Health Departments and Prevention of Motor Vehicle Accidents

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THE MOTOR VEHICLE is the chief cause of accidental death in every age group from 1 to 65 years and outranks any other cause of death in the age group 5 to 30.

Motor vehicle accidents annually kill approximately 40,000 persons, injure approximately 5 million, and cause the loss of 100 million man-days. These accidents injure 1 out of every 10 males between the ages of 15 and 24 and cause 40 percent of all deaths of males in that age group. In the group aged 15–24 years, the proportion of motor vehicle deaths in relation to all deaths has risen phenomenally. Pronounced but less drastic increases are seen in the groups 5–14 and 25–34 years old (fig. 1).

The pattern of nonfatal injuries caused by motor vehicles is similar to the pattern of deaths, being highest in the age group 15–24 years. The estimated number of nonfatal injuries in the United States for the period July–December 1957 is shown in table 1, and the estimated annual injury rate for motor vehicle accidents, in table 2.

On the basis of the mortality and injury data available, motor vehicle accidents would certainly appear to qualify as a public health problem, which it is believed is amenable to the epidemiological approach used in other public health problems. Because of their knowledge of epidemiological procedures and other programs health departments can contribute to the solution of this health problem in a number of ways.

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Epidemiological Approach

The epidemiological approach consists of finding out the who, how, where, and when of accidental injuries and deaths, and, if possible, the why. It includes five steps: collection and analysis of data, examination of apparent relationships, establishment and testing of hypotheses, development and testing of control measures, and incorporation of tested measures into prevention programs.

At present there is not to my knowledge any full-scale epidemiological study of motor vehicle accidents being carried out in the United States. One is planned by the traffic institute of Northwestern University, using an interdisciplinary team consisting of a physician, an engineer, and a social scientist, and an epidemiological study of the automobile accidents of adolescent drivers is planned for joint execution by the Harvard Medical School and the Harvard School of Public Health. Several completed studies have been referred to as epidemiological, but these are concerned solely with the host or with human factors.

Host and Human Factors

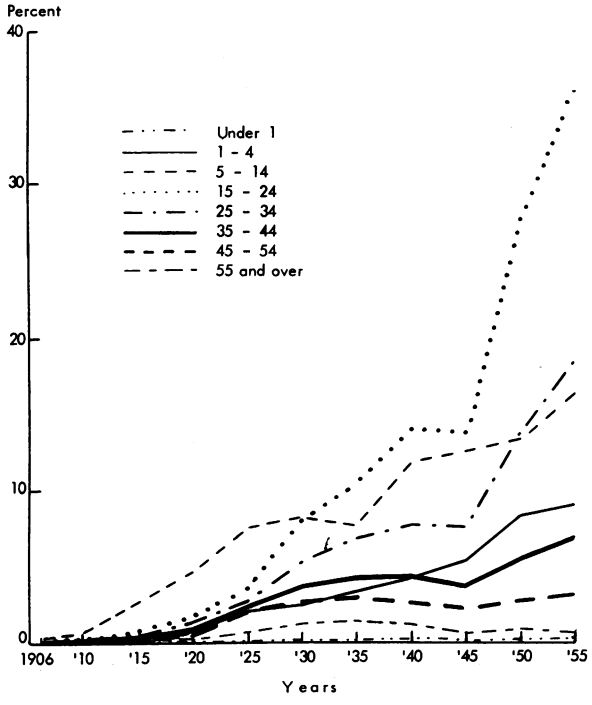
As with most of the diseases, the mortality rate for motor vehicle accidents is higher for males than for females. The chief toll is among young males in the prime of life, although one-fifth of the deaths from motor vehicle accidents

are among pedestrians, and deaths of elderly men and children under 10 years of age contribute greatly to this number. In general, death rates are higher for nonwhite than for white persons. Exceptions are the rates for the age group 15–24, and the group over 75 years old. Married persons, especially men, have lower death rates from motor vehicle accidents than any other marital status group. Rates for divorced men are considerably higher than for other groups (fig. 2).

Health workers generally agree that further knowledge of the human factors in accident causation is needed before significant advances in highway accident reduction can be achieved. Existing knowledge on this subject has been summarized by McFarland and his co-workers (*1*).

The question of "accident proneness" has been explored at length, but sporadically. More than 20 years ago a review of the accident experience of approximately 30,000 drivers in Connecticut showed that a group of less than

Figure 1. Deaths from motor vehicle accidents as percentage of deaths from all causes, by age groups, United States, 1906–55.



SOURCE: Basic data from National Office of Vital Statistics.

