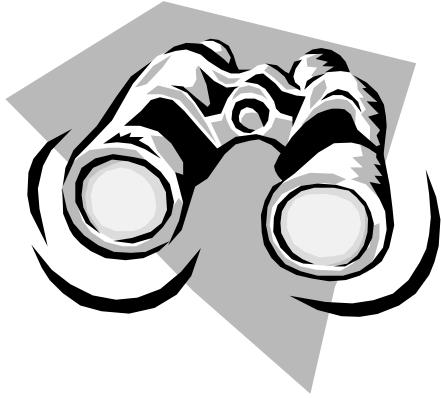


Injury Surveillance



Thomas Songer, PhD
University of Pittsburgh



Why should we be concerned with monitoring injuries?

The importance of monitoring is in knowing how many injuries occur, when they occur, and to whom they occur!

Definitions

Prevention

- Reducing the incidence of disease
- Reducing the prevalence of disease

Control

- Ongoing programs aimed at reducing the incidence or prevalence of disease

Last, Dictionary of Epidemiology

Injury monitoring or injury surveillance is very important, because it lays the foundation for injury control initiatives.

In its simplest form, injury prevention and control represents a reduction in the incidence and/or prevalence of an injury.

All of the injury control measures that quickly come to mind, e.g. seat belts, airbags, helmets, only were implemented after it became apparent that injuries were occurring in relatively high numbers and we needed to do something about it.



Public Health Approach to Injury Control and Prevention

- Define the Magnitude of the Problem
- Identify associated causes and risk factors
- Design and Implement the Intervention
- Evaluate the Intervention

From the public health perspective, monitoring for the frequency of injuries is the first step in the process of developing an injury control intervention. Information on the frequency of injuries begin to define the magnitude of the problem at hand. In other words, monitoring helps to identify the incidence or prevalence of injuries.

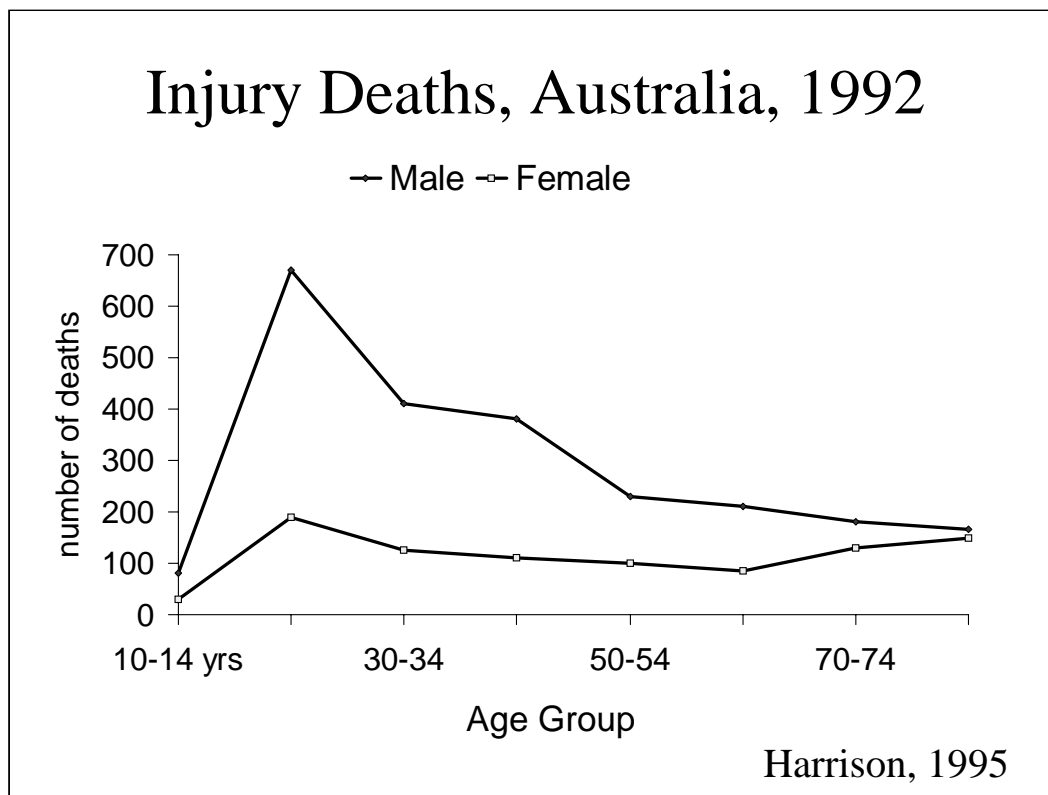
Epidemiology is a Science of Rates

- death rates
 - disability rates
 - hospitalization rates
 - incidence rates
 - prevalence rates
- numerator**
denominator

