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Epidemiological Assessment of the Contributing Factors of Injury Mortality and Morbidity Among Native Americans

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Epidemiological Assessment of the Contributing Factors of Injury Mortality and Morbidity among Native Americans

Yale Univ., New Haven, CT

Prepared for
Health Resources and Services Administration
Rockville, MD

Jul 85
The report is divided into four sections: a) literature review; b) specification of risk factors; c) preliminary assessment of Indian Health Service Community Injury Control (CIC) activities and; d) recommendations for future program direction.

The literature review revealed no substantial differences in injury mortality rates between low income, rural areas in the U.S. and the Native Americans. Conclusions about alcohol use among this group revealed little credible evidence regarding incidents leading to injury. There is little literature that compares injury factors of Native Americans to the general population.

A preliminary evaluation of the injury control program effectiveness was undertaken by examining correlation of changes in particular injuries in populations with activities that could be considered possibly affecting those injury rates. The analysis reveals that significant decreases in hospitalizations for falls, motor vehicles, and purposely inflicted injuries occurred in the period of time from FY 1980-1984. This correlates with the increased level of IHS CIC activities.

The primary recommendation was to use better targeting of injury control interventions through the use of supplemental data forms for severe injuries. These forms were developed as part of the study. Sufficient information should be obtained from this data in necessary detail to develop a CIC program.
Epidemiological Assessment of the Contributing Factors of Injury Mortality and Morbidity Among Native Americans

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This report is the responsibility of the authors and does not necessarily reflect the views of the Indian Health Service or Yale University.
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EPIDEMIOLOGICAL ASSESSMENT OF THE CONTRIBUTING FACTORS OF INJURY MORTALITY AND MORBIDITY AMONG NATIVE AMERICANS

Executive Summary

Literature Review: For at least two decades, mortality from injury among Native Americans per population was about twice that of the population generally. In the late 1970s, the Native American fatality rate was especially high for injury from motor vehicles, drowning, fire and smoke, excessive cold, firearms, and assault. The white mortality rates were higher only in the case of falls and suicides. As mortality from infectious diseases declined, the prominence of injuries as a major cause of mortality and morbidity became even more evident.

The research literature does not provide an explanation for these differences in sufficient detail to be useful for the design of injury control programs directed at specific risk factors. Native American injury mortality rates are not much greater than those for populations in rural areas with low incomes generally. If means to reduce injury to Native Americans can be demonstrated scientifically, the applications to other populations would likely be efficacious as well.

There is a substantial literature on alcohol use among Native Americans, but little credible evidence regarding the involvement of alcohol in incidents leading to injury. Subjective judgments of alcohol involvement by police have been repeatedly shown to be highly inaccurate when compared to measurement of alcohol in body tissues by precise and accurate methods. While it would be foolish to dismiss alcohol as a contributing factor, it probably does not contribute as much to the problem as claims of alcohol involvement based on stereotyped characterizations of alcohol use by Native Americans would suggest. Self-reported total abstinence from alcohol is twice as high among Native Americans as among whites. Among navy personnel, Native Americans were hospitalized for alcoholism three times as often as whites, but their hospitalizations for injury were slightly less than those of whites. When the environments of Native Americans and whites are similar, their injury rates are similar.

Injury control can be considered analogous to infectious disease control. The agent of injury is too much or too little energy exchange with the human organism relative to the organism's resilience. The energy that severely injures is usually delivered by vehicles such as motor vehicles, guns, flammable materials, concentrations of water, or by vectors such as human beings and animals. Traditional injury control efforts, in contrast to those aimed at infectious diseases, concentrated almost exclusively on changing the behavior of the human vectors. More recently, several injury control efforts aimed at the energy and the vehicles that convey it to human hosts have proved successful.

Technical strategies for injury control include prevention or...
reduction of the concentration of harmful amounts of energy, prevention of the release of concentrated energy or modification of the rate of release or spatial distribution relative to vulnerable populations. Damaging energy concentrations or their conveying vehicles can be separated from populations in space, time, or by physical barriers. Basic qualities of the energy can be changed to make it less hazardous and some changes in potential hosts to increase resilience are possible. In the event of injury, both short and long-term adverse consequences can be reduced by emergency medical and rehabilitative systems.

The effect of an injury control program will depend on the identification of one or more of these technical strategies that is acceptable in the political, cultural, and economic environment. In general, modifications of the energy that do not require changes in individual behavior are more effective than attempts to change each individual's behavior. Just as the pasteurization of milk to eliminate biological pathogens before it reaches the user is more effective than persuading every user to heat the milk, modifications of energy and energy vehicles to reduce concentrations of damaging energy is the most successful approach.

Where behavior change is necessary, laws or administrative rules requiring the behavior change are more effective than education or other forms of persuasion. This is particularly true when the behavior is easily visible to law enforcement officers, such as belt use or motorcycle helmet use. Where behavior is not so easily observable, augmentation of enforcement by those in the community in a position to do so is an important factor, such as denial of use of motor vehicle to underaged drivers and denial of sale of alcohol to underaged drinkers.

The more successful behavior change strategies are those aimed at behaviors that require only a single or infrequent effort, rather than daily behavior. For example, persuading people to obtain and install smoke detectors is much easier than persuading them to use seat belts. In some instances, particularly the perception of and reaction to motion, the human organism is incapable of processing information and responding in the amount of time necessary to avoid disaster in certain situations.

Risk Factors. There is little literature that provides a guide to whether the risk factors for injury to Native Americans are the same as in the general population, but more frequent or concentrated, or are different in some ways. Several hypotheses can be generated that could explain the higher rates, but the available data is insufficient to confirm or reject them. For example, motor vehicle deaths are probably higher among Native Americans than whites for several reasons: 1. They drive older vehicles that are covered by fewer of the motor vehicle safety standards. 2. They more often drive pickup trucks that were not covered by federal safety standards until a decade after cars and those not covered will be in use longer. 3. Because of inadequate
incomes, vehicles are less well maintained. 4. The roads on which Native Americans drive are disproportionately two-laned rural roads with no shoulder, few guardrails, dropoffs to the side, and poor or no marking and lighting.

The known risk factors for other types of injury, beyond simple demographics and a few specific materials and products, are less well known than for motor vehicles in the population generally or Native Americans in particular. The opportunity to specify risk factors in more detail is available to the Indian Health Service (IHS) because of the access to both outpatient and inpatient records.

Identifying Vulnerable Populations. Using IHS clinic records from three widely separated areas, the extent to which persons at greater risk of injury could be predicted from prior clinic visits was studied. The rationale for the study was based on the assumptions that illness and stress increase the impairments and distractions that increase the probability of injury, but it is impossible to continuously monitor a population for transient states of stress or illness. The use of medical facilities is a form of self-monitoring that could be useful in identifying more vulnerable populations.

With the exception of children less than five years old, most prior symptoms are not predictive of injury. Thousands of false positives (injury predicted but did not occur) and false negatives (injury with no prior symptoms) are found even in those cases where a prior diagnosis, such as alcoholism, indicates a somewhat higher risk of injury. Among young children, a small group, many with multiple diagnoses, were found to be at high risk of injury within a year of any one of the diagnoses.

The high risk diagnoses included venereal diseases, diabetes, endocrine problems, organic brain syndrome, psychosis, alcoholism, gynecological problems, and environmental problems. About 79 percent of the 228 children in this group had a diagnosis of alcoholism, presumably fetal alcohol syndrome. While 71 percent of the males and 57 percent of the females identified by one or more of the diagnoses had an injury visit within a year, most of the total injuries (69 percent) in that age group occurred to children without any of these diagnoses. Thus, clinic personnel should be aware that children with the specified diagnoses are at great risk of injury (most often falls), but concentration of a large proportion of the injury control program on these children would leave the vast majority of those that will be injured unprotected.

Evaluation of Injury Control Efforts. Beginning in 1981, the Indian Health Service increased its injury control activities. Environmental health officers were given the responsibility for organizing interdisciplinary Community Injury Control (CIC) committees in most service units. These committees met to consider priorities and develop activities directed to injury reduction.
A preliminary evaluation of the injury control activities was undertaken by examining correlations of changes in particular injuries in populations served by particular service units with activities that could be considered as possibly affecting those injury rates. Data on activities were obtained by a survey of area environmental health personnel, most of whom provided counts of numbers of persons trained or equipment distributed in each service unit. The data on hospitalizations and clinic visits for injury were provided on computer tapes. Mortality data for 1983-84 are not yet available from the Center for Health Statistics and, therefore, changes in mortality were not studied.

The type and frequency of activities varied widely among service units. Most of the activities were devoted to training people in various aspects of safety, but more recently distribution of safety equipment such as child restraints, smoke detectors, and fire extinguishers has increased. The cumulated average population trained or equipment distributed for each type of injury had reached only a few percent of the population by 1984.

The analysis indicates that reductions in hospitalization rates for falls were associated with training in general safety, recreational safety, and first aid. Although hospitalizations from motor vehicles and assaults also declined, the reduction was not significantly associated with relevant activities of the CIC programs. Suicide attempts were lowered more in service units with greater fire safety training. A few training activities were associated with greater than expected hospitalizations -- poison prevention in relation to attempted suicides, occupational safety and CPR in relation to falls. It is conceivable that people learned how to harm themselves, in the case of "poison prevention", or became overconfident as a result of the other training. The data are insufficiently detailed to support or reject these possible explanations.

Substantial reductions in hospitalizations occurred from 1980 to 1984 -- motor vehicle injuries by 45 percent, assaults by 36 percent, and falls by 29 percent. Because of the small proportion of the population reached by the demonstrably effective aspects of the CIC programs, all of this reduction cannot be attributed to those activities. Other factors such as junking of vehicles that did not meet federal safety standards, improved emergency medical services, alcohol abuse programs, and the like, probably share in the success, but data are inadequate to specify to what extent.

Some of the activities, such as child restraint use, are known to be effective, but the injuries toward which they were directed were too infrequent in this population to judge the efficacy of child restraint distribution. The data on clinic visits were too often classified as "other" under cause of injury so the extent of the effect of specific programs on specific injury rates cannot be estimated.
In many cases, however, the results are not surprising. Training people in motor vehicle safety in general and defensive driving in particular has been shown in controlled experiments to be ineffective in reducing motor vehicle injuries. Even if training programs were more effective, it would take a generation to train the population at present rates, not counting the new generation that would be born during that time. Without detracting from the success thus far, it is obvious that a more carefully targeted effort would likely be more successful.

Recommendations. The most successful injury control programs historically have isolated specific agents and vehicles that contribute to specific types of injuries and directed programs toward the modification of those hazards. Unfortunately, although IHS data are more complete than for other communities in the U.S., they do not contain sufficient detail for precisely targeted injury control. To alleviate this problem, supplemental data forms are included in this report which can be used to obtain data in the necessary detail. Separate forms are included for falls, motor vehicle injuries, drownings, fire and smoke, assaults, suicide attempts, and a more general form for the miscellaneous other serious injuries.

Initially, at least, attention should be concentrated on injuries selected by severity. Too much time and energy can be depleted trying to prevent trivial cuts and bruises while injuries that kill and hospitalize are neglected. It is recommended that the supplemental data forms be completed on all fatal and hospitalized cases, but only on ambulatory cases that involve fractures or loss of consciousness. Perhaps when the more severe injuries have been brought under greater control, a wider net can be cast.

Collection of data on these severe injuries during the previous year or so in a given service area should give the Community Injury Control committee a good detailed picture of the types and circumstances of injury that contribute most to the problem. By sorting the forms by places and circumstances, problem hazards and problem locations should be evident. The forms also contain a list of possible actions that could be taken and a place for recommended action and followup. Previous experience in injury investigation and control suggests that the injuries are usually highly patterned. Identification of those patterns and direction of countermeasures at specific targets is the first step toward a more effective and efficient program.
LITERATURE REVIEW

Following substantial declines in infectious diseases, in recent decades injuries became the leading cause of deaths among the Native American population, including the Indians in the lower 48 states and Alaska's native populations (Brown et al., 1970). In 1977-79, the deaths from unintentional injury per 100,000 population among Native Americans was about twice as high as that of the white or black populations. Suicides were about the same per capita as the white population and homicides were higher than the white population, but lower than the black population (Baker, O'Neill, and Karpf, 1984). These rates are not age adjusted, and the Native American population has proportionately more children and young people that have higher rates of most types of injury, but it is unlikely that an age adjustment would substantially explain the large difference in unintentional injury deaths.

This review of the literature is divided into four sections: epidemiology, the alcohol factor, injury control strategies, and program evaluations. There are few epidemiological studies. More detailed epidemiological work with a greater variation of geography and cultural background is needed. Much has been written about alcohol problems among Native Americans, but actual alcohol concentrations of persons injured or involved in injury events have not been obtained in adequate samples to document firmly the involvement of alcohol. The possibility that stereotypes have influenced investigators is strong in many cases. One firm conclusion that emerges from the alcohol literature is that there is large variation in alcohol use among Native Americans with differing cultural and other experiential backgrounds.

The third section outlines current thinking regarding analysis of options for injury control and criteria for program selection. Very little research on the effects of injury control programs directed at the problem among Native Americans is available. The final section deals not only with that literature, but also the general literature that discusses principles of effective and ineffective approaches.

Epidemiology

There is very little published literature that correlates injuries to risk factors among Native Americans. The major categories of injury deaths per 100,000 population, compared to the white and black populations during 1977-79, are presented in Table 1. Motor vehicles account for more than half the deaths,
TABLE 1. Deaths rates per 100,000 population for major categories of injury — 1977-79

<table>
<thead>
<tr>
<th>Category</th>
<th>Native American</th>
<th>White</th>
<th>Black</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor Vehicle Occupants</td>
<td>36.6</td>
<td>18.2</td>
<td>12.7</td>
</tr>
<tr>
<td>Pedestrians</td>
<td>12.9</td>
<td>3.4</td>
<td>5.3</td>
</tr>
<tr>
<td>Drowning</td>
<td>8.5</td>
<td>2.9</td>
<td>5.4</td>
</tr>
<tr>
<td>Fire</td>
<td>5.7</td>
<td>2.4</td>
<td>6.5</td>
</tr>
<tr>
<td>Falls</td>
<td>4.1</td>
<td>6.5</td>
<td>4.3</td>
</tr>
<tr>
<td>Excessive cold</td>
<td>3.1</td>
<td>0.2</td>
<td>0.7</td>
</tr>
<tr>
<td>Unintentional Firearm</td>
<td>2.2</td>
<td>0.8</td>
<td>1.2</td>
</tr>
<tr>
<td>All others</td>
<td>18.6</td>
<td>11.5</td>
<td>13.2</td>
</tr>
<tr>
<td>TOTAL Unintentional</td>
<td>91.7</td>
<td>45.9</td>
<td>49.3</td>
</tr>
<tr>
<td>Suicide</td>
<td>13.0</td>
<td>13.6</td>
<td>6.5</td>
</tr>
<tr>
<td>Homicide</td>
<td>15.3</td>
<td>6.0</td>
<td>34.2</td>
</tr>
</tbody>
</table>
with major contributions from drowning, fires, and excessive exposure to cold. The Native American death rate is much larger than that for whites in every category of unintentional injuries except falls. The proportionately larger elderly population, in which falls tend to be higher, probably accounts for the higher rate from falls among whites.

