prevented was $ 272. Significant reductions were observed for assaults among 10–24 year olds and over 25 years. The conclusion is that the reductions were associated to some extent with changes in injury risk and protective factors and were greatest for the injury issues subjected to the most intense activity.

**FUTURE DIRECTIONS**

This review of some of the evaluated interventions that exist in literature was only meant to show that extensive information exist of value for program managers and decision-makers. We look forward to further diving into the literature database and your contribution.
REFERENCES


Bryan-Brown, K., 1995, The effects of children’s traffic club. *In Road accidents In Great Britain* (Department of Transport).


Menckel E, Carter N. The development and evaluation of accident prevention routines: A


Ytterstad B. The Harstad Injury Prevention Study: Hospital-based injury recording and community based intervention. ISM Skriftserie nr 33. 1995. Institute of Community Medicine, University of Tromso, Norway: Troms County, Harstad Hospital.


Community Psychology and Safety: A Psychospiritual Perspective

Mohamed Seedat

INTRODUCTION

Assalamailaikum. Salaam, the Islamic salutary greeting, literally means peace be upon you. In Arabic, salaam also denotes harmony, tranquillity, a sense of security, perfection, accord and connectedness with those around us, contentment and freedom from any jarring element or experience (Al Q’uran, Surah 19, Verse 62, Yusuf Ali translation). This multifaceted peace and associated sense of safety that salaam refers to is founded on an inner and outer harmony. As action-oriented creatures our external harmony stems from integrated socio-political and economic systems and structures that uphold the principles of human rights, dignity, equal opportunity, equity, political democracy and honesty. Inner harmony is based on a synergistic and balanced relationship between the body, self (nafs), mind (‘aql), heart (dil) and soul (ruh).

From this perspective safety assumes a spiritual dimension in addition to the objective and subjective dimensions delineated by safety promotion researchers (Maurice et al., 1998). Whereas the objective dimension is assessed through behavioural and environmental indicators, the subjective is discerned by a population’s expressed feelings of safety and harmony or threat and disharmony. The spiritual dimension is gleaned from the meaning and meaning systems associated with safety by different population groups.

Various texts on safety promotion echo the idea that injuries are preventable and not mere unavoidable random acts ordained by destiny or willed by a Supreme Being (Berger and Mohan, 1996; Laflamme et al., 1999; Maurice et al., 1998). This idea is usually associated with an expressed concern about how notions of predestination and God’s will may engender fatalistic thinking, and result in a resigned social acceptance of preventable problems. These are obviously very legitimate concerns especially if we accept the wisdom inherent in the shifts from ‘accident prevention’ to ‘safety promotion’. However, following Svanström’s (1999) view that ‘What people themselves define as safety and security has proved to be more important to nations, communities and organizations than what academics have argued about’, I wish to venture an additional explanation. Accordingly, I will attempt a closer examination of ideas on safety with specific reference to one South African community and that community’s own meaning system. Thereafter, I will proceed to describe the linkages between safety and the broader context of psychological dispossession. More specifically, I shall seek to fulfil three objectives. Firstly, I will present an account of recent personal experiences and reflections at a mosque in South Africa, which may serve to illustrate the spiritual dimension of safety.
and perhaps offer an alternative understanding of the relationship between the divine and prevention. Secondly, drawing on the ideas of various scholars and additional anecdotal materials, I will attempt to contextualize so-called fatalistic behaviour within the subtleties of prolonged oppression. For this purpose I will make special reference to the legacy of apartheid in South Africa which continues to compromise the emergence of community and individual safety. Thirdly, and by way of delineating a way forward, I aim to highlight four research-related challenges that face community safety researchers.

ACCIDENTS: ACTS OF GOD?

if freedom requires the risk of life, then oppression too requires the fear of physical death

On a recent visit to a mosque that I usually frequent in my childhood town, I saw a large poster, centrally placed on the notice board, which sought to offer an explanation for calamities, murder and crime. After a cursory look at the contents (see Box 1), I dismissed the poster as some religious group’s limited view on the causes of injurious events. My academic training alerted me to the tone and causal relationship assumed in the poster. I am sure some of you may, like me, develop a counter intuitive response to the language on an initial reading. On further examination I noted that the poster was featured alongside various other messages including calls for relief actions in Turkey, Albania, Kosovo and Cape Town, and notices highlighting a range of social welfare services. Interestingly, the notice board also featured a series of messages censoring uncontrolled harmful practices such as smoking, alcohol consumption and violent behaviour. These messages also called on the congregation to observe the mosque and other places of worship as smoke-free zones. I then re-examined all the posters within the broader meaning system prevalent among the sector of Muslims I am most familiar with and the Imam’s earlier sermon. I noted that consistent with the views expressed in the poster all of the messages invoked Q’uranic injunctions and practices, and sayings of Prophet Muhammed and his companions, including classical scholars of jurisprudence, to censure risk-taking behaviours and to alternatively encourage community safety in all its dimensions. That the protagonist of these messages also engaged in various welfare, health promotion and community development initiatives, suggests that for them and their followers injuries and ill health are definitely preventable. However, this Muslim group’s engagement in social welfare activism is punctuated by three ideas. First, calamities, murders, crimes and other injurious incidents are only preventable in so far as they are blessed and willed by the Supreme Creator. Second, protection, prevention and community safety are predicated on individual and collective behaviour, which occur within a particular prescribed socio-moral framework. Third, safety promotion as exercised within a broader ethos of community welfare, is a psycho-social-cum-spiritual endeavour that fosters a dynamic connection to the Supreme Being and a synergistic relationship between divine and material.
AMITIES, MURDER, CRIME. 
WHY? WHY? WHY?

HERES WHY !!!

Abdullah ibn Umar (radhi allahu anhu) narrates. ‘I was among ten people who came to Nabi (sallallahu alayhi was sallam) from the Muhaajireen. He said ‘O Muhaajireen! There are five things I ask Allah’s refuge lest you fall prey to them:

1. SHAMELESSNESS
When shamelessness becomes prevalent and the norm amongst people, they would become entangled in plague and in such diseases that never existed during the time of their forefathers.

2. CHEATING IN TRADE (FRAUD)
When a nation cheats in measure (practices fraud) they would be afflicted by drought, hardships and an oppressive ruler.

3. FAILURE TO PAY ZAKAAT (CHARITY)
When a nation stops paying zakaat they would be deprived of rain. If it were not for the animals it would never have rained.

4. DISHONOURING ONE’S PROMISES
When people break promises, Allah sets over them enemies from another nation, who will usurp (steal) their belongings.

5. VERDICTS IN CONFLICT WITH COMMANDS OF ALLAH
When their leaders refrain from giving verdicts according to the commands of Allah Ta’ala, He subjects them to murder and civil strife.

• FORNICATION, ADULTERY AND INTEREST
Rasoolullah (sallallahu alayhi wa sallam) is reported to have said: ‘The people among whom the taking of interest and indulgence in adultery appears openly have indeed invited Allah’s wrath and anger upon themselves’. (Targheeb)

• BRIBERY
Rasoolullah (sallallahu alayhi wa sallam) also said: “Fear for others will engulf the hearts of people among whom there is much bribery”.

• DISOBEDIENCE TO PARENTS
Further Rasoolullah (sallallahu alayhi wa sallam) also said: “Allah postpones (and defers) the punishment for every sin for as long as He wishes. But the calamity which follows disobedience to parents is very soon. Before death occurs one becomes overtaken by it”. (Durr Manthoor)

• TO TURN A BLIND EYE TO VICE!
Rasoolullah (sallallahu alayhi wa sallam) warned: “Through the
Such spiritualized safety promotion behaviour is not unique to Muslims. Everyday, all over the world, individuals and groups representing major religious systems—Islam, Christianity, Buddhism, Hinduism and Judaism—assume various precautionary measures to protect themselves from injury and a range of other violations. Yet they conscientiously invoke the blessings of the Supreme Being through prayer and a variety of related rituals. Some people place stickers containing prayers in their cars, homes, work places and recreational facilities. Others carry various forms of prayers on their persons. Some people engage in prayer for safety before taking a long trip. These rituals and prayers, as integral features of a larger spiritually inspired belief system, provide meaning and solace especially when precautionary behaviour seems so insignificant in the presence of large-scale threats and structural obstacles generated by oppressive and exploitative socio-economic arrangements of society (see Box 2).

iniquitous deeds of a few people Allah does not cause widespread calamity to descend upon all until such time that those deeds are performed in their presence and they, in spite of being capable of stopping it, refrain therefrom. At such a time the punishment descends upon all, high and low”.

• MAKE AMENDS
  * Perform salaat with Jamaat
  * Recite Sura Yaseen and Ayatul Qursite regularly
  * Make Zikr and Istighfaar abundantly
  * Discharge your Zakaat
  * Increase your charity
  * Do not indulge in extravagance
  * Respect your parents
  * Promote virtue and prohibit vice
  * Earn halaal rizk
  * Stop giving bribery
  * Read Qunoot Nazilaa in Fajr salaah (with intention of seeking protection for yourself and all the Muslims in South Africa and the whole Ummah)

Such spiritualized safety promotion behaviour is not unique to Muslims. Everyday, all over the world, individuals and groups representing major religious systems—Islam, Christianity, Buddhism, Hinduism and Judaism—assume various precautionary measures to protect themselves from injury and a range of other violations. Yet they conscientiously invoke the blessings of the Supreme Being through prayer and a variety of related rituals. Some people place stickers containing prayers in their cars, homes, work places and recreational facilities. Others carry various forms of prayers on their persons. Some people engage in prayer for safety before taking a long trip. These rituals and prayers, as integral features of a larger spiritually inspired belief system, provide meaning and solace especially when precautionary behaviours seem so insignificant in the presence of large-scale threats and structural obstacles generated by oppressive and exploitative socio-economic arrangements of society (see Box 2).

prolonged oppression in the form of discrimination places children and women, in particular, at great risk for mental health problems and disorders

BOX 2

FOR YOUR…

SAFETY AND SECURITY

In these times when mugging, robberies, murder and a string of
It is safe to assume that many of the world’s people, as guided by divine scriptures or divinely inspired text, pursue safety in a manner that is punctuated by consciousness of the divine, unlike the academic tendency to dichotomize the secular and religious. Once we begin focusing our attentions on the study of risk and, alternatively, safety promoting beliefs and behaviours within specific meaning systems and normative structures we are also encouraged to take a contextualized approach. Such an approach will require us to examine the subtleties of psychological dispossession that denies the marginalized, in particular, the right to safety and security and perpetuates fatalistic patterns of behaviour for ideologically suspect reasons.

**PSYCHOLOGICAL DISPOSSESSION**

In preparing for this section of the paper, I considered and debated the various materials that I could use to convey my thoughts on psychological dispossession. I specifically wanted material that could humanize abstract ideas about oppression. So I decided to search for the manifestations of subtle psychological dispossession in present day South Africa. Within hours of my search, a series of very disturbing personal encounters prompted me to reflect on the social and human phenomenon of oppressive subservience that remains common place in South Africa and perhaps in many other parts of the former colonized and enslaved world. While on my usual morning shopping chores at a mall east of Johannesburg, I noticed an elderly woman moving from car to car in the parking lot entreating motorists to purchase grass brooms from her. Before she approached me directly I paid very little attention to her physical demeanour and speech. Within seconds of the elderly lady addressing me I felt embarrassed, uneasy and ashamed. The language of baaskap (subservience) punctuated the lady’s demeanour and sales manner. She addressed me in the language of apartheid servitude. In silence my family and I drove out of the mall. Lost in our own thoughts we drove along for at least fifteen minutes when once again our thoughts were jolted by a group of street children at a very busy intersection. Like the elderly lady they too addressed everyone with
deference and subservience, hoping that among the generous and guilt-ridden motorists they approached, someone would pass on food or money. Realizing that the same culture of subservience ran across the age spectrum, I wondered whether I, like so many other South Africans, had become anaesthetized and blind to the ubiquitous dehumanization produced by apartheid. I could hear the poetic echoes of an internationally renown South African poet, Don Omarrudin Mattera, written thirty years ago, entitled ‘For a Cent’.

Mattera (1983) writes:

Each morning  
Corner of prichard and joubert,  
Leaning on a greasy crutch  
Near a pavement dustbin  
An old man begs  
Not expecting much.

His spectacles are cracked and dirty  
He does not see my black hand  
Drop a warm cent into his scurvy palm  
But instinctively he mutters:  
Thank you my Baas!  
Strange  
That for a cent  
A man can call his brother. Baas!

A contrasting and somewhat more affirming phenomenon is contained in the story of Thabo, a man from Transkei whom I met a year ago. In explaining how he came to seek out our Centre for Peace Action, in the south of Johannesburg, he tells the story of police harassment, personal injuries and a series of other harsh experiences at the gold mines west of Johannesburg. In describing the consequences of the adversity he faced before arriving at our Centre he talks about the experience of psycho-spiritual death. In his own words: ‘I was dead inside and just a body’. However, a deep connection to family, a profound sense of morality and a love for responsibility enabled Thabo to transcend his self-reported transient homicidal, suicidal and criminal thoughts. He was able to muster up sufficient inner psychological and outer social resources to re-link with his heart and spiritual essence and connect with a community-based safety promotion service.

courtesy, affection and concern is reserved for the oppressor and his/her representative institutions while the other is dehumanized and inferiorized through a plethora of ideas and a dubious discourse that contain no empirical truth

Thabo’s resourcefulness, ability to bounce back and seek help with dignity as a contrast
to the many occurrences of subservience, timidity and psychological dispossession still evident in South Africa and perhaps in many other parts of the former colonized world, warrants a nuanced explanation. One reality has become extremely clear in seeking this explanation; even with the repealing of apartheid laws and the introduction of a new constitution, in some ways these acts have served to merely tear down what we now realize was only the scaffolding of apartheid leaving the building behind. Despite the demise of institutionalised political apartheid its mutative psychosocial oppressive presence continues to haunt many people in their dreams and waking life.

Scholars of community psychology, focusing on the dynamics and subtleties of psychological oppression, provide some insight into the collective and individual impact of oppression and their implications for the development of safety as a human right. In explicating the master-slave dialectic Hussein Bulhan (1985) asserts, ‘If freedom requires the risk of life, then oppression too requires the fear of physical death’. Apartheid as a crude institutionalization of racism and economic exploitation could therefore not be implemented and maintained without the threat and exercise of violence. The fear of physical death takes root when armed resistance is defeated, the mind’s reasoning is subverted through the perverted logic that justifies and rationalizes oppression, and the heart’s links to goodness is denied. At best courtesy, affection and concern is reserved for the oppressor and his/ her representative institutions while the other is dehumanized and inferiorized through a plethora of ideas and a dubious discourse that contain no empirical truth. This fear of physical death ‘crystallizes’ as a conflict between individual physical survival and the more profound wish for happiness and contentment that may be achieved through a balance of the various constituent elements of human nature, expressed in the greeting of salaam. Fear pits the baser self with all of its rage, selfish, instinctual and aggressive forces against the human self as located in reason, spirituality and the drive towards inner good.

Fear of physical death diminishes the capacity for struggle and search for safe behaviour as individual survival and the material qualities of life assume a higher premium than the preservation of collective history, community ideals and cohesion, and the search for psycho-spiritual development and safety. The fear of physical death, together with the severe restrictions placed on oppressed people’s time, space, thoughts, actions and nature, may well manifest as a repertoire of fatalistic, subservient and ego-dystonic behaviours.

Another scholar of oppression, James C. Scott (1990), drawing on examples from literature, history and the politics of culture from around the world, discerns both public and hidden transcripts in the master-slave relationship. Public transcripts, including acts of deference, silence, ritualistic subservience and fatalistic behaviours, are merely a mask designed to produce conformity in line with what the dominant group may want things to appear in public.

The public transcript is part and parcel of the dialectic of disguise and surveillance that punctuates relations between the weak and the strong; it is integral to the art of resistance. The hidden transcripts unfold outside the direct surveillance of the dominant group and includes speeches, behaviours, practices, folk tales, rumours, gossip, songs, jokes and gestures that ‘confirm, contradict, or inflect what appears in the public transcript’ (Scott, 1990). The hidden transcripts in Scott’s view provide a critique of the oppressor behind
the cloak of secrecy.

Following Bulhan (1995) and Scott (1990), it may be held that the dominated have a vested interest in maintaining a public aura that reinforces hegemonic appearances. Such adaptation and physical survival tactics may well include a personal toll that may manifest as a higher risk for psychopathology, somatic afflictions, sudden eruptions of rage, fatalism and various forms of risky behaviours. Social coercion that produces an excessive focus on physical survival undermines the search for internal harmony, alienates the oppressed from their true nature and the spiritualized quest for safety. It would be presumptuous and arrogant to assume that fear and psycho-social and spiritual death characterize the elderly lady and the street children, whom I referred to earlier. However, it is safe to assert that their public displays of public subservience—whether conscious or unconscious—must produce internal psychic dissonance that may manifest as passive aggression, repressed rage and anger and maladaptive coping mechanisms. Evidence from the United States and South Africa show that prolonged oppression in the form of discrimination places children and women, in particular, at great risk for mental health problems and disorders (Pillay and Lockhat, 1999; Bulhan, 1985).

The impact of oppression does not escape the historical and current oppressor. For instance, in order for apartheid to have been institutionalized in the way it was, it required the production of depravity, torturous behaviour, the deracination of compassion, and individuals who could serve as agents of fear and terror. These agents of terror and fear underwent a process of dehumanization themselves, who through mechanisms of consent creation, came to assume and justify a racial superiority in exchange for economic, social, and political privilege. Ironically these agents of fear historically and currently continue to be motivated by fear. The impact of ‘swart gevaar’, which refers to the idea of black peril, should not be underestimated. Whereas colonial and apartheid oppression produced notions of bestiality, uncontrolled impulses and intellectual immaturity to inferiorize the colonized person, it also conjured up fears of sexual occupation and geographical expulsion among the dominant sector who then turned inward to create a lager mentality. The lager mentality served to uphold fears and irrational thoughts about blacks and it also subverted the humanity of the oppressor; values and morality were perverted to the extent that compassion, care, mercy and kindness tended to be selfishly reserved for the flesh of your flesh, your fellow oppressor. Today, the black peril has assumed a different form and content, sometimes subtle and sometimes obvious. The interrelated prejudiced notions that blacks are incapable of governance, corrupt and criminal by nature, given to living in squalid and overcrowded conditions even when they move into the cities and formerly white suburbs perpetuates fear and propels a physical exodus wherever and whenever blacks are perceived as a majority. The desire to return to a militaristic order and maintain relics of the apartheid era perhaps continues to manifest itself at the interpersonal, economic and social levels. The nonchalant use of derogatory terms to refer to African gardeners and domestic helpers, and the inadvertent tendency to reinforce the language of subservience when interacting with the most marginalized and dispossessed does little to eradicate the master-slave relationship. At the socio-economic level a cursory survey of business enterprises and places of leisure and entertainment, including public places for dining, will reveal old patterns of socio-political domination and the emergence of a classist society.
the fear of physical death, together with the severe restrictions placed on oppressed people’s time, space, thoughts, actions and nature, may well manifest as a repertoire of fatalistic, subservient and ego-dystonic behaviours

Following Bulhan (1985) and Scott (1990), it maybe argued that for healing and a sense of safety to occur among the oppressed and oppressor the slumbering slave and haughty master within must be respectively ejected. The ejection process, a psychological one, is fraught with many struggles and conflicts. It therefore requires individuals and collectives to re-connect with their humanity through a concerted process of moral and psycho-ethical reconstruction. The dismantling of oppressive political systems is only the first step towards psychological healing and safety promotion, especially within fledgling nation-states struggling to engender democratic forms of governance and social relations. The establishment of safety within a nation-state requires economic equity, social egalitarianism, and moral and spiritual integrity. Most importantly, the historically oppressed who came to assume positions of authority and acquire new found wealth must guard against reproducing the offences and ideology of the oppressor. Otherwise safety promotion will remain an ideal.

FUTURE DIRECTIONS: IMPLICATIONS AND RESEARCH CHALLENGES

In summary, I have employed two key ideas to frame the substantive arguments in my presentation. First, the definition of safety needs be extended to include a spiritual dimension, where relevant, so as to give due consideration to the spiritually minded for whom safety promotion is possible in so far as the Supreme Creator may ultimately will it. Second, efforts programmed to promote safety as a human right must be contextualized and critically considered within oppressive ideology’s mutative presence in this era of increasing globalization. Such a contextualization also enables an alternative analysis that views fatalism as symptomatic of either a profound sense of psychological dispossession or part of a public façade maintained by dispossessed groups in the interest of limited psychic survival. Safety efforts, especially in the South and marginalized sectors of the North, must today grapple with the globalization of materialism, greed, money politics; political expediency, and the commercialization of values and identities. Just as economic globalization restricts the nation-states ability to develop equitable economic structures and policies, the impact of psychological dispossession undermines the promotion of safety. Therefore, our research efforts need to proceed beyond our present evidence lead search for risk and determinants. So what are the intellectual challenges facing the safety promotion movement? I endeavour to describe four interrelated research challenges.

The first intellectual challenge centres on the need to re-examine current dominant notions of human nature within the social sciences and the associated helping professions. The historical secularization of science and knowledge production has tended to create a situation of delimited appropriation within the basic and applied
sciences. Delimited appropriation refers to the intellectual tendency to limit specific ideas and discourse to what is considered their relevant and appropriate place. Hence for instance, ideas about spirituality are to be confined to religious institutions and politics to parliament following the mythical logic that science and the applied professions are neutral, value free and non-prescriptive. The consequent secularized and fragmented definitions of human nature ignore the transcendental and spiritual nature of the individual. The psycho-spiritual conception of human nature detailed by many Islamic scholars, and alluded to earlier in this paper, offers one an alternative to the current secular notions of human essence (Haeri, 1998; Laleh, 1996; Mohamed, 1996; Shafii, 1988). For example, following a close study of the Qu’ran, classical and contemporary Islamic scholars have discerned that the human personality structure comprises of the physical body, the self (nafs), the mind (‘aql), the heart (dil) and the soul (ruh). Whereas the body serves as the source of physical nourishment and mechanical energy, the self (nafs) includes the depraved or commanding animal self, which is equated to the Id, and the human/commanding self. Thus the self can be fearful, impulsive, spiteful, and selfish or in contrast it can be generous, courageous, peaceful and helpful. The mind (‘aql) is the site of practical and abstract intellect, rationality and judgement. Some scholars conclude that the mind (‘aql) is the ‘cornerstone of civilization, cultural reliability and tradition’ (Haeri, 1998; Shafii, 1988). The heart (dil) as the organ of cognition, is the home of emotions and intuitive knowledge. The heart (dil) as the synergistic force harnesses the baser self and steers the energies of the body and mind (‘aql) towards the inclination for goodness, a quality that humans are biologically programmed for. The spirit or Divine spark energizes and provides life to the self (nafs) and the physical body. It is the reflection point for the self (nafs).

When the heart (‘aql) is free of defects such as hatred, suspicion and lust, it will radiate with the source of enlightenment vis-à-vis the soul (uh) and the inclination for goodness. Many such alternative ways of looking at healing and understanding the workings of humans remain unexamined within mainstream thinking, theoretical formulations and prevention procedures.

the dismantling of oppressive political systems is only the first step towards psychological healing and safety promotion

The second intellectual challenge relates to forging operational methodologies that support the contextualization of safety promotion research and applied initiatives within universally acceptable human rights programmes. Due to the intimate relationship between safety and human rights we are required to question the kind of society and associated community safety initiatives we wish to advance. Safety promotion research within a movement that strives for the creation of a tolerant, egalitarian society free of social oppression, economic exploitation, and foreign and local political domination presents theoretical and research imperatives that require innovation and the willingness to transcend the usual boundaries of the empirical social and medical sciences. When operating from a human rights framework the injury epidemiologists will be challenged to forge methods for the operationalizing and incorporation of oppressive systems and the ensuing master-slave dialectic into considerations of risks and determinants. This
challenge requires precise methods for how and where we begin operationalizing exploitative ideologies and systems as risk inducing phenomena. If and once we accept that safety embraces a spiritual dimension, in addition to the objective and subjective dimensions, we may be able to discern a third challenge as well. This third challenge relates to developing replicable strategies for forging linkages with existing collective modes, rituals and spaces of healing and safety that offer solace and contentment alongside all of the current well known individual, group and family oriented modalities of safety promotion. Millions of citizens across various nation-states regularly congregate to participate in various politically and/or spiritually constructed nodes of healing, safety, faith and psycho-spiritual cleansing and development. For instance, the weekly Christian Mass, Jewish Sabbath, Muslim Ju’mah (Friday) Prayer and Buddhist Meditation are occasions for profound reflection, psychological safety, healing, hope, compassion and spiritual bonding to others, nature and the Eternal Reality. Similarly, the many public holidays such as the South African hero’s day, youth day, women’s day and heritage day; are commemorative occasions for reflecting on the atrocities and struggles of the past and honouring the fallen heroes and heroines.

