APPENDIX TWENTY ONE

ECOLOGICAL MODELS FOR THE PREVENTION AND CONTROL OF UNINTENTIONAL INJURY

This chapter discussing the ecological basis of injury prevention and safety promotion was published in the textbook “Injury and Violence Prevention: Behavioural Science Theories, Methods, and Applications” edited by Andrea Gielen, David Sleet and Ralph DiCemente, and published by Jossey Bass in April 2006.

Editor David Sleet was a keynote speaker at 6th Australian Injury Prevention Conference and 2nd Pacific Rim Safe Communities Conference held in Mackay in September 2004, which I co-convened with Kathryn McFarlane. During the conference, I discussed my research and gave Dr Sleet a copy of “Reducing Injuries in Mackay North Queensland” edited by Associate Professor Reinhold Muller and published in 2002 by Warwick Educational Publishing. Dr Sleet was particularly interested in the chapter entitled “Safe Communities: an Ecological Approach to Safety Promotion” authored myself in collaboration with Paul Vardon and Jacqui Lloyd (see chapter five of this thesis). As a result I was invited to co- author a chapter on Ecological Models of Unintentional Injury Prevention with John Allegrante, senior professor of health education at Teachers College, Columbia University and President of the National Centre for Health Education(USA), and Ray Marks, associate professor of health education at Columbia University.

The initial draft of the chapter had already been completed by John Allegrante and Ray Marks when I became involved in the project. I contributed a number of new sections to the manuscript , which were ultimately incorporated into the introduction and the conclusion, resulted in a major revision of the section of ecological models, and new sections on Community Safety Promotion and WHO Safe Communities. John Allegrante as senior author retained final editorial control over the manuscript. However as noted above, my contribution to the final version of the manuscript was substantial.

INJURY AND VIOLENCE PREVENTION

Behavioral Science Theories, Methods, and Applications

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CHAPTER SIX

ECOLOGICAL MODELS FOR THE PREVENTION AND CONTROL OF UNINTENTIONAL INJURY

John P. Allegrante, Ray Marks, Dale W. Hanson

We generally accept the notion that optimal health status and high quality of life enable humans to lead productive lives and contribute to the overall social and economic stability of society. Achieving the utopian ideal of optimal health, however, is not a simple task. The task is made complex because health is not merely a product of individual biological, psychological, and behavioral factors; it is the sum of collective social conditions and the nexus of transactions that is created when people interact with the environment in which they live, work, and play. Simply knowing the pathological causes of a disease or unintentional injury is not enough to achieve the goal of improving health status (Haignere, 1999). Improving health and preventing unintentional injury require attention to the entire social system.

Despite a history dating back to John Snow, whose intervention to stem the 1854 cholera epidemic in London demonstrated the importance of social systems for maintaining human health (Centers for Disease Control and Prevention, 2004), a pervasive ideology of individualism has increasingly colonized public health science and practice (Lomas, 1998). Much of our thinking about health and disease causation has been dominated from almost the start of the twentieth century by the prevailing medical model (Engel, 1977). By extension, injury prevention has been conceptualized as a biomedical construct in which injury is perceived to be a physical event resulting from the sudden release of environmental energy that produces tissue damage in an individual. This reductionist perspective is not only

narrow and ill conceived, it overlooks the importance of the psychological, environmental, and sociocultural factors as individual and collective contributory determinants of injury.

William Haddon, the father of modern injury prevention, prophetically introduced the concept of ecological injury prevention with publication of his seminal paper, "On the Escape of Tigers: An Ecological Note" (Haddon, 1970). Until then, individual behavior was perceived to be the preeminent cause of an accident. But Haddon argued it did not follow that changing individual behavior was the most effective means by which to prevent injury. In the context of the prevailing epidemiological model of causation in which the agent, host, and environment interact, he highlighted the opportunities for harm reduction through redesign of the physical environment. Moreover, he argued that by preventing or dissipating the adverse release of energy, it was possible to minimize the chance of injury without necessarily preventing the accident (Haddon, 1980). By doing so, Haddon precipitated a major paradigm shift from accident prevention to injury prevention.

Now, three decades later, much has been achieved on the strength of this change in paradigm. Health promotion has embraced an ecological perspective on health that realizes the importance of both the physical and social environments and the interaction of the individual with the environment. Mounting evidence suggests that the social and economic environments exert profound and lasting effects on health status and on the incidence, prevalence, and severity of disease and unintentional injury (Laflamme, 2001; Petridou & Tursz, 2001). However, despite evidence suggesting that influences outside the individual play an important role in determining health, the application of this knowledge has not yet been a major focus of intervention policy in the context of the prevention and control of unintentional injury. Perhaps we need to revisit Haddon's original thinking, reappraise the best opportunities for harm reduction within the ecological framework, and ask whether we can capitalize on what has been achieved through reengineering the physical environment by going a step further and simultaneously reengineering the social environment (Hanson et al., 2005).