Despite these large differences at the aggregate level, the death rates are not so very different from the population as a whole when geographic location and income are taken into account. The unintentional injury death rate per 100,000 population among the population as a whole in rural remote areas is 74.6 compared to 91.7 among Native Americans. Similarly, the unintentional injury death rate for the general population with per capita incomes in 1977-79 of less than $3000 was 71.5 (Baker, O'Neill and Karpf, 1984). The average per capita income of Native Americans in rural areas, according to the 1980 Census, was $3562, and this estimate is skewed upward by a small proportion of the Native American population with higher incomes. In exploring risk factors for severe injury among Native Americans, it is likely that one is largely seeking explanations for severe injury among people with low incomes in rural areas generally.

The very limited epidemiological literature on injury among Native Americans is usually descriptive at too aggregated a level to provide very specific targets for programs. Each study is confined to a specific tribe. There has been little exploration of variation among tribes.

In a study of emergency room records, outpatient records, and hospitalizations on the Navajo Reservation in the 1960s, Brown et al. (1970) reported age and sex distributions and injury rates by certain categories of causation and clinical nature of the injury. There was surprisingly little variation in injury rates by age -- the range for both sexes varied from 34 to 46 per 1000 population among various age groupings. Average rates for males were about twice that for females. Falls accounted for 20 percent of the injuries followed closely by pedestrians struck by motor vehicles -- 19 percent. An additional 12 percent involved cutting or piercing objects with the remainder scattered over a variety of causes, none of which exceeded 5 percent. In contrast, 48 percent of deaths were pedestrians struck by motor vehicles, 13 percent were drownings, 12 percent were in fires and 10 percent died from exposure to cold weather. Obviously many of the people who died did not reach clinical facilities before death.

In an analysis of leading causes of death among the Navajo, Carr and Lee (1978) suggest that an accumulation of 30,000 miles per year on a motor vehicle is not unusual on the reservation because of the great distances that must be traversed. Many roads are unpaved and dangerous when wet or iced. The study did not include any correlations among mileage accumulated, road conditions, or remoteness from medical care and other possible factors to motor vehicle deaths, however.
A recent study (Simpson, et al., 1983) of hospital admissions and fatalities from injury, including assaults and suicide attempts, on the Hopi Reservation found a rate of 12 per 1000 persons per year. Hospital days per case averaged 7.4 with a median of 3 days. Motor vehicles accounted for 19 per cent of total cases and 31 per cent of deaths. Falls were 20 per cent of all cases and 15 per cent of deaths. Seventeen per cent of cases were suicide attempts, but 38 per cent of deaths were suicides.

Local area offices of the Indian Health Service have been assembling data to augment the Community Injury Control Programs. Data from the Bemidji Program Area, for example, found a medically treated injury rate of 432 per thousand population in 1976 and 350 per thousand population in 1981 (Office of Operations Research, no date). Not accounting for repeated injury in the same person, this means that about 1 in three persons on the reservations involved in the study was injured sufficiently to seek medical treatment in 1981. The leading causes of injury and the rates in 1981 were falls - 130, cutting and piercing objects - 47, Motor vehicles - 23, animal related - 10.

These studies, considered together, illustrate principles in injury epidemiology. The rates for cause of injury vary substantially depending on the degree of severity considered. For example, motor vehicles are prominent as a cause of death and hospitalization but are substantially less so when ambulatory cases are included. Traditional coding systems do not give sufficient detail about most injuries to discern the circumstances that could be changed to reduce incidence or severity.

A few additional studies have considered suicide and homicide in Native American populations. Although crude suicide rates among Native Americans are similar to those among whites, the age distributions of those involved are markedly different. In research done in the 1960s, suicide completions among Native Americans occurred mainly among persons aged 15 to 35 (63 percent) while the bulk of the suicides for all races occurred to persons older than 34 (75 percent). The suicides among the young Native Americans were said to result from "cultural conflict, and resultant breakdown of old value systems" but no evidence to support that assertion was presented (Ogden, et al., 1970). The same study noted that homicide among Native Americans is higher than that in the general population, but the age distribution of those who die by homicide is more in parallel with that of homicides in the total U.S. population. If there are broadly general causes for these rates, it is not at all clear why the age distributions for homicide and suicide are so similar in the Native American population and so different in the total population.

Shore (1975) indicates a fifteen-fold variation in suicide rates among tribes. He and others note that, among tribes with smaller populations, the rates vary considerably from year to year because a few cases inordinately effect the rates of groups
with a small population base (McIntosh and Santos, 1981). Evidence in this and other studies (Kost-Grant, 1983) suggests that suicide attempts appear as point epidemics; in some groups, at least, a completed attempt will be followed by others. In one instance, Shore noted 13 attempts in 14 days following a suicidal death of a person while jailed.

A study of fatalities among Indians in Canada in the mid-1970s included interviews by native interviewers with survivors at the scene or surviving relatives. Remarkably, more than half of the fatalities occurred in pairs or greater numbers at the same time and place. These multiple deaths occurred mainly in fires, motor vehicles (including pedestrians), and homicides. In 42 of 56 cases of death from unintentional injury, alcohol was measured in blood. The distributions of blood alcohol concentrations were not presented, but the authors noted that all but two were above 0.08 percent by weight, the legal limit for driving in Canada (Jarvis and Boldt, 1982). This is the only study found in which alcohol was actually measured in a complete series of cases. In the U.S. studies of alcohol use by Native Americans, alcohol use is usually inferred from smell, appearance, self-report, etc. by police or clinicians.

The Alcohol Factor

Since alcohol has been repeatedly implicated as a causal factor in severe injuries, it is not surprising that it should be so among Native Americans. It should be emphasized, however, that incidence of injury is much less related to alcohol than severity and that emphasis on a single cause, such as alcohol, may be counterproductve. In the case of Native Americans, the pattern and places of alcohol use has resulted in a tendency for many people to assume, at least in casual conversations with the writer and in more than a little of the literature, that the excess of injuries among Native Americans is almost totally the result of heavy use of alcohol. There is simply no objective evidence that such is the case.

Although none of the studies were done in Native American populations, alcohol has been most thoroughly studied as a causal factor in motor vehicle crashes. Illegal blood alcohol concentrations (0.10 percent or more by weight) are found in about half of fatally injured drivers compared to fewer than five percent of the drivers on the road at similar times and places as the fatal crashes (Haddon, et al., 1958). In nonfatal injury crashes, however, alcohol is found in only a third of drivers and in only about 15 percent of drivers in noninjury crashes (Borkenstein, et al., 1964). Alcohol contributes somewhat to incidence, but far more to severity. Among the possible reasons for this are: 1. alcohol decreases coordination of reactions to hazards that would reduce speed in the crash, 2. alcohol increases aggressivity in driving, and 3. The probability of surviving given crash forces and their consequences is reduced by alcohol's effect on resilience or medical treatment. The extent of the contribution of each of these to the alcohol-
related motor vehicle crash problem is unknown.

Similarly, we do not know the extent to which alcohol contributes to aggressive or other behavior that results in assaults against self or others, or the extent to which alcohol results in impairment in avoidance of assaultive others. Anyone who has had problems with intoxicated people will not deny the probable effect of aggressivity in some, but the precise extent of contribution of this factor is unknown. Impairment by alcohol no doubt increases the probability of drowning, starting a fire or being unable to escape in a fire, falling, being injured while using farm, industrial, or household machines, etc. It far from a complete explanation of these forms of injury, and data from several small studies suggest that alcohol is a factor in less than half the cases in the population generally (Wechsler, et al., 1969; Dietz and Baker, 1974).

Care must be taken in interpreting studies that do not include actual measurement of alcohol on a complete series of cases. The only study found in which alcohol was measured in fatally injured Native Americans in the U.S. showed a significant difference in proportion of population tested among Native Americans compared to all deaths (Westermeyer and Brantner, 1972). Native Americans were more likely to be tested (63 percent, versus 45 percent of all deaths in the same county). Given the large proportion in both groups that did not have blood alcohol measured, and the apparent bias in selectivity for measuring alcohol, one can have no confidence in the validity of the results.

Most studies of alcohol use among Native Americans rely either on self-reports of alcohol use (Whittaker, 1982), classification of alcohol use by police, clinicians, etc., or secondary indicators, such as alcohol arrests (Brody, 1975). These methods are known to have potential biases. If Native Americans have a view of alcohol and the purposes for which it is used that is different from the rest of the population, they may be more or less honest than other ethnic groups in which use is more or less disapproved. To the extent that drinking by Native Americans is stereotyped, police and others may be biased toward reporting alcohol in relation to motor vehicle or assault investigations more often when Native Americans are involved. Also, such a bias could result in more frequent arrests of Native Americans on alcohol charges, although one author has argued anecdotally that the opposite is the case (Brody, 1975). Nevertheless, some conclusions worth considering as hypotheses have emerged from these studies.

A study of trends in "mental health" problems among Alaska Natives during the 1970s indicated an increase in percent of "accidents" that were "alcohol-related" according to clinic records of the Indian Health Service. The percent of injuries associated with alcohol increased from 11.5 in 1971 to 17.8 in 1975 and then declined to 15.7 in 1977 (Kraus and Buffler, 1979). Percent of suicide attempts that were "alcohol-related" increased
from 43.3 in 1971 to 59.7 in 1976. These could be real trends or the waxing and waning of interest in alcohol by clinic staffs. Unless alcohol involvement is substantially underreported in cases of unintentional injury, its involvement does not explain very much of the problem, even with the noted increase.

There is wide variation among tribes in alcohol-related problems. In a study of tribal areas of Oklahoma, the highest rate of arrests for driving under the influence was ten times the lowest rate as was the range of rates in arrests for public drunkenness. Death rates from "alcoholism", cirrhosis, or alcohol poisoning were 29 times as large in the highest group as in the lowest group. A high rate of alcohol-related deaths was associated with high unemployment. Also, the history of the groups with reported high alcohol problems includes more of a hunting culture, emphasis in ceremony on endurance and quest for vision, and a greater loss in cultural tradition in the transition to their present living conditions. The groups with lower alcohol problems, although removed by force from their traditional home areas, nevertheless maintained a way of life more compatible with their present circumstances. They had a tradition of strong community ties and sophistication in agriculture. Also, their leadership in the past emphasized sobriety (Stratton, et al., 1978).

As the wide variation in alcohol use among and within Native American groups has become better known, theories attempting to explain the differences have been developed. Until recently, Native Americans were treated as a homogeneous group and their high injury rates and alcohol problems were considered as a part of a general social pathology that resulted from the disruptions of traditional culture by the invasion and domination of Europeans. Heavy drinking was seen mainly as an anesthetic for psychological and social pain that, paradoxically, increases the pathology.

Without denying the disruptions in history as a major factor in many of the problems of Native Americans, recent theorists have argued that at least some of the variation among Native American groups in use of alcohol is a behavioral response in line with "preexisting and persisting tribal institutions and values" (Levy and Kunitz, 1974; Kunitz, 1976). Drinking patterns vary widely. In groups where intoxication is frowned upon, drinking is done alone and in secret. In groups with a tradition of the seeking of visions and endurance dancing, heavy alcohol consumption in public is more acceptable.

Some of the behavior associated with alcohol use in some Native American groups that is now disapproved by middle class whites was likely learned from the early white trappers, traders, and soldiers whose rioting, fighting and abuse of women while drunk was common in the Nineteenth Century. The extent to which such behavior is caused by alcohol or is tolerated as a part of the "time out" behavior that was learned as associated with alcohol use is unknown. Native Americans who are more integrated
into white society report that their drinking is moderate while drinking in more traditional groups is heavier, at least on the occasions when drinking occurs (Levy and Kunitz, 1974).

Self-reported total abstinence is twice as high among Native Americans as among whites, and is greater among those more integrated into white society than among more traditional groups. Many of those who drink heavily, usually in groups that "keep passing the bottle until its gone", seem to be able to become abstainers without the symptoms of withdrawal identified as evidence of addiction among whites. None of these points are taken to mean that alcohol does not impair Native Americans in such a way as to increase the likelihood of injury when using motor vehicles or in other hazardous environments. The historical evidence on homicide rates, however, do not show an increase in parallel with increased alcohol use (Levy and Kunitz, 1974).

Not only did many early writers consider Native Americans as a homogeneous group with respect to alcohol use, the term "alcoholic" attributed to that use has been applied too uncritically. Addiction to alcohol and drinking styles and circumstances that get people into trouble are not necessarily the same phenomenon. Attempts to discover differences in metabolism of alcohol among races has produced conflicting conclusions. Fenna, et al., (1971) found that Native Canadians metabolized alcohol more slowly than Caucasians but a later Canadian study found the opposite, faster metabolism by Native Canadians (Reed, et al., 1976). A U.S. study that included measures of metabolic enzymes in a Native American and U.S. sample found no racial difference (Bennion and Li, 1976). While there is evidence of a genetic factor that explains part of the interindividual variation in alcohol use (Partenen, et al., 1966), there is no reason to believe that interracial differences, to the extent that they exist, are genetic in origin.

Alcoholism tends to run in families both among Native Americans and Caucasians. Attempts to explain these differences by psychological variables such as depression and locus of control have been questionable. One such study that included Native American and Caucasian college students found no psychological differences between those with close relatives who were alcoholic and those without an alcoholic relative in either racial group (Jones-Saumy, 1983). Native American students did have higher average scores on questionnaire items supposedly measuring depression and attribution of events to chance (i.e., lack of personal control over events). Given their history and resultant economic circumstances, this result should not be surprising. A recent study of locus of control among persons treated in an alcoholic detoxification center found that average scores of Caucasian women and Native American men and women were similar, with Caucasian men claiming a greater amount of control in their lives than the other three groups (Hurlburt, et al., 1983). Locus of control questionnaires may be measuring accurate assessment of ones circumstances rather than some psychological
trait unrelated to the social environment.