These are intensely emotionally and spiritually laden days intended to engender a recommitment to the human rights struggles of the present and future in the search for inner and outer harmony and security. Apart from their cathartic benefits, these religious and spiritualized public holidays contain elements of psycho-ethical and moral reconstruction so vital and essential for the community safety advocate to understand and link with. How do we as public health advocates make the connection to such spiritualized and therapeutic spaces in our endeavours to promote community safety within a human rights framework?

The fourth and final challenge deals with the question of developing safety promotion into a psycho-ethical practice. Approaches and practices that integrate socio-spiritual values based on justice, equity, wisdom, temperance, a balanced regard for self and others are the greatest source of safety, peace and resilience. Such liberatory approaches and practices may enable the curtailment of the baser instinct that continuously demands, ‘I want what I want when I want it’ irrespective of the social, psychological, emotional, physical and spiritual costs. This challenge requires the public health practitioner to reflect on her/his own values and beliefs and engage in self-dialogue as part of the safety promotion solution. It also means wrestling with oppressive systems in their mutated form in our own collective minds as people and our hearts as prevention activists. In concrete terms it requires us to debate and develop an ethical code of conduct that informs our safety promotion work within a human rights framework.

If we are to translate these challenges into well-defined basic and applied research projects we may require substantial intellectual, political and financial resources. Most significantly, we require open-minded modes of enquiry, which are underlined by the quest for innovative explanatory paradigms; the quest for innovative paradigms may be greatly strengthened if safety promotion researchers consider employing multiple ways of knowing and investigating safety phenomena. Because logicempiricist traditions in western ethnosciences have negated humanistic, spiritual, artistic and intuitive ways of knowing, safety promotion researchers do not need to be hostage to the logic that primarily stresses measurement and control for the creation of predictive explicatory
models of human behaviour. The search for liberatory discourse requires openness, freedom of enquiry, assessment of all information obtained by the individual, and the incorporation of multiple methods of research into intellectual endeavours. Religion, spiritual expression, morality, ethics, literature, oral history and intuitive ways of knowing can all make substantial contributions towards the forging of emancipatory paradigms and safety promotion methodology (Asante, 1990; Gordon, 1988; Stanfield, 1985).

These challenges imply that the safety promotion movement and its advocates embrace multiple roles so as to serve as basic and applied researchers, programme developers and human rights activists at the macro and micro levels of society.

In closing, I hope that this paper will ultimately serve as a modest addition to the extensive body of knowledge on the conceptual and operational aspects of safety and safety promotion (Maurice et al., 1998). Whatever the criticisms levelled at this paper, the limitations are my own and the products of fallible human reasoning. But in the words of one of my favourite philosophers, Ali Shariati: ‘Knowledge means struggling, thinking, making observations and adjusting one’s views to reach something. It is not that we should not say nothing until we reach ‘the knowledge of certainty’ and the ‘truth of certainty’ for it is impossible to reach it all at once…We should continue saying and thinking as we reach towards it’ (Sharati, 1974).

REFERENCES

On the night of 2 August 1999, two express passenger trains rammed into each other near Gaisal in Assam, India. Both trains were packed with sleeping passengers and over 300 were reported to have died in the crash. It took a week to clear the debris and conduct an actual body count. Soon after the accident the Inspector of Safety of the Indian Railways undertook a detailed investigation, while almost three weeks later the Government announced the setting up of an Enquiry Commission headed by a retired judge of the Supreme Court. However, long before any of these bodies could submit their reports and immediately after the accident, several ‘authorities’ announced that the crash was due to the ‘negligence’ of the dead driver of one of the trains. Thus, one man amongst several hundreds was singled out not only for his own death but that of many others.

The ideology of the ‘careless worker’, still being resurrected almost a century after the beginnings of the struggle to combat the idea of the accident-prone worker. In fact, the findings of the Safety Inspector, made public several weeks later, clearly indicated that the stretch of track on which the accident had taken place was known to be dangerous with several previous reports of malfunctioning signals and faulty safety procedures. The railway management was severely indicted for not having taken adequate safeguards earlier and for having ignored repeated warnings. This was not the first instance of such reports having been made public. But the myth of the careless worker persists in the public mind. A similar accident near London, about three months later, elicited similar public responses.

Roots of the myth go far back in time. Towards the end of the nineteenth century, industry associations in USA had developed the compensation-safety apparatus to deal with the problem of industrial accidents. This apparatus emphasized compensation over prevention and safety over health. Thus, in 1890, the steel industry was prosecuting workers for disobeying safety orders rather than looking at causes of equipment failure. In 1910, US Steel devised the Voluntary Accident Relief Plan for paying fixed amounts for job related injuries causing death or disability, against a commitment by workers not to sue for damages. Such an approach obviously focused on mechanical, electrical, and fire hazards. However, the injury caused by chemicals in the workplace could not be ignored for long. The first list of standards of Maximum Allowable Concentrations (MACs) for hazardous airborne contaminants was made available only in 1946, after World War II, even though these MACs were not legally enforceable. It took three more
decades into the seventies for a new activism in health and safety to take root in US industry, which squarely blamed worker injuries and diseases on corporations’ unwillingness to spend and on the drive to speed up production (Berman, 1978).

In the eighties progressive labour unions tried to move beyond these simple arguments. For instance, a tripartite committee on occupational safety, health and welfare established in 1984 by the South Australian government, enunciated seven principles of health and safety (Matthews, 1985):

- The toll of injury and disease can be reduced by adopting preventive measures, which have to be balanced against clinical measures.
- A preventive strategy needs to focus on underlying unhealthy work systems, and not on making workers ‘aware’.
- A basic level of safety has to be legally imposed on all industries to place all of them in the same competitive position.
- Standards of health and safety cannot be determined a priori, but only as a social process of evaluation involving workers, employers and government.
- Legal rights and powers have to be conferred upon workers’ representatives to enable them to participate in this social process.
- Fora have to be provided for workers and employers to resolve their conflicts over health and safety measures and standards.
- Preventive measures need to be complemented by provisions for the care of victims of occupational injuries and disease.

Accordingly, the South Australian government signed an accord with the unions recognizing the rights and powers of workers’ representatives. Some of these included the right to participate in inspections, receive information on safety and health, prevent continuation of unsafe work, initiate prosecutions, and function on paid time.

In this context, it would be appropriate to recall that the standards for hazardous chemicals are particularly important since they directly impact on the nature and extent of occupational diseases. Toxicological data on chemicals is crucial for setting of such standards. There are a variety of techniques for obtaining such toxicological data which include Short-term LD50, Short-term Irritancy, Sub-acute, Chronic, Short term Mutagenic, Reproductive, and Behavioural tests. Of these tests, the LD50 is irrational because it specifies the dose at which 50 per cent of the test animals die; while the Short-term Irritancy or Draize test is exceptionally cruel. The Chronic and Reproductive tests are superior indicators of toxicity over the long term but they require large investments of money and time to complete. The Behavioural test is excellent for understanding effects on the nervous system; while the Short-term Mutagenic or Ames test is rapid, cheap, and valuable (Mathews, 1985). World over, industry and regulatory systems depend heavily on the LD50 as a marker of toxicity—as embodied in the Threshold Limit Values set by the American Conference of Governmental Industrial Hygienists, an unofficial body of
‘experts’. Hence, the participation of workers in evaluating and setting standards is crucial to the development of health and safety programmes.

In the nineties environmental activists in USA added another dimension to the control of workplace hazards. They began with an emphasis on pollution prevention as opposed to pollution control and evolved a Toxics Bill of Rights. This contained the Right to Know, the Right to Cleanup, the Right to Compensation, the Right to Law Enforcement, the Right to Participate, Inspect, and Negotiate, the Right to Prevention, and the Right to Freedom from Toxics (Cohen, 1990). However, they also recognized that workers had led the way for citizens in the fight for a clean environment. Thus, technological solutions to pollution included the evolution of substitutes, the production of less waste-intensive products, waste reduction, and recycling linked to job creation and the reduction of medical costs. Community groups even advanced a set of principles for occupational safety and health for chemical hazards (Cohen, 1990):

• Maximum levels above which worker exposure is prohibited.
• Exposure levels that trigger actions such as medical surveillance of workers.
• Comprehensive labelling.
• Protective equipment and control procedures.
• Access by employees to company records and to chemical hazard information.
• Employee training on safe handling of chemicals.

Thus evolution of principles regarding the safety of workers has marked a long trajectory. From a simple principle of payment of minimal compensation for damage to life and limb, workers’ struggles have forced employers and government to accept that it is work systems which are responsible for the creation of hazards. Thus a set of principles have emerged which not only speak of compensation and treatment but also of the need to reorganize work so as to prevent injury and disease. These principles have been further advanced by the activity of environmentalists who have linked hazards at the workplace to pollution outside and have built a bridge between workers and citizens to influence the manner in which production and technological decisions are taken. However, as society has changed, new production technologies have emerged giving rise to new hazards and it is possible that the established principles of health and safety at work may not be adequate. These rapid changes in contemporary society are discussed in the next section.

**CHANGING SOCIETIES**

Changes in society are the basis on which the foundations of labour safety are established. As Berman (1978), commenting on the situation in USA, notes, ‘In the first two decades of this century, monopoly corporations such as US Steel responded to the movement around occupational safety and health by setting up a business-controlled “compensation-safety apparatus”, a stalling operation which, by appearing to be doing something, withheld the issue of working conditions from the public agenda until the late 1960s...In fact, the workers’ compensation system stabilized compensation costs to employers at 1 percent of payroll by almost totally ignoring the problems of long-term disability, occupational disease, and worker rehabilitation. By setting up a closed
compensation bureaucracy, companies avoided the costs and embarrassments of jury trials.’ In other words, investments in safety and compensation were determined by costs, and labour agitation on these issues also meant increased costs to the company.

It was after the massive (and disastrous) strike by steelworkers in 1902 that the steelmakers started reorganizing the industry. It should be noted that it was a time when steel was in massive demand and provided the basis for industrialization and transport. Physical labour was replaced by huge electrical cranes and intricate intra-plant railway systems. Gigantic new furnaces and heaters were built, while formerly separate operations were integrated into single complexes. Production was carried out under military-style chains of command and skilled workers were demoted to semi-skilled status. Union activists were fired and socialists blacklisted or driven underground. The dirtiest and most unpleasant jobs were filled by blacks and immigrants. The pace of work was speeded up beyond belief and the effect on working conditions was disastrous (Herman, 1978). The entire effort was geared to produce as much steel as possible as cheaply as possible.

there is a direct relationship between the mechanisms and policies of international financial agencies and the worsening of working conditions in areas most compliant to models of development based on market criteria

Other industrial sectors followed the lead given by the steel industry. One of the most profitable was the chemicals industry and the two world wars witnessed a huge expansion in the number of chemicals in the workplace and the environment. Petroleum, petrochemicals, and automobiles began to replace steel and railroad as the premier areas for investment. Computing machines and systems transformed the nature of work in offices. The profits from the incredible productivity increases were gradually cornered by fewer and fewer large corporations. Independent farmers and small businesses were marginalized by the alliance of big business with big banks. Such was the magnitude of the industrial explosion that it was estimated in 1988 that between 20 to 400 billion pounds of toxic substances were being emitted to air, land, and water. The Federal government was forced to set up 1,219 Superfund sites, costing more than $100 billion over some decades, to deal with the waste. These disposal sites did not include those of the States and the military, and the budgets did not include the industrial and social costs (Cohen, 1990). Toxic-related jobs were declining but the profits from and production of toxics were rising. Toxic production had become a global enterprise for US Corporations (PHI, 1993).

Trends in the American economy were similar to those that emerged in Europe and, later, in the rest of the world. For instance, in 1985, Intel dismissed 6000 employees, abandoned the memory business to the Japanese, and wagered its future on the 386 microprocessor (SWOP, 1994). A few years later Intel abandoned everything for the Pentium even though senior managers knew that within six years or so the Pentium would be outdated. The rapidly changing nature of the industry, therefore, made hiring and firing the norm. The industry preferred to hire small, female workers of colour who were seen to be more passive, obedient, and easier to manage. Hence, unionization was strictly controlled in the microelectronics industry and the labour force was purposely
divided by race, nationality, and language. Such a work organization not only prompted
the physical movement of the industry to the less developed nations, where wages were
lower and health issues of less concern, but also submerged the health and safety issues,
particularly those related to exposure to glycol ether used as solvents.

As the Permanent People’s Tribunal observed in its 1988 verdict delivered at Berlin,
there is a direct relationship between the mechanisms and policies of international
financial agencies and the worsening of working conditions in areas most compliant to
models of development based on market criteria (PPT, 1992). The Tribunal was receiving
evidence on industrial and environmental hazards and the violation of human rights at its
session at Bhopal in 1992, where it heard several cases from different parts of the world.
Among these were the case of spraying Agent Orange in Vietnam to destroy 14 per cent
of the South’s woody vegetative cover, and the large-scale mining by Benguet
Corporation in the Philippines. Also presented at the session were studies of the effect of
methyl mercury discharges in Japan, the mining by Asian Rare Earths in Malaysia, the
occupational health of textile workers in South Korea and Sri Lanka, the occurrence of
silicosis in workers in Thailand and India, and the incidence of occupational deaths in
factories in Taiwan and the People’s Republic of China.

Even in India, there were parallel patterns. A review of industrial development up to
the late eighties (Qadeer, 1989) revealed that there had been significant diversification,
leading to an increase in the industrial work force, particularly in the unorganized sector.
The new industries had a faster growth rate and were also more hazardous, as shown by
accident records. Thus, the risk to workers had increased because of new and unfamiliar
technologies at the workplace. The majority of the labour force came from the
impoverished migrating peasantry, and those with a better bargaining power, that is, from
the middle and upper castes, dominated the jobs. Women and children had a lower status
at work, while gender, caste, and regional identities were used to divide the workers.

In the nineties there was an impressive growth in the Indian plastics industry, higher
than anywhere else in the world (MOEF, 1997). The use of plastics was spreading in
virtually all high-growth sectors of the economy—in infrastructure, agriculture, building
and construction, telecommunications, consumer goods, packaging, health and medicare.
From 1.88 million tonnes in 1995–96, the demand was expected to cross 4 million tonnes
by 2001–02, even though India’s materials recycling rate of 60 per cent is the highest in
the world. The PVC industry, in particular, was set to vastly expand production as
plastics were replacing traditional materials and creating new markets. For this purpose,
large-scale chlorine-based units were being built on greenfield sites in Gujarat. This was
part of the rapid, unplanned growth of the chemical manufacturing sector in India. The
industry planned to deal with the increased waste crisis by promoting recycling, but this
would only postpone eventual disposal in landfills and incinerators (Greenpeace, 1996).

What is of particular interest in India is the attempt to amend various laws to make the
economy more ‘compatible’ with the global one (IFT, 1999). The proposed changes in
the Factories Act, Trade Union Act, Contract Workers (Abolition and Regulation) Act,
and Industrial Disputes Act ‘indicate the confluence of interests of the Indian capitalist
class and the Indian State’. The convergence of interests is further illustrated by the
report of the Task Force of Indian Trade and Industry, the Ninth Plan document, and the
mandate of the Second National Commission on Labour: all arguing for making the
labour market more ‘flexible’. This is further supported by the recommendations of the Task Force on Administrative and Legal Simplifications—a task force exclusively constituted from the ranks of the big Indian industrial houses—as well as those of the Task Force on Knowledge-Based Industries. Roy, gives examples from New Zealand, Japan, South Korea, and India, to argue that the changes in labour laws taking place in Asia are meant to minimize the legal protection of employment and conditions of work as well as to reduce the legal right and power of unions to bargain for wages and conditions of employment and work (IFT, 1999).

All these changes in society and technology clearly indicate that workers are beginning to face new dangers which need not necessarily fit into the traditional classification of occupational hazards as defined earlier. We shall now briefly consider what these new hazards are.

**NEW HAZARDS**

Workers often do not know what it is that they are handling and what are its toxic effects. Many effects are discovered only after long periods of exposure and the actual incidence of disease in workers or animals.

One of the major hazards is the growth of chemicals in the workplace. According to various estimates, there maybe as many as 100,000 different branded chemicals being used by workers and over 3,000 new chemicals are introduced every year. Only a fraction of these have been adequately identified and studied for their health effects. For instance, Threshold Level Values have been published for only 500 chemicals, while some provisions have been codified for their use and storage, packaging, labelling, and transport. There is no legal control for the introduction of new chemicals. Nor is there a requirement for disclosure of trade names (Mathews, 1985). Hence, workers often do not know what it is that they are handling and what are its toxic effects. Many effects are discovered only after long periods of exposure and the actual incidence of disease in workers or animals. Thus, cancer in coke oven workers was detected on the basis of a study of mortality data over almost 100 years, and the first US regulations were issued only in 1977. Similarly, the carcinogenic effects of Vinyl Chloride Monomer were noticed quite accidentally in 1970 in an experiment with rats, but it was only when deaths occurred in a Goodrich factory that the exposure limits were reduced dramatically from 500 to 1ppm. In the case of poly vinyl chloride, the product itself is a poison, containing a wide variety of cancer causing and hormone disrupting chemicals as additives (Greenpeace, 1996).

Chemicals are also being widely used in agri-business. Farmers and farm workers are exposed to more and higher levels of pesticides than any other segment of the population, both at work and at home. But there is little information about the incidence or the extent of exposure. Birth defects are suspected but there is insufficient chronic toxicity testing (Goldburg, 1990). The use of chemicals in the Vietnam war to defoliate the land is known to have released large quantities of dioxin—one of the most toxic compounds known (PPT, 1992). There are now reports that Monsanto is marketing the same
chemicals for domestic and commercial use as weed killers. The presence of herbicides in ground water is now widely documented. These include atrazine, triazines, metribuzin, metalochlor, and trifluralin—all of which are now the subjects of herbicide tolerance research. In other words, the latest trends in biotechnology are going to increase the use of chemical toxins to kill weeds and pests, which is going to increase the exposure levels of the workers manufacturing and applying these chemicals.

Another growing area of chemical use is the manufacture of microelectronic components, now perceived as the basis for the third industrial revolution. Studies of women in the telecom industry have documented a miscarriage rate double that of women outside. These women were exposed to glycol ether widely used as solvents in the industry. The actual health effects in a small group of 7–8 women in GTE Lenkurt covered an amazing range of diseases: carpal tunnel syndrome, reflex sympathetic distropy, headaches, fatigue, memory loss, attention switching and poor attention spans, slowed reflexes, encephalopathy, positive MRIs (of the brain), hypothyroidism, adrenal gland failure, colour pulps, lupus, cancer, menstrual problems, cervical precancerous tissue, reactive airway disease, multiple chemical sensitivities, high liver readings, sinus surgery, irritability, depression, anxiety, and higher rates of infection. Solvent induced encephalopathy, in fact, is known to induce changes in personality and intellect. This has to be coupled with the existence of a dynamic industry with short term workers and new combinations of chemicals. Since the effects are cumulative over time, the damage may be done long before the worker becomes aware of the danger (SWOP, 1994).

The telecom industry has also given rise to radio frequency and microwave radiations in the 100Hz to 300GHz range. The health effects of these radiations are fiercely contested. Independent scientists say that they have all-pervading biological effects, particularly on fundamental cellular processes. Studies on animals have demonstrated genetic effects, cancer, reproductive effects, cataracts, nervous system effects, blood forming system effects, and immune system effects (Mathews, 1985). However, the industry claims that the effects are local and mediated by heating. Instead of following the precautionary principle and funding research to investigate the actual impacts on worker safety and health—both in the office and the factory—the industry is frenetically pushing a high growth strategy. Coupled with the advances in information technology is the growth of Repetitive Strain Injuries, as workers cope with boring, repetitive tasks in cramped spaces. The overuse of certain muscles and tendons leads to strain. There is a physiological cost to what has been described as a ‘permanent state of arousal’ (Mathews, 1985). This reflects in the greater risk of accidents due to fatigue and long-term organic disease and body changes. It is part of the new technological development which increases mental and physical pressure on workers.

What is of greater concern as a new hazard is how these developments affect the availability of work itself. As the Public Health Institute and the Labour Institute demonstrate (PHI, 1993) in USA, toxic-related jobs may be high paying but are in decline. The loss of a job not only means financial disaster to the worker but also increases the levels of death and violent crimes. Even a full time job does not yield security because wages could be low enough or the tenure of employment short enough to bring the worker below the poverty level. As industry reorganizes to move capital into more profitable areas, it is not only toxic-related jobs that are at stake. New
documentation in India indicates that the incidence of closure is increasing (CWM, 1998). What is common to these closures is the deliberate mismanagement by employers, the collusion by financial institutions and regulatory institutions, and the rejection of worker-proposed plans for revival. In a way it is reminiscent of the trends in the US at the beginning of the century when competition was controlled through an alliance of big business with banks and the federal government, forestalling unionization through welfare and mechanization.

**what is common to these closures is the deliberate mismanagement by employers, the collusion by financial institutions and regulatory institutions, and the rejection of worker-proposed plans for revival**

For instance, the Bharat Gold Mines Limited at Kolar, with a peak employment of 36,000 workers, was branded sick in 1992 and put up before the Board of Industrial Financing and Restructuring (BIFR) for possible revival or closure. An independent detailed study of the unit indicated that the mines were still viable but had been deliberately allowed to deteriorate through ill advised and untenable diversification and the use of a faulty process of extraction. There had been inadequate asset utilization and no investment in research and development since 1962. However, various proposals for revival were rejected by the BIFR and the eventual aim of the management appears to be to sell the mines to a foreign company once the labour force has been reduced to 2,500 workers. The proposed joint venture with a foreign firm envisages introduction of a technology which is already existing in the mines, and extraction of gold from the old dumps. However, the Memorandum of Understanding also provides for prospecting leases. Which means that there may still be ore reserves which are extractable from viable depths. Studies conducted by the Geological Survey in this regard have not been made public and this further strengthens the suspicion of collusion.

Such processes of disinvestment are being advocated all over the public sector, but they are also implicit in the private sector. Thus, Kamani Engineering Corporation in Mumbai became sick due to financial mismanagement in the mid-seventies. The Public Financial Institutions with a stake in the company, took over control in 1975, through the intervention of the Kamani Employees Union, and there was a dramatic turnaround in the fortunes of the company. But in 1992 the management was subverted by another private company, the R.P.Goenka Group, which raised its stakes through a questionable merger and then began to divest the Kamani company of its revenues and capital assets. The Public Financial Institutions have abdicated their responsibilities and the survival of 20,000 workers and a Rs.1 billion-company is at stake. Similar cases have been documented by the Centre for Workers’ Management for Oriental Power Cables at Kota, Kirpal Ispat at Gorakhpur, Deepak Insulated Cable in Mysore, Ganga Vanaspati in Durgawati, and Saha Keil of Hosur. When conjoined with the number of factories closed down on environmental grounds by court orders, it is clear that hundreds of thousands of workers are facing job losses. In many ways, loss of work is the biggest work hazard.

It is, therefore, clear that new principles of work safety have to be evolved in order to meet the new and emerging hazards which face workers in contemporary society. What could these principles be?
EMERGING PRINCIPLES

Two decades ago it had become fairly clear that it was not enough to demand the right to available information. Equally, if not more, important was the implementation of an honest national data-gathering procedure which would avoid wasting limited health and safety resources on trivia (Berman, 1978). However, such a procedure has still not become a regulatory requirement in any country. In India, the data on occupational injury and disease remains hopelessly inadequate and there is little or no funding available to sponsor research in these areas. Incipient public efforts to obtain data remain confined to lobbying for a Right to Information legislation (Mander, 1999).