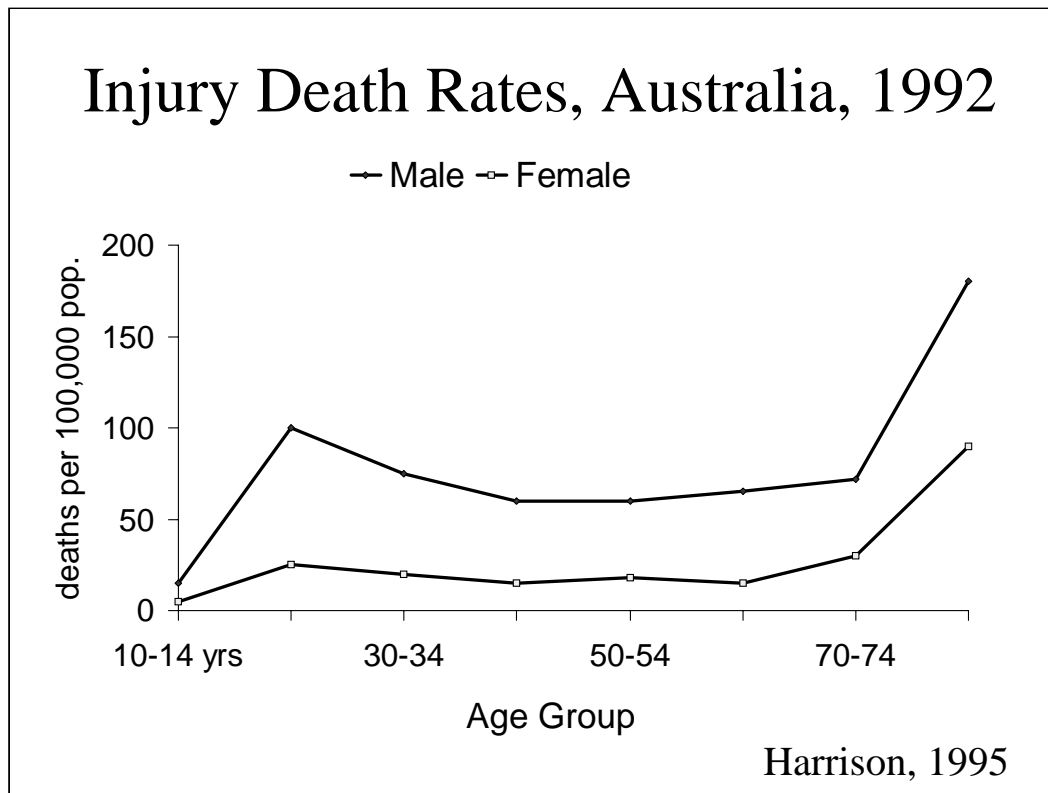
Epidemiology is a science based upon rates. Incidence and prevalence rates provide information on the importance of a disease or injury in a defined population.

Understanding how many injuries occur (the absolute number) provides only one part of the puzzle; the numerator. The second piece is the population in which they occur; the denominator. As we will see, the denominator is a very important factor in defining the significance of a problem.

Effective injury control is based upon an understanding of injury rates; i.e. how many injuries occur within a given population.



In this slide, we see the number of injury deaths in Australia by age and gender. The graph suggests that injury deaths are particularly significant in young adults and men.



In this slide, we see the injury death rates in Australia by age and gender. The message of the graph has changed from that previously. Here we see that injuries are significant in both the young and the very old (75+ years).

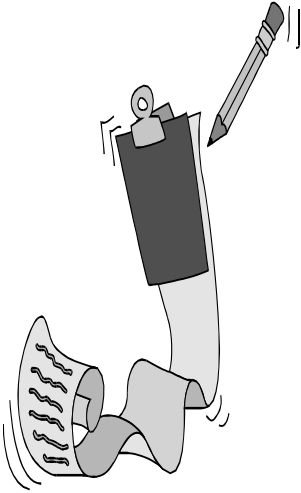
The previous slide considered only the “numerator”; the number of injury deaths. It’s message is different from this slide, which included a denominator (the population in the respective age and gender categories). Thus, numerator and denominator data are both important to defining the magnitude of the problem.

How do we identify injuries?