Among Caucasians in separate studies, persons diagnosed as alcoholic have been found both significantly more external (i.e., less personally in control) and significantly more internal than nonalcoholic persons on measures of locus of control (Barnes, 1979; Hinrichsen, 1976). In correlation with self-reported drinking among college students, frequency of drinking, but not quantity, was related to feelings of more external control (Apao and Damon, 1982). This may simply mean that drinking is more frequent in those who are more susceptible to peer pressure.

Alcohol use in several Native American cultures has been described as largely a peer group phenomenon. Young males in particular are expected to drink at social gatherings, in quantities and at speeds that result in rapid intoxication. In some cases, one author claims, such behavior is at least partly the result of the stereotype of Native Americans as heavy alcohol users. Identification with the group is defined in behavioral terms regarding alcohol. Among young males, he reports, heavy binge drinking in groups is encouraged by the phrase, "go ahead and drink like an Indian" (May, 1982).

Returning to the primary concern here -- injuries, whether or not linked to alcohol -- a study of hospitalizations of persons of different racial and ethnic background while in similar circumstances is of interest. All hospitalizations of persons serving in the Navy from 1973 through 1975 were analyzed by diagnosis and race. Native Americans were hospitalized for "alcoholism" three times more often per capita than whites or blacks and ten times more often than orientals. Yet their hospitalizations for injuries were less (by about 13 percent) than those of whites and blacks, but greater than those of orientals (Hoiberg, et al., 1981).

There were no obvious differences in job classifications or other factors that would suggest why Native Americans should have lower injury rates than whites or blacks, and to the extent that the diagnosis of alcohol problems is correct, one might expect more injuries among Native Americans. There could be biases in diagnosis of Native Americans as alcoholic because of the stereotyping of alcohol use by Native Americans. Native Americans who select service in the Navy may be from tribes that have lower than average injury rates. It is also possible that the higher injury rates of Native Americans in general compared to the general population is a consequence mainly of environmental circumstances rather than cultural or psychological factors. When the environments are similar, the injury rates are similar.

Injury Control Strategies

The necessary and specific cause of injury is a transfer of energy to human tissue beyond the level of resilience, or insufficient energy transfer for the sustenance of the tissue (Gibson, 1961). This fundamental understanding has led to the
explication of the analogy of injury and infectious disease. The agent, energy, is delivered to the host, the person injured, by a vehicle or vector (car, gun, other person). If one can control the amount of energy in proximity to people, either directly, or indirectly through modification of its vehicles, vectors or the environment, then the incidence or severity of injury can be controlled (Haddon, 1980).

As in the case of control of infectious agents (bacteria, viruses), certain controls on energy sources and vehicles and vectors are more acceptable to a given society than others. The first task in consideration of injury control is to specify where the injuries are occurring in space, time and populations and to identify the energy sources and the vehicles, vectors or environmental factors that result in the energy contacting human beings in rates and amounts that are beyond human tolerance. As noted in the section on epidemiology of injuries among Native Americans, much work of this type remains to be done.

In the case of motor vehicle occupants, we need to know the types of vehicles involved, the angles of the crashes, and the extent of seat belt use. Are fatalities occurring mainly in single vehicles striking roadside objects, rolling over, or in multiple vehicle collisions? To what extent are the multiple vehicle crashes the result of conflicts at intersections, passing on two lane roads, etc.? The countermeasures available to reduce injury incidence and severity under these differing circumstances are not the same (Robertson, 1983). Similarly, the recommended countermeasures for child pedestrians struck when darting into roads during the daytime are substantially different from those that occur to older pedestrians walking along roads at night.

Are falls that result in injury among Native Americans mainly among the elderly or children slipping on surfaces in their homes, or are they mainly concentrated among workers, persons engaging in recreation or other activities outside the home? If they are the latter, what are the specific circumstances of the surfaces and heights involved? Are drownings mainly among children in ponds and streams or among adult hunters and fishermen? Are housefires caused more often by dropped cigarettes (as in the population generally), or by cooking, space heating, or other sources? Do deaths from fires occur more frequently among persons while asleep, and if so, where were these persons sleeping relative to potential exits? Do deaths from cold occur mainly from lack of heat in homes or from other specifiable circumstances? Without answers to questions such as these, injury control activities can be substantially misdirected. Once the answers are known, the range of options for changing one or more of the factors involved can be considered.

The second task is to identify the possible technical options for injury control. Ten such generic options that are logically distinct have been identified (Haddon, 1970). Each of these, along with a few illustrations of its possible application, follows:
1. Prevent the marshalling of energy in hazardous concentrations. Do not allow handguns. Do not use especially hazardous road and offroad vehicles such as motorcycles, minibikes, and certain "utility" vehicles. Prohibit the use of particularly hazardous chemicals.

2. Reduce the concentration of hazardous amounts of energy. Limit the speed of road vehicles. Allow only plastic bullets to be sold as ammunition in handguns. Reduce the flammability and toxic gases when burned of home construction materials, chairs, sofas, bedding and clothing. Lower maximum temperatures in water heaters. Limit the number of pills or liquid content per bottle sold of drugs commonly involved in poisonings.

3. Prevent the release of energy that has been concentrated in hazardous amounts. Increase skid resistance of road surfaces. Increase coefficients of friction of floors, sidewalks, bathtubs, and the bottoms of shoes, especially those used by children and the elderly. Make matches, lighters, and containers of flammable liquids difficult to use by children.

4. Modify the rate or spatial distribution of the energy from its source. Use child restraints for small children and seat belts for all vehicle occupants in motion. Use sensors in dams and levees to release water buildup at a controlled rate to avoid breakaway floods. Use containers that have only small spouts when pouring hot or flammable liquids. Provide automatic ventilation in motor vehicles and other structures where poisonous gases may accumulate.

5. Separate in time and space the energy and those to be protected. Remove pedestrian paths and bicycle paths from roads. Place trees, utility poles and other rigid objects away from roadsides at high risk sites. Evacuate populations when hurricanes or flash floods are predicted. Lock up ropes, wires, and similar materials involved in children's strangulations.

6. Interpose a physical barrier between the energy and those to be protected. Require crash helmet use by bicyclists and motorcyclists. Keep guns used for hunting and target shooting in locked storage at clubs or other central places so that they cannot be found in homes by curious children, enraged fathers and mothers, or burglers. Surround swimming areas and waterfilled quarries with unscalable fences and lock gates when unsupervised. Provide firewalls in buildings, and insulated clothing in high and low heat environments.

7. Modify basic qualities of the energy or its exchange with vulnerable populations. Provide soft floors in housing for the elderly. Use soft materials rather than concrete, asphalt and crushed stone for the surfaces of playgrounds. Prepare food to a consistency that pieces cannot become lodged in the trachea.

8. Make those to be protected more resistant to energy
exchanges. Provide blood-clotting factors to persons with hemophilia. Increase exercise programs to improve musculo-skeletal strength, particularly among groups highly vulnerable to falls, such as the elderly.

9. Begin to counter damage already done. Train the population in stopping hemorrhage and the recognition of potential spinal cord injury so as not to exacerbate the damage by avoidable movement of the injured. Provide emergency medical teams placed for quick response and communication systems, such as roadside telephones, for quickly informing them of emergencies. Place smoke and heat detectors, fire extinguishers and fire alarm systems in all dwelling units. Install detectors for released toxic chemicals and radiation in areas where they are used.

10. Stabilize, repair, and rehabilitate the injured persons. Remove superficial scars and bone destruction with plastic surgery. Provide prosthetic devices for amputees and especially designed equipment for work and other activities of the handicapped.

The examples given here are only illustrations of the use of these strategies and are not exhaustive. Obviously some are more feasible than others and use of certain ones would preclude the necessity of using others. Some may be irrelevant to the patterns of injury found in specific Native American groups. The purpose of the ten strategies is to consider systematically the full array of options available. Once these have been considered, choices regarding use of any one can be made on the basis of considerations of redundancy, feasibility, and costs, if any.

When reviewing an array of technical strategies to reduce the incidence or severity of a particular set of injuries, the means of implementing the strategy is perhaps the most important consideration. It is obvious that several of the noted technical strategies would virtually eliminate certain categories of injury. Their use, however, remains problematic because of ignorance of the variety of actions available or various objections to their most effective implementation.

Three basic implementation strategies are available in public health: 1. Change the voluntary behavior of people in immediate proximity to the hazard. 2. Require or prohibit by law or administrative directive the specified behavior of people in immediate proximity to the hazard. 3. Modify the energy and vehicles in such a way that people are protected automatically when they are in proximity to the hazard (Robertson, 1975a).

The frequent emphasis on the first of these often does not take into account human limitations in capacities to perceive and react to hazards in their environments. The large numbers of injury attributable to kinetic energy, the energy inherent in all moving objects, is at least partly the result of lack of human capacity to deal with it. Speed of road vehicles has been researched in that regard.
Human reaction time to environmental stimuli such as red lights and sounds commonly experienced by drivers and pedestrians can take up to two seconds in rested, sober persons in a laboratory. Half require 0.9 seconds or more to react (Johansson & Rumar, 1971). A driver who reacted in 0.9 seconds at the moderate speed of 30 miles per hour (44 feet per second) would travel about 40 feet before beginning to apply brakes or change direction by steering. A child pedestrian darting into the street within that distance would be struck at 30 miles per hour.

Some inevitable collisions of that sort are avoided by driving at slower speeds where people on foot or in vehicles dart out, although few such places can be anticipated. Also perception of speed is limited. For example, persons traveling in cars with the speedometer masked underestimate their speeds by an average of 25 percent at speeds less than 30 miles per hour (Evans, 1970). If drivers were to constantly monitor speed by the speedometer, as currently designed, their reaction time would be slowed to the extent that their eyes were not on the road constantly.

At higher speeds, the problem is further complicated by adaptation. Again with speedometer masked, drivers were instructed to slow to 40 miles per hour after varying periods at 70 miles per hour. After only 5 seconds at 70, the drivers slowed to 44.5 miles per hour; after 20 miles at 70, 50.5 miles per hour was thought to be 40 and after an additional 20 miles at 70, the average was 53.4 thought to be 40 miles per hour (Schmidt & Tiffin, 1969). In another study, distance necessary to pass a forward vehicle on a simulated two-lane road averaged 78 percent less than that actually necessary at 50 miles per hour (Gordon & Mast, 1970).

Size of the other vehicle, from the driver's perspective, is also an apparent factor in the perception of its presence and/or speed. In car-motorcycle collisions, only about 4 percent occur when the motorcyclist is turning left across the path of the oncoming car but 39 percent involve a car driver turning left across the path of a motorcyclist (Griffin, 1974).

Children and the elderly are disproportionately injured in falls, asphyxiations, and burns (Baker, O'Neill & Karf, 1984). Both limitations in perception of hazard and physical ability to react in time to avoid injury are undoubtedly factors in these distributions.

In addition to the physical limits in time of communication among nerve cells and motor responses, the psychological and social aspects of hazard perception and behavior must be considered. Studies of injuries that attribute the vast majority to "human error" do not consider all the physical limitations mentioned, much less the absence in the world of any human being who does not make frequent errors. Even if all people could be made aware of the relative risks of the plethora of hazards to health, an impossible task in itself, the individual who could
synthesize this information, apply it in every situation, never suffering a lapse in attention or alertness, simply does not exist.

Further complicating the issue is the tendency to deny that risk is as applicable to oneself as it is to others. In a national random-sample survey of people who expressed the intention of buying a new car, the interviewees were asked whether the risk of their being injured or killed in a car crash was greater, the same as, or less than persons like themselves. Only 6 percent chose "greater than" compared to 40 percent who chose "less than" (Robertson, 1977a). We do not know the extent to which denial affects behavior with respect to risks of injury. Its involvement in delay in seeking care for cancer (Robertson & Heagarty, 1975) suggests that there may be adverse behavioral consequences. We also do not know whether variations in beliefs about health and prevention of harm among Native American cultures results in behavior that increases or decreases the probability of injury.

Evaluation of Programs

Persuasion. Programs that attempt to change behaviors by evoking voluntary action take a variety of forms from education to operant conditioning to enhancing perception by changes in the environment. Most such efforts that have been attempted on a large scale are strictly educational or a combination of education and skill training. Among the largest of these programs is driver education in the public schools.

Until the 1960's, research on driver education simply compared crash and violation records of students who had completed the course with those of students who had learned to drive by other means. Finding lower crash and violation rates in the high school trained group, the researchers concluded that driver education was the cause of the differences (e.g., Allgair, 1964). When subsequent studies controlled for grades and miles driven, however, the correlation between driver education and crashes disappeared (Conger, Miller & Rainey, 1969; McGuire & Kersh, 1969). This result suggested that drivers who were less likely to crash subsequently (or their parents) selected the course and the course had little or no effect on crashes.

Two controlled experiments in which students were assigned to the course have found no significant effect on subsequent crash records (Shaoul, 1975; Ray, Weaver, Irink, & Stock, 1982). In the latter study, an advanced course designed by psychologists and education specialists was given one group of students; a second group had a course similar to that in most high schools. Neither of these groups had crash records in the following two and a half years that were significantly better than the control group.

Although high school driver education has no apparent effect on the driving abilities related to crashes among individuals, it is harmful in the aggregate because those who take the course are
First reported in one of the above mentioned experiments (Shaoul, 1975), two subsequent studies have found the effect to be large. A comparison of fatal crash rates of 16-17 year old drivers in 27 states found no correlation between the proportion of high school students completing driver education and fatal crashes per licensed drivers in the 16-17 year old group. Numbers of licensed drivers was strongly related to the proportion of 16-17 year olds completing driver education. Thus driver education increased total fatal crashes because it increased licensure in an age group with a high fatality rate without reducing the individual risk per licensed driver (Robertson & Zador, 1978).

In Connecticut, when state funding of driver education was eliminated, nine school districts dropped the course. In comparison with similar districts that continued the course using local funds and fees, the licensure and crash rates of 16-17 year olds tumbled, with only a slight increase in home and commercial training. The net effect was a substantial decrease in crashes of 16-17 year old drivers from communities that dropped the course (Robertson, 1980).