In this chapter, we describe the potential of the ecological model for understanding the antecedent causes of unintentional injuries and guiding intervention for their prevention and control. First, we briefly review the scope and impact of unintentional injuries. Second, we review the origins and conceptualize the elements of the ecological model, using the injury iceberg as a useful metaphor for understanding the multiple levels of intervention required in an ecological approach to injury. We conclude with some applications of the ecological model to the prevention and control of unintentional injury and community safety promotion.

Scope and Impact of Unintentional Injuries

According to the U. S. National Academy of Sciences (2003), unintentionial injury is under-recognized as a major public health problem. Regardless of gender, race, or economic status, injuries are a leading cause of premature death for people of all ages in the United States and other nations with advanced economies.

Deaths due to unintentional injury are only part of the picture. Millions of Americans are injured each year and survive. Sustaining an injury not only causes temporary pain and inconvenience for many; for some, a single injury can result in lifelong disability, chronic pain, and a profound change in the individual's lifestyle. However, although scientific advances and medical technologies have significantly improved the overall health status of advanced nations in the past forty years, unintentional injuries continue to threaten the health of millions. This is largely due to the fact that injury prevention and control have not been perceived as a major public health issue. Rather, injuries have been viewed as unavoidable accidents that are part of everyday life.

A large body of epidemiological and medical research, however, shows that injuries, unlike accidents, do not occur by chance. The science of injury prevention has clearly demonstrated that injuries, and the events leading up to them, are not random. Like disease, the risk of injury follows a predictable pattern. Studying these patterns has made it possible to prevent injuries from occurring and has the potential to decrease injury-related death, disability, and financial burden (Krug, 1999).

Two types of unintentional injury constitute much of the burden of injury-related death and disability in the United States and in most other nations with advanced economies: injuries due to falls and road traffic injuries that result from motor vehicle crashes. These two mechanisms of unintentional injury, both of which have complex antecedents, suggest an array of potential prevention and control strategies that can be aimed at the individual, as well as at the environmental setting in which these injuries occur. Thus, strategies that target both the individual and the environment are more likely to be successful in lowering the prevalence of injuries than any single preventive strategy.

Injuries Due to Falls

Data on injuries due to falls in the United States show that falls are the leading cause of injury deaths among people sixty-five years and older and that one in every three Americans sixty-five years old or older falls each year (Cesari et al.,

2002). Of those who fall and survive, 20 to 30 percent suffer moderate to severe injuries that often reduce mobility and limit independence (Sattin et al., 1990). Falls also result in hip fractures, which have devastating impacts on survival and health outcome among the elderly (Marks, Allegrante, MacKenzie, & Lane, 2003) and increase the risk of premature death (Alexander, Rivara, & Wolf, 1992). Preliminary data for 2003 show that over fifty-eight thousand people, most of whom are elderly, will have died (an age-adjusted rate of 19.9 per 100,000) from fall-related injuries (Hoyert, Kung, & Smith, 2005). Falls are also the leading cause of nonfatal unintentional injuries and emergency department visits for children between the ages of zero and fourteen (Barnes, Adams, & Schiller, 2001). Each year in the United States, falls among this age group account for an estimated 2.5 million emergency department visits (Centers for Disease Control and Prevention, 2005b). In addition to the costs in terms of physical disability, the direct economic costs of treating fall-related injuries are substantial (Englander, Hodson, & Terregrossa, 1996).

A growing body of research evidence now indicates that among the elderly, factors likely to contribute to initial and subsequent falls and fall-related injuries include physical frailty, muscle weakness (Branch, Katz, Kneipmann, & Papsidero, 1984; Tinetti, Speechley, & Ginter, 1988), visual impairments, use of psychoactive medications, and difficulties with gait and balance (Sorock, 1988; Tinetti & Speechley, 1989; Tinetti, Doucette, Claus, & Marottoli, 1995; Wolfson, Judge, Whipple, & King, 1995). In addition to these individual predisposing factors, environmental risk factors for falling include slippery floor surfaces, uneven floors, poor lighting, loose rugs, unstable furniture, obstacles, and objects on floors (Speechley & Tinetti, 1990). Among children, fall-related risk factors are similarly multidimensional for falls from windows and beds and falls that occur on the playground (Dal Santo, Goodman, Glik, & Jackson, 2004). Such falls are due to a combination of human and environmental factors. Thus, what emerges from the epidemiological research that has been conducted to date is that the etiology of falls is sufficiently complex to warrant a falls prevention model that addresses both environmental factors, such as the physical setting in which people live, and individual determinants, such as the physiological and physical status of the individual and behaviors that place the individual at risk for a fall. Multifactorial intervention approaches have shown promise in reducing the risk of falling in community settings (Tinetti et al., 1994; Tinetti & Speechley, 1991).