What methods and approaches have been used to identify the incidence and prevalence of injuries?

Approaches Towards Monitoring Injury in the Population



Death Certificates

Population Surveys

Surveillance

Registries

Capture-Recapture

Typically, the methods available to monitor injuries are quite diverse. They range from the study of injury deaths on death certificates, to specific injury surveillance systems (e.g. traumatic brain injury systems), to registries recording all injury events.

Government Surveys

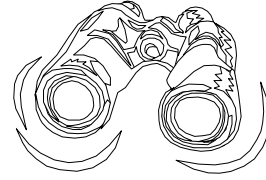
- National Health Interview Survey
- National Hospital Ambulatory Care Survey
- National Hospital Discharge Survey
- Behavioural Risk Factor Survey and Surveillance

Provide a better picture of the health status of the population

There are a variety of government-based surveys that provide information on injury-related events, such as hospital admissions, emergency department visits, and self-reported injuries. These surveys have been developed, more generally, to provide a picture of the health status of the population. As injuries affect the health of the population, we are able to identify them from these instruments.

Which source to use to monitor injuries is often the first question that an injury researcher must answer. The answer is largely defined by the type of injury that one wants to identify, by its usual level of severity, by the resources available for monitoring, and by the feasibility of monitoring the injuries in the community.

Surveillance:



Systematic, regular ascertainment of incidence using methods distinguished by their practicality, uniformity, and frequently their rapidity, rather than by complete accuracy.

Last, 1990

Let's spend some more time talking about each of the major systems for identifying injuries. One means to identify injuries is to establish a surveillance system.

What is a surveillance system? John Last has defined surveillance as the regular assessment of disease or injuries, with a common method, and often an approach that is simplistic rather than complex. One of the key words here is regular assessment. Injury monitoring, such as that with death certificates, is set up to evaluate injuries over time. With common methods, this allows a researcher to examine changes over time in these events.

Types of Surveillance

- Active
- Passive

Commonly, surveillance systems are either active in their pursuit of injury cases or passive.

Active Surveillance

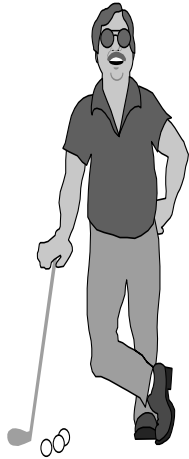


- the collection of data on a disease by regular outreach. Designated medical personnel are called at regular intervals to collect information on the new cases of disease.

monitoring domestic violence in emergency departments

Active surveillance involves the regular monitoring of surveillance sites by designated persons. These persons often call up a site to gather information on injury events that happened in the previous month or week. One example of this process would be the surveillance of injuries from domestic violence in emergency departments. Research personnel would contact emergency departments on a regular interval to identify injury events from domestic violence. As no data sources routinely identify domestic violence injuries, this type of active surveillance is necessary to identify the incidence of domestic violence events.

Passive Surveillance



- data generated without contact by the agency carrying out the surveillance. Reportable diseases fall under this type of surveillance.

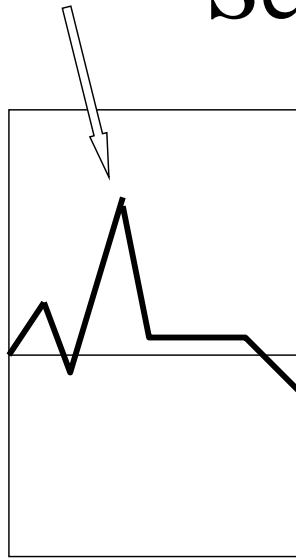
spinal cord injuries

More commonly surveillance systems are passive. By definition, researchers or health department personnel do not go out into the community to find cases. Rather, they develop instruments that persons in the community have to send into them (e.g. death certificates) as a means of identifying events. Reportable diseases such as AIDS and malaria, etc. are monitored in this fashion.

Laboratories, physicians, and hospitals have to report these events to the health department when they identify a case at their institution.

In some states, spinal cord injuries are a reportable condition and are followed with passive surveillance.

Sentinel Events



- An event(s) that can be used to assess the stability or change in the health of a population.

John Last
Dictionary of Epidemiology

Surveillance systems are often used by public health officials to identify sentinel events. This means that officials use a surveillance system to look for dramatic increases in health events. In this sense, the systems form the basis for recognizing problems that are developing in the community that may require intervention. Many injury systems are set up for this purpose.

Deaths from automobile accidents are one example of a sentinel event that is followed closely by the injury community.