In the second driver education experiment mentioned (Ray, et al., 1982), an attempt was made to allow only those who intended to be licensed into the course. This was based on a statement of intention. Despite this effort, the students who completed the courses were licensed at a somewhat younger age than the control group.

Other studies of driver education offered to adults or required by law of drivers with poor records, have found no effect when adequate controls for self-selection have been employed. The so called "defensive driving" course has been studied by comparing the two-year crash records of persons who took the course before the two years and persons who took it after the two year comparison period. No significant difference in crash records was found (Muhern, 1977). Similarly, drivers with poor records randomly assigned to a defensive driving course and a control group showed no significant differences in subsequent average crashes between the two groups (Hill & Jamieson, 1978). Despite such evidence, the course continues in widespread use, including some injury control programs among Native Americans.
In several of the cited studies, there are fewer violations found in trained groups than in comparison or control groups. Proponents of educational programs use this as evidence of success. However, the lack of effect on crashes and the extremely low correlations of violations and crashes (Robertson, 1953) suggest that the courses are not useful for crash risk reduction.

Several experiments in attempted rehabilitation of presumably high-risk drivers have found little or no success. In Nassau County, New York, an education-rehabilitation program for drivers convicted of driving while impaired by alcohol was substituted for the usual sentence in a random sample. Compared to the control group who received the usual sentence, often a license suspension, the education-rehabilitation group had significantly greater numbers of crashes in the subsequent period than the control group (Preusser, et al., 1976). Apparently, a program with no effect was substituted for one that had at least some effect. Controlled experiments of rehabilitation programs for drivers with certain accumulations of convictions for moving violations have found little or no effect of the programs in follow-up studies of the records of case and control groups (Edwards & Ellis, 1976; Fuchs, 1980).

Some controlled trials of counseling in clinical settings have demonstrated small successes in convincing people to use certain forms of protection. Among the most successful was a brochure and counseling by physicians regarding the use of smoke detectors during a physical checkup. Almost half of those who did not have a smoke detector purchased one and 35% were observed to have it correctly installed during a followup home visit. No such purchases were observed in a control group that had visited the same physicians but who were not counseled regarding smoke detectors (Miller, et al., 1982). This study was done in a population in which the cost of a smoke detector was easily affordable for most families. Such may not be the case among those Native American groups with low incomes, and there is no guarantee that one would find a similar response to physician advice if cultural or other factors are different than in the study group.

A similar study of physician encouragement to use child restraints in road vehicles was less successful. An experimental group of parents was counseled by pediatricians about the value of child restraints and each was given a prescription for a restraint and demonstration by the doctor as to its proper use. Compared to a control group that was counseled only on other aspects of health, child restraint use in the experimental group was higher by 23% in one month and 72% in two months, but only 9 and 12%, at four and fifteen months, respectively (Raisingher, Williams, et al., 1981).

Clinical counseling by health educators, who lack the aura of authority of physicians, has no apparent effect on protective behavior. In one experiment, mothers in the hospital with newborns were assigned to one of four groups: 1. Received
literature on importance of child restraint use, 2. Given that literature, a discussion by a health educator especially trained in persuasive techniques, and demonstration of use of the restraint, 3. Given the literature and a free restraint, and 4. No contact in the hospital or afterward. As in the pediatricians' experiment mentioned above, the use of child restraints in these groups was observed as the patients entered the parking area for follow-up visits.

During the observation period 2-4 months later, 28% of the group given free restraints were using them compared to 20-22% in the other three groups. Use was not significantly higher in the group counseled by the health educator or in the group that received only literature when compared to the control group (Reisinger & Williams, 1978).

An experiment attempting to reduce several hazards to children in homes had similar results. Parents who brought children to a prepaid medical plan were divided into experimental and control groups. Household hazards to children were discussed by a health educator with parents of children in the experimental group, who were also given a booklet regarding ten common hazards and a followup phone call to discuss actions taken. The control group did not receive any of these but both groups were given free plastic covers for electrical outlets and locking devices for cabinets.

Eight weeks after the counseling, a surprise home visit was paid to families in both groups and they were asked to participate in a household hazard survey with the home visitor. The hazards that were discussed with the experimental group were not significantly lower in that group than in the control group (Dershewitz & Williamson, 1977). The experimental group did have significantly higher use of the electrical outlet covers but the use of the cabinet locks was not significantly different between the groups (Dershewitz, 1979). Research is needed on the extent to which community outreach workers, who may visit homes on a more regular basis, can persuade people to take precautions.

A less personal approach to education-persuasion is the use of mass media. Some advocates of "social marketing" believe that behavior change can be sold in television ads like commercial commodities. Actually, the success of commercials in obtaining shares of such markets is modest and the creation of new markets is unusual. Nevertheless, the access to large audiences at relatively low cost per person reached justifies the attempt to change injury related behavior by this means. Unfortunately, the efforts are seldom evaluated scientifically on a small scale before being used on a large scale. Those campaigns that have been studied do not breed optimism for the efficacy of the approach.

A series of radio and television messages encouraging seat belt use in road vehicles was used intensively in one community, moderately in a second, and was withheld from a third community.
which served as a control. After five weeks of the campaign, belt use, observed at selected sites in the communities, was no higher in the experimental communities than in the control (Fleischer, 1972).

A nine-month television campaign that would have cost $7 million in 1972 dollars if done nationally was tested experimentally. Several ads, based on previous research regarding factors related to belt use, were shown 943 times on one cable of a dual-cable television system used to test commercials. The two cables are laid out in a community in a checkerboard fashion, providing a cross section of the population on the experimental and control cables.

Observations of belt use by drivers were linked to the households on a given cable by matching addresses of the households of the vehicle owners (from license tag numbers) to the billing addresses of the cable system. No significant differences were found in belt use between drivers from households on the two cables or between these and households not on either cable before, during, or a month after the campaign (Robertson, et al., 1974).

A campaign on fire hazards that mixed media efforts with programs for civic groups had a small effect but a mixture of media and teaching materials for schools had none in a second community when compared to a third, control community. The eight-month campaign increased knowledge of 44% and 13% applied the knowledge when needed (McLoughlin, 1982).

Attempts to use the principles of operant conditioning to change injury-related behavior have had varied success, apparently depending on types of rewards or punishments used and/or the extent of general administrative control of recipients of the conditioning by organizations that have used these methods. Use of a type of punishment in the general population in an attempt to increase seat belt use was a dismal failure. Use of rewards for belt use and other protective behaviors in certain corporations has been partially effective.

In 1972, the federal government allowed a buzzer-light system to be used by auto manufacturers in lieu of increased automatic crash protection in cars. If seat belts in the outer front seats were not extended more than six inches from their stored positions, the buzzer sounded continuously and the light indicated that belts were to be used. The public responded by disconnecting the system or knotting the belts more than six inches from the retractor, in the latter case rendering them unusable. Surveys of belt use within months of introduction of the system revealed no significant difference between belt use in buzzer-equipped cars and those manufactured in the same model year before the requirement of the system (Robertson & Haddon, 1974).

In 1974, the government allowed a system that would not
permit the car to start if a certain weight were detected in the outer front seats without the belts being extended in a new sequence each time the seat was used, or latched, again as a substitute for automatic protection. With the exception of an air bag option on the most expensive Buicks, Cadillacs, and Oldsmobiles, all manufacturers used the interlock belt system, as it was called.

Observations of belt use by drivers of interlock-equipped cars revealed 59 percent belt use, remarkably more than in other vehicles (Robertson, 1975b). That success was shortlived, however. Complaints to Congress about cars not starting with dogs and groceries in the seat led to prohibition of the mandatory use of interlocks and continuous buzzers by law. Within three years, belt use in interlock-equipped cars had declined to 15% (Phillips, 1980).

Several studies of the use of lottery-like reward systems in company or shopping center parking lots have found increased belt use during the period that the rewards are offered (e.g., Elman & Killebrew, 1978). Various reward schedules and sustainability of the effect when rewards are withdrawn are being investigated. Belt use declines when rewards are no longer offered and is lower among workers paid by the hour than among those on salary (Geller, 1981).

Where it is possible to provide information on behavioral performance or results, some improvements have been observed in industry. Workers in high noise environments greatly increased their use of ear protection in groups when audiometric test results before and after exposure were displayed on bulletin boards (Zohar, Cohen & Azar, 1980). Use of water spray to simulate the pattern of flying metal fragments when grinding machines are turned on resulted in more frequent recommended behavior by those who experienced it (Rubinsky & Smith, 1973). Group decision making regarding goals for safe behaviors and charts of frequency of the behaviors displayed in a prominent place have also been found effective during the period that behavior is observed (Komaki, et al., 1978). The behaviors do not persist beyond the period of observation, however, suggesting that such efforts must be sustained indefinitely for continual effect.

The difficulty in perceptions of speed, distance, and other vehicles by drivers has been partly offset in a few instances by attempts to alter the environment to improve perception. Placing a brake light above the center of the trunk of cars, just under the rear windows, decreases the frequency of rear-end collisions while braking by 50% (e.g., Reilly, et al., 1980). The effect is apparently not the result of novelty because two lights, one to each side at the same level, do not have the crash-reducing effect.

Stripes twenty inches in width painted across roads at exponentially decreasing intervals create the illusion of
acceleration when driven across at a constant speed (Denton, 1980). These cause some drivers to decelerate and can be used at toll booths, traffic circles, and in the approaches to curves.

Specific characteristics of road sites such as curvature and grade have been identified as disproportionately involved in certain types of fatal crashes (Wright & Robertson, 1976). These were used in one state to choose sites to place reflectors on the center stripe of roads approaching curves. Comparison of night/day crashes in these areas suggested a reduction of about 20 percent in crashes at night (Wright, et al., in press). Illuminated sections of roads also have fewer nighttime crashes than those not illuminated, correcting for other factors (Box, 1971).

Laws and Administrative Rules. The laws and administrative rules aimed at injury control range from prohibition of homicide to the "no bare feet" rule in the ice cream parlor at the beach. Two basic types can be delineated, those that attempt to deter behavior that increases the risk of injury (e.g., driving while intoxicated) and those require protective behavior (e.g., use of child restraints when transporting small children).

Various factors contribute to the effectiveness or ineffectiveness of laws and administrative rules. The behavior must be strongly related to the incidence and/or severity of injury. Either there must be compliance because of general conformity to rules or the belief in the importance of the rule, or the rule must be enforceable by persons with authority to do so. In the case of laws, if the police do not arrest, prosecutors do not pursue the cases or negotiate lesser charges, or judges and/or juries fail to convict and impose sentences, the force of a law is undermined (Zimring & Hawkins, 1973). Other important factors are the extent to which the behavior can be directly observed by authorities, and the degree of augmentation of enforcement by persons other than authorities (Robertson, 1983). Also, the law must be sustainable in the political arena.

Laws requiring motorcycle helmet use are highly effective (the technology works and the behavior is easily observed for purpose of enforcement). More than 99% of motorcyclists comply with the law and deaths decline about 30% when such laws are enacted (Robertson, 1976). Although a majority of the public and the majority of motorcyclists favor the laws, a minority of motorcyclists have intensively and successfully lobbied to overturn the laws in the majority of U.S. states.

Laws prohibiting driving with blood alcohol above certain concentrations have been increasingly popular politically but are very difficult to enforce. A police officer cannot observe blood alcohol directly and must have probable cause to detain someone for a blood or breath test. Based on roadside surveys, in which people are asked to voluntarily have a breath test without prosecution, and on arrest rates for driving while intoxicated in the same areas, the highest arrest rate for the offense ever
recorded was one in 200 (Beitel, et al., 1975). Widely publicized crackdowns create the impression that the probability of arrest is high and motor vehicle fatalities decline somewhat during such crackdowns. These effects have repeatedly been shown to be temporary (Ross, 1982). As people learn that the actual probability of arrest hasn't changed much and/or the publicity dies down, drivers return to their usual behaviors.

Where enforcement of laws is augmented by persons other than police in a community, the effects of law on injury control are more sustained. States with higher ages for purchasing alcohol, enforced mainly by bartenders and storekeepers, have fewer fatal crashes by drivers less than the specified age (Williams, et al., 1975). Prohibition of driving at certain hours by teenagers in a few states, undoubtedly enforced mainly by parental control over the family car, reduces substantially the crashes of drivers of the specified ages during those hours with no offsetting increase during other hours (Preusser, et al., 1982). Laws directed at the sale and registering of handguns have been found more effective in reducing handgun deaths, intentional and unintentional, than those against possession, use in a felony, and the like (Geisel, et al., 1969). The former laws are largely enforced by gun dealers.

An easily observable behavior that could be enforced by police, but that involves substantial discomfort, inconvenience, and cost to the persons affected, is often not in compliance with the law. The use of child restraints by children below a certain age when traveling in cars is required in most states. Observations of children traveling in cars, however, reveal that the vast majority of such children are not restrained (Williams & Wells, 1981). Apparently, the cost of the restraints, the hassle of getting the child in and out of them, and having to contend with children who do not like to be confined substantially offsets any tendency to comply with laws in general or the specific fear of arrest.

Severe sentences, the subject of perpetual public debate and enormous legislative energy, are among the least important factors in the effect of law. The deterrent effect of capital punishment on homicide, if it exists at all, is not evident in comparisons among states that adopt or drop the penalty and others where no such changes are occurring (Bowers, 1974). If there is a deterrent effect, it may be more than offset in numbers of lives lost by innocent people who would be executed as the result of false or misleading evidence in trials. The highly touted deterrent effect on drinking and driving that supposedly occurs in the Scandinavian countries is not confirmed by a closer examination of the evidence (Ross, 1982).

Regulation of Hazardous Agents and Vehicles. Government regulations that reduce hazards automatically have several advantages. They do not depend on acknowledgment of hazard and action by the persons to be protected. They do not give advantage to unscrupulous manufacturers who take advantage of the ethical
manufacturer who provides automatic protection but at a necessarily higher price than his competitors. The economies of scale are maximized when everyone is required to use the technology.

Because corporations have most of the same rights in law as individuals, but far more resources, adoption of regulations that require corporations to change a product or process has been difficult and those extent remain under frequent attack. While some of such corporate managements' resistance may be a concern for loss of sales due to increased costs, interviews with executives of regulated industries suggest that the primary reason is resentment at loss of complete control of the business (Lane, 1954).