Road Traffic Injuries

Although road traffic death rates declined dramatically throughout the twentieth century, motor vehicle crashes are the leading cause of injury mortality in the United States for people aged one to thirty-four. The Centers for Disease Control and Pre-

vention (CDC) reports that more than 41,000 people die on the nation's roads and highways, with more than 3 million suffering nonfatal injuries (Centers for Disease Control and Prevention, 2005a). Of those who died in motor vehicle crashes, 5,586 were teenagers, 2,055 were children, and nearly 8,000 were sixty-five years of age and older. Annually, this results in approximately 500,000 hospitalizations and over 4 million visits to the emergency department. Moreover, motor vehicle–related deaths and injuries account for more than $150 billion in costs each year.

Like falls, motor vehicle crashes and their associated injuries have multiple determinants; however, because of the weak behavioral technologies of the past, efforts to prevent injuries have largely focused on passive approaches. Nonetheless, with the decline in the potential for further engineering improvements, it has become clear that in addition to other considerations, behavioral modification is essential to effective road safety (Lonero & Clinton, 1997).

Because of the evidence from a wide variety of studies that have shown that even the simplest behavior is determined by a complex mix of biological, psychological, and sociocultural factors, the consensus among experts is that behavior change is most likely to occur in the context of comprehensive, multisectoral, participative, and socially supportive interventions (Lonero & Clinton, 1997). Road safety interventions thus need to incorporate an ecological approach (a mix of behavioral, environmental, and policy approaches) if we are to continue to make progress in the prevention of motor vehicle crashes and associated injuries.

The Ecological Model

Concepts underlying the ecological model date back to the early twentieth century when Park, Burgess, and McKenzie (1925) are believed to have coined the term *human ecology,* extrapolating the theoretical paradigm of plant and animal ecology to the study of human communities. More recently, Last (1995) defined *ecology* as "the study of relationships among living organisms and their environment" (p. 52), while *human ecology* refers to the "study of human groups as influenced by environmental factors, including social and behavioral factors" (p. 52).

Interventions that simultaneously influence multiple levels and multiple settings of an ecological system may be expected to lead to greater and longer-lasting changes in health outcomes (Cohen & Swift, 1999). This notion is supported by emerging data indicating that multiple determinants account for premature deaths occurring in the United States and other advanced economies. McGinnis, Williams-Russo, and Knickman (2002) have attempted to enumerate and quantify these determinants. They have estimated that genetic predisposition accounts for 30 percent of early deaths; social circumstances, 15 percent; environmental

factors, 5 percent; behaviors, 40 percent; and shortfalls in medical care for 10 percent of all premature deaths. It follows, then, that the most effective interventions to address multiple influences occur at multiple levels (Smedley & Syme, 2000).

Despite growing acceptance of the multiple determinants of health, according to Stokols (1992, 1996), health promotion programs often lack a clearly specified theoretical foundation or are based on narrowly conceived conceptual models that fail to take into account the individual's interactions with the physical and social environments. This perspective has grown out of rich history and conceptual background that underlies contemporary thinking about ecological models and is grounded in both psychology (Sells, 1969) and the science of public health (Sallis & Owen, 2002). For example, B. F. Skinner's work (1953) showing how the environment could shape animal behavior, Kurt Lewin's concept (1966) of ecological psychology and environmental forces, and Albert Bandura's notion (1977) of reciprocal determinism and person-environment interactions in social learning theory all constitute psychology's recognition of the multiple influences of the environment on human behavior.

Although the ecological approach was inherent in Snow's decision to take the handle off the Broad Street pump and thus constitutes the first true application of ecological thinking in public health, Edward Rogers (1960) was one of the first to advance the conceptual and potentially pragmatic value of ecological models in organized public health efforts. This ecological perspective—especially as applied to changing health behavior—was furthered by Moos (1980), Green and McAlister (1984), and McLeroy, Bibeau, Steckler, and Glanz (1988). As noted by McLeroy et al., "The purpose of an ecological model is to focus attention on the environmental causes of behavior and to identify environmental interventions" (1988, p. 366) that can be used to improve health. Green and Kreuter (2005) have expanded on this by proposing a socioecological program planning model of health promotion where health and safety can be interpreted in the context of the whole (ecological) system. There are three dimensions to this system: (1) the individual and his or her behavior, (2) the physical environment, and (3) the social environment. According to Green and Kreuter, each dimension can be analyzed at five levels:

1. The *intrapersonal level*, which is concerned with characteristics of the individual, that is, his or her knowledge, skills, life experience, attitudes, and behaviors as they interface with the environment and society.
2. The *interpersonal level*, which refers to the immediate physical environment and social networks in which an individual lives, including family, friends, peers, and colleagues and coworkers.
3. The *organizational level*, which refers to commercial organizations, social institutions, associations, clubs, and other mediating structures. They have structures, rules, and regulations enabling them to pursue specific objectives and

have direct influence over the physical and social environments maintained within their organization.