Registry:



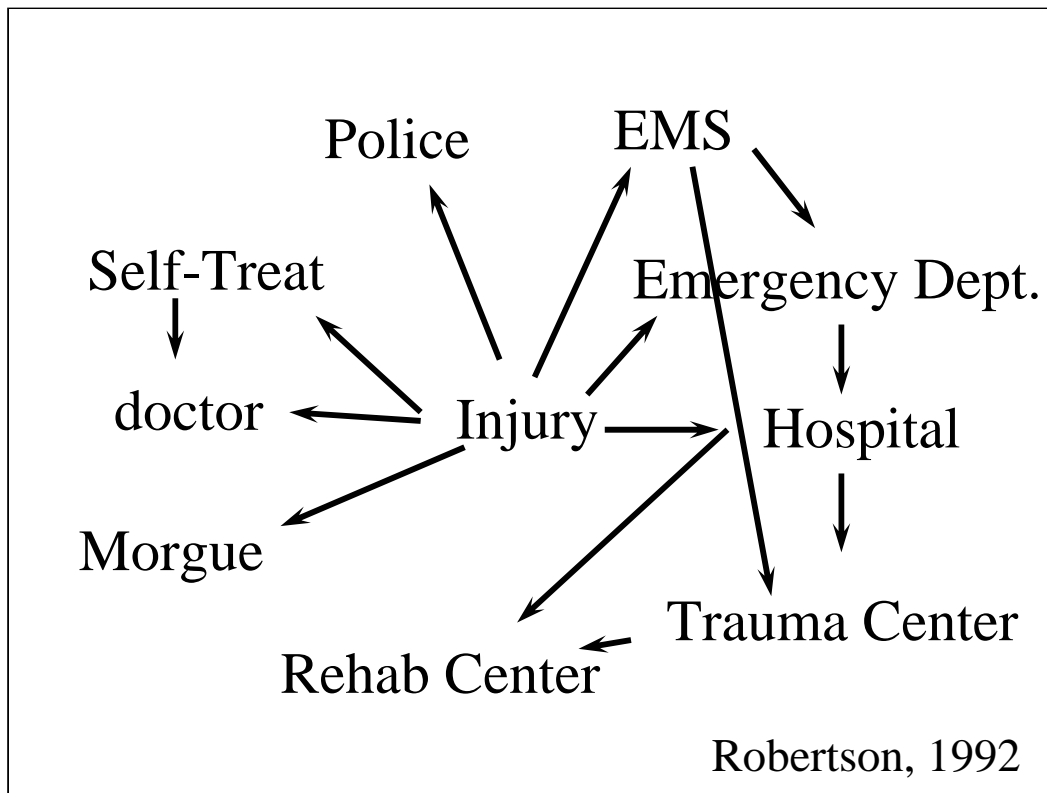
A file of data concerning all cases of a particular disease or other health-relevant condition in a defined population such that the cases can be related to a population base.

Last, Dictionary of Epidemiology

Another means of identifying injuries is through registries. Registries try to identify all cases of injury, whilst surveillance systems try to identify changes in the frequency of events on a rapid basis. Surveillance systems often sacrifice ascertainment for the sake of having a system that can identify potential epidemics more quickly. Because they seek 100% ascertainment, registries are usually expensive to maintain. In the area of injuries, trauma registries have been established to monitor injury events requiring treatment in trauma centres.

Where do the data for the numerator and denominator come from in injury surveillance?

Let's move from our general discussion of monitoring into a more specific discussion of current issues in injury monitoring. Which source to use to monitor injuries is often the first question that an injury researcher must address. The answer is largely defined by the type of injury that one wants to identify, by its usual level of severity, by the resources available for monitoring, and by the feasibility of monitoring the injuries in the population.



Injuries can be identified from a number of data sources. Several of these sites are outlined above. In general, injuries can be identified at any stage of their occurrence on the injury pyramid; from the less severe events to those that result in death. The source of where you will want to go to identify a specific injury will depend upon its severity (does it require medical attention? If so, what type of medical resources are required?), and often its legal implications (is it an injury from violence? In this situation police records may also identify injuries). Most monitoring of injuries, though, are currently based upon health system records.

The monitoring of incidence unfortunately is more complicated than the monitoring of mortality, because incidence data are hard to come by, registration of cases is even now seldom complete, and increases in the recorded rates may be due to an increase in the efficiency of registration.