Disclosure of all available information still remains an extremely valuable principle, particularly in the context of the huge number of untested chemical substances present in the workplace. But the demand for disclosure is no longer confined to the health effects of the substance. New principles are emerging for a cradle-to-grave approach, in which information is provided about where and when the chemicals are going. In addition, preparation for worst-case scenarios of accidents and releases is becoming a mandatory requirement (SWOP, 1994). Such an approach has been adopted in what are known as the Silicon Principles for the microelectronics industry:

- Establish a comprehensive toxics use reduction programme
- Develop health and safety education programmes and health monitoring
- Work with local communities to establish ‘Good Neighbour Agreements’.
- Implement Worker Improvement Programmes and Economic Impact Statements.
- Support National Research and Development policy directed by civilian (as opposed to military) needs
- Establish corporate policies requiring equal standards for sub-contractors and suppliers.
- Establish corporate standards that are enforced equally, domestically and internationally.
- Establish a life-cycle approach to all manufacturing, from Research and Development to Disposal.
- Work closely with local communities and workers to ensure full oversight and participation.

These principles are supported by three other requirements relating to the protection of work and security:

- Open, binding commitment goals for employment.
- Affirmative action in hiring at all levels.
- Benefits packages to include medical benefits and child-care services.

Greenpeace International has proposed three similar principles for toxics reduction (Greenpeace, 1996):
- Search for substitutes and alternatives.
• Increase funding for pollution monitoring and control.
• Re-evaluate all materials and processes to reduce use and release of persistent, toxic pollutants.

Both these approaches support victim’s assertions as documented at the hearings of the Permanent People’s Tribunal (PPT, 1992):

• I do not want to be a victim; steps must be taken to guard against victimization.
  • If I am a victim I want all available help from industry, government, and the community.
• I do not want to be re-victimized by governments, companies, courts, and the medical and legal professions.

Based on these assertions, the Tribunal set out four major findings as follows:
• The clear violation of universally recognized human rights of victims—the right to life, the right to health, the right to livelihood and the right to a healthy, pollution free environment.
• The inadequacy of the law and legal procedures and existing regulatory mechanisms to prevent such violations, to provide redress to victims and to punish those responsible for violations.
• The irresponsibility of those engaged in various industrial and other hazardous activities, which involve release of toxic substances or making of products injurious to human health and the environment, in failing to exercise a duty of care to those afflicted by such activities.
• The positive role of victims’ organizations and human rights activists in struggling to create countervailing power to enable victims to obtain redress and to press for the accountability of those responsible for causing death and damage.

The Tribunal proceeded to further lay out a strategy for providing adequate protection against these human rights violations, inadequacy of the law, and irresponsible behaviour:

• Formulating legally enforceable rights to life, health, livelihood, and healthy environment.
  • Strengthening legal and regulatory mechanisms accordingly.
  • Asserting the right to information of workers and the community.
  • Strengthening the public capacity to monitor.

At a seminar on the Sick Industrial Companies Bill held in New Delhi, organized by the Centre for Workers’ Management (CWM, 1998), several recommendations were made by the participants regarding how sickness should be defined and what could be done to protect jobs. These may be summarized as follows:

the biggest threat to a worker’s life is the possibility of having no work at all, or having work that creates products that are dangerous to the entire community
• Define industrial sickness using the net worth concept
  • Potential sickness should be flagged where the net worth drops to 50 per cent of equity
  • A tripartite mechanism has to be set up for monitoring incipient and potential sickness
  • The reference to BIFR has to be mandatory with the responsibility lying with the management but the right of referral has to be extended to all interested parties
  • The responsibility for providing full information to BIFR lies with the company
  • The revival scheme should be assessed on the basis of techno-economic criteria, not on the financial interests of secured creditors
  • The BIFR should ensure that all concerned interests are heard and protected, expert assistance is engaged, and the financial institutions cooperate
  • There should be a deterrent for defaulting on commitments
  • There should be continuous and regular monitoring of revival procedures
  • The BIFR should have the status of a civil court for enforcement
  • There should be complete participation of workers in rehabilitation or sale in all BIFR proceedings
  • The workers have a right to all information
  • When exercising their right to take over a sick unit, special consideration should be given to workers’ equity.

When all these recommendations are put together what emerges are principles of safety which translate into a veritable Charter of Rights for workers which may be enumerated as follows:

• Right to work and to participate in all decisions regarding the security and safety of work.
  • Right to determine and regulate socially safe products, materials, equipment, and processes in all work.
  • Right to organize without fear of victimisation.
  • Right to collect all information, particularly with respect to the nature of long-term hazards, and the accuracy of reporting and evaluating systems.
  • Right to competent and safe co-workers, supervisors, managers, researchers, and experts.
  • Right to health, both within and without the workplace.
  • Right to prosecute irresponsible authorities, managers, and polluters.

Such a Charter of Rights is clearly a major advance on the hitherto restricted understanding of health and safety at work, primarily because it takes the concept of safety and health out of the persona of the worker alone and locates it firmly within the realm of production in society. Thus, it recognizes that the biggest threat to a worker’s life is the possibility of having no work at all, or having work that creates products that are dangerous to the entire community. This is a universal vision of health and safety, and such a vision challenges those basic social forces which determine how a society may
grow. In other words, it no longer focuses on the harm to the individual worker but on the potential destruction of the whole world.

REFERENCES


Achievements in Consumer Product Safety and the Challenges of Globalization

Wim Rogmans

INTRODUCTION

This paper reviews the achievements in consumer product safety measures since the early seventies and looks into the perspectives of global markets. It will also address the opportunities and threats of liberalization of markets, in view of ensuring the provision of a sustainable development of minimum safety requirements an extending part of the world’s population.

This paper presents a short review of the development of product safety policies in the West since the seventies and a summary of basic regulatory tools for ensuring effective product safety policy, a bird’s-eye view on the main domains of regulatory activities related to consumer product safety. Lessons will be drawn on what works in product safety regulation and what does not. Finally, developments in regulatory policies in the nineties, initiated in view of the growing internationalization of trade and commerce, are discussed. These developments are clearly linked with the globalization of markets and may contribute to a wider sharing of the attainments in the West in the field of consumer product safety.

In this paper consumer product safety is to be understood as being related to non-food products. Compared to food regulations the history of the regulation of non-food products is shorter. It is only in this century that non-food products are being regulated, although not unambiguously, under a separate body of law, enforcement and international exchange. Irrespective of the critical events that we still witness in the food sector nowadays, the regulation and control of food has matured much more and has become more consistent than it has for non-food. Within the category of non-foods, medicinal drugs and motor-vehicles as fields of interest have been excluded, as there are well-developed, separate structures for regulation and control in these areas (Drug Control Agencies and Transport Safety Agencies, respectively).

The concept of consumer products has a wider scope in this paper than that of some product safety agencies, as it includes the entire domestic environment, i.e. private dwellings and neighbourhood environment, such as play yards and schools. By including these locations, the concept of ‘consumer product safety’ encompasses the domain also referred to as ‘home and leisure area’. However, it does not include work-and traffic-related safety issues. It is evident that these boundaries cannot be drawn too rigidly, as there are apparent overlaps, such as injuries related to bicycling which can be classified as a leisure activity but is often transport-related also.
The focus here is on consumer product safety measures, voluntary or mandatory measures that aim at improving the inherent and physical characteristics of a product or of environmental features, in order to lower the risk of an injury event or the severity of injury outcome. These measures typically focus on those that Haddon (1980) claimed to be more effective, such as separating vulnerable risk groups from harmful agents (fencing, guarding, increasing child resistance to packaging) and reducing the impact of energy transfer during the injury event (providing risk groups with shock absorbing materials, such as helmets and shin guards, or improving the shock absorption capacity of environmental features such as floor coverings and playground surfaces). Measures that aim at changing risk group’s behaviour towards safer handling dangerous situations, are out of the scope of this paper, as these are covered by information campaigns, educational programmes and community interventions. However, in this respect again a sharp distinction is sometimes difficult to make, as a number of interventions include environmental adaptations as well. (Recent reviews of such programmes refer to Towner et al., 1993 and Svanström, 1999).

A final limitation of this review is caused by the fact that most consumer product safety initiatives have been developed and implemented in high income countries, mostly OECD member states (North America, western Europe, Japan and Australia in particular). It is evident that safety has its price and even in high income countries the willingness to pay that price is not unlimited.

authorities of the EU member states are bound to monitor the compliance of products with the general requirements and to adopt wide-ranging powers of regulatory control

For the time being we have to learn our lessons mainly from experiences in the high income countries, not ignoring the fact that increasing globalization of markets will facilitate opportunities for low income countries as well.

PRODUCT SAFETY POLICY: DEVELOPMENT OF REGULATORY FRAMEWORK

Protection of health and safety of consumers by means of product safety regulation was an important governmental concern long before the development of product safety as a separate policy sector was. However, regulatory and monitoring activities in this field, which in many countries date to the turn of the century, concentrated on certain specific product areas—food and pharmaceutical products. On a piecemeal basis other specific product groups, such as electrical and gas appliances, were added to the body of statutory requirements.

Consumer concerns

Changing consumption patterns and the availability of large quantities of technically complex consumer products in the post-war period of economic recovery, prompted a
more systematic and consistent approach of product safety issues. In past decades, most industrialized countries incorporated four categories of basic actions in their product safety policies, i.e. (OECD, 1983):

- preparatory action: surveillance of consumer products on the market in order to identify product hazards
- regulatory action: development of product related safety standards and regulations
- monitoring action: inspection and testing of consumer products to ascertain compliance with existing safety standards
- corrective action: immediate intervention in case of the detection of unexpected hazards and defective products.

These developments were inspired by the growing recognition of consumer concerns in the sixties, which led to the creation of private and semi-public consumer organizations. In USA, vocal leaders attracted the attention of the press and Congress, on the issue of automobile safety. In western Europe family organizations started a consumer movement in the early fifties, followed by cooperative movements and trade unions in the sixties. Finally, consumer organizations established themselves as private bodies, often supported by public grants, and developed an important service business. Examples are Consumers Association (UK), Consumentenbond (NL) and Stiftung Warentest (Germany).

The growing economic and political importance of the consumer movement in the sixties prompted governments to incorporate consumer viewpoint in policy development and to protect consumer interest through adequate regulation and enforcement. It was also a response to statistical evidence that safety concerns of public authorities should not be limited to traditional domains, but also encompasses the area of product-related injuries: evidence which is still valid today (Table 1).

Table 1

Comparative statistics (USA-EU) on the three traditional safety domains (work, traffic and consumer product related)

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<tr>
<th></th>
<th>Eu</th>
<th>UbA</th>
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<tbody>
<tr>
<td></td>
<td>GBP</td>
<td>$</td>
</tr>
<tr>
<td><strong>Work related:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>deaths</td>
<td>6,000</td>
<td>6,500</td>
</tr>
<tr>
<td>injuries</td>
<td>10 million</td>
<td>1 3,2 million</td>
</tr>
<tr>
<td>estimated costs</td>
<td>96 billion GBP</td>
<td>1 45 billion $</td>
</tr>
<tr>
<td><strong>Traffic related:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>deaths</td>
<td>45,000</td>
<td>42,000</td>
</tr>
<tr>
<td>injuries</td>
<td>3 million</td>
<td>3,4 million</td>
</tr>
</tbody>
</table>
The response of governments generally took the form of the creation of a separate consumer policy unit, often within the trade department, the creation of advisory bodies such as a consumer affairs councils and the establishment of specialized agencies for consumer product safety.

**General Safety Acts**

For Consumer Product Safety Policy, the year 1972 may be considered as an important milestone as this was the year in which the US Consumer Product Safety Commission was created, and in Europe (Paris), the heads of states of the European Communities agreed on the basic rights of consumers, granting the highest priority to the right of safety and establishing an independent service for consumer safety within the European Commission.

Concurrent with these institutional frameworks, new regulatory frameworks were introduced by means of general ‘product safety acts’. In principle these acts apply to a wide range of products and in addition provide powers to establish safety requirements on a product by product basis. The available penalties under these laws vary in severity and include fines, legal provisions for product recall and bans.

General laws of this type were introduced firstly in Canada (Hazardous Product Act, 1969) and USA (Consumer Product Safety Act, 1972), followed by the UK (Consumer Safety Act in 1978, revised and integrated into the Consumer Protection Act in 1987) and the Consumer Product Safety Act in Japan in 1984 (Table 2). In other countries, such as Germany and the Netherlands, the general product safety requirements were included in framework regulation that had originally been designed for a broader policy domain, such as the safety of work equipment (Germany) or the safety of foods and other commodities (Netherlands). In the European region, the General Product Safety Directive (GPSD) promulgated by the European Community in 1992, is intended to harmonize the European member states’ current general safety regulations. It imposes on producers to market safe products exclusively and to provide customers with the relevant information, in order to enable them to assess the risks inherent in a product in normal or reasonably foreseeable use. They must also monitor in an adequate way the safety of products put on the market and take appropriate action (including withdrawal of products from the market) to avoid safety problems.

\[
\begin{array}{ll}
\text{estimated costs} & 195 \text{ billion GBP} & 150.5 \text{ billion $} \\
\text{deaths} & 80,000 & 22,000^2 \\
\text{injuries} & 40 \text{ million} & 29.5 \text{ million}^2 \\
\text{estimated costs} & 70 \text{ billion}^1 & 400 \text{ billion $}^3 \\
\end{array}
\]

\(^1\) medical costs only \(^2\) product related injuries under CPSC’s jurisdiction only \(^1\) direct and indirect costs such as suffering and lost earnings

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the important pre-condition remains that all parties concerned can contribute to the rule/standard-making process.

Authorities of the EU member states are bound to monitor the compliance of products with the general requirements and to adopt wide-ranging powers of regulatory control. In case of conflicting approaches among the Member States, the European

Table 2

Summary of relevant consumer product safety legislation in EU (and UK, France, Germany, specified at national levels) and in USA, Japan and Australia

<table>
<thead>
<tr>
<th>REGION/COUNTRY</th>
<th>EUROPEAN UNION</th>
<th>UK</th>
<th>FRANCE</th>
<th>GERMANY</th>
<th>USA</th>
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<tbody>
<tr>
<td></td>
<td>Special Directives</td>
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<td></td>
<td>Low Voltage (1973)</td>
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<td>+ State</td>
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<td></td>
<td>Aerosols (1975)</td>
<td></td>
<td></td>
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<td>Flamm.</td>
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<tr>
<td></td>
<td>Pressure Vessels (1987)</td>
<td></td>
<td></td>
<td></td>
<td>Fabrics</td>
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<tr>
<td></td>
<td>Food Imitations (1987)</td>
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<td>Fed</td>
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<td></td>
<td>Toys (1988)</td>
<td></td>
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<td></td>
<td>Hazard</td>
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<tr>
<td></td>
<td>Machinery (1989)</td>
<td></td>
<td></td>
<td></td>
<td>Substar</td>
</tr>
<tr>
<td></td>
<td>Gas Appliances (1990)</td>
<td></td>
<td></td>
<td></td>
<td>Prevent</td>
</tr>
<tr>
<td>Main Responsible Authority</td>
<td>DG Consumer Policy and Consumer</td>
<td>Dept. Trade and Industry (Consumer)</td>
<td>DG de la Consairrance, de la</td>
<td>Ministery of Labour and Social Affairs</td>
<td>US</td>
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Achievements in consumer product safety 239
Commission consults a Committee on Product Safety Emergencies, upon the conclusion of which the Council of Ministers is entitled to take a final decision. How well thought these measures and mechanisms for interventions may appear, the crucial issue in the EU today remains the lack of a proper implementation of the GPSD in national law, in national enforcement practice and in efficient decision-making processes at EU-level. In general there is still a North-South-division in Western Europe as regards the quality of product safety control and the Commission lacks competent steering power in solving safety disputes among member states efficiently (Micklitz, 1990).

Although the GPSD provides, in theory at least) national authorities with a powerful tool to intervene in case of unreasonable failures in product/service delivery to consumers, it also needs further upgrading (CEG, 1998; Rogmans, 1999) by:

- establishing a duty for producers to inform (notify) authorities at once in case of a safety problem
- requiring member states to adopt powers to recall or ban products in case of an emergency

majority of these regulations focus on construction safety and fire-resistance only…Since most of the critical features, such as stairways and domestic appliances, are implemented in the stage of final construction and habitation, enforcement and control are most inadequate.
• improving the transparency and rapidity of information exchange and subsequent decision making (including an upgrade of risk assessment methodologies)
• using stricter guidelines for the application, design, durability and limitations of warnings and safety instructions provided with the products.

These recommendations are also valid for general safety acts in other regions such as Japan and Australia. The US act may serve as a model in this respect.

**Specific regulations**

Since the turn of this century specific product regulations were introduced on a piecemeal basis. Consequently, in addition to the general safety act (CPSA of 1982) the US-CPSC administers the more specific rules related to the Federal Hazardous Substances Act, the Flammable Fabrics Act, the Poison Prevention Act and the Refrigerator Safety Act (Table 2).

In the EU-region the piecemeal-approach has resulted in a wide range of (high risk) product category-specific Directives, a number of which are relevant for consumer safety, e.g. the directives on electrical appliances (Low Voltage Directive), toys and power equipment (‘machinery’). The majority of these directives have been (re-)designed in accordance with the so-called ‘new approach’ with respect to harmonization of European Community legislation. The former approach of harmonization consisted of a long and cumbersome process of full and detailed integration of all parts and parcels of individual member state’s legislation into harmonized community legislation. The core elements of the ‘new approach’ are (Brack, 1999):

• European product law is limited to so-called *fundamental legal requirements* concerning the safety of (groups of) products with regard to the health of product users;
  • these abstract, rather vague, fundamental prescriptions are worked out in further *technical* detail by appointed European normalization organizations which deliver *standards*;
  • all products marketed in any of the EU member states must conform with the fundamental legal safety requirements, which ought to be indicated by the CE-mark (‘Conformité Européenne’) on each commodity, which conformity with technical standardized specifications is optional, not mandatory
  • the mandatory legal part of this product law system of rules is linked to the optional technical standardization part of the system by the concept of presumption of conformity.

A product is presumed to conform to fundamental legal requirements if it is manufactured according to the standardized specifications issued by the officially appointed standardization bodies, i.e. the Comité Européen de Normalization (CEN) and the Comité Européen de Normalisation Electrotechnique (CENELEC). The key concept of the presumption of conformity demonstrates clearly that the proper functioning of this ‘new approach’ depends greatly upon the work that is being done within the normalization
organizations. They are responsible for the conscientious interpretation and analysis of abstract legal safety requirements in order to transform them into workable specifications.

The process of delegating the definition of technical details to private standardization bodies is being regarded by some observers as privatization of the rule making powers (Brack, 1999). Others underline the opportunities this process may offer for speeding up the process of standardization and for increasing the flexibility of technical specifications in response to market development. The important pre-condition remains that all parties concerned can contribute to the rule/standard-making process, a reason why the European Commission supports the input from consumer, experts in this process through the coordinating body, ANEC. However, even in case of a product category as vital as ‘toys’, the result of consumer expert input in the standardization process appears to be very limited (Petre, 1995).

**Liability regulations**

Concurrent with the evolution of a more consistent set of ‘preventive’ regulations, the ‘strict liability’—principle made its entrance into courtrooms in the late sixties. Liability schemes had been available in most countries for many decades and were intended to provide consumers with a just compensation for damage and injuries incurred and to deter producers of goods and services from delivering sub-standard quality. Proof of failure in product safety had to be provided by the plaintiff and the plaintiff had to establish that the breach of the legal duty by the producer was due to negligence or fault (‘fault based’—liability or liability ‘under negligence’). However, under ‘strict liability’ the plaintiff does not need to show fault or negligence on the part of the defendant-manufacturer and the court’s focus shifts from the complicated study of the knowledge and behaviour of the manufacturer to the more simple and objective analysis of the characteristics of the product/service delivered. Some nations allow the defendants to defend themselves on the state-of-the-art or development risk principle, which protects them from liability with regard to defects in their products that were unknown at the time of production, given the then existing technology.

The impact of strict liability was significant in the USA in the seventies and led to what is described as the ‘product liability’-crisis: an outcry of business representatives, stating that product liability insurance was becoming either unobtainable or not affordable at all. A more careful study of the situation revealed that although the costs of product liability insurance did increase in the seventies, the average cost amounted to less than one per cent of sales in high-risk industries (Abott, 1980). It also concluded that strict liability and increased insurance costs forced many manufacturers of high-risk products to devote more time and resources to product liability cost prevention. Also insurers are providing high-risk companies with cost prevention advice more often and are including stricter requirements for quality assurance, including safety, in their insurance policies.

the wide use of blister packs has short-cut the need for further regulation in that domain, as it is assumed that blister packs reduce effectively the possibility for young children to get access to a potentially dangerous number of tablets
The European Liability Directive (1985), however, did not result in the same outcry as did US legislation in the seventies, which is particularly due to the fact that:

- the European Directive being ‘less strict’ than US-legislation, provided producers with a number of means of defence
- in Europe liability lawsuits are tried before judges (unlike in the USA before juries). Judges tend to adhere more strictly to the stipulations in the law and to be less tempted to award punitive damages
- contingent-fees (no cure-no pay), as claimed by attorneys in the USA, are not allowed in Europe
- in Western Europe the social security system in general covers already a greater part of the losses in income suffered by injured and/or disabled victims of product failures.

Naturally, business representatives and insurers were most vigilant when the debate on the European Liability Regulation commenced in the mid-seventies, however, a constructive dialogue resulted in a directive acceptable to both consumer advocates and business.

In many countries the implications of this strict liability for consumers, however, is still the subject of controversy (OECD, 1995). Many critics argue that the current developments in the product liability area have brought about higher prices for consumers, less innovation and a more litigious society, where individual responsibility is gradually being replaced by judicial policy-making. On the other hand strict liability creates strong incentives that influence business behaviour and performance towards greater responsibility, as well as a more diligent monitoring to prevent defective products from reaching the market place.

The policies of regulating product safety

In reconstructing the history of product safety policies and its evolution during the past decades, the process and the results seem to be well-organized and logical: a ‘triptych’ of legislative measures (first of all a general product safety regulation) secondly, a separate set of requirements for high risk categories and thirdly, compensation requirements in case of damage or injuries), including provisions for information gathering, market control, consumer information (e.g. labelling) and emergency measures (among which withdrawal of products) as well.

However, in most countries product safety regulation has been a highly political issue with strong ideological pressures during the last decades (Brannigan, 1991). The debate included both the question of whether any regulation is needed at all (Viscusi, 1984) and the issue of public authorities’ capacity to regulate and control product safety (Shavell, 1984).

The political conflict was sharpened by business lobbies, media pressure and consumer activism. The critical debate is on the interpretation of two basic consumer rights: the right to safety and the right to choose, which is one of the reasons why most regulations were initiated in response to critical events and pressures from public and industry, and a minor number by consistent risk assessment methodologies.
It is evident that the general safety legislation, which became effective in most countries in the late seventies and early eighties, amended a lot of gaps that the piecemeal approach and the resulting Vertical’ safety requirements left. This was not the result of a shift from a ‘freedom of choice’ ideology towards a ‘right to safety’ principle, but was clearly inspired by the advent of regional trade markets: it is the free-competition and free-trade principle that led to abolishing discriminating technical barriers to trade, i.e. bringing technical requirements for safety at a common level within the ‘single market’ of the EU and other trade blocks, such as NAFTA (USA, Canada and Mexico). This has been the most powerful force for governments to line up current product safety policies, to speed up the process of harmonising existing regulations (as the European Commission did through its ‘new approach’) and to promote international standardization through CEN and ISO-International Standardization Organization. It put product safety on the national and international agenda of the European Union member states, USA, Japan and Australia in particular and has resulted in a stronger and more consistent institutional and regulatory infrastructure for product safety.

**Single markets—single product safety regulations?**

Focusing now on the framework for safety regulations within the trade blocks, the question is how they succeeded in promoting inter-state trade, given the existing diversities in safety requirements that still exist among them. In this respect two examples, namely the US-model and the EC-approach, are instructive.

To many the US serves as the model of ‘one single market’. Yet the situation with respect to product safety is much more complex. Under the US Constitution, inter-state commerce should be free from any unreasonable burden of state interference. This may be viewed as being similar to the contents of Article 30 of the EU Treaty concerning national restrictions on trade between member states (Brannigan and Meeks, 1991). However, as under article 36 of the EU Treaty, the states of the USA are also free to set safety requirements for both internal and external products, unless the motive or effect would be discriminatory to out-of-state producers. Concerning inter-state trade, the federal government can nevertheless pre-empt any power of the state, but often federal statutes set minimum requirements only, allowing any state to set higher standards (for example, seat belt legislation). With regard to products regulated under the CPSA, however, the ruling is that in case a product safety standard is effective under the CPSA, no state shall have the authority to establish mandatory requirements, unless these are identical to the requirements of ‘the Federal Standard’.