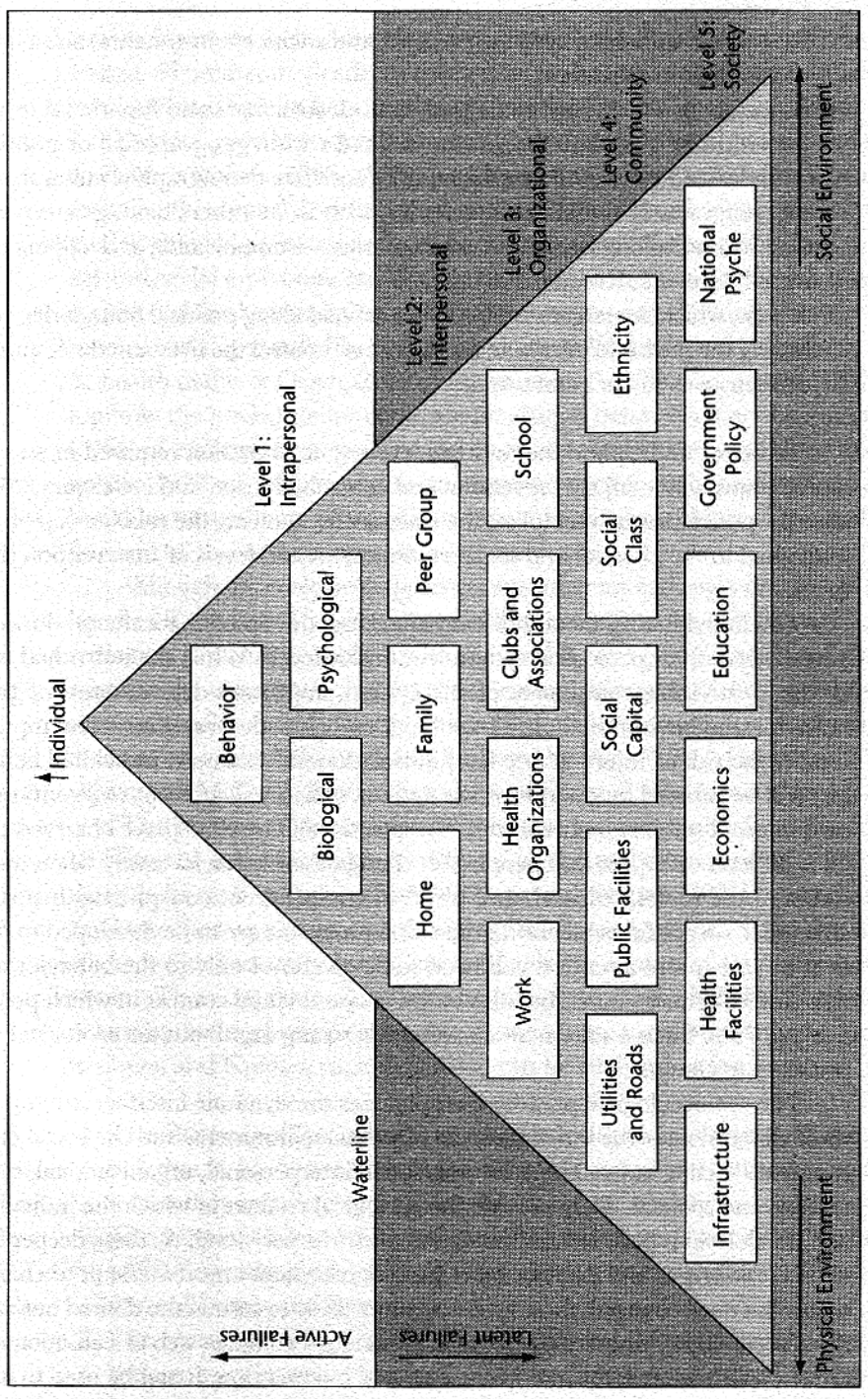
4. A *community,* which may be defined in both structural and functional terms. Structurally, a community can be defined within geographical or political boundaries. Functionally, a community may share demographic, cultural, ethnic, religious, or social characteristics, with its members having "a sense of identity and belonging, shared values, norms, communication and helping patterns" (Green & Kreuter, 2005, p. 256).
5. *Societies,* which are larger systems, often defined along political boundaries, possessing the means to distribute resources and control the lives and development of their constituent communities.

To better understand the multiple levels of intervention required in an ecological approach to injury prevention and control, Hanson and colleagues (2005) have proposed a visual metaphor, the *injury iceberg,* showing the relationship of the individual to the physical and social environment and levels of intervention (Figure 6.1).