Research on the effects of regulation varies in quality. Enormous declines in death rates associated with trains, airplanes and boats paralleled the adoption of regulations for these vehicles. One suspects that the regulations were at least partly responsible but direct comparisons of vehicles that met the specifications of technology and those without apparently was not done (Robertson, 1963).

The 1968 federal safety standards for cars (trucks were largely exempted until 1977 models) were found by several researchers to reduce occupant fatalities in the regulated vehicles (e.g., Levine & Campbell, 1971). Research that separated deaths in regulated cars and those of pedestrians, bicyclists, and motorcyclists struck by those cars found significantly lower death rates in all four groups when compared to unregulated vehicles, controlling for mileage and vehicle age. The crash avoidance standards, such as improved braking systems, reduced glare in driver's eyes and side running lights included in the regulations, apparently reduced risk to other road users as well (Robertson, 1981b). By the mid 1970s, the 1968 motor vehicle safety standards had reduced deaths by about 9000 per year from what would be expected without them. One of the possible explanations for higher motor vehicle fatality rates among Native Americans is their reported greater use of pickup trucks relative to the population generally. To the extent that their vehicles are preregulation models, greater fatalities would be expected.

Conclusion

Given the complexity of the issues, there is no simple prescription for amelioration of the injury problem. The principles noted in the review of intervention programs can be used to choose approaches that have the best chance of success. Because of cultural and historical factors, however, ongoing evaluation of the effects of chosen approaches among Native American groups must be undertaken. There may be barriers to success in those groups that are not prevalent in other populations.

There have been few published studies of the effects of
injury control programs for Native Americans. Apparently some innovative approaches have been adopted, but not studied in terms of injurious consequences. In one service area, reflective materials were attached to animals to increase their visibility to drivers at night (Kane and Kane, 1972), but no study of effects on crash rates was reported.

The few available studies examine data before and after a change in a program or law without adequate controls for alternative explanations. Declining hospitalization rates from injuries, as well as other conditions, were observed in association with use of health aides "who provide transportation, visitation, and advocacy" in one community (Guidotti, 1980). It is unclear what the health aides did that could account for an effect on injuries.

Followup studies of treatment programs for persons diagnosed as "alcoholic" have reported reduced use of alcohol and accompanying problems in some of the patients (Wilson and Shore, 1975; Westmeyer and Peake, 1983). As noted earlier, many Native Americans who drank heavily at one stage in life are reported to be able to abstain without withdrawal. Since the treatment studies had no control group, it is not possible to attribute reduced alcohol use to the programs. The researchers may be observing reduced consumption that would occur with or without the therapy.

Since alcohol use is illegal on many reservations, it has been argued that the alcohol-related crash rate is higher among Native Americans because those who drink often do so off the reservation and must drive long distances afterward. One study of a reservation where alcohol sales in two communities on the reservation were legal for two months in 1970 has been reported. Unfortunately, the state agency responsible for motor vehicle crash records would not cooperate. Arrests of Native Americans in the county bordering the reservation declined by one third compared to the same months in the prior and subsequent year, with no increase in arrests (actually some decrease) on the reservation (May, 1975). It is not clear why the tribal government again banned sales after only two months. Because of the short time of legalization, and the lack of data on actual effects on injuries and other problems, one cannot say with confidence that legalization would have a net benefit. It is certainly worth trying for a time with more definitive study of the results.

The path is clear for some innovations in injury control among Native Americans and some good science in documenting the effects.
SPECIFICATION OF RISK FACTORS

As is evident from the literature review, specification of how risk factors affect each type of injury among Native Americans is not possible. The literature on injuries among Native Americans is inadequate to accomplish this task in a precise way. Several factors are known to strongly affect the incidence and severity of specific types of injuries in other populations. Some of these, such as age and sex, are not modifiable and are of interest only to identify populations in which countermeasures should be targeted. In this section of this report, the known major factors that contribute to the types of injuries that predominate among Native Americans will be summarized. Investigation of clinical visits for causes that might be indicative of increased risk of injury was also completed and is summarized.

Motor Vehicles. Motor vehicles account for more than half the injury deaths of Native Americans and substantial proportions of nonfatal but severe injuries. The risk of injury in motor vehicles is affected by a large number of driver, vehicle and environmental factors. The major driver factors are age, human limitations, and alcohol impairment. The major vehicle factors are handling characteristics, size, energy absorbing capability, and poorly maintained equipment. The major environmental factors are road design, lighting, and signal systems. The relative importance of these factors in the Native American population could be different than the remainder of the population, but there is little evidence to suggest the extent to which these factors are more prevalent for the Native American population.

Fatal crash rates decline exponentially as age of driver increases. A 16 year old has 10 times the fatal crash rate per mile driven of a 30 year old (Robertson, 1983). The Native American population is disproportionately young. In 1980, 31 percent of that population in reservation states was 15 to 29 years old, compared to 27 percent of the U.S. population (Indian Health Service, 1984). We do not know whether persons in that age range drive more or less in reservation states than in the population generally. The age difference in the Native American population and the population generally is even larger at younger ages. Thirty-three percent of the Native American population was less than 15 years old in 1980 compared to 23 percent of the total U.S. population. Any evaluation of effects of countermeasures to motor vehicle injuries in the coming years must account for the coming increase in the population of an age with the highest crash rates.

Human limits refer to the abilities of people to perceive and react to motion of themselves and others. As detailed in the literature review, rate of error in judging speed of movement of self and others among sober, rested drivers in the laboratory and on the road is very large. The precise contribution of these misperceptions to crash incidence and severity remains to be
documented, but the attribution of crashes to "human error" in perceiving and reacting to motion is substantial. The assumption that such "error" is correctable by education has been repeatedly proved false. It is more likely inherent in the species, and therefore, no more or less prevalent among Native Americans than others.

Alcohol is a causal factor in half of fatal crashes, a third of non-fatal injury crashes, and about 15 percent of all crashes. Alcohol impaired pedestrians are also more likely to be struck by motor vehicles than are sober persons at the same times and places (Haddon, et al., 1961). The precise extent of alcohol use among Native Americans while driving, or walking on or in proximity to streets and roads, is unknown. Higher rates of cirrhosis-related deaths suggest that heavy alcohol use is more prevalent among Native Americans than the U.S. population as a whole (Indian Health Service, 1984). As noted in the literature review, however, Native Americans in the Navy do not have higher hospitalizations for injury despite higher hospitalizations for "alcoholism". Without objective measures of alcohol in drivers, we cannot say with any confidence that alcohol contributes to a greater crash rate among Native Americans than among the population generally.

Certain vehicles have very unstable handling characteristics. Motorcycles are a prime example and the Jeep CJ5, which has a high center of gravity, has been found unstable in turns and has been found substantially overinvolved in fatal crashes. Motorcycles have about 8 times the death rate per registered cycle as cars per registered vehicle, despite the fact that cars are driven more than twice the miles per year of motorcycles. So-called offroad vehicles generally -- although the CJ5 is the worst -- have significantly higher occupant death rates than other cars and trucks (Baker, et al., 1984). Vehicle size in general is a primary factor in severity of injury in a crash. Vehicle occupants are twice as likely to die in vehicles with wheelbases less than 100 inches as in vehicles with wheelbases of 120 inches or more (Robertson and Baker, 1975). It is not known whether the mentioned, more hazardous, vehicles are used more or less by Native Americans compared to the rest of the population.

Substantial improvement in crashworthiness of cars has resulted from the crash avoidance and energy absorption principles adopted in response to federal safety standards. Beginning in the mid 1960s, federal standards for brakes, glare in drivers eyes, energy absorbing steering assemblies, energy absorbing windshields, improved door latches to reduce ejections, and several others, were adopted and upgraded periodically. The result has been a reduction in occupant death rates per mile driven, and of deaths of other road users struck by cars, of about 9-10 percent per model year in each succeeding model year (Robertson, 1984).

The federal safety standards were not applied comprehensively to pickup trucks until 1977. To the extent that Native Americans
drive older vehicles and pickup trucks proportionately more than
the population generally, as they are alleged to do, their
fatality rates would be expected to be higher. As the older
vehicles are junked, the death rates should decline, controlling
for the projected increase in young drivers noted previously. The
reductions in motor vehicle deaths per population during the
1970s occurred later among Native Americans than among the
general population. It declined 4.4 percent from 1970 to 1975
compared to a 22.2 percent decline in the U.S. population as a
whole. From 1975 to 1980, however, the Native American rate
declined 34.8 percent while the rate for the total population
increased 7.5 percent (Indian Health Service, 1984). Some of
these changes may be for other reasons, but one suspects that the
disproportionate use of vehicles of older model years is a factor
in the lagged reductions for Native Americans.

Detailed study of crashes suggest that 10 to 20 percent of
vehicle crashes in a state with annual motor vehicle safety
inspections were the result of poorly maintained vehicle
components (U.S. Department of Transportation, 1975). In the
absence of inspections, the rate is higher (Colton and Buxbaum,
1968). The most important vehicle components are brakes and
tires. Poorly maintained exhaust systems along with rust holes
also contribute to deaths by carbon monoxide poisoning in
vehicles parked with the motor running. Recent analysis of
scheduled annual or semianual vehicle inspection does not find
sufficient effectiveness to justify the cost (Thompson, in
press). Random inspections of vehicles using the roads is
associated with a decrease in crashes when about 16 percent of
the vehicles are inspected, but not when only eight percent are
inspected. Because of court decisions regarding random stopping
of vehicles on the road, random inspection may not be acceptable
(Robertson and Stolwijk, 1984). Poor maintenance is correlated
with vehicle age and low incomes, a problem prevalent among large
proportions of Native Americans. Therefore, it is likely, but yet
to be investigated, that part of the excess injuries of Native
Americans is the result of a greater frequency of poorly
maintained vehicles.

The road environment is strongly correlated to the incidence
and severity of injury in motor vehicles. Comparison of the
characteristics of single vehicle fatal crash sites with sites a
mile back in the direction from which the vehicle came found
curvature and downhill grade to be highly correlated with the
fatal sites. Curvature greater than 6 degrees within 500 feet of
the sites was twice as frequent at fatal as at comparison sites.
Such curvature in combination with a downhill grade of 2 percent
or more was 4 times more frequent at fatal sites than comparison
sites (Wright and Robertson, 1976).

All fatal crashes are far more frequent on rural, uncontrolled
access roads than on other types of roads. The deaths per 100
mile travelled on such roads are about 2.5 to 3 times those on
uncontrolled access urban roads or on rural or urban limited
access roads (Baker, et al., 1984). Although mileage accumulated
by Native Americans by type of road has not been documented, the location of the larger reservations, their road systems, and the road systems in adjacent areas suggest that a disproportion of Native Americans' road travel is on the less safe roads. The typical road on a reservation is a two-lane road with little or no shoulder. Most roads have dropoffs on each side of the road varying from a few feet to a chasm. Guardrails or other barriers to prevent vehicles from leaving the road and rolling over are rare.

Fatal crashes are twice as frequent at night as in daytime, despite the fact that more miles are driven during the day. Some of the increased severe crash rate at night is due to the greater use of alcohol during night hours, but research on lighting of highway sections has indicated that night crashes are at least partly due to reduced visibility in darkness (Box, 1971). The day-night distribution of driving by Native Americans is unknown, but the roads on reservations and adjacent areas likely have proportionately fewer lighted areas than the roads in the U.S. as a whole.

A major factor in crashes at signaled intersections is the timing of the signals. An intersection where the red-yellow phase is 10 percent shorter than that recommended for roads with specified approach speeds, has, on average, 6 times the crash rate of an intersection that has a 10 percent greater than recommended red-yellow phase (Zador, et al., 1984). The numbers of signalized intersections on reservations and in adjacent areas is unknown, and the timing of their signals is unknown. Given the rural nature of many of these areas, signalized intersections are probably less of a factor in the severe crashes of Native Americans than they are in the total population.

Drowning. The drownings per capita among Native Americans was 2.9 times that of the general population in 1977-79. The excess for Native Americans occurs in the age group 15 to 60 years old (Baker, et al., 1984). Little is known about the circumstances of drownings in the Native American or U.S. populations. The circumstances likely vary from climate to climate. Despite the ubiquitous lakes in northern Minnesota, data from the Bemidji area office of IHS indicates that drownings there are rare. One suspects that drownings are also uncommon in the southwest desert areas, with the exception of areas adjacent to rivers with swift waters. The cold waters of Alaska are prime candidates. If IHS adopts the data gathering forms proposed later in this report, an unprecedented opportunity to study the circumstances of drowning in different environments will be realized.

Fire. The very young and very old are the populations most often injured in fires. Increased disorientation in an emergency and the limits on mobility in segments of these populations are the likely explanations for their increased risk. The Native American death rate in fires was 2.4 times that of the general population in 1977-79 (Baker, et al., 1984). The Native American population has proportionally more children than the total U.S.
population and the fire deaths per population are higher in the 0-4 age group among Native Americans compared to whites. The fire deaths are somewhat greater among elderly Native Americans than the white population, but Native Americans have only about half the proportion of population 65 years or older. Thus, age would not seem to be the total explanation of the excess death rate in fires.

In studies of fire injuries in Ohio and California, severe injury and deaths from fires were mainly in house fires. The ignition sources in fatal fires were primarily cigarettes dropped and left to smolder in beds, furniture or newspapers (29 percent), cooking units (9 percent), space heating (8 percent), inauspicious (6 percent), and electrical systems (4 percent). The "unknown" category was large (31 percent) (U.S. Fire Administration, 1978). Twenty-nine percent of hospital admissions for burns are those that resulted from hot liquids, which is the predominate cause of nonfatal burns to children (Feck, et al., 1978).

The extent of the application of these risk factors to Native Americans is unknown. Each is likely involved, but smoking behavior, types of cooking and heating units, etc. may vary from the population generally.

Falls. Fatal falls per capita increase exponentially with age, from fewer than 5 per 100,000 in persons less than thirty years old to about 20 per 100,000 among Native American and other nonwhite 80 year olds (Baker, et al. 1984). White 80 year olds have an even higher rate. Primarily because the proportion of the Native American population that is 65 or older is about half that of the total population, the fatal falls per capita among Native Americans is lower than among the total population. Nevertheless, falls are an important contributor to fatalities and disabling injuries.

Falls of children and the elderly usually occur in the home, or in the case of the elderly, in institutions for their care. Children's severe injuries tend to occur in falls from one level to another (window to ground, crib, bed or table to floor, etc.) while severe injuries in the elderly tend to occur in falls on stairs or slips on the same level while walking, or may occur from the pressure on the bones while walking prior to the fall. Falls from ladders and scaffolds are primarily a problem among adult males and these increase with age.