The US-market in essence is a single market, but product safety is regulated at different levels and the respective states may respond to hazards in an entirely different way, reason why a dynamic tension between federal and state regulations is noticeable, almost a kind of competition on the opportunity to regulate, as the US-regulatory activity is highly political. Given the inherent openness of the US-governmental system (Freedom of Information Act) and effective public control on decision-making by administrative agencies (‘due process’ doctrine), this leads to a transparent process of risk analysis and decision making. It puts a halt effectively to unreasonable state actions and allows for a diversity of addressing safety issues according to local needs in terms of risks, demands
of industry and consumer expectations.

**product safety measures, through voluntary standards or mandatory regulations, cannot be implemented effectively without concurrent investments in raising risk-awareness, willingness to implement measures and in creating a sustainable culture of safety**

As regards establishing a European single market, until 1984 within the European Union the object was to fully harmonize the different technical regulations and standards. However, this approach proved to be unsuccessful due to the time-consuming and cumbersome procedures. It certainly was not realized for 50 per cent by the year 1993, the then magic year the EC had set as deadline for completing the internal market.

To speed up the process the ‘new approach’ was introduced in 1984 (see the section in this paper on Product safety policy: development of regulatory framework). An important feature of this approach is that member states are obliged to recognize products manufactured in other states in conformity with harmonized European standards or transposed national standards. In order to facilitate manufacturers to provide evidence of conformity to a new approach directive, the European Commission developed a complex system of conformity assessment and marketing approval. According to this system, for low risk products, such as ‘bandages’ and ‘toys’ (sic), a manufacturer’s declaration of conformity can be sufficient, whereas for more complex products, such as ‘chain saws’ and ‘circular saws’, assessment and certification by independent testing houses is required. These testing houses have to be approved by competent authorities for this purpose and notified to the Commission and other Member States and are therefore called ‘notified bodies’.

Unlike the US system, the EU kept focusing on the prerogatives of European legislation. Failing to implement these in detailed regulation, the EC invented the ‘solution’ of the presumption that national regulations and standards are not conflicting with European Directives and Standards, unless proven to be so by one of the member states. The end result is that as in USA, the European Union allows for different levels of regulation (federal vs. state), that reflect different levels of risk acceptance, standards and requirements. On top of that we have to mention the major differences in enforcement practices among EU member states (Micklitz, 1990; Sutherland, 1994).

**EFFECTIVENESS OF PRODUCT SAFETY MEASURES**

As stated earlier, product safety measures may deal with a vast array of environmental features and product characteristics that are relevant for ensuring safety at home and in leisure time. A large number of these measures have been initiated inspired by ‘common sense’ and are not being evaluated at all. The outcome of these measures is at best being monitored by authorities who consult routine statistics (and apply economic models such as the CPSC, who calculate the savings as a result of for example its standard for walk-behind mowers at $ 300 million per year), as well as feedback from professional groups such as the fire brigades in the case of fire prevention measures and the toxicology
centres with regard to poison prevention measures. This leaves us with a limited number of effectiveness studies reported in the literature only, which differ considerably in:

- problem area being addressed, e.g. the prevention of bath tub drowning, residential fires, or dental injuries in field hockey
- scientific rigour of the research design, mostly being pre-and post-tested only and randomized controlled trials being the exception

So far a consistent meta-analysis on product safety measures in general has not been performed, with the exception of the short study published by Vrijenhoek and Weperen (1997), who conclude that:

- effectiveness studies on product safety measures are scarcely being reported
- the majority of these reported studies measure the results in proxy measures, the relation of which with injury reduction targets is mostly defined vaguely
- the research design does not allow for unequivocal conclusions on the relation between trends and safety measures as introduced.

Irrespective of these flaws in rigour in research design, analysis and reporting, a great number of reported studies are instructive and several have been instrumental in implementing good practices worldwide. An example of the latter category is the mandatory provision of child safety closures for toxic household products (caustics for example), which after a successful introduction in the USA in 1970, has been adopted by most of the countries in the western hemisphere. But there are other instructive examples such as the successful introduction of smoke detectors, window guards and personal protective equipment (helmets, shin guards, mouth guards and so on).

In the following section we will briefly review a number of studies that we ordered with respect to subjects the primary field of application of which is either related to the domestic area (residential setting including domestic products) or to the community environment (schools, play grounds and recreational areas).

**Methods addressing the domestic environment and related products**

This section addresses measures that aim to improve the safety of private dwellings as well as specific products and appliances used in these. The review is certainly not exhaustive and will focus on the domestic environment, i.e. on building regulations and measures to control fire hazards, hazards of falling from windows or stairs and measures to control toxic risks.

**Building codes**

A large number of accidental injuries and deaths are related to environmental hazards at home, among which slippery surfaces, loose rugs, objects on floor, inadequate lightning, poorly designed stairs, flat glass in doors, substandard gas and electrical facilities.

In most countries building codes and standards intend to control a number of these hazards by setting minimum safety requirements. With the exception of the requirements for gas and electrical facilities (and the appliances, which are governed under separate international product regulations), the details in the building codes vary from country to country (Pauls, 1991), and even within countries uniformity is lacking, as in many cases.
the implementation of most technical details for private homes is left to local authorities. The majority of these codes lack clear cut minimum safety requirements for hazardous features such as stairs, windows, balconies, flat glass and hot water supply, regardless of the apparent effectiveness of these measures as we will see in the following sections.

Enforcement is another flaw in current building regulations. As in view of the aspect of safety the majority of these regulations focus on construction safety and fire-resistance only, enforcement is effected by construction engineers solely and only in the design and construction stages. Since most of the critical features, such as stairways and domestic appliances, are implemented in the stage of final construction and habitation, enforcement and control are most inadequate. The fact that the potential aspect of enforcement can be improved, is illustrated by a study in Massachusetts (Ghallangher et al., 1985). While conducting home safety inspections in accordance with the State Sanitary Code, this study found an average of 11.1 code violations per household. Follow-up visits revealed full correction of these violations, thus demonstrating the effectiveness of this approach.

**before introducing new product safety measures one should consider seriously any unforeseen side effects of regulations**

**Window guards and safety gates**

A guard is a most effective tool to prevent children from falling from windows or stairs. Studies have documented the importance of security windows and balconies. In New York city the ‘Children can’t Fly’ programme, by the implementation of window-guards on high-risk houses, brought about a 50 per cent drop of serious injuries and deaths due to window falls (Spiegel and Lindamann, 1977).

Gates on stairways are potentially very effective in preventing young children from falling, however, the major problem in most dwellings is how to find a way to attach them firmly, permanently mounted and closed child-proof (Joffer, 1988). This item should be part and parcel of standard building codes, whereas now parents are struggling with temporary provisions of dubious quality or, when the accordion-type of gates is used, of even greater risk—namely suffocation—than the hazard they intend to address.

**Fire safety**

Numerous studies have examined the efficacy of smoke-detector-give-away campaigns, with and without installation, or of low-cost purchase opportunities (Neily et al., 1993). Most of these campaigns addressed high-risk neighbourhoods, such as low-income and ethnic communities and neighbourhoods with a high proportion of children or elderly residents. These studies report favourable results although long-term compliance, for instance regular checks on batteries and proper maintenance, is weak. The potential efficacy of smoke alarms, which in the USA is reported to be at about 86 per cent of all fire deaths (Federal Emergency Agency, 1980) is thereby seriously hampered.

New technologies have made smoke detection more reliable as well as affordable at low costs. For this reason, undoubtedly, standard requirements for reliable smoke
detectors, which are installed properly with the mains connected, should be included in building codes, as it is reported already to be in half the number states in the US. In the European Union, Norway is the only country applying a national regulation in that respect.

Another measure that may reduce the damage of fires is by mandating the use of sprinkler systems in high-risk buildings, i.e. the old and wooden apartment houses and densely populated apartment buildings. By mandating cigarettes to be fire-safe and cigarette lighters to be child-safe, important ignition sources can also be addressed effectively. This is also true for regulating the flammability of children’s clothing as well as carpets and curtains. Most product safety authorities are struggling with introducing such legislation as the counter pressure from manufacturers is heavy and the evidence of the number of lives being saved as well as the amount of cost reductions achieved, are not incontestable.

Toxic household products and medicines

The regulation of the safety of packaging containing cleaners and pesticides for domestic purposes is one of the most evident success-stories in product safety. During a period of fifteen years the US-Poison Prevention Packaging Act (issued in 1970) resulted in a decline in the number of deaths by one-fifth the number reported before 1970. The PPPA also requires childproof containers for a number of medicinal drugs, including over-the-counter-drugs such as aspirins. Also in this respect the Act proved to be most effective and resulted in a decline of half the number of deaths and hospitalizations in this respect in ten years’ time (see among others Walton, 1982).

Inspired by this success almost all Western countries now have legal requirements for the childproof packaging of toxic domestic products. For medicinal drugs the wide use of blister packs has short-cut the need for further regulation in that domain, as it is assumed that blister packs reduce effectively the possibility for young children to get access to a potentially dangerous number of tablets. However, it would be advisable to provide the tablets in opaque plastic cells and sufficiently strong strip materials, to prevent children from opening them.

Unlike the dramatic reductions in poisonings by liquids and solids, poisoning by gases and vapours remains a huge problem. Carbon monoxide is the major cause of such poisonings, mainly due to gas operated water heaters installed in poorly ventilated homes (EC, 1998). Also unventilated space heaters are responsible for a significant number of deaths each year (CPSC, 1984). The advent of modern and central heating systems has reduced considerably the number of CO-deaths, as well as of deaths due to fires. However, in rural and low-income areas and in dwellings designed for temporary habitation (recreational homes) the CO-hazard remains an important threat. Regulation and regular control of heating systems should be enforced more strictly, while in addition the campaigns for installing CO-detectors should be promoted, similarly to the successful promotion of smoke detectors. Finally, there is a need to inform the new urban generation, that is unaware of the CO-risks, how to cope with the potentially lethal equipment in their temporary residences.
standardization process is not as flexible and rapid as expected and, even more so, still dominated by business interest and financing and therefore leads too often to rather biased end products

Measures addressing the community environment

This section looks somewhat beyond the domestic setting and addresses safety issues that are relevant in the wider community, such as safety at day care centres and schools, at playgrounds, of surface water in the neighbourhood and in swimming pools, on sport fields and while cycling.

Day care centres and schools

In most countries safety and health of day care centres is under the responsibility of health authorities, whereas that of elementary and secondary schools is under the educational authorities. Most of the safety requirements are included in a broader set of instructions that are part of the licensing contract between authorities and the centres/schools. In addition, in most countries the occupational safety and health requirements that employers are obliged to provide for their work force, apply to the educational sector as well (Laflamme and Menckel, 1997). However, this often leads to ambiguous situations, as the exact safety requirements are not made explicit to all parties at all times, nor is the enforcement responsibility clearly defined.

As a result of this in the day care centres and school environments lots of initiatives are left to the management itself and the local authorities, without proper exchange and synergy at a national level. An exception may be those countries that have mandatory insurance schemes for pupils and teachers alike, like Germany. These insurance schemes include important facilities for safety check programmes, teacher training and school education, as well as technical requirements for school buildings and equipment in use (BAGUV, 1996).

Not surprisingly the number of carefully evaluated school and day care safety programmes is very minor. This is due to the fragmentation of regulatory and enforcing powers, the culture and the professional attitudes in this particular setting, which reinforce self-control and auto-determination in managing educational centres. A new development is this respect is the certified inspection scheme based on agreed national standards of good practice (Weperen, 1998).

Playgrounds

Playground-related injuries constitute an important part of childhood trauma. Most of them are due to falls in play areas (collision with other children, stumbling) or falls from monkey bars or other equipment, reason why impact absorption of playground surfacing is the first and most effective measure one can take. There is ample evidence (Mayer, 1996; Sibert, 1999, Mott et al., 1997) that under specific conditions and maintenance requirements sand, wood chips and artificial surfaces (rubber tiles) can significantly reduce the severity. In most countries guidelines on playground surfacing are made available through safety agencies and standardization bodies, however, only in a few
countries these guidelines are made mandatory through regulation and enforcement schemes. This is also true in respect of requirements and standards set for playground equipment. Although a large number of guidelines for design, installation and maintenance are available nowadays, the majority of them are being applicable on a voluntary basis. Only in a few countries (like the Netherlands and the UK) regulations are effective and therefore also inspection schemes to enforce full compliance.

Contrary to the effectiveness of improving shock absorption of surface materials, the results of stricter requirements for playground equipment are less well proven. This does not imply, of course, that we can continue to expose young and vulnerable children to substandard and potentially hazardous equipment. For this reason many local authorities and an increasing number of national authorities are willing to implement the available guidelines and standards such as those of CEN (1997 and 1998) on a voluntary basis.

**Surface water**

Drowning rates are highest among pre-schoolers, while low income groups and some ethnic minorities are disproportionately affected as well. This may be due to greater exposure, insufficient swimming skills or lower risk-awareness. The majority of drowning among this age group occur in the neighbourhood, i.e. residential swimming pools, garden ponds and in nearby lakes, canals and ponds.

In Australia a few states apply compulsory requirements for private swimming pools to be provided with child-proof barriers (Dept. Local Gov., 1991; Pitt, 1991). Owing to its effectiveness the implementation has been also considered in other regions of the world, such as the USA. Studies by the US-CPSC indicate that a 70 per cent-reduction of private swimming pool drowning among young children may be achievable by fencing all private pools (Baxter, 1987).

These measures will not make adult supervision redundant, neither re-engineering of other hazardous areas in the neighbourhood, such as the water side of ponds, canals and lakes. Effective measures for lowering the risk for children of getting from the waterfront into surface waters are available (Jaartsveld, 1994) but are not yet included in a uniform set of standards for local authorities and urban designers.

**Sports**

Product safety measures in sports focus mainly on the design of effective protective equipment, such as helmets and braces and on improving the safety of sports accommodations and equipment. Examples of the latter are the provision of slip-resistant floors, improving the construction strength of equipment and optimizing impact absorption of landing pads. Another example in this category is the development of so-called ‘breakaway’-bases used in baseball and soft ball in order to reduce the damage of injuries due to collisions with ‘sports furniture’ (Janda et al., 1993).

Specific consumer products that have proven to help reducing the impact of injuries in sports are: horse riding helmets, mouth guards, eye and face protectors, shin guards, knee braces, high top shoes and taping. There is ample, biomechanical, evidence that such products have a productive effect and lower the risk of a serious injury (Munro et al.,
However, the quality of products offered to amateurs sportsmen should be improved remarkably, in order to have the protective effect reflected in a significant drop of serious injuries also. Both mandatory and voluntary requirements, i.e. standards, will facilitate that process in due course.

**too often product safety measures are developed and designed upon ‘crisis management’—in response to an event or series of events that necessitate authorities to intervene**

**Bicycling**

There is ample evidence from the US and Australia suggesting that both incidence and severity of head injuries are lower in cyclists wearing helmets, when compared to those who are not (Rivara, 1998). However, the target groups continue to oppose strongly to the wearing of helmets: inconvenience, costs, and the ‘nerd’-effect are major barriers still. Yet, the state of Victoria, by means of continuous promotion and finally compulsory legislation succeeded to increase the helmets wearing percentages from 5 per cent in the seventies up to 83 per cent in 1992 (Graitcher, 1995). Other measures that can reduce injury risk among bicyclists concern the stability of the construction of bicycles, cyclists’ conspicuousness and road design, i.e. separate lanes for cyclists and for motorized vehicles. The latter type of measure in particular has proven to be most effective, if properly applied (a line mark in the road does not provide sufficient separation).

**Conclusions: What makes it work and what does not**

We can draw a number of conclusions from the evaluation of product safety measures developed so far. Firstly, apart from the fact that product safety measures do not always require the full active participation of the target group in getting things safer, the many examples quoted above show ample evidence that it is a fallacy to believe that product safety measures would be ‘passive’ measures. Proper installation, use and maintenance of smoke detectors, stair gates, child safety caps, cycle helmets, protective taping, pool fences and so on, require the active and continuous participation of the target group. Therefore product safety measures, through voluntary standards or mandatory regulations, cannot be implemented effectively without concurrent investments in raising risk-awareness, willingness to implement measures and in creating a sustainable culture of safety.

Secondly, some success stories may easily be transferred from one region to others, e.g. child resistant packaging for toxic products, but others do not as easily, e.g. wearing bicycle helmets. Environmental (road conditions), natural (landscape), social (transport needs), economic (access to less risky modes of transport) and cultural (cycling for fun or purely for transportation) factors determine for example the actual choice of transport modes and the safety precautions to be taken. A blind transfer of the successful helmet story from Australia to the Netherlands will be a waste of energy and resources. This is even more true for the transfer of good practice in high-income countries towards low-income countries (Berger and Mohan, 1996).
Thirdly, before introducing new product safety measures one should consider seriously any unforeseen side effects of regulations (Farquhar, 1998). The presumed effect of ABS on speeding behaviour of adults is a popular example, but in the consumer product safety field there are actual examples of negative side-effects of regulations, such as parents putting turpentine in open containers for convenience of use. The side-effect of regulating barriers for children to prevent them from getting access to hazardous environments, is that is may be difficult for others to obtain access easily as well. Also, it is quite harmful for elderly if they cannot open blister packs or disclose gates easily, which need to be opened in case of fire.

Fourthly, too often product safety measures are developed and designed upon ‘crisis management’, i.e. in response to an event or series of events that necessitate authorities to intervene. Of course, there are a lot of good examples where actions are based upon thorough examination of the problem, investigation of alternative solutions, support for change and so on. In Western countries in particular a tradition has been established in this respect, but even that region knows a multitude of safety problems that are not adequately dealt with and that are left to local parties to be solved, such as the safety at day care centres, schools, in sports, recreation (in particular in preventing drowning) and not least in home design and maintenance. Whereas there are clear incentives for national authorities to regulate movables (see section on Product Safety Policy: developments of regulatory framework), regulating important safety features in the neighbourhood environment is apparently regarded as being less urgent.

Fifthly, no law is effective without proper enforcement. In most regions of the world confidence in that is seriously jeopardized as a result of the outbreaks of serious events in the food sector and also due to problems with non-food, such as products intended for children, toys and pushchairs in particular. It happens that one of the firstly regulated categories of products, i.e. toys, causes problems continuously, which even result in conflicts between national authorities on how to interpret the standards and/or regulations as internationally agreed upon (OECD, 1996). These conflicts occur, irrespective of the internationally well-organized toy industry and the great efforts of European and US authorities to reach consensus on essential requirements. Apparently the toy-market is much too volatile and dynamic for authorities to control pro-actively, as they lack prime information on product development, technological advances of materials, production logistics and distribution.

So, what makes product safety measures work? A systematic approach that transgresses ‘local thinking’ by:

• identifying the right issue to address, taking into account the number and severity of injuries, the economic costs and personal sufferings, the community concern about the issue and the support basis at policy and administrative level;

• identifying feasible and low cost intervention measures, based upon thorough knowledge of community’s risk perception and willingness to adopt such measures also on the long term. Such measures should be made as consistent as possible with those measures that have been implemented yet effectively, including a full assessment of side-effects and compensatory behaviour as well;
• reassuring a consistent support level in the community and at political and administrative level by concluding joint agreements for implementing the envisaged measures;
• implementing measures while monitoring continuously the process and its results, which includes permanent feedback to the parties involved in order to sustain their commitment.

despite the influence of the consumer movement in putting consumer protection and product safety on the political agenda, most of the product safety measures in the past decades were clearly inspired by trade policy

GLOBAL TRADE AND PRODUCT SAFETY

Despite the influence of the consumer movement in putting consumer protection and product safety on the political agenda, most of the product safety measures in the past decades were clearly inspired by trade policy, in particular the wish either to protect local markets from products of unknown qualities or, as in the case of the USA and the EU, to open internal markets with a (semi-federal structure. The globalization of markets has provided an even stronger impetus to national governments to harmonize many of the relevant legislations and the detailed requirements laid down so far either in specific law or in national standards. The question, however, is whether this will lead to a ‘race to the bott “downward harmonization’), or to a sharing of the highest possible level as attained in the most advanced member states (‘upward harmonization’).

Globalization: a mixed blessing?

For better or worse, globalization has become the economic buzz word of the nineties. National economics will undoubtedly become more integrated as cross-border flow of trade increases. The positive point of view in this regard is that globalization will boost productivity and living standards everywhere, as it allows for large-scale economics, better division of labour between countries and more transparent competition. Critics, however, worry among others about the erosion of the ability of governments to protect acquired levels of health and well being of citizens.

However, regardless of the discussion on the ‘new’ global economy, globalization is not an unprecedented phenomenon: in the second half of the nineteenth century, owing to remarkable declines in the costs of transport (railways and steamships) and reduction of trade barriers, the flow of products across borders was huge. This ended abruptly with the World War I, after which the world moved into a period of strong protectionism. After World War II, the big economic powers agreed to reduce trade barriers, which was a vital prerequisite for recovering from economic depression. This resulted in the General Agreement on Tariffs and Trade (GATT), which was replaced by the World Trade Agreement (WTA) in 1995. Yet, the integration of markets is still far from complete: although the ratio of trade to total output, i.e. merchandise trade as a percentage of GDP, has increased considerably in most countries since 1950, it exceeds the figures of 1913
only slightly.

Even more remarkable is the fact that a large part of international trade is not global at all but is limited to trade with neighbouring countries: e.g. 60 per cent of German export takes place within the EU region and 80 per cent of Canadian export ends up in the USA.

So, today, instead of global trade we are witnessing a huge expansion of intra-regional trade-activity. Naturally, the establishment of regional trade associations, such as the EU, NAFTA and APEC, has been most instrumental in this respect. These three trade-blocks also account for 90 per cent of the total international trade. Undoubtedly, due to the revolutionary development of the information and communication technology, which has only just started its impact on the consumer goods markets, an international trade, which will be genuinely global, will expand significantly during the years to come.

From single regional markets to one global market: mutual (dis-) agreements?

Since the agreement on opening trade markets worldwide and the implementation of the WTA in 1995 in particular, a new impetus is given to the authorities in trade blocks to look for common principles and frameworks in addressing product safety issues. But there are other pragmatic reasons for reassessing the performance of the traditional regulatory frameworks, as they did not meet sufficiently the needs for business to:

- develop new technology and materials rapidly, without being burdened by detailed technical, often obsolete, regulations;
- shorten the period of time to market new products and services and being free from cumbersome and costly procedures for conformity testing to be performed in each new market; and
- adapt flexibly to different markets and cultures and be able to anticipate on differences in consumer expectations, local traditions and cultures, without jeopardising essential safety requirements.

The solutions found for these problems were:

- boosting the process of international standardization, which allows for a more rapid response to changes in technology than the rule-making process did and also reduces significantly the workload of regulators. This resulted in a commitment from industrial states to work preferably towards international (ISO) standards exclusively;
- setting up a programme for mutual recognition of testing procedures and testing houses, in order to avoid multiple testing and to simplify procedures of accreditation, such as the EC-scheme for mutual agreements and the bilateral agreements between EU and countries like USA, Canada, Japan and Australia;
- promoting cooperation and exchange among business, governments and consumer representatives, as through the Transatlantic Dialogue on Consumer Affairs.

The EC-New Approach (promoting the importance of standards) and the EC-Global
Approach (furthering mutual recognition on testing and certification within the region) can be seen as the precursors of the new policy of international governments with respect to globalization of markets and new means for controlling product safety.

**Stakeholders’ view**

We have to question the effectiveness of establishing reasonable levels of safety on the one hand and the creation of open competition, not hampered by further restrictions, on the other hand.

A recent study performed by OECD (1996) provides better insight in the point of view of business on national and international product safety and safety regulations. The study focused on four product categories (toys, home appliances, power equipment and personal protective equipment), the related business and regulations. The study reveals that first of all manufacturers regard conformity of their products with standards as essential as it helps to protect the company’s reputation, it reduces safety risks for consumers and reduces the risk of legal liability. To manufacturers and their trade associations, product safety standards and conformity requirements are becoming more important as global competition intensifies. They emphasize, however, the differences among the great variety of product safety standards and the burdens of conformity assessment procedures. What might appear to an outsider as insignificant variations in product standards, create, in view of manufacturers, costly production difficulties.

It is revealing that manufacturers identify major differences in particular in a product category with a history of study and negotiating as long as is the case with toys. According to the study report, the divergencies between national and regional standards on toys are ‘a source of great dissatisfaction’, which could be remarkably improved by the harmonisation of all major standards (i.e. ISO, EU-standards and US-standards). Another suggestion made is the use of ‘hazard-based’ approach standards design, using injury evidence as basis for requirements. The publication of general guidelines (an example of an ISO-Guide is to be found in Table 3) is also an important tool for getting product safety being a core concern in all stages of production, starting with product development and design.