The individual is, metaphorically speaking, the tip of the iceberg—just one part of a complex ecological system with many levels. While the individual may be the most visible component of this system, important determinants of their behavior and environmental risk are "hidden below the waterline." Attempts to modify the risk of injury at one level in isolation (for example, individual behavior) will be resisted by the rest of the system, which will attempt to maintain its own internal stability (homeostasis). Syme and Balfour (1998) have observed that "it is difficult to expect that people will change their behavior easily when many forces in the social, cultural, and physical environment conspire against such change. If successful behavior modification programs are to be developed to prevent disease, more attention will need to be given not only to the behavior and risk profiles of individuals, but also to the environmental context in which people live" (p. 796). Such a statement constitutes a strong argument for ecological approaches to change.

The socioecological paradigm emphasizes the dynamic interface among the three dimensions—the individual, the physical environment, and the social environment—acting at five levels: intrapersonal, interpersonal, organizational, community, and societal. They provide the ecological context in which the individual acts. Each level is built on the foundation of a "deeper" level. As these deeper levels become larger and exercise more inertia, it becomes more difficult to change them. But once changed, these levels are more likely to sustain the desired outcome (Swerissen, 2004). This ecological model provides a complex web of causation and creates a rich context for multiple avenues of intervention. It can be used to map the key links in an accident sequence, identifying upstream latent failures, along

FIGURE 6.1. INJURY ICEBERG ECOLOGICAL MODEL.



Source: From "The Injury Iceberg: An Ecological Approach to Planning Sustainable Community Safety Interventions," by D. Hanson, J. Hanson, P. Vardon, K. McFarlane, J. Lloyd, R. Muller, et al., 2005, *Health Promotion Journal of Australia, 16* (1), p. 6. Copyright © 2005 by the *Health Promotion Journal of Australia.* Reprinted by permission.

with the more obvious downstream active failures. Identifying the most strategic links thus ensures effective action.

Applications of the Ecological Model in Health Promotion and Injury Prevention and Control

Now that there are ecological models of health promotion, behavior modification, and identified potential strategies for intervention, the ultimate challenge remains: applying what we have learned in the real world. The transition from researching what works (efficacy) to researching how to make it work in a complex social setting (effectiveness) is not as straightforward as many assume (Howat, Cross, & Sleet, 2004). At the heart of the problem is how researchers and practitioners address the problem of complexity conceptually and methodologically (Glasgow, Lichtenstein, & Marcus, 2003). An ecological construct of injury causation is necessarily complex.

Efficacy trials test whether an intervention does more good than harm when administered under optimum conditions (Flay, 1986). To ensure internal validity, contextual factors are carefully controlled. A standardized intervention program is delivered in a uniform fashion to a specific, and usually homogeneous, target audience. Isolating the experimental variable from the influence of contextual factors can elucidate a clear relationship between the control and experimental variable. Effectiveness trials test whether an intervention does more harm than good in real-world conditions. Here the focus is on ensuring external validity. The population tested is unlikely to be homogeneous, and the outcome of the trial may be influenced by many extraneous contextual factors (Glasgow et al., 2003). Efficacy research may offer little insight into the practical challenges of implementation in a community social system if it has conceptually avoided the impact of contextual factors on outcome. Thus, if injury prevention is the science of controlling context, safety promotion is the art of managing context.

While the use of behavioral and social science theories in the context of injury prevention and control has been limited to a selected few (Trifiletti, Gielen, Sleet, & Hopkins, 2005), there has been increasing interest in ecological models in population health and safety promotion (Gielen & Sleet, 2003). A number of published studies have demonstrated the growing importance of this approach in a range of areas of health promotion. For example, recent studies designed to promote physical activity (MacDougall, Cooke, Owen, Willson, & Bauman, 1997; Sallis, Bauman, & Pratt, 1998; Sallis et al., 2001); improve health status of low-income, multiethnic women (Peterson et al., 2002); stimulate environmental change to support physical activity and dietary behavior change among adolescents in

schools (Dzewaltowski, 1997; Dzewaltowski, Estabrooks, & Johnston, 2002); and prevent obesity among young people (Booth et al., 2001; Davison & Birch, 2001; Longjohn, 2004) have all used a broad ecological framework with which to design intervention strategy that addresses the health problem under study at the individual, familial, community, and societal levels. The application of the ecological model in injury prevention and control has shown the most promise in falls injury prevention, road traffic injury prevention, and community safety promotion.

Falls Injury Prevention

In addition to the prevention of road traffic injury, there is increasing support for the application of multifactorial interventions that target at-risk populations in reducing falls among both children and adults (Marks & Allegrante, 2004). A good example of a multifaceted community-based program for reducing the incidence of falls injury in the elderly is that published recently by Clemson et al. (2004). This group studied the impact of improving individual falls self-efficacy and lower limb balance and strength, while improving home and communal environmental and behavioral safety. Attention to regular visual screening and medication reviews was encouraged. Compared to a control group, the intervention group experienced a 31 percent reduction in falls. A similar home-based intervention to prevent falls among community-dwelling frail older people that included a home environmental assessment, the facilitation of any recommended changes, and training in the use of adaptive equipment reduced falls rates, especially among previously frequent fallers (Nikolaus & Bach, 2003).