Sir Richard Doll, 1990

Injury monitoring, just like other forms of monitoring systems, is full of potential problems and biases. The classic monitoring system is that based upon death certificates. It is usually possible to identify all of the events because of laws requiring registration of deaths, and because the endpoint is quite severe. Monitoring systems for morbidity, including injuries, encounter more difficulties. It may be impossible to identify all events, population data may be hard to identify, and methods for monitoring events may change over time (leading to better or worse identification of events). These are all factors with injury surveillance, and the next section of the lecture will deal with several of these issues.

Numerator Issues



- Definition
- Ascertainment
- Severity

Several issues affect the numerator in injury monitoring systems. That is, the number of injury events identified. Three factors; the definition of an injury, the ascertainment of injury events, and the severity of injury are outlined here.

One of the first steps to establishing a monitoring systems is to define the event which you will seek to identify. In injury monitoring systems, the definition of the injury used can influence the number of events identified. For example, if you are monitoring head injuries, a definition of a head injury that results in loss of consciousness will identify a different number of events than a definition that includes lacerations to the face in addition to concussions and a loss of consciousness.

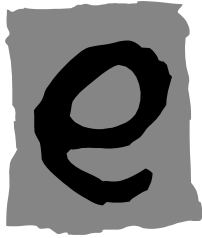
ICD-9 Codes

N Codes - Nature of injury, anatomy

E-Codes - External cause of injury

Second, the definition chosen to identify injuries usually will have some limitations built into it. For example, there may be a fine line between determining if some events are suicides or homicides. If a person with a history of crime activity is found dead because his car crashed off of a cliff, what is the appropriate cause of the injury death? This problem is magnified for deaths from drug overdoses; are these events that are unintended or intentional?

Most surveillance systems for injuries are based upon contact with the health care system. Injuries are usually defined in medical records by ICD codes. Two types of codes are of most interest; N-codes (nature of injury codes) which identify the anatomy involved in the injury, and E-codes (external cause of injury codes) which identify the events leading to the injury.



E-codes

Are often missing on medical records

Some states now require their use in ED
and Hospital Admission records

Important for identifying cause of injury
and designing control programs

Help to assign intent

Very often, the E-codes used to identify the cause of injury will be missing, or not stated in the medical records. This creates a huge problem if you want to have a monitoring system to identify injuries from motor vehicle accidents.

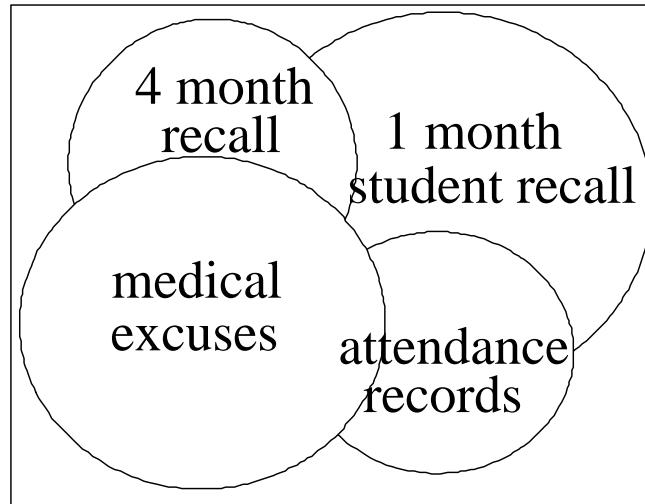
Some states, including Pennsylvania, have now mandated the use of E-codes in hospital records. This is an attempt to improve the accuracy of the medical record in identifying injuries, and many injury researchers have spend a great deal of time on improving the use of E-codes in medical records. Many still are doing so today.

But this raises an interesting debate. As most injury monitoring systems are based upon medical records, the presence of an E-code is very important to identifying and defining injury events. However, for injury research, are we better off trying to improve E-coding, or would it be more worthwhile to use other methods for injury monitoring.

Injury monitoring systems based upon medical databases are passive surveillance systems. There usually is a person sorting through a large medical database. The debate is if this is a direction that the area of injury epidemiology should be spending a great deal of time in, or are we better off in developing studies and systems that require active surveillance.