Predicting Injury from Clinic Visits

In a large-scale analysis of 761,883 clinic visits by 155,575 persons to service unit facilities in three widely separated areas, an attempt was made to explore the patterns of clinic visits prior to visits for injury. If certain diagnoses were predictive of injuries, it would be possible to develop a system of visit monitoring to identify persons at increased risk of injury. To the extent that certain medical conditions place one
at greater risk because of stress, medications used, and the
like, or to the extent that family stress, alcohol problems, and
the like, manifest themselves in medical contacts, it may be
possible to identify persons whose risk is increased and for whom
an intervention might be preventive of the injury.

The details of the study are presented in Appendix A. Certain
diagnoses are predictive of injury among children less than five
years of age, namely venereal diseases, diabetes, endocrine
problems, organic brain syndrome, psychosis, alcoholism,
gynecological problems, or environmental problems. The vast
majority (79 percent) of the 228 injured children with one or
more of these diagnoses had a diagnosis of alcoholism, presumably
fetal alcohol syndrome. Apparently children with such a diagnosis
are frequently seen for multiple problems and are at a high risk
of injury. About 71 percent of the male children with one or more
of the specified diagnoses was seen for an injury within a year
and 57 percent of the female children with one of the diagnoses
was subsequently seen for an injury. The data are not specific
enough to indicate whether the injury is because of impairment or
stress in the child or because of a parental problem.

It should be emphasized that the vast majority (89 percent)
of injured children less than five years old did not have such a
diagnosis. Therefore, total concentration of injury control
efforts on the small minority at especially high risk would
neglect the bulk of the problem. To the extent that programs
directed to reduction of maternal alcohol use are successful, the
injuries in their children might be reduced as well.

Among older children and adults, few diagnoses are predictive
of injury. Use of those that show some correlation, such as
alcoholism, would result in thousands of false positives (injury
predicted but did not occur) and false negatives (injury not
predicted, but nevertheless occurred). This conclusion is
tempered somewhat by the fact that the identification system in
IHS records is not structured so that members of families can be
identified and studied as a unit. It is conceivable that stress,
alcohol problems, and the like, are seen in family members that
are not necessarily the persons at greatest risk of injury in the
situation. Given the low degree of association of injury with
other prior diagnoses, it is doubtful that linkage of records of
persons within the same household would improve predictability
enough to justify the establishment of a record monitoring
system.

Clinicians in IHS should be alerted to the fact that young
children with the specified diagnoses are at high risk of injury.
Given the syndrome of frequently overlapping diagnoses, these
families are no doubt well known to a variety of clinical
personnel. Perhaps outreach workers and/or visiting nurses could
be alert to household hazards and attempt to persuade the family
to modify them. Given the large number of injured persons without
the specified diagnoses, this effort should not be the primary
focus of the CIC programs.
PRELIMINARY ASSESSMENT OF THE COMMUNITY INJURY CONTROL PROGRAMS OF THE INDIAN HEALTH SERVICE

In response to the knowledge of high injury rates among Native Americans, the Indian Health Service began program planning for an injury prevention program in 1961. The environmental health program was given primary responsibility for this effort. The environmental health officer in each service unit was asked to form a Community Injury Control Committee (CIC). These committees were interdisciplinary, including clinical personnel and representatives of the community. The committee's task was to set priorities and develop programs for injury prevention and severity reduction.

Actual activities and the target injuries toward which those activities were directed have varied widely among service units in each year and from year to year. The primary activities have focused on training individuals to avoid hazards or to treat injuries with first aid or cardiopulmonary resuscitation (CPR), but more recent activities have included sale or rental of child restraints in many service units and the distribution of smoke detectors, fire extinguishers, and friction strips for bathtubs in a few. Chimney cleaning equipment is available for loan in one or two service units.

While it is early to assess the long range impact of community injury control on the injury rates among the Native American population, after three years of widely varied activities, it is possible to measure the correlation of levels of activity directed at specific injuries and the changes in those specific injury rates among service units. The purpose of this report is to present this preliminary analysis.

Method

Two sets of data were required for the analysis -- injury frequency and severity and injury control activity. Mortality data are not yet available from the National Center for Health Statistics for the years 1983-84. Therefore, it was thought that too little information was available to correlate activity to mortality rates. Data on hospitalizations for injury and clinic visits for injury for the years 1980-1984 were provided on computer tapes by the Indian Health Service.

To assess activities, each environmental health officer at the area level was contacted and sent forms requesting detailed activity reports for each service unit. These forms were patterned after the activity reports required of the local environmental health officers with a few additional details. The forms included number of persons trained in particular aspects of injury prevention or emergency first aid and CPR, as well as the number of loans or distributions of safety equipment.
Estimated population size in each service unit during each year, 1980-1984, was provided by the Indian Health Service, based on the 1980 census, and adjusted in subsequent years by adding births and subtracting deaths. Visit rates for each specific major type of injury were calculated per hundred population and hospitalizations per hundred population were calculated for each service unit with a population greater than 2000 in 1980. Service units serving smaller populations were excluded to avoid excessive variation attributable to small numbers in statistical tests. Injury control activities per hundred population for each type of activity in each service unit were calculated for the years 1982-1984.

Despite the limit on population size of the service units included, examination of the year-to-year injury rates indicated some instability in many service units, as would be expected in relatively small populations. To reduce the instability for statistical analysis, the 1980-81 rates were combined and the 1983-84 rates were combined. The 1980-81 rate was subtracted from the 1983-84 rate in each service unit to obtain the change that occurred from before to after the increase in injury control activities. This change in each specific type of injury was correlated to the cumulation of relevant CIC activity per population directed at that specific type of injury during 1982-84. Data on activities prior to 1982 were incomplete for too many service units and were therefore not included.

For each major injury type, a multiple regression model was used to assess the correlation of each activity, controlling statistically for the others. The regression coefficients provide an estimate of the impact of a given activity on injury rates.

The general form of the model is:

\[ C = a + b A + b A + \ldots + e \]

where \( C \) = change in injury rate \( j \) from 1980-81 to 1983-84
\( A \) = sum of injury activity rate \( i \) from 1982-1984
\( b \) = regression coefficient indicating increase (if positive) or decrease (if negative) in percent injured per change in activity
\( e \) = residual variation

As shall be noted in the discussion, the most frequently reported cause of injury in clinic visits was "other". During visits to several service units, it was noted that some clinic personnel use this category without bothering to obtain information or fill in the boxes indicating more precise causes. Also, the categories for indicating cause available on clinic report (AFC) forms contain several ambiguities. Thus, results regarding clinic visits should be viewed with substantial
scepticism. In the case of hospitalizations, cause is coded by the International Classification of Diseases E codes which are reasonably reflective of specific types of injury. Therefore, far more credence should be given the results regarding hospitalizations.

Results

Usable data were available from 54 service units based on the population size criteria and return of activity reports. Two large areas containing several service units each did not return reports and are excluded both from summary statistics and regression analyses.

Community Injury Control Activities. The average activities per hundred population during 1982-1984 are indicated in Table 2. It is not known to what extent different people were trained in different aspects of safety or the extent to which there is overlap, that is, a few people trained in several courses. Since a small proportion of the total population was trained or had received safety equipment, one would not expect a large effect on injury rates during this startup period. To the extent that the principles learned are transferred informally to others, or those trained in first aid and CPR are available to several people who might need them, the effect could be greater than these numbers suggest.

Table 2. Average Yearly Community Injury Control Activities and Total Per Hundred Population, 1982-1984, in 54 Service Units of the Indian Health Service

<table>
<thead>
<tr>
<th>Activity</th>
<th>1982</th>
<th>1983</th>
<th>1984</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Safety Training</td>
<td>1.1</td>
<td>2.2</td>
<td>2.5</td>
<td>5.8</td>
</tr>
<tr>
<td>Motor Vehicle Safety Training</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(excluding Defensive Driving)</td>
<td>0.6</td>
<td>2.0</td>
<td>1.1</td>
<td>3.7</td>
</tr>
<tr>
<td>Defensive Driving</td>
<td>0.2</td>
<td>1.2</td>
<td>0.6</td>
<td>2.0</td>
</tr>
<tr>
<td>Recreation Safety Training</td>
<td>0.6</td>
<td>2.0</td>
<td>3.9</td>
<td>6.5</td>
</tr>
<tr>
<td>Occupational Safety Training</td>
<td>0.2</td>
<td>1.1</td>
<td>0.5</td>
<td>1.8</td>
</tr>
<tr>
<td>Poison Prevention Training</td>
<td>0.3</td>
<td>0.3</td>
<td>0.2</td>
<td>0.7</td>
</tr>
<tr>
<td>Water Safety Training</td>
<td>1.0</td>
<td>1.8</td>
<td>1.2</td>
<td>4.0</td>
</tr>
<tr>
<td>Fire Safety Training</td>
<td>0.6</td>
<td>0.3</td>
<td>0.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Gun Safety Training</td>
<td>2.2</td>
<td>3.9</td>
<td>4.2</td>
<td>10.3</td>
</tr>
<tr>
<td>Extreme Temperature Training</td>
<td>1.0</td>
<td>0.1</td>
<td>0.3</td>
<td>1.4</td>
</tr>
<tr>
<td>First Aid Training</td>
<td>0.6</td>
<td>0.8</td>
<td>0.3</td>
<td>1.7</td>
</tr>
<tr>
<td>CPR Training</td>
<td>1.1</td>
<td>1.0</td>
<td>0.3</td>
<td>2.4</td>
</tr>
<tr>
<td>Cultural Identity and Stress</td>
<td>0.7</td>
<td>0.5</td>
<td>0.7</td>
<td>1.9</td>
</tr>
<tr>
<td>Child Restraint Distribution</td>
<td>0.2</td>
<td>0.4</td>
<td>0.5</td>
<td>1.1</td>
</tr>
<tr>
<td>Smoke Detector Distribution</td>
<td>0.1</td>
<td>0.1</td>
<td>0.8</td>
<td>1.0</td>
</tr>
<tr>
<td>Fire Extinguisher Distribution</td>
<td>0.1</td>
<td>0.1</td>
<td>0.2</td>
<td>0.4</td>
</tr>
</tbody>
</table>

In addition, a few friction slip kits for bath tubs and chimney cleaning kits were used, but these were less that 0.1 percent of the population.

32
Hospitalizations. The average hospitalization rates per hundred population in 54 service units for each year are presented in Figure 1. Substantial reductions in hospitalizations for falls, motor vehicle and assault injuries occurred from 1980 to 1984. Only slight decreases were found in the other major causes of injury hospitalizations -- suicide attempts, poisoning, cuts or piercing, and fire or smoke.

Table 3 presents the results of the regression analysis of hospitalizations associated with fall injuries. Several activities are associated, but not all in a favorable direction. The activities associated with decreased hospitalizations for falls include percent of the population trained in general safety, recreational safety, and first aid during 1982-84. However, the coefficients for occupational safety training and CPR are positive, indicating that fall hospitalizations increased (or declined less than expected) in service units with greater amounts of such training. The coefficients for the other activities listed, training in cultural identity and stress management and distribution of friction slips, are in the "right" direction, but are well within the range of random fluctuations in samples of this size, that is, they are not large enough to be considered statistically reliable. The R squared of 0.35 indicates that about 35 percent of the variation in changes in fall injury rates can be attributed to factors in the model. Much variation remains unexplained.

Table 3. Regression Analysis of Change in Hospitalizations for Fall Injuries, 1980-81 to 1983-84, in Relation to Injury Control Activities in 54 Service Units of the Indian Health Service.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Regression Coefficient</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Safety Training</td>
<td>-0.02</td>
<td>-2.29</td>
<td>0.03</td>
</tr>
<tr>
<td>Recreation Safety Training</td>
<td>-0.01</td>
<td>-2.18</td>
<td>0.03</td>
</tr>
<tr>
<td>Occupational Safety Training</td>
<td>0.03</td>
<td>2.34</td>
<td>0.02</td>
</tr>
<tr>
<td>First Aid Training</td>
<td>-0.04</td>
<td>-2.55</td>
<td>0.01</td>
</tr>
<tr>
<td>CPR Training</td>
<td>0.04</td>
<td>3.25</td>
<td>0.01</td>
</tr>
<tr>
<td>Cultural Identity and Stress</td>
<td>-0.03</td>
<td>-1.56</td>
<td>0.13</td>
</tr>
<tr>
<td>Friction Slips</td>
<td>-0.21</td>
<td>-1.26</td>
<td>0.21</td>
</tr>
</tbody>
</table>

R Squared = 0.35

The association of hospitalizations for motor vehicle injuries and possibly relevant CIC activities are presented in Table 4. None of the coefficients are statistically significant and the variance explained is a very low, only 7 percent.
FIGURE 1. AVERAGE HOSPITALIZATIONS PER 100 POPULATION BY CAUSE
INDIAN HEALTH SERVICE
Table 4. Regression Analysis of the Association of Injury Control Activity Per Hundred Population and Changes in Hospitalizations Per Hundred Population for Motor Vehicle Injuries, 1980-81 to 1983-84, in 54 Service Units of the Indian Health Service

<table>
<thead>
<tr>
<th>Activity</th>
<th>Coefficient</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor Vehicle Safety Training</td>
<td>-0.02</td>
<td>-1.47</td>
<td>0.15</td>
</tr>
<tr>
<td>Defensive Driving</td>
<td>-0.01</td>
<td>-0.67</td>
<td>0.51</td>
</tr>
<tr>
<td>General Safety Training</td>
<td>0.00</td>
<td>0.22</td>
<td>0.63</td>
</tr>
<tr>
<td>First Aid Training</td>
<td>0.00</td>
<td>0.22</td>
<td>0.63</td>
</tr>
<tr>
<td>CPR Training</td>
<td>0.00</td>
<td>0.08</td>
<td>0.94</td>
</tr>
<tr>
<td>Culture Identity and Stress</td>
<td>0.00</td>
<td>-0.14</td>
<td>0.89</td>
</tr>
<tr>
<td>Child Restraint Distribution</td>
<td>0.01</td>
<td>0.20</td>
<td>0.84</td>
</tr>
</tbody>
</table>

R Squared = 0.07

The regression results for hospitalizations resulting from assaults are presented in Table 5. None of the activities possibly relevant to reduction of the incidence or severity of these injuries is statistically significant by usually accepted standards. The variation explained is quite low, only 3 percent.