Current conformity assessment procedures seem to be of even greater concern to manufacturers and trade associations. The majority of manufacturers who responded to the survey of OECD (1996), stated that current testing and certification requirements add significantly to their costs: they feel that a product should only be tested once, upon which the results should be accepted worldwide.
In 1987 the first edition of ISO/IEC Guide 50, *Child safety and standards*, was published. Since then, standards-makers have had the possibility to consult this valuable guide in order to address child safety in an adequate and consistent way. A few years ago, the ISO Consumer Policy Committee (COPOLCO) decided that the Guide needed to be revised. This would create an opportunity to incorporate recent views on child safety, and to bring it more in line with the general Guide (ISO/IEC Guide 51:1999, *Safety aspects—Guidelines for their inclusion in Standards*). An *ad hoc* working group with experts from all over the world prepared a draft that was formally published early in 1999.

Hazards as a source of injury—a new focus for Guide 50
The new edition of ISO/IEC Guide 50 places more emphasis on hazards, as the sources of injury/harm present in products and the environment. The first edition focused more on products, accidents and injuries, and these categories were not always clearly distinguished, e.g. scalds and other injuries appeared in a list of ‘accidents’.

The Guide starts with a general approach to child safety including the principles for a systematic way to address hazards. This latter issue is closely linked to ISO/IEC Guide 51. Next, specific developmental characteristics of children are described that place them at a particular risk of injury: body size, motor development, cognitive development, and psychosocial factors.

Types of hazard
The Guide’s principal clause is devoted to hazards to which children may be exposed during their use of or interaction with a product, along with specific suggestions for addressing those hazards.

- **Mechanical** hazards are the most widespread; several sub-types are distinguished and they are discussed in detail.
- **Thermal** hazards can be the origin of burns (hot surfaces) and scalds (hot liquids).
- **Chemical** hazards in the field of child safety are often linked to typical child behaviour, like putting various objects in the mouth.

**Electrical** hazards are associated with all electrical equipment. **Radiation** is not a very common hazard in the household, but products like microwaves and smoke alarms require special attention. In addition, solar radiation is a natural hazard for which various products claim protection.

**Biological** hazards can be associated with many types of product where growth e.g. bacteria and moulds, is feasible. **Inadequate protective function** may not seem a hazard as such, but it is a useful means to link performance requirements of e.g. bicycle helmets and stair gates to safety levels. If the consumer expects a protective function, its absence constitutes a hazard.

Similarly, **safety information** is an important means for producers to communicate with consumers. The pre-sale information should enable a well-informed choice between products; information accompanying the product should give guidance to use and maintenance, and warn of residual hazards that cannot be sufficiently reduced by design.
Given the dynamics in product safety regulation in the seventies and eighties and the introduction of more flexible arrangements for reaching agreement on essential requirements, we have to question the effectiveness of establishing reasonable levels of safety on the one hand and the creation of open competition, not hampered by further restrictions, on the other hand. In high-income countries product safety policies stand at a crossroads. Recent events in the domain of food safety in particular, but also in non-food product safety (e.g. phthalate in toys and children’s products, cigarette-lighters and flammability of furniture), seem to undermine the confidence in national and international authorities to ensure proper levels of product safety consistency.

**Pitfalls**

In implementing the more flexible approach towards product safety a number of serious weaknesses became evident:

- the standardization process is not as flexible and rapid as expected and, even more so, still dominated by business interest and financing and therefore leads too often to rather biased end products (ANEC, 1994);
- conformity assessment is trusted to notified bodies that do not necessarily possess the broad disciplinary background needed for products that are in use in different settings and conditions. A recent study revealed that a number of notified bodies in the EU miss essential competence as required for the directive they were acknowledged for (Bryden, 1996);
- inter-administrative cooperation in enforcement and control of product safety remains a daunting task, taking into account the great variety in enforcement practices in the different countries and continents, insufficiency in information exchange (regardless of obligatory structures such as the Rapid
Exchange system in the EU), and the lack of agreement on methodologies for risk assessment and enforcement decision-making (Rogmans, 1996).

The process of deregulation and market flexibility apparently has led to a greater ambivalence in specific requirements in vigour and in responsibilities the main stakeholders have to carry out in view of product safety control. It is evident, however, that in regulating product safety during the next decades, authorities should not make a U-turn and should not restart the more technical and detailed process that may lead to mandatory standards nailed down in legislative rulings.

**Need for integrated approach**

One of the challenges for safety regulations and business in forthcoming decades is the technological revolution, which will certainly have its bearing on quality, functional properties and safety aspects of consumer products, but will also open new opportunities for developing new products and components for existing products in a rapid pace. In future markets, service and product industries need to respond quickly to these developments, not being needlessly hindered by restrictive standards and procedures. In this respect, the trend towards more standardization instead of detailed regulation and common general procedures for conformity testing has to be welcomed. However, the process includes many more stakeholders, including business and consumer representatives, than one was used to in the past decades of top-down regulation. It therefore needs much more orchestration on behalf of government authorities in order to lead this process of reaching consensus on safety requirements and its conformity testing towards an effective result.

Effective decision making requires the involvement of the major stakeholders and an open and transparent debate regarding the relevant safety requirements based on evidence and best practices. The present challenge for the trading blocks is to establish adequate infrastructures for orchestrating such decision-making in the respective regions as well as at international level. This goes far beyond the efforts invested today in regulatory and enforcement exchange and requires among others the establishing of regional agencies responsible for consumer product safety analogous to the CPSC in USA. It includes also (Rogmans, 1997):

- the establishment of clearing houses in the various regions, linking all relevant data and providing easy access to vital information on consumer product-related risks and their prevention;
- the advancement of analysis and research that supports a high quality of standards, regulation and emergency measures as well as properly targeted information and educational programs;
- strengthened and coordinated enforcement and control of safety provisions and regulations; and
- increased efforts in safety promotion and coordinated programs for safety education and information.

Free trade and freeing business from excessive constraints is essential for the economic
growth and development of all nations. Only with visionary leadership can we ensure that 
free trade goes hand-in-hand with fair trade and that the global market place will 
maintain one of the most fundamental values: the protection of citizens against accidental 
injuries and deaths.

REFERENCES

Abott, H., 1980, Safe enough to sell?—Design and product liability, (Design Council, 
London).
ANEC, 1994, Report on standardization work in the interest of consumers. (European 
Association for Coordination of Consumer Representation in Standardisation, 
Brussels).
BAGUV, 1996, Sicherheit im Unterricht—ein Handbuch für Lehrkräfte, Bundesverband 
Unfallversicherung, München.
Berger, L.R. and Mohan, D., 1996, Injury Control—a global view, (Oxford University 
Press, Delhi).
Brack, A., 1999, The CE-mark and the new European approach to product safety law, 
Bryden, A., 1996, Consumer product safety: a growing role for third party conformity 
Group, London).
CEN, 1997–1998, European standards for playground equipment, their instalment and 
CPSC, 1984, Status report on gas heating systems, (Consumer Product Safety 
Commission, Washington, DC).
Washington, DC).
Dept. Local Government, 1991, Swimming pool fencing review group. (Child Accident 
Prevention Foundation Australia).
European Commission (EC), 1998, CO-intoxication: a silent killer in wintertime, 
Brussels.
detector performance, Washington DC.
Gallangher, S. et al., 1985, A home injury prevention programme for children, Paediatric 
Clinic North America, 32, pp. 95–112.
Graitcher, P.L. et al., 1995, A review of educational and legislative strategies to promote 
Haddon, W., 1980, The basic strategies for reducing damage from hazards, Hazard 
Prevention, 16, pp. 8–11.
Jaartsveld, R., 1994, Safety of water surfaces (in Dutch only), Educatieve uitgever, 
Montfoort.
Janda, D.H. et al., 1993, A prospective study comparity standard and breakaway bases in
ISO-bulletin, Geneva/
Technologies, Therapies, Emotions and Empiricism in Pre-hospital Care

Mathew Varghese

INTRODUCTION

Trauma patients form a heterogeneous group who have suffered tissue damage from exposure to some form of energy. The most common denominator in any trauma patient is bleeding. This could be external or internal bleeding. Neuronal damage and direct damage to chest, abdominal viscera all significantly modify the outcome of trauma, independently and along with physiological changes associated with bleeding. Over 50 per cent of trauma patient’s mortality in the first hour results from traumatic brain injury. Traditionally accepted markers of physiological status of the patient are used for monitoring the patient’s condition in most situations. These include pulse, blood pressure, respiratory rate and temperature and in a head injury patient the level of consciousness of the patient. However, monitoring parameters in the field situation and taking steps to correct them are difficult because changes in physiological parameters in the body are closely linked to multiple organ systems. No system can be taken in isolation.

Pre-hospital care developed as a speciality to minimize the damage to the patient before definitive care is made available. A lot of controversy exists regarding what should be the ideal pre-hospital management for the injured patient. No system is ideal for all areas. Policy formulations for pre-hospital management of the injured will obviously be determined by the availability of trained personnel and technological and economic resources at hand. But what is the optimum level of care and who should provide it? In other words, what pre-hospital interventions should we make when we have all the resources to ensure that the largest number of trauma patients survive with minimum morbidity.

BEYOND THE ABC OF RESUSCITATION?

Conventional first-aid to an injured includes resuscitation, dressing of wounds and splintage. In principle resuscitation at the accident site and at the hospital site is not very much different. The classical description of the ABC of resuscitation took care of the most vital aspects of survival for a patient and also prioritized the sequence of intervention, that is the maintenance of a clear Airway, establishment of Breathing, and establishment and assessment of Circulation. To achieve these a large number of technologies and therapies have developed over the years.
Different centres for pre-hospital care follow different protocols. These include: Basic Life Support (BLS), Pre-hospital Trauma Life Support (PHTLS) and Advanced Trauma Life Support (ATLS). Several recent reports are available on the relevance of individual components of these protocols and experimental studies to validate them (Sampalis, 1992; 1994; Martin, 1992; Bickel, 1994; Teach, 1995; Adams, 1996; Eisen, 1998; Bissell, 1998). Pre-hospital resuscitation theoretically results in improved end organ perfusion and oxygen delivery in the pre-operative phase, in the field and during patient transfer reducing subsequent morbidity and mortality (Owens, 1995). A review of the ABC of resuscitation steps should clarify some of the controversies surrounding prehospital care.

**Maintenance of a clear airway**

Extension of neck and elevation of chin may be the only-step required for maintenance of a clear airway. At times this may not be sufficient. Foreign bodies, blood and vomitus in the mouth may need to be cleared. The oesophageal obturator airway is designed to provide ventilation by occluding the oesophagus and by default forcing oxygen through the oropharynx into the trachea and lungs (Don Michael, 1968). This is not routinely recommended now because of several complications associated with it. According to the ATLS protocol (ATLS 1993), if the patient is not breathing after clearing of airway then insertion of an endotracheal tube may be required. However, endotracheal intubation is a procedure, which needs training and skill. This will need a medical or paramedical person to be present at the accident site. Some countries have restrictions on the use of endotracheal tubes and only licensed persons are allowed to insert them. A lay person cannot do endotracheal intubation. At times endotracheal intubation can be done only with narcotic analgesics (Gerich, 1998), midazolam (Dickinson, 1999) for ‘clenched teeth’ may prevent attempts at intubation. A small percentage of these endotracheal tubes may actually be in the oesophagus (Pointer, 1988; Gerich, 1998; Dickinson, 1999). However, Gerich (1998) reports that only 1 out of the 8 patients with surgical airways survived. Combitube is another alternative for airway management in emergency situations where personnel trained in tracheal intubation are not available.

A lot of controversy exists regarding what should be the ideal pre-hospital management for the injured patient

According to some of the protocols, repeated failed attempts and inability to maintain sufficient oxygen saturation (90 per cent), during repeated intubation attempts represent indications for surgical airway by doing a cricothyrotomy (Gerich, 1998).

Irreversible brain damage occurs between 5–10 minutes of cessation of breathing. To provide a trained person at the accident scene within this period is very difficult. Help from bystanders can be useful during this time. A trained bystander could call for help, clear the airway or extend the neck, lift the chin to ensure breathing.

If after clearing of the airway the patient does not breathe he will need mouth-to-mouth-expired-air-ventilation or if available a bag-valve-mask-ventilation. Mouth-to-mouth-expired-air-ventilation is a highly specialized psychomotor skill, which has to be
learnt, rehearsed regularly before it can be performed successfully. In a Norwegian study (Bjorshol, 1996), among health and rescue workers outside hospital it was found that only 1 per cent were able to perform satisfactory cardiopulmonary resuscitation (CPR) of cardiac arrest patients according to accepted guidelines. Of these only 17 per cent ventilated and compressed efficiently with a rhythm of 2 breaths for 15 external cardiac compressions or 1 breath for 5 cardiac compressions, and 50 per cent believed that they were efficient in life saving first aid.

There is a wide variation in the effectiveness of mouth-to-mouth resuscitation provided for cardiopulmonary arrest. The best results are obtained only when the person providing CPR is periodically rehearsing the procedure.

In a patient with a high probability of cervical spine injury manipulating the neck for endotracheal intubation could be dangerous. More sophisticated techniques of nasotracheal or fibreoptic assisted intubation technique are recommended for these patients. New technologies going well beyond the simple ABC of resuscitation!

Establishment/assessment of circulation

Most trauma patients bleed. Bleeding could either manifest externally or could be occult, internally. Internal bleeding is particularly difficult to assess if it is occurring in the abdominal or pelvic cavity. Bleeding into the chest is also difficult to assess but the dramatic presentation of an associated lung or heart injury may give sufficient warning of the damage underneath. If the patient’s assessment is done soon after the injury and pulse and blood pressure parameters are taken as gold standards, then there could be a serious error of judgement as haemorrhage into closed cavities may take time to manifest as alterations in these measured values. This is because it takes sometime before physiological signs of compensation or decompensation become apparent.

The human circulatory system functions as a closed loop. Any break in the vessels converts this closed loop into an open system. As more and more blood leaks out, the heart will have less and less blood available to pump. Initially the body compensates by increasing the heart rate and then mobilizing fluids away from the non-vital parts of the body. With decreasing blood in the system the blood pressure drops pulse becomes rapid and feeble till it cannot be felt. Medically such a patient is described to be in a state of haemorrhagic shock. There are numerous definitions of haemorrhagic shock involving blood pressure, heart rate and urine output. Traditionally, when blood pressure, heart rate and urine output return to normal it was presumed that resuscitation was complete. However, a majority of patients may not be in uncompensated shock and some patients of compensated shock may continue to have clinical signs of uncompensated shock (Porter, 1998).

Pre-hospital medical care and care in the hospital is aimed at preventing the development of traumatic haemorrhagic shock and the consequences of shock in an injured patient. This can be achieved by

• control of bleeding
• replacing the blood lost with blood
• replacing the blood volume lost by fluid replacement.
Control of bleeding

If the patient is bleeding externally, direct pressure with a gauze or a clean cloth is an effective method of controlling blood loss. If the wound is on the limbs then elevation and direct pressure together are very effective.

Tourniquets, which were once popular as effective method of controlling blood loss, are now not recommended at all. In fact, tourniquets are dangerous and some patients have even lost their limbs because of improper use of tourniquets. Direct pressure and elevation are the only safe methods recommended.

Internal bleeding cannot usually be controlled by non-surgical methods. Assessment of blood loss internally into the chest or abdomen is very difficult in the pre-hospital phase. Hence in patients with suspected chest or abdominal injuries the aim should be to transfer the patient as quickly as possible to a hospital for definitive treatment.

Blood transfusion

Replacing blood for blood is ideal intervention theoretically. This is neither possible nor desirable in all injured patients receiving pre-hospital care. This is not possible in all patients or desirable in injury patients receiving pre hospital care. O(−ve) is a rare blood group and its availability is poor even in hospitals. With the possibility of HIV and hepatitis infection there is an added deterrent to the use of blood widely in trauma patients. There are some ambulances in the world which have blood banks with O(−ve) blood. If direct cross matching is to be done this takes about 30 minutes. There does not seem to be any additional advantage in having blood available within ambulances.

Blood group identification is recommended by some transport authorities to be included in the driving license. Though it is good to know your blood group for donating others, advance knowledge of blood group of the injured patients does not in any way hasten the transfusion of blood. This is because blood matching has to be done by the care provider in any case.

Intravenous fluids

Intravenous fluids are widely used as volume replacements for blood loss. This is done both in the pre-hospital and in the hospital phase. Placement of intravenous access lines is considered an important part of pre-hospital care. The ATLS protocol specifically recommends the insertion of two large bore (16 G or more) catheters for intravenous fluid transfusion. In adult injured patients 1–2 litres of Ringer’s lactates are recommended.

Krausz (1992) found that intravenous access placement failed in 27 per cent of cases and an average of 10–12 minutes were lost in placement of intravenous cannula. Placement of an intravenous cannula is particularly difficult in a shocked patient as all the veins collapse in shock. In children this is difficult even when they are not in shock as the normal caliber of their veins is small.
A number of studies recommend starting of intravenous line on the plea that it can maintain the fluid volume in circulation when it is compromised as a result of injury. Lewis (1986) has shown that intravenous infusion is of benefit only if the bleeding rate is more than 25–100ml per minute, the pre-hospital time is more than 30 minutes and the intravenous infusion rate is equal to the bleeding rate.

Newer technologies being made available aim at increasing the volume of fluid infused in shorter times to keep pace with the rate of loss of blood. These include very large bore catheters and use of rapid infusion devices. In children intraosseus infusion has been recommended to overcome the difficulties of intravenous cannula placement. This has been associated with complications of osteomyelitis and compartment syndromes.

Hypertonic saline has been used on the rationale that only smaller volumes need to be transfused, and that they help mobilize body fluids faster. All these techniques are aimed at increasing the circulating fluid volume in the presence of a leaking closed loop of the system.

Recent animal experiments have shown that in swine models aggressive saline infusion led to greater bleeding and failed to improve survival (Kowalenoko, 1992; Owens, 1995). In rat tail experiments using hypertonic saline Krausz (1992) reported greater bleeding and rapid haemodynamic worsening and early death when infusion were given without control of bleeding. Results of experiments in mice show that haemodilution is an unfavourable condition for the natural defense mechanism against hemorrhage (Okumura, 1995).

A critical review of earlier experiments showing that intravenous fluids were useful clearly reveals a design flaw in the experiments. In all these experiments a certain percentage of blood volume of the experimental animal was withdrawn and then the effect of fluid replacement studied. In the newer experimental design blood was withdrawn and a cannula was left in the place (or by some other method) to simulate continuous bleeding. This change in technique produced dramatically different results.

In normal human physiology continued bleeding leads to a reduction in blood pressure. This reduction in blood pressure causes the initiation of a reflex narrowing of blood vessels carrying blood to the periphery. The lowering of blood pressure and narrowing of blood vessels reduce the pressure head of blood at the injured site. This allows clot formation and sealing off all injured blood vessels.

By infusing intravenous fluids without controlling bleeding the normal physiological response of the body is prevented. This delays clot formation and sealing of injured blood vessels. The blood loss therefore, can be much more than when no infusions are given. The reason for not seeing a marked increase in mortality and haemorrhage in the patients infused with intravenous fluids is possibly because of the fact that the rate and volume of fluid infused in most pre-hospital injured patients is very low.

The volume as well as the rate of fluid infusion seems to influence the outcome of haemorrhage in experimental studies. Rapid infusions of large volumes increased blood loss but seemed to improve survival. Where as moderate fluid volume was not associated with significant blood loss regardless of rate. The greatest blood loss was seen in animals with slower rates of infusion (Soucy, 1999). The correct rate of infusion and volume of infusion in any given patient is still a matter of conjecture though a number of algorithms are available.
In an evaluation of the use of intravenous fluids in penetrating truncal injury patients (Martin, 1992) found no significant difference in post-operative complications and rate of survival to hospital discharge. The study concluded that further studies are necessary to determine if it is advantageous to delay fluid resuscitation until surgical intervention. In pre-hospital times of 30–40 minutes, mortality following trauma is not influenced by the pre-hospital administration of intravenous fluids but is related to the severity of underlying injuries (Kaweski, 1990). Bickell (1994) found improved survival and decreased perioperative complications in patients with penetrating torso injuries with delayed resuscitation. Teach (1995) found pre-hospital fluid therapy was inconsequential to outcome in 47 of 50 patients, possibly beneficial in 2 out of 50 and possibly detrimental in one of 50 patients.

Though widely used all over the world, increasing evidence suggests that infusion of intravenous fluids in the pre-hospital setting, may not be useful but could be harmful also.

**Pneumatic antishock garments (PASG) or military antishock trousers (MAST)**

These were introduced in 1970 for use in trauma patients. PASG corrects hypotension of increasing peripheral resistance and by autotransfusion of blood from the compressed site to the central area of circulation. Serious complications have been associated with its use. They involve development of neurovascular injuries, development of compartment syndromes and pressure necrosis. In a healthy volunteers study, PASG was found to reduce the vital capacity and tidal volume of volunteers significantly. MAST markedly decreased the abdominal contribution of breathing (−57 per cent ± 22 per cent) (Riou, 1991). Survival of injured patients is not improved despite increase in blood pressure. In a prospective randomized study no significant differences were found in hospital stay and mortality following use of PASG (Chang, 1995). The use of PASG or MAST is not recommended any more in the pre-hospital setting.

**Tourniquets, which were once popular as effective method of controlling blood loss, are now not recommended at all**

In summary, the best treatment for bleeding in a traumatized patient is surgical control of bleeding and not haemodynamic manipulations with fluids, blood or PASG.

**Pre-hospital cardiac arrest**

If bleeding continues and the volume of blood reduces markedly, the heart will stop functioning as a result of hypoxia and decreased volume of blood to pump. The heart could also arrest as a result of direct injury to the heart and lungs or as a result of head injury causing damage to vital centres.

In trauma 60 per cent of deaths occurs at the site of injury and 40 per cent occur in the hospital (Kries Jr., 1986). In Turnkey’s classification 50 per cent of deaths in trauma occur immediately within 1st hour, 30 per cent occur early (1 hr-1 week) while 20 per cent deaths occur late (after 1 week) (Trunkey, 1983). The immediate and late trauma
death rates are not affected by changes in pre-hospital care. Some of the early deaths can possibly be prevented by interventions in the pre-hospital period. The ‘golden hour’ as described by Cowley (1977) and the ‘platinum half hour’ as described by Pepe (1990) underlines the importance of early interventions in trauma patients. However, if a trauma patient develops a cardiac arrest before he reaches the hospital the chances of survival are poor even after cardiopulmonary resuscitation. In a study of 138 cases who had CPR in the pre-hospital period there were no survivors (Rosemurgy, 1993). In 23 patients who required CPR in the pre-hospital phase again there were no survivors (Tsai, 1987). Gallagher (1955) found that only 46 per cent of bystanders were able to do effective CPR in outside hospital cardiac arrest.

Increasing number of studies are reporting the futility of attempting CPR in the pre-hospital cardiac arrest patients in trauma.

**Triage**

The classification of patients according to medical needs and matching of these patients to available care resources is called triage. This helps to save time and avoids shunting of patients from one centre to another. For optimal allocation of resources in the treatment of trauma it would be useful to be able to decide as early as possible which patient will benefit most from transport to a dedicated trauma centre (Bond, 1997). This may be difficult in patients who have neuronal injury or truncal injury which is in the early evolving phase. Different criteria and indices have been evolved for transportation of patients to a designated trauma centre. The pre-hospital index takes into consideration, systolic blood pressure, pulse/min, respiration and consciousness. An index of 0 to 3 is minor trauma, 4 to 20 is major trauma. This is reportedly better when the mechanism of injury criteria is also taken into consideration (extrication time is more than 20 minutes, ejection, occupant death, steering wheel deformity, fall of more than 50 feet and injuries of automobile vs pedestrians). The ideal triage criteria in any given situation is difficult.

**Ambulances and transportation of patients**

Ambulances have become synonymous with transportation of the injured and the sick. Transportation of the injured have been done in all kinds of vehicles. Faster and more comfortable modes of transportation have been designed with a view to take the patient as rapidly as possible to a definitive care facility.