A number of studies have demonstrated that multifaceted community-based approaches are more effective than single-strategy intervention approaches (for example, Dyer et al., 2004; Huang & Acton, 2004). Moreover, an ecological approach that focuses on the multiple causative factors that put people at risk for falls, as well as health promotion policies that foster high-quality screening and intervention programs, are indicated. As outlined in the ecological model, the need to train personnel, who can implement preventive interventions and risk assessment processes, as well as counsel individual clients, will also be required if we are to reduce falls. Moreover, legislation to optimize safety in the home and its environment and adequate medical coverage and funding for counseling are needed for achieving successful preventive outcomes (Marks & Allegrante, 2004).

Road Traffic Injury Prevention

There is general consensus that single interventions do not have the same impact as multiple interventions in efforts to reduce or prevent injury. Health promotion approaches to road traffic injury prevention have been advocated for this reason

(Sleet, 1984; Sleet, Wagenaar, & Waller, 1989). Indeed a CDC report describing motor vehicle safety as one of the twentieth century's important public health achievements strongly suggested that this was due to the fact that the interventions that were successful in improving motor safety were those that were designed to account for the multiple risk factors involved in motor vehicle injuries (Centers for Disease Control and Prevention, 1999; Dellinger, Sleet, & Jones, in press; Gielen & Sleet, 2003). The changes held responsible for the improvements in motor safety included legislative policies, educational programs, and changes in the physical and social environment (Gielen & Sleet, 2003; see also Chapters Ten and Eleven).

As early as 1989, Simons-Morton et al. (1989) proposed that taking an ecological perspective of individuals within their social and physical environments, a diagnostic framework identifying factors associated with drinking and driving injuries, and applying a conceptual intervention model with multiple components and four phases, plus evaluation criteria for societal and practice settings, would prove beneficial. This has been subsequently supported by Howat, Sleet, Elder, and Mayock (2004). These investigators have suggested that while health education interventions alone may not be effective for preventing alcohol-related traffic injury, ecological approaches may be beneficial. This is because in ecological intervention approaches, each intervention builds synergistically on the strengths of every other one. More specifically, given the complexity of issues that have an impact on driving under the influence of alcohol, ecological approaches to reducing alcohol-impaired driving that use all four components of the health promotion model proposed by Howat and his colleagues are likely to be especially effective. Lonero and Clinton (1997) listed four broad classes of tools with which to influence driver behavior: legislation, enforcement, education, and reinforcement. Moreover, the World Health Organization (WHO), in its report on preventing road traffic injuries (Peden et al., 2004), focuses on a systems approach to prevention, including the interaction among its elements—vehicles, roads, and road users and their physical, social, and economic environments.

There are five main elements of the ecological model in injury prevention and control:

1. Unintentional injury is determined by many different factors.
2. Behavior that leads to unintentional injury has both situational and psychological influences.
3. There are powerful sociological and environmental factors influencing injury.
4. Because safety is an ecological concept, determined by the relationship between an individual and his or her physical and social environment (Hanson, Vardon, & Lloyd, 2002b), prevention programs need to be sufficiently comprehensive to account for the dynamic interface between these dimensions.

5. Interventions must address beliefs, attitudes, behaviors, and environmental factors and involve community stakeholders in finding their own solutions.

Community Safety Promotion

To focus solely on the biomedical concept of injury prevention is to misunderstand the fundamental nature of the human experience, and hence how the positive state of "safety" is achieved. Maurice et al. (2001) define *safety* as "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" (p. 237). The United Nations, in its 1994 report on human development, has asserted that safety and security is a fundamental human right and an essential condition for the sustainable development of societies (United Nations Development Program, 1994). Safety is as much concerned with the subjective dimension—the perception of safety—as it is with the objective dimension—the absence of injury. It is as much concerned with the community in which individuals reside as it is with the behavior of the individuals who comprise the community. Thus, it is evident that safety is a psychological, sociological, and environmental phenomenon, as much as it is physiological. As such, safety is inherently an ecological concept (Labonte, 1991).

Moller (2004) states, "The community-based model for injury prevention is an explicit approach to achieving reductions in the incidence of injury at the population level by the application of multiple countermeasures and multiple strategies in the context of community defined problems and community owned solutions" (p. 1). Thus, community-based safety promotion is not a single intervention but rather a set of processes that are implemented simultaneously and synergistically in the hope of promoting safety in a specific community. In each community, the mix and type of interventions used will differ because communities differ (Moller, 1991, 2004). Effectively managing context by implementing the most appropriate mix of strategies to address the specific injury problems faced by an individual community is the critical factor determining the success of community-based interventions. Most important, the community must be involved in the process of defining the problem, identifying practical solutions, and mobilizing the resources necessary to implement and sustain the solution (Coggan & Bennett, 2004). Few would dispute this principle, but a real shift toward community empowerment has been hard to achieve. While it is easy for politicians, bureaucrats, and senior researchers to "talk the talk," it is more difficult for them to "walk the walk" when this entails sharing control over the social or research agenda and especially difficult when it involves surrendering absolute control over the assignment of resources.