Table 1. Estimated incidence of motor vehicle injuries, July–December 1957, continental United States

Age, in years	Both sexes	Male	Female
All ages	2, 444, 000	1, 346, 000	1, 097, 000
Under 15	281, 000	104, 000	175, 000
15–24	748, 000	482, 000	265, 000
25–44	710, 000	387, 000	323, 000
45–64	491, 000	284, 000	207, 000
65 and over	209, 000	85, 000	124, 000

NOTE: Detailed figures may not add to totals because of rounding.
SOURCE: National Health Survey data, July–December 1957.

4 percent of the operators had 40 percent of the fatal accidents, 36 percent of the injury accidents, and 38 percent of the noninjury accidents (*2*). In 1938 the Wichita, Kans., police department did a study of accident repeaters. Their findings have been reported in an unpublished monograph. In the intervening 20 years the number of studies to determine the characteristics of accident-prone individuals, or accident repeaters, has been legion.

The concept of accident proneness as an innate, immutable characteristic is giving way to the opinion that, because of mutable characteristics, some people in a group sharing the same environmental risks are more "susceptible" to accidents than are others in the same group. Personal factors being investigated may be conveniently divided into behavioral and attitudinal characteristics, health and physical characteristics, and effects of temporary conditions caused by such factors as alcohol, smoking, drugs, medication, and fatigue.

Behavior and Attitudes

Studies to determine the characteristics of chronic traffic law violators and accident repeaters have been many and varied, both in the armed services and in civilian groups. While gross relationships appear, many of the findings are conflicting. Moreover, application of the findings to control programs is difficult.

A study based on findings in the armed services is underway in Denver, where tests are being administered to high school children in an effort to find the factors which "discriminate" between safe and unsafe drivers. Researchers

have found that immaturity, lack of hostility restraint, lack of stability, absence of tension tolerance control, and aggressiveness are some of the personality characteristics associated with an excessive number of accidents.

Several studies are currently in progress to develop "scales" for measuring these personality traits. It is hoped that the knowledge gained can be incorporated into driver education and other safety programs. The health department can make a definite contribution to the prevention of motor vehicle accidents by promoting and assisting with driver education courses and driver improvement clinics and by helping to translate the results of research into practical education programs.

Studies are being planned and carried out on methods of changing or modifying behavior through the group approach, and otherwise. Corollary studies are needed on the relationship between attitudes and knowledge of safety laws and measures and between attitudes and behavior. Of particular importance in this regard are the studies on the attitudes and behavior of elderly people and on methods of modifying them, since elderly pedestrians have a very high death rate.

Physical and Sensory Defects

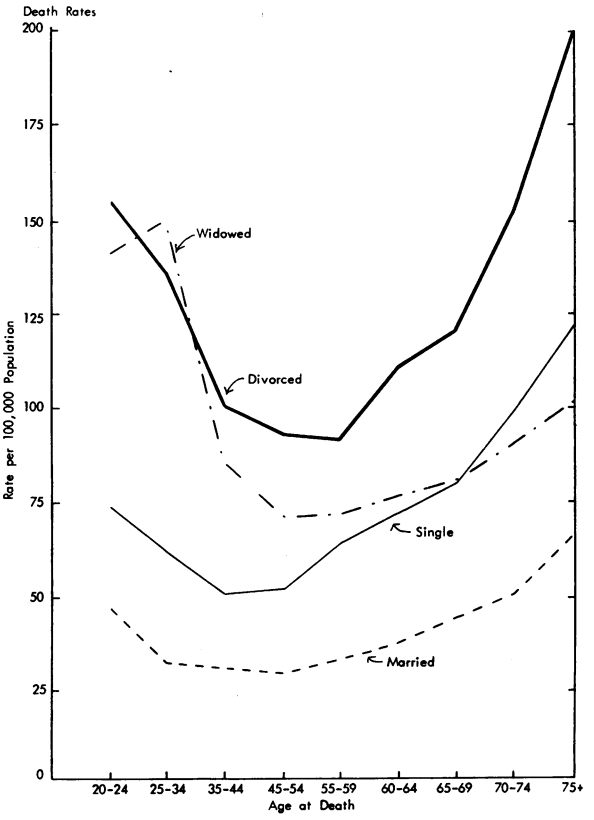
It apparently is generally agreed that organic disease, impaired functions, and aging processes increase the accident potential of persons, but the effect of these conditions on actual accident occurrence is, at present, speculative. The extent to which these persons "compensate" for their deficiencies is not known, and differences in "exposure" make comparisons difficult. One

Table 2. Estimated injury rate for motor vehicle accidents per 1,000 persons per annum, by sex and age, continental United States

Age, in years	Both sexes	Male	Female
All ages	29	33	25
Under 15	11	8	14
15–24	72	100	47
25–44	31	35	27
45–64	29	34	23
65 and over	29	26	32

SOURCE: National Health Survey data, July–December 1957.