The time interval between injury and arrival at a hospital has an influence on the outcome of trauma. A comparison of transportation time of patients in different wars of this century is summarized in Table 1.
The marked decrease in mortality in the Vietnam war cannot be attributed to a reduction in pre-hospital times alone. Hospital care of injured has changed completely between World War I and the Vietnam war. Reduction in transportation time is only one of the parameters that had changed between World War I and the Vietnam War.

When a person is injured it is assumed that he or she will be transported by an ambulance to the hospital. In reality, in a large number of countries this is not so. This is particularly true in a number of rural areas of the world and urban areas of several low income countries. Even in high income countries some of the patients are transported by non-EMS vehicles (Demetriades, 1996). Interestingly patients with severe trauma transported by private means in this setting were found to have better survival than those transported via EMS system. Persons without access to telephone also often use private transport to transfer trauma patients to a trauma centre. Of the 4 per cent patients transported in private vehicles 50 per cent did not have access to telephone. Among the others, fear of delay and under estimation of the severity of trauma were the other causes (Hammond, 1993). In Philadelphia 61 per cent of Police Chiefs indicated that police officers would occasionally ‘scoop and run’ with a critically ill child rather than wait for the emergency medical services to arrive (Sinclair, 1991).

Table 1

Summary of mortality rates and transportation times in different wars of this century

<table>
<thead>
<tr>
<th>WAR</th>
<th>TRANSPORTATION TIME (in hours)</th>
<th>MORTALITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>World War I</td>
<td>12–16</td>
<td>8%</td>
</tr>
<tr>
<td>World War II</td>
<td>6–12</td>
<td>4.5%</td>
</tr>
<tr>
<td>Korean War</td>
<td>2–4</td>
<td>2.5%</td>
</tr>
<tr>
<td>Vietnam War</td>
<td>1.5–2</td>
<td>2%</td>
</tr>
</tbody>
</table>

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Though it is important for the injured patient to reach a definitive care facility at the earliest in urban situations with short transportation times excessive speeding cannot improve transportation times.

In a study done in Delhi it was found that ambulances transported only 4 per cent of patients. Of the injured 51 per cent were transported to the hospital by taxies. About 53 per cent of these patients were transported within 30 minutes of the injury (Maheshwari, 1989). Despite the fact that they were not transported in ambulances this is comparable to some of the best transportation times in the world with good communication facilities and excellent ambulance services. In a comparative study of trauma mortality patterns, Mock (1998) reported no patients were transported in ambulances to a teaching hospital in Ghana while over 90 per cent were transported by ambulances in Mexico and Seattle. In Ghana 58 per cent were transported by ambulances and 22 per cent by private cars. The
differences in mortality in this study could not truly be attributed to increased time of transportation or differences in treatment.

**Equipment in ambulances**

The ambulance itself may be a simple vehicle with a stretcher or it could be fitted with the most sophisticated equipment for monitoring and providing advanced cardiac life support with defibrillators. In trauma patients the probability of revival after pre-hospital cardiac arrest is practically nil, unlike in cardiac disease patients. Usually the injury has caused so much of haemorrhage that the oxygen carrying capacity of blood would be significantly deranged and the myocardium is unlikely to respond to defibrillation.

Numerous other equipment like suction machines and immobilization devices for limb or spinal trauma also form part of ambulance equipment. However, there is no data to suggest that use of these equipment alter the outcome of trauma.

**Speed of ambulances**

Though it is important for the injured patient to reach a definitive care facility at the earliest in urban situations with short transportation times excessive speeding cannot improve transportation times. This speeding may in fact contribute to risk of injury to patients, other motorists and pedestrian on the road. The incidence of fatal ambulance crashes during emergency use is reportedly higher than during non-emergency use. These are particularly higher for lights and siren travel (Saunders, 1994; Pirrallo, 1994). There are anecdotal reports of injuries to patients and people outside ambulances involved in crashes.

A recent study has shown that ambulances with flashing lights and sirens do not significantly reduce patient transportation time. The study used ambulances with lights and sirens and a control ambulance without any of these, it revealed the mean time saved to be 43.5 seconds in 50 trips (Hunt, 1995). Use of sirens also significantly disturbs the patients being carried in it. The noise of sirens and traffic also disturb recording of blood pressures of patients in moving ambulances (Prasad, 1994).

**Air ambulances**

Air ambulances have been promoted with a view to reduce transportation times and hence reduce mortality, air ambulances are costly, and their health benefits are small (Snooks, 1996). The study found that there was no improvement in response times and the time on scene was longer for helicopter-attended patients. Logistic regression analysis in helicopter transported trauma patients have shown that transportation by helicopter does not affect the estimated odds of survival (Brathwaite, 1998).

Another study showed that a large majority of trauma patients transported by both helicopter and ground ambulance has low injury severity measures. Outcomes were not uniformly better among patients transported by helicopter. Only a very small subset of patients transported by helicopter appear to have any chance of improved survival based on their helicopter transport (Cunningham, 1997). Doubtful benefits have also been
reported by Koury (1998) and increased mortality, 18 per cent compared to 13 per cent for ground transported patients for helicopter transportation of victims in urban area Schiller (1988).

Helicopter services may have a role in remote inaccessible areas in the sea, desert or mountains. However, routine use of air ambulances in the urban setting is not cost effective.

**Ambulance personnel**

The number and training of ambulance personnel varies from place to place. Some have only drivers trained in emergency care while others have emergency care paramedics. In some parts of the world there are physician-manned ambulances. Trained medics and paramedics are posted in the emergency medical service ambulance to ensure that the trauma patients receive optimal care from the site of injury. Physician-manned on scene care was found to cause a significant increase in scene time and total pre-hospital time. These delays are associated with an increase in the risk for death in-patients with severe injuries (Sampalis, 1994). Physicians on the scene tend to try to provide more care in the field than well trained paramedics, therefore, the time to definitive care of the haemorrhage may be delayed (McSwain, 1995).

With the information available it seems that in an urban setting all that is required is a comfortable vehicle with sufficient space to carry the injured safely to a hospital.

**Role of medication**

Analgesics for trauma patients and cardiac drugs for non-trauma patients are the most commonly used medications. Fentanyl was used in 75.4 per cent of patients with fractures during transportation to the hospital (DeVellis, 1998). Drugs were administered in 8.5 per cent of urban emergency patients and 7 per cent of rural emergency patients either at site or during transportation (Moss, 1993). So far, there is no reported evidence that pre-hospital medications are either beneficial or cannot be delayed until the arrival at the emergency room.

**Care of wounds**

Antiseptics and antibiotics are not necessary for care of wounds. All that is required is to keep the wound clean. Healing is a natural process, which cannot be hastened by any medicine and ointments can only delay healing. In case of small wounds if the wound is dirty then the best treatment is to wash the wound with clean water. This is the only first aid that may be required for small wounds and abrasions.
**Splints for the injured**

Fractured/dislocated limbs can be splinted to help reduce pain and prevent further injury to the patient. This is an important first aid measure and must be attempted on scene to make the patient more comfortable. All kinds of materials can be improvised to work as splints and if nothing is available the opposite uninjured limb of the patient can function as an effective splint. Air splints are available which encircle the limbs and compress tissues. These can cause serious damage if applied too tight. Softer easily available materials like cushions, pillows or even rolled up magazines and newspaper may be equally effective without causing further damage.

**Care of the spine**

Recognizing a spinal injury is not easy even for trained medical personnel. However, a high index of suspicion can prevent paralysis and further damage in a spinal cord injured patient. Spinal cord injury must be suspected if the patient has a head injury, is unconscious or has altered sensorium, has paralysis of the limbs or is complaining of pain in the neck or back. There is, however, significant variation in clinically clearing cervical spine practice among emergency duty physicians (Cone, 1999).

If spinal cord injury is suspected then the best first aid is to treat the patient as a ‘log of wood’. All movements of bending, extending or rotation is to be avoided. Four or five persons can together transfer a patient as a ‘log of wood’.

A semi-rigid collar for the neck or even a simple rigid board can be used for shifting the patient. Repeated transfer of the patient is to be avoided in all patients suspected to have spinal cord injury.

**ATLS vs BLS**

In the mid-seventies, cardiac patients were found to do much better with the availability of ALS care. It was assumed, therefore, that all patients would do better with more being accomplished on the field (McSwain, 1995). This assumption neglected a basic premise of patient care: the most important factor in patient survival is the time from the onset of the emergency to the provision of definitive care. There has been a lot of controversy about the value of ATLS for injured patients (Trunkey, 1984). ATLS involves a greater use of technology, psychomotor skills and medication for pre-hospital care.

BLS on the other hand focuses on basic airway support, control of bleeding, immobilization of spine and provision of supplemental oxygen when required.

In a sample of 360 severely injured patients Sampalis (1993) found that the outcome of trauma is not affected by ATLS on the scene. Cayten (1993) also found no benefit from the use of ATLS for trauma patients with pre-hospital times less than 35 minutes. This was also reported by Adams (1996) and Sampalis (1994). Jurisdictions throughout the US and some other parts of the world have invested substantial time and resources into creating and sustaining a pre-hospital advanced life support (ALS) system without knowing whether the efficacy of ALS-level care had been validated scientifically. The
strongest support for ALS level care was in the area of responses to victims of cardiac arrest (Bissell, 1998). Sampalis (1992) reported provision of ALS on scene was associated with a higher incidence of mortality where as definitive care in level 1 or 2 compatible hospital was associated with a lower mortality.

‘Scoop-and-run’ versus ‘stay-and-stabilize’

There are proponents for and against each of these approaches, ‘scoop-and-run’ involves extrication of the patient, maintenance of a clear airway, protection of spine and control of haemorrhage whenever possible. ‘Stay-and-stabilize’ on the other hand involves placement of intravenous lines, infusion of intravenous fluids, application of PASG and endotracheal intubation whenever required.

A review of literature and the physiological processes involved suggests that in urban areas with transportation times of less than one hour and no delay in extrication scoop-and-run seems to be the best policy.

Backup at the hospital

All hospitals do not have the same level of expertise for managing trauma patients. Unnecessary shifting from one hospital to another hospital can be avoided if proper triaging is done in the beginning. The quality of a trauma system can be assessed by the rate of preventable deaths. One question that can help is if this patient had sustained the accident in front of the hospital in a normal working day, might death have been prevented? The main failures in a review of trauma deaths were found to be errors and delays during the first phases of in-hospital assessment and care. An improvement in pre-hospital care will be almost useless if the quality of definitive in-hospital management is not addressed (Stochetti, 1994).

FUTURE

We are in a situation where something as basic as starting of an intravenous fluid in a traumatized patient is being labeled as controversial. Factual meta-analysis needs to be done to separate what really works from what is perhaps useful. The future may find that even some of our very basic parameters of measurement of end points of resuscitation may have changed completely.

One of the dilemmas of pre-hospital care has been ‘are we doing too little for a damage which seems too much?’ Our emotional response seems correctly to be to do whatever possible to save as many lives as possible. There is a need, however, to avoid deification of technology and to homogenize responses in a problem which is essentially heterogeneous. To make scientific conclusions we must have well-controlled prospective
randomized studies. There exists a strong general feeling that randomizing pre-hospital care is unethical (Gold, 1987). However, there are natural control populations in place in the world where a total contrast of no pre-hospital care exists along with places where high-tech pre-hospital care is practised. Advantage could be taken of such situations, normalize them for different injuries to have a controlled study. Until such carefully designed studies are carried out we will continue to grope for answers and components of pre-hospital care will remains controversial.

REFERENCES

Adams, J., Aldag, G. and Wolford, R., 1996, Does the level of pre-hospital care influence the outcome of patients with altered levels of consciousness?. *Pre-hospital Disaster Medicine, 11*(2), pp. 101–104.


Trauma mortality patterns in three nations at different economic levels: Implications for global trauma system development. *Journal of Trauma*, **44**(5), pp. 804–814.


The Burden of Violence: An International Public Health Perspective

Etienne Krug

INTRODUCTION

In recent times, we have all been exposed daily to the terrible images of human misery caused by deadly conflicts in Kosovo, East Timor, Sierra Leone or the Democratic Republic of Congo. The mass graves, mass rapes, and massive exodus are the most visible part of the iceberg of violence. More discrete, but widespread, is the daily suffering of children who are abused by their caregivers, women victims of violent partners, elderly persons maltreated by their children or caregivers, girls subjected to genital mutilation, or students who cannot attend school without being at risk of being threatened, beaten or shot. During the last few years, Public health professionals are increasingly taking a stand against accepting violence as an inevitable part of our modern world and are taking actions to reduce its incidence.

Violence has been defined in many ways. The definition of violence commonly used by the World Health Organization is that violence is ‘the intentional use of physical force or power, threatened or actual, against another person or against oneself or against a group of people, that results in or has a high likelihood of resulting in injury, death, psychological harm, maldevelopment or deprivation’ (WHO, 1996).

While there is no universally accepted typology for violence, the groupings most commonly used are: interpersonal, self-inflicted and organized violence (WHO, 1997). Another way of categorizing violence is by dividing it into political, economic and social violence. Each of these groups can in turn be divided into more specific areas such as child abuse, intimate partner abuse, elderly abuse, youth violence, sexual violence, etc. (Frege et al., 1995). It is useful to subdivide violence into these different sub-types to be able to study specific risk factors or trends. Sub-types based on the motivation of the perpetrator are useful because they highlight the need of different approaches for prevention. However, whatever the typology used, it is also important to keep in mind that there are many links between each of these types of violence: for example, victimization of assault or abuse has been associated with a higher risk of suicide (Stark et al., 1995). Victimization of child abuse has been described as a risk factor for subsequent violent behaviour (Maxwell and Widom, 1996). Exposure to intimate partner violence is a risk factor for future violent behaviour; and variables used to measure the social acceptability of violence, such as the death penalty or the involvement in wars, have been associated with the homicide rate in a society (Gartner, 1990). Reducing one type of violence may therefore also contribute to decrease levels of other types of
violence.

Traditionally, violence has been addressed by the legal area. Only during the last decades has violence been increasingly recognized as a Public health problem in the United States and a few other high income countries (Mercy et al., 1993; Rosenberg and Fenley, 1991). In the rest of the world, violence, and injuries in general, is still absent from the Public health agendas.

The added value of the Public health approach is that it is interdisciplinary, science-based, and focused on prevention (Frege et al., 1995). Public health is at the intersection of medicine, epidemiology, sociology, criminology and several other fields. Bringing together the strengths and approaches of each of these fields, allows Public health to be innovative. Public health is guided by science. Interventions are based on the diligent study of risk and protective factors. Interventions are, or should be, evaluated before implemented on a wider scale. It is its focus on primary and secondary prevention, however, that is the main strength of the Public health approach to violence. As a complement to the more traditional judicial approach that is mainly based on punishment of the perpetrators, a method for tertiary prevention, Public health proposes primary and secondary prevention. Public health believes that by addressing its social, economic or other causes, a considerable proportion of violence will be prevented.

THE GLOBAL BURDEN

reducing one type of violence may therefore also contribute to decrease levels of other types of violence

An increasing number of countries are reporting information on their annual mortality to the World Health Organization (WHO). In 1999, WHO has compiled the data that has been provided by member states and has made estimates to cover regions for which less detailed information exists. Some of the results of these analyses were presented in the World Health Report 1999, others are presented in this paper

Mortality

It is estimated that in 1998, 2.3 million people died from violence: 42 per cent of these deaths were classified as suicide, 32 per cent as homicide and 26 per cent as war-related (WHO, 1999) Worldwide the homicide rate is 12.2 per 100,000 population. There are considerable regional differences in the relative importance of these type of deaths: for example, in China, there are 7 suicides for each homicide. However in Sub-Saharan Africa, and in Latin America and the Caribbean there are 13 and 5 homicides for each suicide, respectively (WHO, 1999).

A shocking statistic is that in the beginning of the third millennium, 4 per cent of all persons who die in the world are intentionally killed by another person or by themselves! Despite the large burden of infectious diseases, almost 5 per cent of all deaths in low and middle income countries in 1998 were due to intentional injuries. In the high income countries, 2 per cent of all deaths are due to intentional injuries. In Sub-Saharan Africa,
among males, the proportion of all deaths due to violence reaches almost 9 per cent. China is the only ‘region’ where the proportion of deaths due to violence is greater for females than for males. This is due to the high suicide rate among females. In China, almost half (45.5 per cent) of all injury deaths among females are suicides. This is more than double the proportion in the Emerging Market Economies—21.7 per cent (Murray and Lopez, 1996).

Like for many other health problems, violence is not distributed evenly among income groups. The homicide rate for countries in the low and middle income group is estimated to be three times higher than the homicide rate in countries from the high income group (13.6 compared to 4.3). The homicide rate in Africa (48.8 per 100 000) is 11 times higher than the homicide rate in high income countries. Interestingly however, the gap difference in suicide rates between high and middle/low income countries is much smaller (12.5 and 17.4 per 100 000).

Disability adjusted life years (DALYs) lost

In 1990, war, self-directed, and interpersonal violence were ranked 16, 17 and 19th, respectively, among the leading causes of the world’s disability adjusted life years (DALYs) lost, the numbers of years of life lost from premature death combined with the loss of health from disability (Murray and Lopez, 1996). It is estimated that in 2020, war will rank 8th, interpersonal violence 12th and self-directed violence 14th.

War is among the 15 causes of DALYs lost for persons age 0 to 44. Homicide is the 4th leading cause of DALYs lost in the age group 15 to 44, the most economically productive group. In the high income group, homicide and violence rank among the 15 leading causes of DALYs from age 0 to 44.

Other types of morbidity

It is important to realize that the DALYs rankings are certainly an underestimation of what the global burden of violence really is. To calculate the DALYs attributable to violence, war or self inflicted injuries, only fractures, wounds, amputations, crushing, burns and poisonings were taken into account (Murray and Lopez, 1996). However, victimization of violence also causes a large number of other health consequences. Victimization by family or intimate partner violence can, for example, lead to depression, suicidal behaviour, eating disorders, smoking, or alcohol or drug use (Kaplan et al., 1998; Kaslow et al., 1998; Stark et al., 1995; Pederson et al., 1998). In addition to these health consequences, victims of sexual violence can also suffer from unwanted pregnancy or sexually transmitted diseases (Holmes et al., 1996). Populations exposed to political violence or conflict often suffer malnutrition or from increases in infectious diseases (Kakar et al., 1996; Toole, 1997).

In the United States alone, every year, almost 3 million children, are abused (National Research Council/Chalk and King, 1998). WHO recently estimated that annually 40 million children are suffering from child abuse worldwide. Studies focusing on sexual abuse of children have been conducted in many countries and have shown clearly that the problem crosses boundaries and cultures. Although, because of the methodological and
definitional differences in the way the studies were conducted, countries should not be compared to each other, estimates of sexual abuse compiled in a study of 20 countries from 4 continents, ranged from 7 per cent to 36 per cent for girls and 3 per cent to 29 per cent for boys (Finkelhor, 1993). The WHO Database on Violence against Women, a global compilation of statistics from research reports and documents, leads us to the same conclusion, showing the universality of violence against women (WHO, 1999). Results from a sample of studies with similar epidemiological characteristics and representing countries from all continents and income groups, showed that depending on the country, from 5 per cent to 67 per cent of women interviewed, reported having been physically abused by an intimate partner during their lifetime. The percentage of women who reported having suffered from attempted or completed rape by an intimate partner ranged from 6 per cent to 48.5 per cent.

PREVENTING VIOLENCE

4 per cent of all persons who die in the world are intentionally killed by another person or by themselves!

Despite these staggering statistics, the data also shows that violence is preventable and should not be considered as an inevitable part of society. For example, while some countries have been involved in numerous wars, other countries have not been at war for decades. Firearm death rates in Asia are almost 100 times lower than in the Americas (Krug et al., 1998). Suicide rates in Africa are much lower than in high income countries. We need to take the time, to learn from these important cross-cultural differences to prevent further unnecessary premature deaths through the development of sound interventions and policies.

Research has allowed to establish some principles for interventions in the area of youth and domestic violence prevention. These principles were developed based on careful research into the risk and protective factors and on evaluation of different types of interventions. At this stage most of the research has been conducted in western societies and little is known about the universality of these principles. What is certain however, is that there are no easy remedies to violence. Violence is a complex issue with complex causes and only a number of interventions implemented at the same time at different levels will allow for notable improvements.

Another lesson is that interventions need to occur at early stages. To be efficient, interventions need to target children as early as possible and before adolescence. Even behaviours that occur during adolescence, like school violence, or even adulthood, such as child or intimate partner abuse, need to be prevented by intervening during childhood.

Interventions can be conducted at different levels: the individual, the family, peer groups or the larger community (Dahlberg, 1998). Examples of interventions that target the individual are programmes that focus on anger management or self-control. These interventions aim at changing an individual’s attitudes and beliefs. Family level interventions focus on improving the way parents supervise and discipline their children. Training programmes for parents or home visitation programmes are used to prevent
child abuse. Programmes that focus on changing group interactions are often peer mediation programmes. In these programmes, youth are assisting other youth by mediating conflicts or serving as positive role models. At the community level, interventions focusing on improving neighbourhoods or school settings can be undertaken. These interventions can target the physical environment (for example, increase lighting), improve school security (for example, use of metal detectors) or also focus on behavioural changes such as anti-violence awareness campaigns.

In addition to these primary prevention efforts, secondary prevention efforts are needed to reduce the long term impact of violence on victims and their families. Adequate emergency referral systems and pre-hospital and hospital care are needed for the treatment of injuries. In many parts of the world, this is still a problem. For example, it is estimated that 2/3 of landmine victims die because of lack of appropriate emergency response system. Psychological support also needs to be given to victims of the different types of violence. For example, support groups are often very helpful for victims of intimate partner violence or sexual abuse.

A WORLD REPORT ON VIOLENCE AND HEALTH

During recent years, some important developments, have taken place in the international arena. These developments will contribute to including violence in the national Public health agendas. In view of what it described as a dramatic increase in the incidence of intentional injuries, the Forty-Ninth World Health Assembly adopted resolution WHA 49.25 in 1996, declaring violence a leading worldwide Public health problem (WHO, 1996). The Resolution urged member states to assess and develop science-based solutions to the problem. In 1997, a Plan of Action to Reduce Violence was prepared, based on the four steps of the Public health approach, moving from problem to solution. The first step is to determine the magnitude, scope, and characteristics of the problem. The second step is to study the factors that increase the risk of disease, injury, or disability, and determine which factors are potentially modifiable. The third step is to assess what can be done to prevent the problem by using the information about causes and risk factors to design, pilot test, and evaluate interventions. The final step is to implement the most promising interventions on a broad scale. The WHO collaborating centres were instrumental in assisting WHO to set the stage for these two milestones.

The WHO programme for Violence and Injury Prevention is in the process of building upon the WHA resolution and Plan of Action. In collaboration with several centres and experts from around the world, WHO is producing the World Report on Violence and Health. The goals of this document are to raise worldwide awareness about the Public health aspects of violence and to highlight the contributions of Public health to understanding and responding to the problem of violence. More specific objectives of the document are 1) to describe the magnitude and impact of violence cross-nationally; 2) to elucidate cross-national patterns of violence; 3) to provide a baseline for measuring change and progress; 4) to summarize existing information on risk factors, prevention approaches, and policy responses; 5) to provide directions for future research; and 6) to make recommendations for future action in Public health.
WHO recently estimated that annually 40 million children are suffering from child abuse worldwide

The primary audience for the report will be decision makers, Public health officials and practitioners, and journalists. A number of international experts have been invited to write chapters based on the data and on current relevant issues. The report will be released in January 2001 at the WHO Executive Board meeting and will be widely distributed to governmental and non-governmental agencies. The report will also be made available on the World Wide Web in a format that will allow easy use of the data by researchers. We hope that the report will be another milestone in developing the global Public health strategy for violence prevention.

FUTURE DIRECTIONS:

The World Report on Violence and Health will include clear recommendations for future directions, targeting especially those countries that are willing to complement the work being done by their judicial system by starting to implement the public health approach to violence prevention and control. Some of these recommendations are summarized as follows:

• Intersectoriality

   Violence is such a complex issue and involves so many different sectors that only a multi-sectorial approach will allow us to address the issue. Intersectoral collaboration is needed. Many of us work with psychologists, sociologists, medical doctors and criminologists, and many of us also work in the field of Public health. A step further should be taken to bring together Public health officials from ministries, agencies and universities with representatives from organizations representing justice, police, urban planning, human rights and other fields. Specific partnerships need to be developed at local, national and international levels: For example, the concepts and strategies developed by Public health should be promoted through partnerships with the media. The media can help us to change people’s attitudes and eventually behaviours, and we can learn from the experience of other health issues, like tobacco or reproductive health. Well-built communication strategies could help us change perceptions about issues like domestic violence or change the image associated with owning firearms.