The reality is that power is asymmetrical, especially for poor or disenfranchised communities. In an era of financial accountability, economic rationalism, and aggressive competition for funding, short-term, project-based funding is the norm. Projects come and go depending on their ability to secure and maintain ongoing funding. This perpetuates a cycle of dependency in which short-term political agendas assume more importance than long-term community development. Professionally driven, externally initiated, and exogenously funded interventions have the potential to exacerbate this dependency if they do not build community capacity, encourage self-sufficiency, and foster self-efficacy in the prioritized target community (Hanson, Vardon, & Lloyd, 2002c).

We should not overlook the research implications of sharing control with a community coalition. In the context of community-based participatory research, this means a researcher has no innate right to set the parameters of a community effectiveness study; rather, this must be negotiated with the community (Green & Mercer, 2001). Stated another way, researchers must learn to work with community contextual factors rather than against them. However, researchers can have a significant influence on the community agenda. Communities appreciate and respect timely, relevant, and credible scientific information. Access to local injury surveillance data is a powerful tool for focusing the agenda of community safety promotion coalitions on strategic epidemiological issues (Hanson et al., 2003; Hanson, Vardon, & Lloyd, 2002a).

If population gains in health and safety are to be achieved and sustained, then this is contingent on the identification, mobilization, and development of local resources (McLeroy, Norton, Kegler, Burdine, & Sumaya, 2003). Outcomes dependent on external resources are vulnerable. The solution is to maximize the capacity of a community to institutionalize and maintain an outcome within its own "ecosystem" (Hanson et al., 2005). Eva Cox (1995) has identified four types of community resources that enable such capacity:

Financial capital: The economic resources available to a community. While clearly important, it is frequently overemphasized at the expense of other forms of capital.

Physical capital: The natural environment and man-made resources (for example, buildings and equipment) available to a community.

Human capital: The skill and knowledge of the individuals contained within a community.

Social capital: The "features of social organization such as networks, norms, and trust that facilitate co-ordination and co-operation for mutual benefit" (Putnam, 1995, p. 67).

Despite the controversy regarding the definition and operationalization of social capital (Labonte, 1999; Lin, 1999), the concept does highlight the important fact that a community is more than the sum of its parts and that the way communities organize and mobilize their social resources is an important resource in itself. Different types of social capital have been identified by Putnam (1995):

- The societal norms that define the community's expectations of the behavior of individuals and organizations within the community
- The ability of individuals and organizations within a community to form relationships of trust and thereby work collaboratively to identify and solve health, environmental, and sociological problems.
- The strength and effectiveness of individual, organizational, and social networks contained within a community (Hanson, Muller, & Durrheim, 2005)

Lin (1999) has suggested that the type of social capital necessary to maintain desirable social behaviors is different from the type of social capital necessary to change them. Social capital based on group cohesion (societal norms and community expectations of acceptable behavior) is useful to maintain desirable behavior (Hanson, Muller, & Durrheim, 2005). For example, wearing seat belts is now normative behavior. In the United States, seat belt use increased from 11 percent in 1981 to 68 percent in 1997 (Centers for Disease Control and Prevention, 1999). Drunk driving is also increasingly perceived to be socially unacceptable (Isaacs & Schroeder, 2001). While legislation and enforcement have undoubtedly contributed to this change in community standards, changes in community standards have meant that aggressive legislation and enforcement of child restraint, seat belt laws, and drunk-driving laws is considered politically acceptable by majorities of the American population.

In contrast, the type of social capital necessary to induce change is different in quality. Rather than being a function of group cohesion, it is a function of relationships that span boundaries and thereby induce change by producing social, political, and bureaucratic leverage (Hanson, Muller, & Durrheim, 2005; Burt, 2001; Granovetter, 1973). Here, individuals—whether political champions (for example, William Haddon as director of the U.S. National Highway Safety Bureau), consumer health advocates (for example, Ralph Nader in his "Unsafe at Any Speed" campaign of the 1960s), or community activists (for example, Doris Aitken, founder of Remove Intoxicated Drivers and Candy Lightner, founder of Mothers Against Drunk Driving)—can be important agents of change (Isaacs & Schroeder, 2001). This is because of the strategic relationships such individuals are able to build with others in the community and the way they use these relationships to advocate for organizational, social, and structural change (Pitt & Spinks, 2004).