Sources for Monitoring Injuries

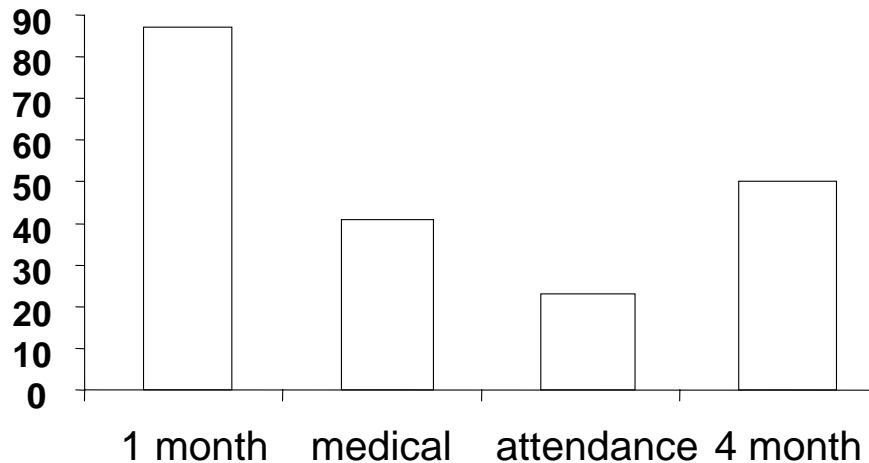
Woodland Hills School District



The second major factor influencing the numerator in injury research is that of ascertainment. Different sources of identifying injuries have different levels of ascertainment. Some may identify nearly all events, while others may only capture one-half.

This slide shows the four sources of identifying injuries among adolescents in the Woodland Hills School District. It was part of a study done by colleagues in the department of epidemiology. The intent of the study was to identify the incidence of injuries in adolescents. Four sources were used to identify injuries. Injuries in this study were defined as events requiring medical attention.

Percent ascertainment for each of the four monitoring sources

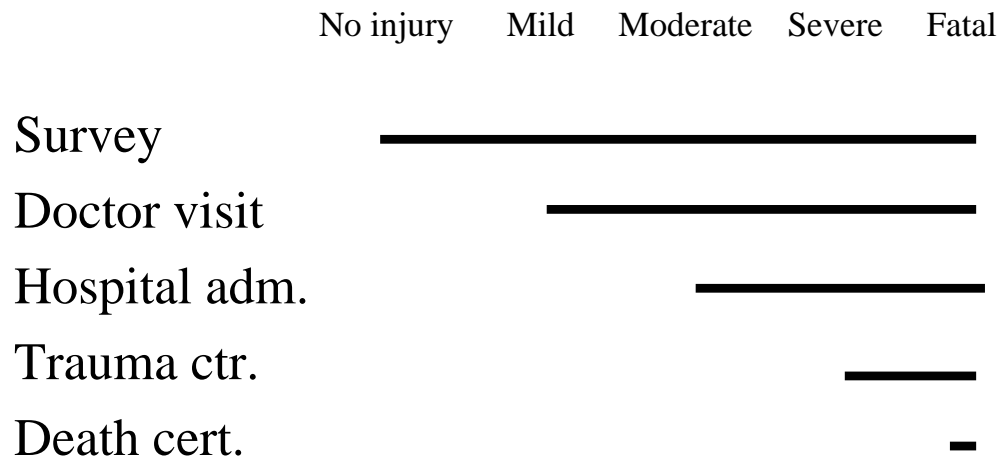


Each of the four sources, though, had different levels of ascertainment associated with them. The best source was a survey of the students that asked them to report any injury events in the previous month. This source identified 88% of all the injuries that occurred. In contrast, the poorest source was one based upon identifying injuries from school attendance records. It only captured 25% of all of the possible events.

Generally, in monitoring, there are tradeoffs to consider. While the one month recall was the most accurate source, it required more labor to accomplish. Whereas, the source based upon attendance records was quite cheap to use as an injury monitoring source. You get what you pay for!

Consider again the debate on E-coding. It is usually less expensive to dredge through a large medical database than to establish an active surveillance system. Part of this debate, thus, involves costs. Is it sufficient to have injury control policies based upon systems that have poor ascertainment, but don't cost a lot of money. Or are we better off with more accurate estimates of the incidence of disease (which require a greater commitment of resources).

Data Sources and Injury Severity



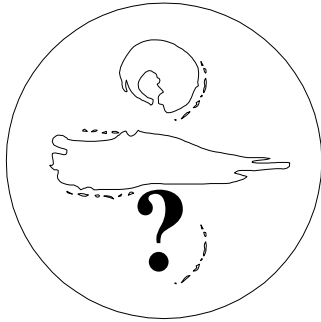
Rogams, 1995

The third issue affecting the numerator in injury monitoring is that of injury severity. Consider the injury pyramid that we discussed in the previous lectures. The most frequent occurrence of injury involves less severe outcomes. Events which result in death are considerably more severe, but occur less frequently.