   Partnerships are also needed between Public health and related agencies and fields. For example, Public health, international diplomacy and human rights share many concerns and issues, in particular a prevention based approach. In a recent article, the Swedish Foreign Minister, issued a call that resembled closely the Public health approach: ‘We need a global structure for conflict prevention. We must identify structural risk factors, shed light on root causes, and design efficient means to find peaceful avenues to developments that may otherwise
lead to violence’ (Lundh, 1999). Public health efforts could strengthen the activities developed in diplomacy or human rights by sharing its tools around which its science and data-based approach are structured. Sound epidemiological principles would strengthen the basis and the monitoring and evaluation of the implementation of international treaties. Public health could gain in strength by building upon the human rights mechanisms and using its international tools.

• National and local strategies

National and local leaders should call upon relevant organizations to jointly develop plans, strategies and interventions to address violence. Although this approach has been taken on a few occasions by a handful of countries, it is still a rare phenomenon. Workers in different disciplines should join forces to develop joint national and local strategies that would include the sharing of data, for example between justice and health, the definition of terms and the joint implementation and evaluation of interventions. Well-defined goals, objectives, strategies and time lines would be instrumental in reducing violence.

• Address the root causes of violence

As stated earlier, the causes of violence are multiple and complex. In fact, some of the causes, such as the gap between rich and poor, seem sometimes far removed from the area of Public health or even, often seem to be out of reach because of the magnitude of the problem. However, it is important that Public health contributes to research and other efforts in trying to address root causes such as poverty and the social acceptability of violence.

• Global information sharing

Although we spend a considerable amount of time writing and communicating about our work, we still spend too much time re-inventing the wheel. This is especially true at the international level. We should use every opportunity to share our experiences across borders, especially with those who do not always have access to scientific journals or international conferences. The World Health Organization is already playing an important role in this respect and will hopefully be able to continue to increase its activities in the development of guidelines and recommendations for best practices.

• Joining forces

As stated earlier, separating violence into different sub-types, such as child abuse, intimate partner and youth violence, allows for in depth studying of the specific risk factors or prevention programmes. However, it often also leads to a situation where experts in the different sub-types of violence have become so specialized that they do not communicate with or read the work of experts in any of the other sub-types. This over-fragmentation leads to isolation and some of the common factors or links between the different types of violence are overlooked. Worse, in some cases where joint efforts for awareness raising, resource mobilization or priority setting would have been more powerful, these efforts are weakened by the absence of unified vision and strategies. Artificial barriers should be eliminated as much as possible to allow for a joint, stronger, integrated approach.
• Distribution of resources
We should strive for a distribution of resources reflecting the burden of injuries. At present, the donor community does not always allocate resources toward the problems or places with the major burden. For example, although victims of landmines and their families deserve all the support we can give, is it cost-effective to concentrate such a large proportion of resources on a group of victims that represent 0.3 per cent of the total number of injury deaths in the world? Although child abuse and intimate partner violence are widespread and cause terrible damage, a very large proportion of victims and perpetrators of violence are adolescent and young males, who also need our attention.

firearm death rates in Asia are almost 100 times lower than in the Americas

• Evidence base
Building our knowledge and interventions on sound epidemiological data is the strength of Public health. All countries should start by studying the magnitude and characteristics of the problem in its own reality. Interventions should be based on culturally relevant data and evaluations should be systematically incorporated in programmes.

• Be patient.
Smallpox was not eradicated in a few years and the fight against TB, AIDS and many other health problems has already taken decades. With all of its complexity, violence will certainly not be eliminated in the near future. The involvement of the Public health community in violence prevention and control is still at its very early stage. Plutarch is quoted to have said that ‘Perseverance is more prevailing than violence; and many things that cannot be overcome when they are taken together, yield themselves up when taken little by little’

REFERENCES

Kaplan, S.J. et al., 1998, Adolescent physical abuse: risk for adolescent psychiatric


A New Vision for Suicide Prevention: The Public Health Approach

Mark L. Rosenberg and James A. Mercy

INTRODUCTION

The public health approach differs from traditional approaches to suicide prevention. Suicide has traditionally been seen as a mental health problem. In this view, suicide was seen as caused by mental illness, and prevention consisted of identifying and treating persons with the types of mental illness that led to suicide. These illnesses usually include depression, manic depressive illness, schizophrenia, and serious character and anxiety disorders. The traditional approach has also focused on treating patients with mental illness one at a time as they come for mental health care in clinical settings, with treatment provided by mental health clinicians. The public health approach is based on three fundamental principles: it is focused on prevention, based on science, and inclusive in scope. Suicide is an important global health problem and takes a large toll in almost every country. The examples in this paper are drawn from the US, but we believe that the public health approach to suicide prevention advocated here will be useful around the world.

BACKGROUND: SUICIDE IS A WIDESPREAD PROBLEM IN THE US AND GLOBALLY

The starting point for public health involvement in suicide is, of course, its impact on physical and emotional health. In 1996, suicide was the ninth leading cause of death in the US (Kachur et al., 1992). Each year suicide claims more than 30,000 lives and about 80 per cent of those who die are males. Surveillance of adolescent suicidal behaviour has shown us several alarming trends (Rosenberg et al., 1987). From 1952 through 1992 suicide rates among adolescents and young adults nearly tripled and from 1980–1992, the rate of suicide among persons aged 15–19 years has increased by 28.3 per cent (81 per cent of this increase was due to the increase in firearm-related suicides) and among persons aged 10–14 years the suicide rates increased 120 per cent (CDC, 1994; 1995; 1997). From 1980–1992, the rates among African-American males aged 15–19 years increased 165.3 per cent (CDC, 1998). In addition, a 1993 nationwide survey of high school students found that in the 12 months preceding the survey, one-fourth had seriously considered suicide and one in twelve had attempted suicide.

Though suicide rates are rising among adolescents, the rates continue to be highest among persons aged 65 years and older (CDC, 1996). From 1980 to 1992, overall suicide
rates increased for persons in only two age groups: 5–19 years and those above 65 years. The ten-year period 1980–1990, was the first decade since the forties that the suicide rate for older US residents rose instead of declined. In 1992, persons aged over 65 years accounted for 13 per cent of the population but over one-fifth of all suicides. Because older persons are the fastest growing age group in the United States, the number of suicides in this age group will probably continue to increase.

Information on the precise global health burden of suicide is not available but estimates of the relative and absolute contribution of suicidal behaviour to the global health burden have recently become available through a comprehensive assessment of mortality and disability due to disease and injuries in 1990 and projected to 2020 (Murray and Lopez, 1996). The burden of suicide is quantified by measures of two general types of health consequences: (1) premature mortality as measured by numbers, rates, and years of life lost due to suicide, and (2) disability (sensory, cognitive functioning, pain, affective state, etc.) as indicated by a new measure called Disability adjusted life years Lost (DALYs).

The DALY is a new method of measuring disease burden; it is based on a quantification of disability that is derived from the incidence, duration, and severity of the morbidity and complications associated with specific conditions (Murray, 1996). The method was developed by the World Health Organization and the World Bank to overcome the limitations of using mortality as the sole measure of health impact. While the DALY measure is an advance in assessing the burden of disease, it has limited application. The information needed to calculate the DALY is often incomplete, particularly in many developing countries, and suitable indicators to measure such factors as the psychological consequences of suicidal behaviour have not yet been developed or made generally available. Nevertheless, it is useful as a crude indicator of the health impact of nonfatal suicidal behaviour across different regions of the world and relative to other health problems (For details on how DALYs are calculated see Tables 1, 2 and 3 at the end of the paper; Murray, 1996).

for many years people feared that asking people about suicidal thoughts might actually influence them to commit suicide

THE PUBLIC HEALTH APPROACH IS FOCUSED ON PREVENTION

The public health focus on prevention means that the goal is to prevent suicides in the future, a goal that can be measured by reductions in the suicide rate. The focus on the future means that it is important to think about persons who may not yet be at high risk for suicide. It is important to think about persons who are still young, or about older persons who still have their important social supports but might be at high risk later when they lose these supports. The focus on prevention also means that we must be activists. Many people are quite fatalistic about suicide. They believe that suicides have always occurred throughout recorded history and they will continue to occur and there is nothing we can do about this problem, no way we can prevent it. It is important to change this view of suicide. Public health takes an activist stance and says that this is a cause and effect world: if we can understand the causes, we can affect the outcomes. If we
understand the causes of suicide, we can prevent suicides in the future. One pre-eminent public health practitioners in the world, William Foege, said that ‘the most important problem facing public health today is not the problem of HIV/AIDS, not the problem of substance abuse, and not violence. It is the problem of fatalism’.

It is also quite important to translate research findings and scientific understanding into programmes that are actually delivered and information that is easily understood and used by the people who need to use it (O’Carroll, 1990; O’Carroll et al., 1991; O’Carroll and Silverman, 1994; Potter et al., 1995; CDC, 1998). The focus on prevention does not in any way diminish the importance of providing care for victims and survivors.

It is usually helpful to describe the suicide prevention approaches and programmes actually in place in a country, state or community. In 1992, CDC published a document entitled *Youth Suicide Prevention Programs: A Resource Guide*, as part of its effort to evaluate specific interventions (CDC, 1992). This publication outlined the eight major suicide prevention strategies being used by the most successful youth suicide prevention programmes in the US. The strategies include gatekeeper training, suicide education, screening programmes, peer support programmes, crisis centres and hotlines, and ‘intervention after a suicide’ programmes. The guide serves as an information resource for those interested in learning about the types of prevention activities in the field, and, most importantly, indicates two major preventive strategies that seemed promising. The two principal strategies are to reduce the prevalence of risk factors and to identify and intervene with high-risk persons. Interventions should be developed earlier on the pathway toward suicide. For example, if the use of alcohol increases the risk for suicide, then young children at risk for alcohol abuse should be given the skills to resist alcohol when they get older. If geographic mobility and lack of social connections increases the risk for suicide, then employers should work to promote geographic stability or provide counselling resources and parental education when families are forced to move for their work.

Another way to intervene earlier along the pathway and to reduce risk factors would be to involve children earlier in preventive programmes. Children and youth may be more educable and behaviours and skills learned earlier tend to endure. Children can also be taught skills to equip them to deal with many different types of violence. New methods of delivering proven effective interventions also need to be developed. Involvement in suicide prevention should extend beyond the traditionally-involved mental health professionals. Schools could administer screening programmes to identify children and youth at high risk for suicide. And communities could become involved in decreasing access to lethal means of suicide. Agricultural agents, for example, might become involved in eliminating the use of pesticides that are frequently swallowed by suicidal young women in rural areas (CDC, 1990).

Another implication of intervening earlier is that we need to target increasingly larger groups as we intervene earlier because we have less information in hand to help us identify those at the highest risk. A useful approach involves dividing target groups for suicide prevention activities into three levels of risk. The lowest level of risk group targeted is the general population and programmes aimed at this broad range of persons are called ‘universal’. The next highest level of risk might be those in the population who have some indication that they are at higher-than-average risk, but not so high that an
attempt is more likely than not. Programmes aimed at this group would be called ‘select’. Finally, programmes for those at the very highest level of risk, would be called ‘indicated’.

THE PUBLIC HEALTH APPROACH IS BASED ON SCIENCE

nowhere is there a greater need to develop an evidence-based approach to suicide prevention than in evaluating and demonstrating ways to prevent suicidal behaviour especially at the community and population levels.

The public health approach uses science as the basis for action. A simple model for how public health applies science to suicide prevention is based on four steps, each step characterized by a question. First, we ask ‘What is the problem?’ This leads to try to answer the questions a good journalist would ask: Who are the people involved? What methods do they use? When and where does it happen? We use epidemiological data to answer these questions, looking at tens, hundreds, or thousands of cases. In public health, the collection of such data to describe and track a problem is called surveillance. For many years people feared that asking people about suicidal thoughts might actually influence them to commit suicide. This has not been shown to be a real risk. We need to do a better job of describing and tracking the problem of suicidal behaviour (Birkhead et al., 1993). Work is now going on to set up monitoring systems that will tell us how often suicidal behaviour occurs. To do this we need clear definitions of the various types of suicidal behaviours and we need to test these for validity and reliability (O’Carroll, 1989). We need definitions that will apply to both children and adults, and we need to differentiate between suicide mortality, i.e. completed suicides, and suicide morbidity (Rosenberg et al., 1988; CDC, 1993). For example, we can ask whether a person ever felt so bad that they thought about hurting themselves seriously, whether they ever actually made a plan to hurt themselves, whether they ever did hurt themselves, and whether they ever hurt themselves so seriously that they required medical attention. Our monitoring systems can also monitor risk factors for suicidal behaviours and tell us who is at greatest risk, and whether the problem is improving or worsening over time.

The second step of the public health approach asks: ‘What are the causes?’ What are the risk factors that increase the likelihood a given person will commit suicide? (Hirschfeld and Davidson, 1988) What kind of risk factors might be inherent the make-up of the individual, such as a susceptibility to depression or alcoholism? What kind of risk factors might there be in the individual’s social environment, such as a family history of suicide, domestic violence or social isolation of young brides (Smith et al., 1986; Moscicki, 1995; Kellerman et al., 1992; Wintemute et al., 1999; Potter et al., 1998; Gould et al., 1980). What kind of risk factors might there be in the physical environment? These risk factors would include firearms, pesticides, or high bridges. We need to increase our knowledge of the causes of suicidal behaviour. For example, research on risk factors has shown that substance abuse, mental illnesses, family influences, such as a history of violence or family disruption, media influences, and access to firearms are potential reasons for the increase in adolescent suicides (DHHS,
1989; Davidson and Gould, 1989; Davidson et al., 1988; Brent et al., 1989; Brent et al., 1989; Kellerman et al., 1993; Cummings et al., 1997; Wintemute et al., 1999; Mercy et al., 1993). Frequent geographic moves, alcohol use and exposure to an acquaintance or relative’s suicides may also play a part in a young person’s suicide and research is currently being conducted to answer these questions. Impulsive and aggressive behaviours may also play a more important role in suicide than had been previously recognized (Tom Simon, personal communication, Oct. 1999). Characteristics for suicide among older persons also differ from those among younger persons. The risk factors for suicide among older persons include alcohol abuse, depression, greater use of highly lethal methods, and social isolation. In addition, older persons make fewer attempts per completed suicide, have often visited a health care provider shortly before their death, and have more physical illnesses and affective disorders. New research on risk factors should describe differences between risks for mortality and morbidity, and should help to understand risk and protective factors in diverse populations. We also need to better characterize risk and protective factors and their interaction, and we need to look at the similarities between risk factors for interpersonal and self-directed violence (Mercy et al., 1993).

The third step of the public health approach is to take what has been learned about patterns of the problem, and about the causes of the problem and then generate and critically evaluate interventions. Perhaps nowhere is there a greater need to develop an evidence-based approach to suicide prevention than in evaluating and demonstrating ways to prevent suicidal behaviour especially at the community and population levels. We need to learn the effectiveness of specific interventions in preventing suicide, to find how to combine specific interventions into effective programmes, and to show the effectiveness of suicide prevention programmes and policies in a wide range of different community settings.

The last step in the public health approach to suicide prevention focuses on the implementation of prevention programmes and asks the question ‘How do you do it?’ How do you mobilize resources at local, state, national, regional, and global levels to put interventions in place and sustain them over time? This step requires that we understand how to mobilize the ‘political will’; how to communicate scientific information about suicide prevention; and how to integrate a wide array of suicide prevention and support services into health, education, justice, social service, military, and other sectors.

Scientific evidence is needed and will continue to be needed because suicide is an ever-changing story: it changes as we understand more about it, and there are real changes in the phenomenon of suicide as people, the social environment, and the physical environment all change.

THE PUBLIC HEALTH APPROACH IS INCLUSIVE

Suicide prevention has long been a concern of psychiatrists and others who treat mental illnesses, since mental illness is an important risk factor for suicide. However, the clinical treatment of mental illnesses is insufficient in itself, as clearly demonstrated by rising suicide rates among teenagers, young adults, and the elderly. The clinical approach
should be supplemented by a broader, Public health approach, for several reasons.

**Suicide is not solely determined by mental illness**

Mental illness is not the only relevant risk factor in the causal mechanism leading to suicide. Research has consistently pointed to the importance of many other factors unrelated to mental illness as important determinants of suicide, such as accessibility to firearms, geographic mobility, parental loss, family disruption, being a friend or family member of a suicide victim, alcohol and drug use, and social isolation. If suicide prevention efforts focus solely on mental illness and ignore the contribution of other factors that contribute to suicide, many lives will be lost that might otherwise be prevented.

For those suicides for which mental illness is the key risk factor, it is inappropriate to confine prevention efforts to the mental health sector.

Mental health practitioners can only accomplish the important clinical work they do when patients come to see them. There are many factors, however, that determine whether suicidal patients seek help from mental health professionals. The most striking example of progress in this area is the training of ‘gatekeepers’ across a variety of disciplines (e.g., education, general medicine). These gatekeepers often play a critical role in facilitating proper care by mental health professionals, but the training of these gatekeepers is a task which is in large part beyond the scope of mental health systems. This is but one example in which both the broader perspective and the multidisciplinary tradition associated with public health practice at CDC can uniquely contribute to suicide prevention.

An effective approach to suicide prevention requires the collaboration of individuals in Public health, mental health, medicine, education, and social services in both the public and private sectors.

One of the most important developments in the field of suicidology in the last 30 years has been the recognition that suicide prevention cannot be accomplished solely through the efforts of one societal sector. This realization was clearly recognized by the Secretary’s Task Force on Youth Suicide and highlighted among the major recommendations of this body (DHHS, 1989). Collaborative, multisectoral work, and a clear focus on suicide prevention put public health in the best position to coordinate and elicit the valuable contributions to suicide prevention that can be made by a wide variety of agencies, organizations, and professionals.

Although mental illness is an important risk factor for suicide across all age groups, mental illness plays its least important role in the etiology of suicide among youth aged 15 to 24 years, the group in which suicide rates have been increasing most rapidly.

Research has shown that mental illness, particularly depression, may be less frequently
associated with suicide among young people than among older adults. In fact, only a small proportion of teen suicides occur among teenagers with manic depressive or schizophrenic psychosis because these conditions are relatively rare. Consequently, prevention strategies which focus on mental illness are insufficient for the prevention of youth suicide.

The principle of inclusivity also suggests that we need to have a broad view of violence and recognize the linkage of suicide to other types of violence. Efforts directed simultaneously toward multiple types of violence may help to reduce suicide rates more quickly than efforts focused on suicide alone. For example, victims of child abuse face a higher risk of suicide than do non-victims. Thus, if we can prevent child abuse, we can reduce the risk of suicide by giving many more people lives free of abuse. Similarly, since women who were sexually assaulted face a higher risk of suicide, by reducing the incidence of sexual assault we can simultaneously decrease the risk of suicide for many women.

An inclusive approach to suicide prevention also suggests that we should be effective in communicating scientific information about suicide prevention. Governmental agencies should work with state and local partners to conduct educational, training, and public awareness activities to disseminate scientific information about suicide prevention to the public, policy makers, health departments, community-based organizations and other entities. Abroad and inclusive Public health approach should address the reporting of suicide. For example, such guidelines were developed from a workshop composed of researchers, clinicians, Public health officials, educators and news media professionals.

An inclusive approach will foster coalitions that integrate a wide array of suicide prevention and support services. Integrative leadership is the operative principle. Such private/public partnerships, coalitions, and networks can bring together national organizations, federal agencies, foundations, businesses, state and local health departments, community-based organizations and others to prevent suicide.

THE NEW VISION IS POSITIVE AND OPTIMISTIC

The most important value of the public health approach is the underlying notion that we can do better. This is a cause and effect world and if we can understand the causes we can change the effects. We must remember that the ultimate goal is prevention (United States Public Health Services, 1999). If we focus on prevention, use the answers that science can give us, and are inclusive in our approach we could set ourselves the goal of cutting suicide rates in half and we can do that. Wherever we are.
CALCULATING DALYs

Table 1

States or territories by demographic region

Demographically developed regions

Established market economies (EME)

Andorra, Australia, Austria, Belgium, Bermuda, Canada, Channel Islands, Denmark, Faeroe Islands, Finland, France, Germany, Gibraltar, Greece, Greenland, Holy See, Iceland, Ireland, Isle of Man, Italy, Japan, Liechtenstein, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Portugal, San Marino, Spain, St. Pierre and Miquelon, Sweden, Switzerland, United Kingdom, United States.

Formerly socialist economies of Europe (FSE)

Albania, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, The Former Yugoslav Republic of Macedonia, Moldova, Poland, Romania, Russian Federation, Slovakia, Solvenia, Ukraine, Yugoslavia

Demographically developing regions

India

China

Other Asia and Islands (OAI)

American Samoa, Bangladesh, Bhutan, Brunei Darussalam, Cambodia, Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Guam, Hong Kong, Indonesia, Johnston Island, Kiribati, Democratic People’s Republic of Korea, Republic of Korea, Lao People’s Democratic Republic, Macao, Malaysia, Maldives, Marshall Islands, Mauritius, Midway Island, Mongolia, Myanmar, Nauru, Nepal, New Caledonia, Niue, Northern Mariana Islands, Palau, Papua New Guinea, Philippines, Pitcairn Island, Reunion, Seychelles, Singapore, Solomon Islands, Sri Lanka, Taiwan, Thailand, Tokelau Island, Tonga, Tuvalu, Vanuatu, Viet Nam, Wake Island, Wallis and Futuna Islands, Western Samoa

Sub-Saharan Africa (SSA)


Latin America and the Caribbean (LAC)

Anguilla, Antigua and Barbuda, Argentina, Aruba, Bahamas, Barbados, Belize, Bolivia, Brazil, British Virgin Islands, Cayman Islands, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, French Guiana, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Mexico, Montserrat, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, St. Kitts and Nevis, St. Lucia, St. Vincent and
the Grenadines, Suriname, Trinidad and Tobago, Turks, and Caicos Islands, Uruguay, U.S. Virgin Islands, Venezuela

**Middle Eastern crescent (MEC)**

Afghanistan, Algeria, Armenia, Azerbaijan, Bahrain, Cyprus, Egypt, Former Spanish Sahara, Georgia, Islamic Republic of Iran, Iraq, Israel, Jordan, Kazakhstan, Kuwait, Kyrgyzstan, Lebanon, Libyan Arab Jamahiriya, Malta, Morocco, Oman, Pakistan, Qatar, Saudi Arabia, Syrian Arab Republic, Tajikistan, Tunisia, Turkey, Turkmenistan, United Arab Emirates, Uzbekistan, West Bank and Gaza Strip, Yemen

*Data from: Murray and Lopez, 1996, Annex Table 1. State or territories included in the Global Burden of Disease Study, by demographic region.*

### Table 2

Numbers* and rates** of suicide-related deaths and DALYs by region, world-1990

<table>
<thead>
<tr>
<th>Suicide Mortality</th>
<th>Suicide DALYs (1,000s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
</tr>
<tr>
<td><strong>US</strong></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
</tr>
<tr>
<td>Male</td>
<td>25</td>
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<tr>
<td>Female</td>
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</tr>
<tr>
<td><strong>EME(-US)</strong></td>
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<tr>
<td>Total</td>
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<tr>
<td>Male</td>
<td>56</td>
</tr>
<tr>
<td>Female</td>
<td>25</td>
</tr>
<tr>
<td><strong>FSE</strong></td>
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</tr>
<tr>
<td>Total</td>
<td>81</td>
</tr>
<tr>
<td>Male</td>
<td>62</td>
</tr>
<tr>
<td>Female</td>
<td>19</td>
</tr>
<tr>
<td><strong>India</strong></td>
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<tr>
<td>Total</td>
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<tr>
<td>Male</td>
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<tr>
<td>Female</td>
<td>45</td>
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<tr>
<td><strong>China</strong></td>
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<tr>
<td>Total</td>
<td>343</td>
</tr>
<tr>
<td>Male</td>
<td>159</td>
</tr>
<tr>
<td></td>
<td>Deaths from all causes</td>
</tr>
<tr>
<td>-------</td>
<td>------------------------</td>
</tr>
<tr>
<td></td>
<td>Total (n)</td>
</tr>
<tr>
<td>Female</td>
<td>184</td>
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<tr>
<td>Male</td>
<td>40</td>
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<tr>
<td>Female</td>
<td>27</td>
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<tr>
<td>Total</td>
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<td></td>
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<tr>
<td>SSA</td>
<td>Total (n)</td>
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<tr>
<td>Male</td>
<td>13</td>
</tr>
<tr>
<td>Female</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>472</td>
</tr>
<tr>
<td>LAC</td>
<td>Total (n)</td>
</tr>
<tr>
<td>Male</td>
<td>16</td>
</tr>
<tr>
<td>Female</td>
<td>7</td>
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<tr>
<td>Total</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>593</td>
</tr>
<tr>
<td>MEC</td>
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<td>Male</td>
<td>32</td>
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<tr>
<td>Female</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>1,335</td>
</tr>
<tr>
<td>World</td>
<td>Total (n)</td>
</tr>
<tr>
<td>Male</td>
<td>456</td>
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<tr>
<td>Female</td>
<td>330</td>
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<tr>
<td>Total</td>
<td>786</td>
</tr>
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<td>18,967</td>
</tr>
</tbody>
</table>

Note: legal intervention-related deaths were included in the overall violence category but not in the homicide category. Therefore, the sum of the subcategories of violence-related deaths do not add up to the total.