Figure 2. Death rates from motor vehicle accidents for males, by age and marital status, 3-year average, continental United States, 1949–51.



SOURCE: National Office of Vital Statistics.

of the problems in the study of accident causation is to select groups which are exposed to constant risk and to observe them long enough to obtain meaningful data.

Employers of persons who will be exposed to high risk of accident can accept presumptive evidence of physical impairments in making their decisions concerning the hiring of applicants. Therefore, employers may accept a list of conditions which would be bars to employment as drivers of commercial vehicles, and licensing agencies may refuse to issue licenses to persons having these conditions. Refusal of permits to private drivers is, however, another question, and the evidence of the effect of a condition or defect must be more unequivocal than now exists for many of them before they can be refused licenses to drive. Studies of the effect of all types of conditions

and impairments on accident frequency and severity are badly needed.

The accident experience of a group of persons with an impairment might be compared with the experience of a control group free from that impairment, matched by age, exposure, and whatever other variables are recognizable. A corollary study should be made on the methods of keeping records of physical condition and the details of accident causation. Because of the difficulty of selecting appropriate groups with particular defects and following their accident experience, it may be more appropriate to give complete physical examinations to a sample of drivers applying for new licenses and of older persons applying for renewals of existing licenses at a particular center. Additional tests for attitudes may also be included. By making a complete followup of drivers who are examined and selecting an appropriate control group without the defect or impairment of these drivers, the same series of observations could be used for testing various hypotheses.

Effect of Temporary Conditions

Temporary states and conditions which cause a reduction in mental awareness or diminished reflexes obviously result in an increased liability to accidents. Unquestionably, persons who are under the influence of alcoholic beverages are more likely to have accidents than those who are not, but what is the effect of low levels of alcohol present in the blood some time after drinking?

The effect of smoking on drivers of automobiles is not clear, especially when smoking is combined with carbon monoxide and with high altitudes. The effects of various drugs on human efficiency are also not entirely known, either as to undesirable side effects or induced mood changes.

When automobile drivers fall asleep, it is obvious that fatigue is accident inducing, but other aspects of fatigue are not as clear. More work needs to be done on so-called operational fatigue, which has been stated to be partly the result of frustration and conflict within the individual.

Needed studies of the effects of these various factors include: the effect of certain drugs on social behavior and emotions, and consequently on accidents; the relationship of sleep and dozing to accident occurrence and the value of certain remedial measures; the relationship of temporary attitudes to the occurrence of accidents; the phenomenon of "road hypnosis" and factors instrumental in causing it and in reducing it; and the relationship of operator performance to levels of alcohol in the body. Many planned studies aim at determining some of these relationships. The New York State Health Department, for example, proposes a broad study of the relation of personal factors to accidents and plans to use the knowledge gained for educational and licensing purposes.

For all studies relating variables to accidents, the construction and use of an automobile simulator of high sensory and motor fidelity, which could be used to produce a variety of experimental situations under controlled conditions, would be a distinct advancement. Such a simulator would allow observation of the behavior and reaction of the driver, with a view to discovering what he does under various conditions which may lead to accidents; under what conditions he is more likely to respond poorly; the deficiencies, either in him or in his environment, that may produce such hazardous behavior, or failure to behave; and in what ways such dangerous behavior may be corrected or avoided.

Environment

When we discuss environment, we ordinarily think of geographic distribution, and because the "rate per 100,000 resident population" best expresses the extent of any health problem, this rate is customarily used in calculating geographic distribution of diseases or injuries.

Rates of motor vehicle deaths or injuries by place of occurrence of accidents, however, are usually calculated per estimated number of miles driven in an area. This rate may be appropriate for estimating the risk of accidental death while driving, but for estimating a person's chance of being killed in a motor vehicle accident, the rate per population is the appropriate one. Parenthetically, the accidental death rate is the only rate for a major cause of death which is calculated with the "agent" of exposure as the base rather than the number of people at risk. We never calculate the ma-

laria death rate per 100 million mosquitoes or per square miles of swamp or the syphilis death rate per millions of spirochetes or other numerical measure of exposure.

An analysis of accidental deaths from motor vehicles, based on residence, reveals somewhat of a pattern. The 5 highest rates in 1956 were recorded for Wyoming, New Mexico, Montana, Arizona, and Idaho; the 5 lowest, for Massachusetts, Rhode Island, Connecticut, New Jersey, and New York. The "rate per miles driven" gives a somewhat different pattern and places Alabama, Louisiana, and South Carolina among the five States with the highest death rates from motor vehicle accidents. Apparently, driving is more hazardous in the south than in some other areas, although a person's chance of being killed in a motor vehicle accident are highest if he lives in the Rocky Mountain States. Based on fuel usage per capita in the United States, people in the western States drive more than those in the eastern States.