Table 5. Regression Analysis of Change in Hospitalizations for Assault in Relation to Injury Control Activities of 54 Service Units of the Indian Health Service, 1980-81 to 1983-84.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Coefficient</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Safety Training</td>
<td>0.00</td>
<td>0.11</td>
<td>0.91</td>
</tr>
<tr>
<td>Gun Safety Training</td>
<td>0.00</td>
<td>0.34</td>
<td>0.74</td>
</tr>
<tr>
<td>First Aid Training</td>
<td>0.00</td>
<td>0.03</td>
<td>0.98</td>
</tr>
<tr>
<td>CPR Training</td>
<td>0.01</td>
<td>0.46</td>
<td>0.65</td>
</tr>
<tr>
<td>Cultural Identity and Stress</td>
<td>-0.02</td>
<td>-0.90</td>
<td>0.37</td>
</tr>
</tbody>
</table>

R Squared= 0.03

Change in diagnosed suicide attempts that resulted in hospitalization is analyzed in relation to injury control activities in Table 6. The only coefficients that are statistically significant are those for training in poison prevention, and fire safety. While a decrease in suicide attempts occurred in areas where fire safety training was more frequent, the direction of the coefficient on poison prevention indicates increased suicide attempts in service units where training in poison prevention occurred. About 23 percent of the variance is explained by the model.
Table 6. Regression Analysis of Injury Control Activities in 54 Service Units of the Indian Health Service Related to Changes in Hospitalizations for Attempted Suicide, 1980-81 to 1983-84.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Regression Coefficient</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Safety Training</td>
<td>0.00</td>
<td>-0.63</td>
<td>0.53</td>
</tr>
<tr>
<td>Poison Prevention Training</td>
<td>0.08</td>
<td>2.66</td>
<td>0.01</td>
</tr>
<tr>
<td>Fire Safety Training</td>
<td>-0.04</td>
<td>-2.41</td>
<td>0.02</td>
</tr>
<tr>
<td>Gun Safety Training</td>
<td>0.00</td>
<td>0.26</td>
<td>0.79</td>
</tr>
<tr>
<td>First Aid Training</td>
<td>0.00</td>
<td>-0.37</td>
<td>0.71</td>
</tr>
<tr>
<td>CPR Training</td>
<td>0.00</td>
<td>0.48</td>
<td>0.63</td>
</tr>
<tr>
<td>Cultural Identity and Stress</td>
<td>0.00</td>
<td>-0.38</td>
<td>0.71</td>
</tr>
</tbody>
</table>

R Squared=0.23

Changes in hospitalizations for poisoning were not significantly related to relevant control activities. The regression analysis is presented in Table 7. About 5 percent of the variation is accounted for by the activities in the model.

Table 7. Regression Analysis of Change in Hospitalizations for Poisoning, 1980-81 to 1984-84, in Relation to Injury Control Activities in 54 Service Units of the Indian Health Service.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Regression Coefficient</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Safety Training</td>
<td>0.00</td>
<td>-0.70</td>
<td>0.48</td>
</tr>
<tr>
<td>Poison Prevention Training</td>
<td>0.02</td>
<td>0.63</td>
<td>0.53</td>
</tr>
<tr>
<td>First Aid Training</td>
<td>0.00</td>
<td>-0.26</td>
<td>0.79</td>
</tr>
<tr>
<td>CPR Training</td>
<td>0.01</td>
<td>0.59</td>
<td>0.56</td>
</tr>
<tr>
<td>Cultural Identity and Stress</td>
<td>-0.01</td>
<td>-1.15</td>
<td>0.26</td>
</tr>
</tbody>
</table>

R Squared= 0.05

As seen in Table 8, none of the relevant CIC activities is correlated significantly with changes in hospitalizations due to wounds from cutting and piercing objects. About 11 percent of the variation is explained in this model.
Table 8. Regression Analysis of Change in Hospitalizations Due to Injury from Cutting or Piercing Objects, 1980-81 to 1983-84, in Relation to Injury Control Activities of 54 Service Units of the Indian Health Service

<table>
<thead>
<tr>
<th>Activity</th>
<th>Regression Coefficient</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Safety Training</td>
<td>0.00</td>
<td>-0.04</td>
<td>0.97</td>
</tr>
<tr>
<td>Recreational Safety Training</td>
<td>0.00</td>
<td>-1.25</td>
<td>0.22</td>
</tr>
<tr>
<td>Occupational Safety Training</td>
<td>0.01</td>
<td>1.40</td>
<td>0.17</td>
</tr>
<tr>
<td>First Aid Training</td>
<td>-0.01</td>
<td>-1.36</td>
<td>0.18</td>
</tr>
<tr>
<td>CPR Training</td>
<td>0.00</td>
<td>0.53</td>
<td>0.60</td>
</tr>
<tr>
<td>Cultural Identity and Stress</td>
<td>0.00</td>
<td>-0.57</td>
<td>0.57</td>
</tr>
</tbody>
</table>

R Squared = 0.11

Table 9 presents the regression analysis of change in hospitalizations related to fire and smoke. The model explains only about 6 percent of the variation, and no one of the single program activities is correlated to a statistically significant degree with the change in hospitalization rates.

Table 9. Regression Analysis of Change in Hospitalizations From Fire and Smoke Injury, 1980-81 to 1983-84, in Relation to Injury Control Activities in 54 Service Areas of the Indian Health Service

<table>
<thead>
<tr>
<th>Activity</th>
<th>Regression Coefficient</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Safety Training</td>
<td>0.00</td>
<td>-1.18</td>
<td>0.24</td>
</tr>
<tr>
<td>Fire Safety Training</td>
<td>0.00</td>
<td>0.67</td>
<td>0.50</td>
</tr>
<tr>
<td>First Aid Training</td>
<td>0.00</td>
<td>-0.72</td>
<td>0.47</td>
</tr>
<tr>
<td>CPR Training</td>
<td>0.00</td>
<td>0.49</td>
<td>0.62</td>
</tr>
<tr>
<td>Cultural Identity and Stress</td>
<td>0.00</td>
<td>-0.39</td>
<td>0.70</td>
</tr>
<tr>
<td>Smoke Detectors</td>
<td>0.00</td>
<td>0.53</td>
<td>0.60</td>
</tr>
<tr>
<td>Fire Extinguishers</td>
<td>0.01</td>
<td>0.76</td>
<td>0.45</td>
</tr>
</tbody>
</table>

R Squared = 0.06

Clinic Visits. The average clinic visits per hundred population in each year for the most frequent categories of cause checked in clinic visits are presented in Figure 2. As noted previously, a large proportion of the causes of injury were indicated as "other", varying from a high of 11 per hundred population in 1980 to 7 per hundred population in 1984 with no apparent increase in the other causal groupings. This could represent increased accuracy of reporting, resulting in some cases that would have been reported as "other" at the turn of the decade now being reported under their specified categories. To the extent that this might have occurred in service units with more active CIC committees, who may have included more accurate reporting as a goal, the correlations of activities and clinic visits for injuries would be spurious.
Figure 2. Average Clinic Visits Per 100 Population by Cause
Indian Health Service
The regression analyses of the change in the specific injury groupings indicated only two statistically significant correlations. Training in motor vehicle safety was associated with increased incidence of clinic visits for motor vehicle related injury. Training in fire safety was associated with a decline in clinic visits for suicide attempts, similar to the finding with respect to hospitalizations. Otherwise, there was no significant correlation between specific activities and clinic visits for specific injuries that those activities could be expected to affect (tables not shown).

Discussion

This analysis suggests that some of the reduction in hospitalization rates for injuries that occurred during the 1982-1984 period in service units of the Indian Health Service can very likely be attributed to specific injury control activities. Reductions in hospitalizations for falls are associated with training in general safety, recreational safety, and first aid. The two other types of injuries with the greatest declines in hospitalizations, motor vehicles and assaults, were not associated with specific activities. Less of a trend was seen in other types of injury and there were few correlations with injury control activity. Hospitalizations for suicide attempts declined more in service units with greater fire safety training.

The fact that other activities are not significantly associated with injury reductions cannot be taken as conclusive evidence that they are totally ineffective. The analysis is not refined to the extent that it is possible to link persons with particular training or safety equipment with exposure to hazard in such a way as to say that specific exposures cause less harm when the person is better trained or equipped. There is evidence from carefully controlled studies that training in motor vehicle safety and defensive driving does not reduce individual risk of injuries, and injuries are increased from training teenagers in high school to drive. The lack of correlation with hospitalizations here is, therefore, not unexpected. The correlation of increased clinic visits for motor vehicle injury with motor vehicle safety training could be a causal effect if that training is resulting in greater use of vehicles by young people.

The increase in hospitalizations associated with training in poison prevention could also be causal. More detailed data on whether poisons were used in the suicide attempts would be necessary to draw a stronger conclusion. The association of increased fall injuries with occupational safety and CPR training is puzzling. It is conceivable that these would make people overly confident, but no good experimental evidence exists to support such a hypothesis.

Some of the lack of finding effects could be due to the rarity of the outcome or the activities. For example, use of child restraints is known to reduce injury to children. The hospitalization rate for vehicle occupant injuries to children
less than five years old was less than one tenth of one percent per year, however. Therefore, the effect of child restraints would not be detectable in this analysis.

The reader should not be misled into thinking that all the reduction in hospitalizations resulted from the significantly correlated injury control activities. From 1980 through 1984, hospitalizations for motor vehicle injuries fell 41 percent while those from assault and falls each fell 35 percent. With only a few percent of the population trained in relevant correlated activities, these activities could account for only a fraction of the observed reductions in hospitalizations.

It is possible that some activities were better conducted or better targeted to the most vulnerable populations in individual service units, but that the effects would not show up in an aggregate analysis. It is likely that other favorable trends have had a substantial effect. For example, motor vehicle safety standards reduce injury and prerelation vehicles were being junked at an accelerating rate during the 1980s. Improved housing, changes in use of alcohol, and the like, could be factors in part of the reductions in falls and assaults. Although these rates declined in the same period, the declines among them are not highly correlated among service units. In other words, a service unit that had a large decline in hospitalizations for falls did not necessarily have a decline in motor vehicle or assault cases. This lack of correlation suggests that some unmeasured activity, such as alcohol programs or improved emergency medical services, does not account for a great deal of the seeming parallel declines in hospitalizations for falls, motor vehicle injuries and assaults, seen in the averages for all service units.

Some injury control activities in specific communities not specifically initiated by the committees may also be a factor. For example, in one service unit visited during the course of this study, a fence along a road to keep animals from wandering onto the road had been constructed by the state after a lawsuit regarding injury in a vehicle that struck a horse in the road. Documentation of all the factors that could have affected the injury rates was beyond the scope of this investigation, if such documentation is indeed possible from existing records.

If the effect on clinic visits of specific injury control measures is to be documented in the future, the specific causes must be accurately recorded on APC forms at the time of the clinic visit. While the reduction in clinic visits classified as "other" by cause could have been at least partially the result of CIC program activities, the large proportion attributed to "other" causes when filling out APC forms renders the data too crude for credible analysis.
RECOMMENDATIONS

While some success of injury control activities can be inferred from the preliminary evaluation, it is evident that more precise targeting of activities toward specific causal factors is needed. At the current rate of training a few percent of the population annually on a wide range of aspects of the injury problem, it would require more than a generation to reach the existing population. By that time a new, untrained generation would have been born and grown up. We do not believe an injury control program that is not targeted to exposure to specific hazards can have more than a marginal effect on the problem. Also, the frequency of activities directed toward certain categories of injuries (p. 32) is not as reflective of the frequency of the injuries (p. 34) in the population as it might be. More importantly, it is necessary to understand in more detail the circumstances of particular types of injuries in local service units for the CIC committees to choose more rationally those activities to pursue.

The most successful injury control efforts historically have been those that identified patterned characteristics of distribution of the types of energy that damages, and the ways in which that energy reaches the individuals injured. When these factors are identified, means to control the energy and/or its delivery to the host can be specified and attempted where feasible.

Some examples of successes using this approach follow, not necessarily because we expect these specific problems to be found among Native Americans, but to illustrate the use of this approach. In the Nineteenth Century, railroad workers had a very high injury rate because of the dependence on time tables to avoid collisions of trains on the same track, lack of uniform braking of all cars, and the flexible chains used in joining cars. The adoption of automatic signaling systems, automatic uniform braking systems, and automatic coupling systems was associated with an 80 percent reduction in rail worker fatalities from 1890 to 1920 (Swaim, 1980). Deaths of children from ingestion of aspirin declined 80 percent from 1965 to 1975 in association with the introduction of aspirin containers that children could not open easily (Done, 1978). Emergency room visits for crib-related injuries declined 44 percent and deaths were reduced 34 percent in association with warnings regarding width of slats that had previously been found associated with most of the crib-related injuries (Office of Strategic Planning, 1979). Motor vehicle occupant fatalities per mile travelled were reduced about 40 percent and some reductions occurred in collisions of motor vehicles with pedestrians and bicyclists in association with standards for motor vehicle crashworthiness, brake performance and visibility (Robertson, 1981). In New York City, detailed investigation of children's deaths from falls discovered that the vast majority occurred when the child crawled out a window of a multistoried building. A program by the health department to warn parents in high risk areas and distribution of
barriers to be placed over the windows resulted in a decline in fatal falls. When the barriers were required on windows of all high rise buildings, fatal falls of children from such buildings declined 90 percent from the preintervention rates. (Bergner, 1982).

The common theme in these success stories is that the ameliorative strategy was directed at some aspect of an injury problem that was known to be a critical point in the causal pattern. Children may crawl out of windows while their parents are away, arguing, depressed, drunk, or simply turning their backs for a few moments to attend to another child. If the health department had focused its efforts toward changing the full range of such a variety of social and behavioral factors, it would have doubtless been less successful. In all of the noted circumstances, as well as others, the crawling child is protected from a fall out the window by the barrier.

One criterion for good applied research is that one knows when the research is undertaken what actions one would take given the possible alternative results. We believe that the specification of factors that can be changed to reduce incidence and severity of injuries of Native Americans should, initially at least, concentrate on identification of types of energy that injures, and the circumstances that resulted in that energy accumulating to greater or less than the human tolerance level in proximity to the person injured. If and when the means of modifying psychosocial factors that result in greater exposure to damaging energy are developed, investigation of the contribution of those factors would be appropriate. With exception of the study of patterns in clinic visits prior to injury noted above, at present, specification of the contribution of such factors would probably not lead to effective amelioration.