* Numbers In thousands

** Rates per 100,000 0,000 population

Table 3

Percentage of all deaths that are suicide related, 1 990
REFERENCES


Centers for Disease Control, 1992, Youth Suicide Prevention Programs: A Resource Guide. (Atlanta, GA: Centers for Disease Control).


Barbarism and Solitude: Reflections on Globalization and Violence

Emmanuel Rozental-Klinger

‘Total war and cold war have brainwashed us into accepting barbarity. Even worse: they have made barbarity seem unimportant, compared to more important matters like making money’ (Hobsbawm, 1997). In his lecture titled ‘Barbarism: A Users Guide’, Eric Hobsbawm makes this statement that clearly and directly outlines the relationship between globalization and violence. In fact, it is my view that the very process by which we have become brainwashed to accept and to perpetrate barbarity is what we currently know as globalization.

The process of accumulation of capital begins by turning a certain amount of money into means of production and labour. This operation takes place in the market, within the orbit of circulation. The second stage of the movement, the production process, ends as soon as the means of production are turned into merchandise whose value exceeds the value of its parts, containing the initial capital invested plus a surplus value. In turn, this merchandise is sent out again into the orbit of circulation. It is necessarily sold, realizing its value in money, in order to turn this money into new capital, and so the cycle repeats itself endlessly (Marx, 1958).

‘I was invited to witness the trade. My guest was a gang member and only 15 years old. He trusted me and wanted to get out of trouble. He knew he was going nowhere and that he would likely end up murdered at a young age. He wanted to break the cycle. A police agent in uniform brought the weapon to the dark alley. He was paid the price that had been agreed upon, and left warning against any leaks in secrecy. I saw the gun. That was just the beginning of a cycle. The same weapon had belonged to the leader of another gang and taken away from him by the officer. A few days later, the same policeman, assisted by two others, chased and arrested his client and “found” him illegally carrying a gun. They beat him and let him go. He had three hours to get a set amount of money or else they would lay charges. He had no choice, plus, he needed the gun. He paid the price and recovered the weapon. The cycle continued. The next time he was caught, after the new beating, the gun was never returned to him. A new client bought it for a better price. Each time, crimes were committed with the weapon. Each time, the price of the recycled weapon went up’ (or an excellent ethnographic study of urban violence see Vanegas, 1998)

Key resources such as money, labour and means of production, and the market, constitute the essence of the process of capital accumulation. Specific roles and relationships
between human beings are established for this process to occur: those between the owners of capital and the labour force.

The labour force is constituted by people who sell their time and effort to the owners of the means of production. Their labour generates the surplus value, the source of profit for the owners of capital. In exchange, labourers are remunerated at set market prices. Cheaper, more efficient, skilled labour generates more surplus value and greater capital accumulation. Within this process, human beings, particularly those who find themselves having to sell their work as labour, are reduced to another resource of the production process aimed at the accumulation of profit for the owners of capital.

The market is a necessary stage in the process of capital accumulation, a stage where trade of goods, services and people (labour), takes place.

Technology is another key resource in this equation. Technologies have affected and indeed transformed the productive processes extending beyond them to almost every sphere of human activity (Ellul, 1964).

‘As I see it, technology has built the house in which we live. The house is continually being extended and remodelled. More and more of human life takes place within its walls, so that today there is hardly any human activity that does not occur within this house. All are affected by the design of the house, by the division of its space, by the location of its doors and walls. Compared to people in earlier times, we rarely have a chance to live outside this house. And the house is still changing; it is still being built as well as being demolished’ (Franklin, 1999).

given these facts and processes, globalization is itself a form of violence, generalized and exercised against the majority of the world’s population

Technology is the outcome of productive processes, hence its development and use is determined by capital accumulation, while simultaneously transforming the relations of production between labour, means of production, capital and the market. Control over the production and use of technology is determinant of power over markets, production and accumulation.

Technology is not the sum of the artifacts, of the wheels and gears, of the rails and electronic transmitters. Technology is a system. It entails far more than its individual components. Technology involves organization, procedures, symbols, new words, equations, and, most of all, a mindset’ (Franklin, 1999).

Societies are involved in complex conflicting processes whereby specific social actors represent their interests in their struggle for power over the production and distribution of essential resources. Within the modern capitalist State, the main actors involved in conflictive processes over key resources have traditionally been organized labour and capital. The State has provided the scenario and the ‘rules of the game’ for such processes to take place. The outcome is an expression of the balance of power between the majorities (labour and other social actors) and capital (minorities). In general, the
interests of economic development tend to take precedence over other priorities, particularly when labour and other social interests are weak or fragmented. Economic development and the generation of wealth serve the accumulation of profit for the interests of capital. Yet, it is argued that this accumulation is simultaneously the means towards social development. Consequently, markets expand as a result of increased production and accumulation, which constitutes measurable growth.

Each individual State is immersed in a global market. The actors defining ‘rules of the game’ are increasingly multinational and transnational. Modern development is based on the premise of unlimited growth and the universalization of the market. Individuals within societies and societies within world economies have entered the realm of expanding, merging and stronger global capital accumulation interests, with greater and growing power to produce and use key resources. Weakened nation-states and increasingly fragmented and disorganized labour, and other social actors, strive to survive. Such is, in essence, the process of globalization. A process that has given rise to the fourth world (Castells, 1998).

It was part of the daily newscast, a story of yet another factory being closed and of its workers being laid-off. A woman had her face against the wired fence. As the reporter approached her; her tears became visible and her moans of despair louder. ‘What am I going to do now? What am I going to do? I have four children at home and nothing to feed them with’.

The most visible and expected outcome of globalization is inequality with gross concentration of power and wealth in a few hands and massive exclusion and deprivation among growing majorities. A market for profit is necessarily amoral and immoral. Amoral, because it is not intended for human well being, but for profit accumulation. Immoral, because it promotes excessive accumulation by a privileged minority while others (the immense majority) are deprived from their most basic needs and rights. According to the Human Development Report 1999 (UNDP):

- The global labour market is increasingly integrated for the highly skilled corporate executives, scientists, entertainers and the many others who form the global professional elite with high mobility and wages.
- Inequality has been rising in many countries since the early eighties.
- Inequality between countries has also increased. The income gap between the 20 per cent of the world’s people living in the richest countries and the 20 per cent in the poorest was 74:1 in 1997, up from 60:1 in 1990 and 30:1 in 1960. By the late nineties the 20 per cent of the world’s people living in the highest income countries had:

  * 86 per cent of world GDP while the bottom 20 per cent had just 1 per cent
  * 82 per cent of world export markets while the bottom 20 per cent had just 1 per cent
  * 68 per cent of foreign direct investment while the bottom 20 per cent just 1 per cent
  * 74 per cent of world telephone lines, today’s basic means of
communication while the bottom 20 per cent just had 1.5 per cent.

- OECD countries with 19 per cent of the global population have 71 per cent of global trade in goods and services, 58 per cent of foreign direct investment and 91 per cent of all internet users.
  - The world’s 200 richest people more than doubled their net worth between 1994 and 1998, to more than one trillion dollars. The assets of the top 3 billionaires are more than the combined GNP of all least developed countries and their 600 million people.
  - The recent wave of mergers and acquisitions is concentrating industrial power in mega corporations, at the risk of eroding competition. By 1998 the top 10 companies in pesticides controlled 85 per cent of a 31 billion dollar global market/ and the top 10 telecommunications, 86 per cent of a 262 billion dollar market.
  - In 1993 just 10 countries accounted for 84 per cent of global research and development expenditures and controlled 95 per cent of the US patents of the past two decades. Moreover, more than 80 per cent of patterns granted in developing countries belong to residents of industrial countries.

New technologies and modes of production are increasingly capital intensive. Workers are either absorbed in lower-paying jobs or become marginalized. In order to gain comparative advantage workers and smaller firms enter a ‘race downwards’ whereby they decrease wages in order to remain competitive. Under these circumstances, child labour, prostitution and other forms of exploitation become commonplace and are understandably defended by their victims as a source of income, when other sources are denied to them.

State structural reforms at the service of global capital are leading to an increasingly serious problem of unemployment, turning to unemployability in an environment where there is declining responsiveness to those with the least power and the most need. This phenomenon, added to chronic employment deficits (particularly in the most dependent economies) has led to the rise of the ‘underclass’. Beyond the ‘reserve labour force’, these people have become superfluous and unnecessary—they have been expelled from productive activities. They have been made invisible.

Large urban ghettos occupy most of the Third World cities where the majority of the population survives under precarious conditions. In fact, entire countries are ‘more marginal today than they were at independence from colonialism’ (Apter, 1997).

**social exclusion, within contexts characterized by inequity and poverty is fertile ground for all kinds of violence**

Given these facts and processes, globalization is itself a form of violence, generalized and exercised against the majority of the world’s population. Within the context of extraordinary technological development and given our global unprecedented ability to generate wealth, poverty is the outcome of inequity and as such it constitutes violence against the poor (Hobsbawm, 1994).

In spite of the growing evidence of a crisis in terms of increasing inequity, exclusion
and human suffering generated by capital, the most prevalent attitudes towards it are:

- An almost religious faith in the goodness of capital. It is the perspective from within, professed mostly by those directly benefiting from the system and its expansive perspectives. Data and evidence describing exceptions are presented as proof to the likelihood of a better future. Widespread failures are discarded as exceptions. The invitation is to trust the system, for it will eventually solve its problems.

- A pragmatic position recognizes the risks and damages caused but, given that there are no realistic alternatives, a damage containment process must be in-place and all practical efforts should be made to choose the best of all evils.

- Practical indifference to calamities and sufferings of others is taken to be a legitimate mode of personal conduct. This is probably the dominant moral culture for most of the duration in most of the societies known as liberal (Geras, 1999).

These structural determinants of violence are manifested in the context of particular societies and nations where they occur within specific historical processes, among actors and their relationships. Social exclusion, within contexts characterized by inequity and poverty is fertile ground for all kinds of violence. When deprivation and opulence coexist, violence is perceived as functional to the satisfaction of needs that appear otherwise inaccessible.

‘A Sunday morning gathering was taking place in a health center within one of the most violent neighborhoods in the city of Cali. A group of young people had come to talk about their most pressing problems and needs. The issues were poverty, lack of access to education and health care, abuses by the authorities, drug abuse and drug trade, racism and many other issues that combined with each other to become almost inseparable. A young man talked about the need for a profound transformation that would not come about until and unless local people suffering and understanding these problems would gather political power to act on behalf of these communities. He spoke about the need for new leadership and the role youth (such as himself) should play in this regard. Someone spoke about “sicarios” (hired assassins). When the young man was asked if he would consider murdering somebody he did not know for, say, a million pesos (US $ 500) his reply was: “I would give it serious consideration. We could do a lot with that money at home”.

Beyond certain threshold of inequity, the distribution of income and wealth seems arbitrary. Frustrations exacerbate when differences are perceived as unfair. In the eyes of the ‘have-nots’, the ‘haves’ are unfairly blessed by undeserved privileges or luck. The relative positions of individuals in society do not seem to correspond to any objective criteria. Social positions and benefits are not the outcome of efforts or of the objective evaluation of merits but of favorable or unfavorable circumstances. The entire social structure appears illegitimate. What is the meaning and value of on-going individual effort and work if they will have minimal or no impact on generating better social and...
living conditions? Under such circumstances, the past, along with established class structures, pre-determines the present and denies access to a better future. When the past is the major determinant of the future, violent means appear as legitimate options (Fitoussi and Rosanvallon, 1997).

These structural determinants are compounded by institutional and interpersonal determinants.

Institutions—formal or informal, governmental and non-governmental—constitute ‘the rules of the game’ and the provision of services within societies. The processes of market liberalization and globalization are having a direct deleterious impact on institutions, particularly on those established for the provision of essential services (health, education) for those in most need in the less developed world (UNDP, 1999).

Under critical circumstances, institutions lose legitimacy and they either tend to reproduce the violence that benefits dominant interests, or are weakened, distorted or their function is replaced by illegal organizations that assume their role. The relationship between institutional determinants and violence has been studied (Apter, 1997; for the case of Colombia see Deas et al., 1999). In Colombia, where homicide constitutes the first cause of death, more than 90 per cent impunity for this crime encourages its recurrence and explains the appearance of extra-institutional justice mechanisms (Romero, 1999).

The northern front of ELN, the National Liberation Army, the second most powerful leftist guerrilla group in Colombia, sends a public communiqué dated 20 November 1999 with regards to the case of Orlando Rodriguez, a member of Barranquilla’s city council and whom, according to the source, has had control of the budget since the eighties. Quoting government and official sources, the front denounces continuous theft of public resources and requests more public information from credible sources in order to carry out a criminal process in view of the fact that his wrongdoings have been treated with absolute impunity.

The ethics of interpersonal relationships are altered under circumstances of poverty. Quite often the preservation of personal integrity requires that one threatens the integrity of others, and vice versa. Under circumstances of growing exclusion, encouraged rugged individualism, and aggressive competition for survival, the use of force is preferred to solidarity, and aggression overrides conciliation. Conflicts tend to be resolved by the elimination (physical and otherwise) of the counterpart. Differences become unacceptable and social intolerance grows out of proportion. The weakest become the most vulnerable—elderly, women, children, immigrants, minorities, youth (UNESCO, 1998; Castells, 1998).

Under the influence of globalization, political, criminal and interpersonal forms of violence are, not surprisingly, on the rise (Guerrero Baron, 1999). Although easy to distinguish in theory, the boundaries between these violent expressions are often indistinguishable.

when the past is the major determinant of the future, violent means appear as legitimate options

Political violence is an organized attempt to change the power relationships between
social actors. Its expressed intent is to alter the control over key social resources. According to Apter, it is carried out ‘for a designated and reordering purpose: to overthrow a tyrannical regime, to redefine and realize justice and equity, to achieve independence or territorial autonomy, to impose one’s religious or territorial beliefs’ (Apter, 1997). ‘It is a rational phenomenon, no different generically speaking than normal politics except in terms of its means’ (Apter, 1997). Within the context of growing inequality and exclusion promoted by the interests of capital accumulation, ‘(w)ithout suggesting a one-to-one correspondence between negative conditions and political violence, what is happening today and developmentally, increases the possibilities for violent discourse’ (Apter, 1997). Class, ethnicity, religion, race, language and doctrines are revalidated as ways of defining redeeming projects, discourses and their communities. Fundamentalisms are also on the rise. Political violence in our world can be easily explained (although not always easily justified) as a necessary reaction to a global process that leaves few other viable alternatives for real and effective democratic political participation. The threat and destruction of social movements encourages a wide spectrum of political organizations that resort to violent means (Hobsbawm, 1996).

Criminal violence includes a wide range of expressions from the sporadic disorganized criminal activity to the globalized organized criminal economy. (For an excellent analysis of the subject see ‘The Perverse Connection: The Global Criminal Economy’ in Castells, 1998) The latter can be understood as illegal global capital. Its purpose is the accumulation of profit through the extraction of surplus value from a wide variety of productive illegal processes. It is a source of labour for increasing numbers of people throughout the world. The concentration of power and wealth in the hands of the owners of this illegal capital follows the economic pattern of the legal accumulation processes. The type of illegal commercial activities in which organized crime is involved generates risk. Risk calls for the use of violent means. The combination of risk and violence exerts economic, cultural and political impacts. These impacts are felt at every level of the legal and illegal market, as well as on political processes. As a result, the number of those affected, involved and responsible for the criminal economy is growing. According to the Human Development Report 1999 (UNDP, 1999):

‘Deregulated capital markets, advances in information and communications technology and cheaper transport make flows easier, faster and less restricted not just for medical knowledge but for heroin—not just for books and seeds but for dirty money and weapons. Illicit trade—in drugs, women (sic), weapons and laundered money—is contributing to the violence and crime that threaten neighborhoods around the world…The Internet is an easy vehicle for trafficking in drugs, arms and women (sic) through nearly untraceable networks. In 1995 the illegal drug trade was estimated at 8 per cent of world trade, more than the trade in motor vehicles or in iron and steel. Money laundering—which the International Monetary Fund (IMF) estimates at equivalent to 2–5 per cent of global GDP—hides the traces of crime in split seconds, with the click of a mouse. At the root of this is the growing influence of organized crime, estimated to gross $1,5 trillion a year, rivaling multinational corporations as an economic power. Global crime groups
have the power to criminalize politics, business and the police, developing efficient networks, extending their reach deep and wide’.

The prevalent assumption is that criminal violence refers to the activities of mafias, drug trade, prostitution, black markets and the like. It is important to recognize as criminal and violent, a broad spectrum of activities that increasingly involve white-collar criminals, governments and government officials, prestigious international figures and even heads of State. Crime and violence are not only what the media and the governments denounce as such. A few examples will illustrate this point. The Iran Contra affair, where the US government at the highest level was involved in cocaine and arms trade in order to overturn foreign governments by violent means and against its own national constitution. Augusto Pinochet, one of several former dictators and heads of State involved in crimes against humanity. The massive crises generated by unregulated capital speculators whose direct result in barbarity and human suffering has not been adequately recognized.

And there are other types of international crime. The global economy is promoted by capital in order to free the markets to open and fair competition. Evidence demonstrates (as stated earlier) the growth of monopolies, the concentration of wealth and power in fewer hands and the growing restrictions imposed on the ‘freedom’ of the market by merging capital mega interests. While governments are being pressured to lift their barriers to trade, privatize and enter open competition under the threats of economic and political strangulation, giant multinational conglomerates close the door to open-trade and impose monopolies.

As Anatole Kaletsky reported (November, 1999), Microsoft business genius Bill gates, has maintained ‘highly profitable levels in software prices by establishing and exploiting monopoly power’. A recent anti-trust decision demonstrated how ‘there can be no further doubt that Microsoft deliberately used its absolute control over key operating software to deter computer manufacturers from marketing cheap, simplified computers and to stifle quality improvements in innovations’. In the meantime, the more commonly recognized global criminal economy grows, mostly by taking advantage of the opportunities created by the expansive global legal economy. There is a growing consumer illegal market for drugs and arms. Any measures taken against these harming processes have had little impact. The markets keep growing and expanding. At most, transient control is obtained. It seems increasingly plausible that the growth of the global legal capital necessarily promotes the growth of its counterpart (and sometimes associate) illegal side (Castells, 1998).

Political violence in our world can be easily explained (although not always easily justified) as a necessary reaction to a global process that leaves few other viable alternatives for real and effective democratic political participation.

Some obvious contradictions with devastating outcomes in terms of loss of human life and extreme suffering need to be approached directly. One of the most obvious examples of such contradictions is the emphasis placed on repression of production by the US war against drugs (mostly involving military aid and arms transfers and trade). Simultaneously, Colombia is a market for American produced armament. No war against
arms production and trade is launched within the United States. The producers of weapons are protected (while the US is not exempt from internal arms-related criminal offences, such as shootings from school yards to the stock market).

The expanding global economies have created a world of individualized consumers, in need of a ‘quick fix’ that can be bought and which will provide immediate and predictable results (Williams, 1983, Hobsbawm, 1994). It is not surprising that addictive behaviours are on the rise. Yet, few efforts are made to unveil the determinants of widespread consumption of illegal drugs (Fitoussi and Rosanvallon, 1997). The approach is a repressive-moralistic one, which can only promote the growth of this market. It seems likely that the combination of repressive measures taken against organized crime with predominant social marketing strategies that invite and manipulate consumerism and addictive behaviours constitute the best promotion for illegal drug trade.

‘Their strategy is to base their management and production functions in low-risk areas, where they have relative control of the institutional environment, while targeting as preferential markets those areas with the most affluent demand, so that higher prices can be charged’. This is clearly the case for the weapons and drug cartels (Castells, 1998).

For the masses of people increasingly involved in criminal activities, the distinction between legal and legitimate becomes a matter of survival. When obeying the law under circumstances of increasing exclusion leads to further deprivation and hopelessness, the illegal activities are justified as legitimate and find increasing support in masses of urban poor (particularly young) throughout the world. If they do not find violence and crime, violence finds them (Castells, 1998; Hobsbawm, 1997; Apter, 1997; Penaranda-Guerrero, 1999).

As Castells (1997) summarizes it: ‘In many contexts, daring successful criminals have become role models for a young generation that does not see an easy way out of poverty, and certainly no chance of enjoying consumption and live adventure. From Russia to Colombia, observers emphasize the fascination of local youth for the Mafiosi. In a world of exclusion, and in the midst of a crisis of political legitimacy, the boundary between protest, patterns of immediate gratification, adventure and crime becomes increasingly blurred.

In German Castro Caycedo’s partial interview of Pablo Escobar, former leader of the Medellin drug cartel, explains how he became involved in criminal activities when he was young and poor working for less than minimum wages in downtown Medellin carrying heavy loads. At the end of the day, he was just as poor, hungry and tired. Nobody noticed him, especially not the girls. At the time he used to watch those of his age involved in the emerald and marihuana trades. They dressed well, looked clean, had fancy cars and were respected and recognized by everyone. Is that not what everyone wants, especially when young and full of energy?

Unfortunately and in view of the impact of globalization, criminal or otherwise, the real question is: why wouldn’t youth (and everyone for that matter), join organized crime?

In conclusion, given the complex but all too obvious relationships between violence and globalization, and the risk both these processes pose to the survival of our species and of life on our planet, it is imperative to overcome the pragmatic indifference that allows us to co-exist and perpetrate human suffering. What is the alternative? This is not
a question for experts, but a challenge for humanity. The fact that we do not have the necessary answers to it cannot continue to justify our complicity with an order that imposes death and pain to most human beings in the world. The only acceptable reaction to this challenge is to find the means and the ways to overcome this age of wealth and darkness.

Finally, markets and capital have been extraordinary means for the unprecedented generation of wealth. But we need to find ends different to those of limitless accumulation and greed, and transform markets into regulated means for the enjoyment and protection of life. The hints we need are probably found within realities such as the one affecting Colombia, plagued by violence and by contrast, stubborn and creative joy. Learning from them might guide us in the direction of the strength and true meaning of the human spirit, whereby there will be, out of our own will, an end to the seemingly eternal solitude. As Gabriel Garcia Marquez said it when he accepted the Nobel Prize in 1982: ‘I dare to think that it is this outsized reality, and not just its literary expression, that has deserved the attention of the Swedish Academy of Letters.

A reality not of paper, but one that lives within us and determines each instant of our countless daily deaths, and that nourishes a source of insatiable creativity, full of sorrow and beauty, of which this roving and nostalgic Colombian is but one cipher more, singled out by fortune. Poets and beggars, musicians and prophets, warriors and scoundrels, all creatures of that unbridled reality, we have had to ask but little of imagination, for our crucial problem has been a lack of conventional means to render our lives believable. This, my friends, is the crux of our solitude’.

REFERENCES


Guerrero Baron, Javier. La sobre-politizacion del narcotrafico en Colombia en los anos ochenta y sus interferencias en los procesos de paz. En Penaranda, Ricardo, Guerrero, Javier. De Las Armas a la Politica, pp 219–296 (Bogota: Tercer Mundo)


Kaletsky, Anatole, 1999 When corporate interests dwarfed the consumer The Times. London. Tuesday, 9 November p. 35


Rubio, Mauricio, 1999, La justicia en una sociedad violenta. In Reconocer La Guerra
para Construir la Paz compiled by Deas, Malcolm and Llorente, Maria Victoria. (Bogota: Uniandes, Cerc, Norma). pp 201–235
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