Given the large differences in the severity of injury which can exist, the most appropriate source to identify injuries will depend to some extent upon the severity of injury that you want to identify. If you want to evaluate injury deaths, appropriate sources would be death certificates and coroner's records, and not surveys. On the other hand if you wanted to be able to identify self-treated injuries, then surveys are more appropriate, and systems based upon hospital records would be inappropriate.

Consider also that surveys provide information on people who have not been injured. Thus, giving you some assessment of exposure data. One drawback of injuries identified from medical records, is that you only know the risk factors for people who have injuries. You do not know how these factors may differ from the people who are not injured. This is a crucial point if you want to be able to identify events that places someone at risk for an injury and the importance of that risk.

Denominator Issues



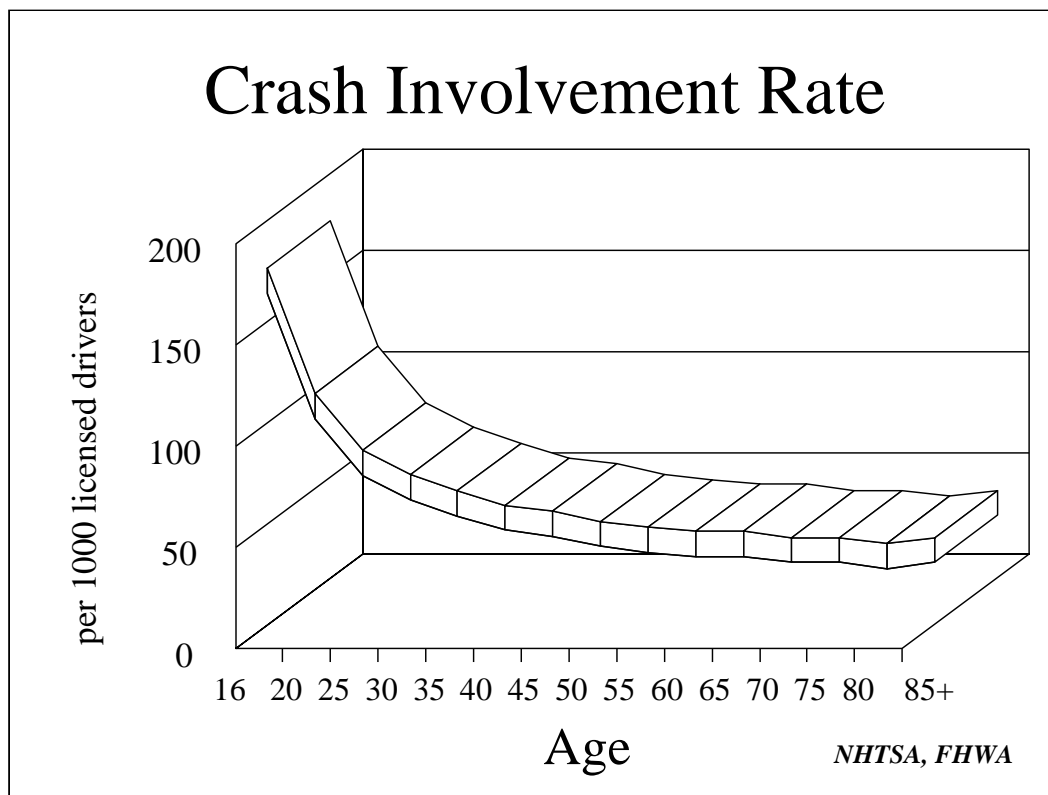
- Population Base
- Which Denominator?

Injury rates identified from monitoring systems may also be affected by influences on the denominator. The two most important factors to consider here are 1.) if the rate should be based upon a population or rely upon only those individuals identified in medical systems, and 2.) if you choose a population base, which population figures do you use.