As is evident from the literature, the primary forms of energy that increase fatal injuries per capita among Native Americans above the national average are mechanical energy generated by moving motor vehicles, lack of oxidation adequate to provide the organism necessary energy in drownings, and heat and toxic gases in fires, as well as assault toward self and others. The hospitalization data examined in the evaluation section (p. 34) indicates that falls, poisons, and cutting or piercing objects are also important serious, but nonfatal, injuries. We do not know enough detail about those incidents among Native Americans to specify the exact reductions that would occur from interventions at particular points in the injury process. It is also likely that specification of detailed patterns of circumstances of the more common severe injuries would result in discovery of nodes in the injury process where intervention is most feasible.

Without data on the extent of specific hazard involvement in the actual injury experience of Native Americans, we cannot recommend a ranking of the causal factors at this point. For example, we doubt that many vehicle crashes of Native American
drivers occur at intersections with lighted signals, given the low density of vehicles in the remote rural areas where many Native Americans live, but without data on the nature of the sites where severe crashes occur, we cannot be sure that the timing of intersection lights is not a major factor.

In the case of motor vehicle fatalities, detailed data are gathered nationally, but there are no identifiers of race in the data. An attempt was made to match the fatal crash file to the vital statistics file in counties that have substantial concentrations of Native Americans, using age, sex, and date of crash to identify those crashes in which Native Americans were involved. This proved impossible because too many people die on a different day from the day of the crash, and apparently often not in the same county. Thus, there were too many ambiguities in the matching to have confidence in the results.

To provide detail on the circumstances of severe injuries for the purpose of better targeting activities to the vehicles and agents that contribute to severe injuries in specific populations, we recommend a supplement to the current data gathering forms to reflect more specific information that would be useful in choice of countermeasures. We have developed forms for this purpose and pretested them on nine cases during field visits to IHS service units. Each major type of injury requires a form for that type. One of the potential users of the forms suggested that the form for each injury be of a different color to facilitate their use.

The logic behind the information to be gathered should be obvious. It makes no sense to distribute friction strips for bathtubs if the major bulk of fall injuries are occurring on icy porches. In the case of motor vehicles, the countermeasures are very different depending on whether the injury was to a vehicle occupant in a crash with a tree, a vehicle occupant in a head-on crash, a vehicle occupant in an intersection crash, a pedestrian struck on an open road at night, a pedestrian crossing at an intersection, etc. Although the current data gathered by IHS is superior to that available in most communities, it does not provide the detail necessary to choose very specific countermeasures.

We suggest that these forms be used for recording information only on severe injuries -- for example, all deaths, all hospitalizations, and ambulatory cases where there were fractures or loss of consciousness. Using the more detailed information, the injury control committees can make more reasoned choices of countermeasures and specify the populations and locations where they are most needed. For example, a simple pin map of the motor vehicle cases with different colored pins for specific types of crashes would specify sites where ameliorative action is most needed.

These supplementary forms are mainly for the use of the local CIC committees, although IHS may wish to retain copies and code them for documenting in greater detail the nature of the injury.
problem among service areas. If the local CIC committees will cluster these reports by types of injury, detailed location of the person when injured, means whereby the inordinate energy reached the injured person, and consider the ten countermeasure strategies noted in the literature review, a set of priorities for countermeasures that are feasible with the resources available, or new resources justified by the analysis, should be more easily developed.

Specific patterns of injuries may suggest reasonable interventions other than those that have been studied in the past. Indeed, it would be very useful for the developing field of injury control to have a wider range of countermeasures that are studied as to effectiveness. Study of the effects of attempted use of specific countermeasures in a variety of populations is also useful to identify factors that are barriers to adoption of the countermeasures. We know that child restraints, seat belts, smoke detectors, etc. are effective when used, but that does not mean that it is easy to persuade people to use them and keep them maintained, particularly in populations with low incomes where other problems may seem more pressing.

The most important measure of the effectiveness of a given program is a reduction in the injuries that were the focus of the program. Confidence that the program accounted for the reduction is greatly enhanced if the reduction does not occur in a similar population that did not have the program. Preferably, the program would be assigned at random to some groups and not others (the pure experiment), but that may be unrealistic in IHS given the relative interests and enthusiasms of CIC personnel in differing areas.

The obvious study design of choice in this situation is the so called quasi-experimental design, in which specific types of injury rates before and after the adoption of countermeasures against those specific types of injuries are compared among groups that received the countermeasure and those that did not. This approach will be limited in IHS in some cases because the populations in which countermeasures have been adopted are too small or unique to provide stable or adequate comparisons. Nevertheless, as the CIC programs develop, the opportunity to study the effectiveness of a variety of approaches is perhaps unprecedented.

The major task in preparing for these evaluation studies is the documentation of the types of interventions, the level of effort and population targeted, and the dates of the initiation of the efforts as well as major changes in the efforts and the times of cessation. We have included on the proposed supplemental data forms a place for recommended actions and a followup to see if the actions were taken. The primary purpose of this section is to motivate the committees to take action when a pattern of particular types of hazard emerge. That section could also be used to supplement reporting of activity for purpose of evaluation.
MOTOR VEHICLE INJURY -- Supplemental Data

Name ___________________ Age ___ Sex: M _ F _ Chart No. ____________

Severity: ______ fatal ______ hospitalized ______ ambulatory (fracture,
loss consciousness, only -- exclude others)

Service Unit ______ Date injured ______ Date treated ______

Directions to the site of the incident______________________________

________________________________________________________________

________________________________________________________________

Type: Single vehicle occupant __ Rollover __ Fixed object __ Both

Multiple vehicle occupant__ Frontal __ Side __ Rear

Motorcyclist __ Single Vehicle __ Multiple vehicle

Pedestrian __ Crossing intersection __ Crossing elsewhere
 __ Walking along road __ Vehicle came off road
 __ Laying in road __ Other (What? ____________)

Bicyclist __ Crossing intersection __ Crossing elsewhere
 __ On road parallel to traffic __ On road
 __ against traffic __ Motor veh. came off road
 __ Other (What? ____________)

Lighting: __ Daylight __ Dark __ Dark but lighted __ Dawn or Dusk

Signals: __ None ______ Flashing Warnings __ Red-Yellow-Green __ Stop
 __ sign __ Yield sign __ Other (What? ____________)

Crash Protection: __ Seat belt __ Child restraint __ Crash helmet

Roadway Jurisdiction: __ Tribe __ BIA __ County __ State __ Fed.

Site modification that might have prevented the injury or
severity (check all that apply):
 __ No pass stripe __ Roadside hazard removal
 __ Rumble strips __ Signalized intersection
 __ Median barrier __ Reflectors on curve
 __ Snow removal __ Improve road skid resistance
 __ Separate pedestrian walkway from road
 __ Other (What? ____________

Recommendation to appropriate authorities:

Action ____________________________________________
Authority _________________________ Date __________
Followup date to see response to recommendation __________

Action taken? ____________________________
Date of repeated recommendation (if necessary) __________
Followup date on response to repeated recommendation __________

Final disposition __ no action recommended
 __ recommended action taken
 __ alternative action taken
 __ recommendation ignored

See reverse side for narrative
FIRE RELATED INJURY -- Supplemental Data

Name _______________________ Age ___ Sex __M__F Chart No. _____
Severity: _____ fatal _____ hospitalized ____ ambulatory (loss of consciousness and/or immobilization only, exclude others)

Service Unit ____ Date of injury ______ Date treated ______
Directions to the site of the incident __________________________

Victim sleeping when fire began? ____ yes ____ no

Place of fire: ____ home ____ car ____ other (What? _______________)

If home, number of door exits to the home? ____

Location of the victim ____ bedroom ____ living room
____ bathroom ____ kitchen
____ Other (Where? _______________)

Ignition or heat origin: ____ cigarette ____ cooking unit ____ woodburning space heater ____ kerosene space heater ____ other space heater ____ chimney ____ electrical wiring ____ arson
____ household water ____ food or drink
____ other (What? _______________)

Material first ignited: ____ chair or sofa ____ bed ____ loose papers
____ clothing on person ____ other clothing
____ house framing ____ cooking grease
____ other (What? _______________)

If in a building, smoke detector installed? ____ yes ____ no
If yes, did detector give alarm? ____ yes ____ no ____NA
Was a fire extinguisher available? ____ yes ____ no
If yes, was it used? ____ yes ____ no ____NA

Modification that might have reduced injury or severity:
____ additional exit ____ smoke detector ____ batteries in detector
____ fire extinguisher ____ sleeping nearer exits
____ properly installed cooking unit ____ properly installed wood stove ____ properly installed kerosene heater
____ cleaned chimney ____ reduced hot water temperature ____
____ less tip-prone food or drink container
____ other (What? _______________)

Recommended to appropriate authorities:
Authority _______________ Date __________
Action recommended __________________________

Followup date to see if action taken ________
Date of repeated recommendation if necessary ________
Disposition ____ no action ____ recommended action ____ Other
____ See reverse side for narrative
DROWNING OR NEAR DROWNING -- Supplemental Data

Name __________________________ Age __ Sex _M _F Chart No.________

Severity: __ fatal __ hospitalized __ ambulatory (loss of
consciousness only -- exclude others)
Service Unit __________ Date injured ______ Date treated ______
Directions to site of the incident ________________________________

Victim know how to swim? __ yes __ no

Water temperature at time of the incident? __

Body of water involved: __ bathtub __ supervised beach
__ unsupervised beach __ river __ nonbeach __ lake __ nonbeach
__ ocean __ nonbeach __ irrigation ditch __ drainage ditch
__ swimming pool __ flood __ other (What? ________________)

Watercraft involved: __ none __ motorboat __ sailboat __ surfsail
__ rowboat __ canoe __ motorized raft __ nonmotorized
__ raft __ other (What? ________________)

Preventive gear available: __ lifeline __ life jacket
__ floating cushion __ nonsinkable boat __ fenced area
__ other (What? ________________)

Modifications that might have prevented the incident or reduced
severity:
__ lifeline __ life jacket __ floating cushion
__ nonsinkable boat __ fenced off area
__ supervised swimming area __ flood warning and
__ evacuation __ Other (What? ________________)

Recommendation to appropriate authorities:

Action ____________________________________________
Authority __________________________ Date ____________
Followup date to see response to recommendation ________
Date of repeated recommendation (if necessary) _________
Followup date on response to repeat recommendation ______
Final disposition __ no action recommended
__ recommended action taken
__ alternative action taken
__ recommendation ignored

See reverse side for narrative

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## INJURY FROM A FALL -- Supplemental Data

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Sex</th>
<th>M</th>
<th>F</th>
<th>Chart No.</th>
</tr>
</thead>
</table>

**Severity:**  
- **Fatal**  
- **Hospitalized**  
- **Ambulatory** (include only if loss of consciousness or fracture)

**Service Unit**  
**Date Injured**  
**Date Treated**

**Directions to the site of the incident**

**Type of fall:**  
- **Same level**  
- **Different level** (approximate number of feet)

**Same level location:**  
- **Bathtub**  
- **Other bathroom**  
- **Bedroom**  
- **Kitchen**  
- **Living room**  
- **Basement**  
- **Attic**  
- **Home yard**  
- **Sidewalk**  
- **Street**  
- **Public building**  
- **Private building**  
- **Sports field**  
- **Other**

(Where? not applicable)

**Different level location:**  
- **Exterior stairs to house entrance**  
- **Stairs to upper floors**  
- **Stairs to attic**  
- **Stairs to basement**  
- **Stairs in public building**  
- **Stairs in private building**  
- **Home porch or landing**  
- **Window**  
- **Roof**  
- **Tree**  
- **Cliff or other dropoff**  
- **Ladder**  
- **Other** (Where?)

**Modification that might have prevented injury or severity:**  
- **Skid strips in tub**  
- **Skid strips on stairs**  
- **Nonskid rug**  
- **Nonskid shoes**  
- **Handrail**  
- **Snow or ice clearance**  
- **Soft carpet**  
- **Stair repairs**  
- **Fence or other barrier**  
- **Sports equipment** (What?)
- **Other** (What?)

**Recommendation to appropriate authorities:**

<table>
<thead>
<tr>
<th>Action</th>
<th>Authority</th>
<th>Date</th>
</tr>
</thead>
</table>

| Followup date to see response to recommendation | Date |

**Action taken?**

**Date of repeated recommendation (if necessary)**

**Followup date on response to repeated recommendation**

**Final disposition:**  
- **No action recommended**
- **Recommended action taken**
- **Alternative action taken**
- **Recommendation ignored**

**Narrative on reverse side**
ASSAULT -- Supplemental Data

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Sex</th>
<th>Chart No.</th>
</tr>
</thead>
</table>

Severity: ___ fatal ___ hospitalized ___ ambulatory (include only if loss of consciousness or fracture)

Service Unit __ Date injured __ Date treated __ Directions to the site of the incident ______________________

Where did the assault occur? ___ home ___ other house ___ bar ___ other business ___ elsewhere

Assailant relation to the injured? ___ spouse ___ father ___ mother ___ child ___ sibling ___ other relative ___ other family ___ acquaintance ___ stranger ___ unknown

Weapon used in the assault? ___ body (fists, feet, etc.) ___ gun ___ knife ___ other sharp object ___ blunt object ___ fire or heat ___ poison ___ other (What? ____________)

Apparent reason for the assault? ___ rage ___ robbery ___ mental illness ___ other (What? ______________________)

Modification that might prevented repeated injury or severity:
___ limit number of drinks purchasable in bars
___ metal detector at door of bar and refuse service to those armed with gun or knife
___ do not allow bottles that shatter as containers for alcoholic beverages
___ provide lighting in high risk area
___ arrest of the assailant
___ remove assailant from the home
___ remove person assaulted from the home
___ Other (What?) ______________________

Recommendation to appropriate authorities:

<table>
<thead>
<tr>
<th>Action</th>
<th>Authority</th>
<th>Date</th>
</tr>
</thead>
</table>

Followup date to see response to recommendation __________

Action taken?
___ Date of repeated recommendation (if necessary) __________

Followup date on response to repeated recommendation __________

Final disposition ______ no action recommended
___ recommended action taken
___ alternative action taken
___ recommendation ignored

__ Narrative on reverse side