Weather is an environmental factor which obviously affects motor vehicle accidents. Because of lack of comparability of exposure data, statistics on the effect of weather, lighting, and road conditions are hard to evaluate, and the extent to which drivers compensate for obviously unsafe conditions is unknown. Statements in the newspapers, taken from gross statistics and indicating that most accidents occur on dry pavement on clear days and that the "safest time to drive" is between 2 and 4 a.m., are generalizations which have no practical value. Exposure data for rate calculations are needed in comparing the "risk" of driving under various circumstances. Fall and winter are, however, known to be the seasons of highest occurrence of accidental deaths from motor vehicles in the United States.

Surveys and Records

Data on injuries are obtained chiefly from surveys and reports from various sources. The National Health Survey is providing data from which national and regional estimates can be made. The California Health Survey provides data about accidental injuries in California. The Connecticut State Department of Health is about to undertake a family injury survey, which should provide a wealth of information on both highway and other accidental injuries in Connecticut.

Injury reports by hospitals and physicians can provide information useful to health departments. Worcester, Mass., has an injury reporting system in operation, and in New Bedford, Mass., childhood accidents are being reported. Some such measure of the incidence of injuries is necessary for the evaluation of preventive programs, educational or otherwise.

Accident records of traffic or motor vehicle bureaus are another important and sometimes overlooked source of information to health departments. The Georgia Department of Public Health is making a study of traffic accident records to determine their usefulness in developing programs of highway safety.

The National Office of Vital Statistics has designed supplements to the death certificate which are used from time to time by some State health departments to obtain more information on motor vehicle accidents than is now available from the death certificate.

Program Evaluation

Program evaluation is a well-established procedure in all health departments. A requisite of program evaluation is a baseline of data from which to measure change. For example, if certain measures are instituted, do highway injuries and deaths decrease? Inherent in such evaluation is stability of statistics. Death statistics, of course, are comparable but may not be large enough to show meaningful trends in nonpopulous areas. Some type of injury measurement is necessary for determination of the results of programs of prevention of motor vehicle accidents.

Secondary Prevention

For every death on the highway more than 100 persons receive nonfatal injuries. The emergency care given an injured person is an important factor in determining whether the injury results in death, permanent disability, or recovery. The care of injured persons usually consists of first aid, transportation, and medical management of injuries. Health depart-

ments could well concern themselves with local methods of administering first aid.

At Cornell University, significant research is being done into the aspects of the automobile which cause or accentuate injuries. As a result of their findings, the newer cars have incorporated into their designs features such as safety locks on doors, padded dashboards, recessed steering wheels, factory installed safety belts, and the like (*3*).

The design of the automobile is outside the control of health departments, but other methods of preventing or minimizing injuries following accidents merit their interest. Promoting the use of safety devices, including properly installed safety belts, would seem to be a legitimate concern of health departments.

Need for Cooperation and Research

Since highway accident prevention is a concern of various community agencies, official and voluntary, cooperation between the health department and these agencies is important. A committee of representatives from these agencies might increase the contribution of epidemiological techniques, program evaluation, and other public health and medical skills to the field of highway accident prevention.

Through epidemiological research health departments can offer a challenge to physicians and others to enter and remain in the field of public health. Research "is an important key to the grand strategy of effecting change from the traditional in public health to the newer challenges . . ." (*4*).

Summary

Motor vehicle accidents are amenable to the same epidemiological approach as other public health problems.

No full-scale epidemiological studies of motor vehicle accidents are now in progress, but several are planned and more are needed.

Health departments can contribute to accident prevention and traffic safety in a number of ways. Among these are promoting and assisting with driver education courses and driver improvement clinics; helping to translate the results of research into practical education; promoting systems of first aid; promoting use of safety devices, including safety belts; and cooperating with official and voluntary community agencies.

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Appointments in International Health

H. van Zile Hyde, M.D., has been appointed Assistant to the Surgeon General for International Health. Horace DeLien, M.D., succeeds him as chief of the Division of International Health, Public Health Service.

Dr. Hyde's duties include liaison with the Department of State and other governmental agencies concerned with international health. He will continue as United States representative on the Executive Board of the World Health Organization. Dr. Hyde has been chief of health activities in the Institute of Inter-American Affairs and in the Technical Cooperation Administration, chief of the Middle East Office of the United Nations Relief and Rehabilitation Administration, and, for the last 5 years, chief of the Division of International Health.

Dr. DeLien has directed the health program of the International Cooperation Administration in the Philippines for the past 7 years. In the extensive reorganization of the Philippine health services, he helped establish rural health units throughout the islands, rehabilitate 61 government hospitals, and provide training for public health personnel. Before going to the Far East, Dr. DeLien was associate chief of health activities, Bureau of Indian Affairs, for 8 years.