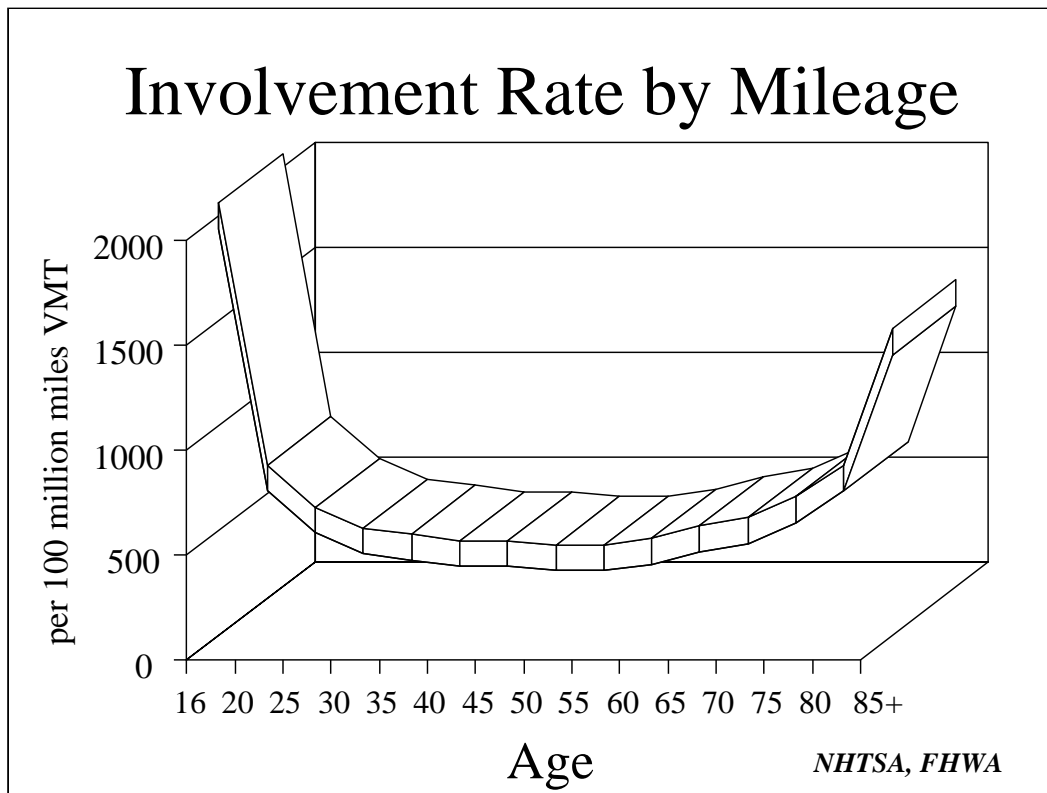


What is the crash risk related to older drivers? How important is this risk?

The endpoint of interest and the population of interest (denominator) are both important to identifying and defining the risks associated with certain activities. Just as different endpoints may suggest different levels of risk of injury, different denominators may do the same. Consider this example:



In general, there are fewer numbers of older persons licensed to operate motor vehicles than younger persons. If the denominator of interest for your quantification of risk is the number of crashes among drivers licensed to operate a vehicle, then it appears that the crash risk of older drivers is substantially less than that of younger drivers. (y axis: per 1000 licensed drivers)



However, if you examine the number of crashes by the distance traveled then the crash risk of older drivers is much different. Second only to the youngest of drivers. (y axis : pers 100 million vehicle miles traveled). The elderly tend to have less mileage driven than other ages.



If you examine death rates from crashes by distance traveled, the risk level again changes. Older drivers in this scenario have the greatest risk. (y axis : per 100 million miles)

Limitations in Injury Surveillance

- Few standards or guidelines
- Lack of population-based data
- Inflexibility of data systems
- Inability to integrate data systems
- Important data elements are not collected

This slide summarizes some of the key limitations affecting injury monitoring. First, there are few gold standards in injury epidemiology, which results in many different approaches to defining injuries. Where standards exist, such as E-codes, there are not available everywhere.

Second, existing data systems are often difficult to integrate together. Crime-based systems do not always assess injuries. Emergency medical transport systems do not always match up with emergency department or hospital admission records. This makes tracking of injuries events through medical systems very difficult to do. It probably is better to study the natural history of injuries through population-based studies.

Third, these types of population-based studies, though, are not frequent in number. Most of our current understanding is based upon persons who are injured. We know little about how they differ from those who are not injured.

A Minimum Basic Dataset for Unintentional Injuries

- Age, Gender, Ethnic Group
- Place of occurrence
- Date of Injury
- Outcome of Injury
- Location of Injury
- Activity when accident happened

To address some of these limitations and concerns, a proposal has been brought forth to establish common data within all of the data sources for identifying injuries. The data elements of the core dataset are shown here. The thinking behind this initiative is to begin the process of standardizing the information that is collected on injuries. In this way, it will be possible to have some comparisons between data systems and over time.

This has been an introduction to the important issue of injury monitoring. In the next lecture, we will review some of the current data sources for identifying injuries and their limitations.