WHO Safe Communities

Safe Communities is an approach to injury prevention and safety promotion that is supported by the World Health Organization (WHO, 2005; Svanstrom, 1999). The safe community model seeks to understand injury and intervene at a community level. By involving people in finding their own solutions to community problems, the community aims to be a catalyst for environmental, structural, sociological, and political change. This empowers the community, and ultimately individuals within a community, to change their environment and their behaviors to reduce the risk of injury and increase the perception of safety. It is therefore an ecological paradigm of safety promotion (Hanson, Vardon, & Lloyd, 2002b). WHO-designated Safe Communities are demonstration communities, which others can model when seeking to establish their own community safety programs. There are currently ninety-six WHO-designated Safe Communities (WHO Collaborating Center on Community Safety Promotion, 2005). Communities are assessed for WHO designation based on six indicators, designed to encourage best practice in safety promotion:

1. An infrastructure based on partnerships and collaborations, governed by a cross-sectoral group that is responsible for safety promotion in their community
2. Long-term, sustainable programs covering both genders and all ages, environments, and situations
3. Programs that target high-risk groups and environments and programs that promote safety for vulnerable groups
4. Programs that document the frequency and causes of injury
5. Evaluation measures to assess their programs, processes, and the effects of change
6. Ongoing participation in national and international Safe Communities Networks

Spinks, Turner, Nixon, and McClure (2005) conducted a systematic review of the WHO Safe Communities approach on behalf of the Cochrane Collaboration. They identified seven community-controlled evaluations using population-based injury morbidity and mortality data. These studies were conducted in four countries from two geographical regions: Scandinavia (Sweden and Norway) and Australasia (Australia and New Zealand). Although the authors concluded that the WHO model is effective in reducing injuries in whole populations, important methodological limitations were present in all studies. Perhaps this is not surprising given the methodological, organizational, political, and financial challenges of conducting large, robust studies of this type.

Programs conducted in Scandinavia demonstrated stronger population outcomes than those conducted in Australasia. Falkoping, a city in Sweden demonstrated a 23

percent decrease in all injury morbidity rates at the time the community coalition was active (Schlep, 1987). Motala, also a city in Sweden, demonstrated a 13 percent reduction in injury rates (Timpka, Lindqvist, Schelp, & Ahlgren, 1999). Harstad, (a city in Norway), produced significant reductions in child burns and scalds, and traffic injury rates (Ytterstad, 2003; Ytterstad, Smith, & Coggan, 1998). In New Zealand, the Waitakere Safe Communities Project documented a significant reduction in child injury admission rates, but was unable to demonstrate a significant reduction in hospitalization rates for all ages and all injuries (Coggan, Patterson, Brewin, Hooper, & Robinson, 2000). In Australia, the Shire of Bulla (later to become the Hume Safe Communities) was unable to demonstrate a significant reduction in injury rates (Ozanne-Smith, Day, Stathakis, & Sherrard, 2002). The Latrobe Valley Better Health Injury Prevention Program (Day, Ozanne-Smith, Cassel, & Li, 2001) was able to demonstrate reductions in age-standardized emergency department presentation rates using a quasi-experimental design (6,594 per 100,000 persons in the first year of the program to 4,821 in the final year), but there was no control community, and this study did not fulfill the selection criteria for the Cochrane Review.

No studies were identified of WHO Safe Communities in poorer countries, so any generalization of these results to the international community must be undertaken with caution. However, Spinks et al. (2005) conclude it is time to conduct an appropriately funded and rigorously conducted global multicommunity trial of the Safe Communities approach.

Conclusion

This chapter began by highlighting injury prevention as a biomedical construct based on a reductionist view that injury is a physical event resulting from a sudden release of environmental energy producing tissue damage in an individual. Such a conceptualization of injury underestimates the effect of environmental and social contextual factors on population-level injury outcomes and narrows the possibilities for the design and effectiveness of intervention. Injury prevention and control and the promotion of safety have physical, psychological, and sociological dimensions and thus should be considered an ecological concept.

To better understand that concept, Hanson's injury iceberg is a useful metaphor for an ecological system of injury causation. In this system, the individual is just the tip of the iceberg, the most visible and identifiable component of a complex system in which the individual interacts with the physical and social environment. The most enduring means to reduce an individual's risk of injury in such a system is to systematically address the physical and social environmental

factors hidden beneath the waterline, which ultimately shape individual and social behaviors that give rise to injury.

While much has been achieved in the past fifty years, we face a new frontier of challenges in the prevention and control of injury at the outset of the twenty-first century. The epidemiological evidence is converging to tell us that social influences have profound impact on population health and injury outcomes. We must use this evidence to attack the problem of the social and environmental determinants of injury with the same energy, urgency, and intellectual rigor that our predecessors attacked the physical determinants of injury in the late 1900s. This will provide fertile new ground to advance injury prevention and control in the future. However, we must accept that current reductionistic scientific methods have limitations in their ability to deal with the complexity of socioecological systems. Scientists, administrators, and practitioners need to move out of the complacency of their comfort zone and embrace research tools, theories, methodologies, and types of evidence and safety promotion practice that can accommodate, elucidate, and manage this complexity. Some of these techniques already exist; others are yet to be developed and tested.

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