Injury Surveillance Training Manual






Participant Guide

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INJURY SURVEILLANCE TRAINING MANUAL

"The reason for collecting, analyzing, and disseminating information on a disease is to control that disease. Collection and analysis should not be allowed to consume resources if action does not follow."

William H. Foege, M.D., M.P.H., Former Director,
Centers for Disease Control and Prevention
In: Horan M, Mallonee S. Injury Surveillance.
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Centers for Disease Control and Prevention
Julie L. Gerberding, M.D., M.P.H.
Director

National Center for Injury Prevention and Control
Ileana Arias, Ph.D.
Director

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— *Victoria Espitia-Hardeman*

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INJURY SURVEILLANCE TRAINING MANUAL

Team Coordinator

Victoria Espitia-Hardeman

Development Team

Hoang Dang
Douglas Klaucke
James Mercy
Carmen Sanchez-Vargas
Denise Traicoff
David Wallace
Rick Waxweiler

Public Health Students in Practice

LaShawn Curtis
Nevada Wolf

Pilot Test in El Salvador

Rafael Chacon
Wilfredo Chara
LaShawn Curtis
Silvia de Garcia
Roberto Florez
Julio Rocha
Gloria Suarez
Denise Traicoff
David Wallace

Pilot Test in Honduras

Gloria Suarez-Rangel

Cover Photos

Jose Fernando Rios, Journalist
Instituto Cisalva, Universidad del Valle, Cali

Editor—English Version

Lisa Jeannotte

Editor—Spanish Version

Dilia Franz

Reviewers—English Version

Ileana Arias
Carmen Clavel-Arcas
Alberto Concha-Estman
Linda Dahlberg
Ann Dellinger
Martha Highsmith
Arthur Kellerman
Sue Mallonee
James Mercy
Leonard Paulozzi
David Sleet
David Wallace
Rick Waxweiler

Pilot Test in Nicaragua

Carmen Clavel-Arcas
Fabiola Prado
Julio Rocha

Pilot Test in Brazil

Vilma Gawriyswesky
Sonia Gesteira
Leonard Paulozzi
Eugenia Rodrigues

Reviewers—Spanish Version

Carme Clavel-Arcas
Alberto Concha-Eastman
Rodrigo Guerrero Velasco
Joanne Klevens
Gloria Suarez-Rangel
Maria Isabel Gutierrez

Injury Surveillance Conceptual Art

Diane Speight

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Introduction

INTRODUCTION

Overview

This manual has been designed primarily for professionals who develop or operate surveillance systems and conduct prevention activities in less-resourced countries. It describes the steps needed to establish and maintain an injury surveillance system; provides information on designing and monitoring prevention activities; and provides guidance for making informed decisions about injury prevention. The curriculum used in this manual emphasizes the following:

1. Basic epidemiological skills needed to conduct surveillance and prevention activities;
2. Participation by different sectors and institutions in injury prevention and control efforts—including federal and local governments, health and transportation sectors, forensic medicine, law enforcement, justice systems, family counseling offices, and nongovermental organizations; and
3. Injury surveillance and prevention activities at the local level, where stakeholders are closest to the injury data and can specifically address injury problems.

This manual contains an overview, an introduction to the conceptual famework of injury prevention, and six surveillance sessions. You are encouraged to perform the exercises using your local injury data.

A. Learning Objectives

By the end of the course, participants should be able to:

1. Understand the conceptual framework of injury prevention;
2. Assess injury data sources and describe the injury problem;
3. Build a coalition to support the injury surveillance system and prevention activities;
4. Determine the appropriate methodology for the surveillance system;
5. Define and develop an analysis plan for the surveillance data;
6. Use injury surveillance data to inform injury prevention;
7. Define an evaluation plan for the surveillance system and monitor prevention activities.

B. Target Audience

This manual targets public health officials who are or will be responsible for an injury surveillance system, including Field Epidemiology Training Program (FETP) trainees, epidemiologists, and health professionals. The audience must include stakeholders, human rights advocates, and personnel from a transportation office, forensic medicine, or law enforcement (police, district attorney, etc.).

C. Content of Sessions

Session I. Understand the Conceptual Framework of Injury Prevention
Terms and key concepts about injury prevention are presented in this session, such as: What is an injury? What is the difference between unintentional and violence-related injury? What is the impact of injury on public health? Session I will answer these questions and will demonstrate the important role epidemiologists and public health officers play in addressing serious public health issues. This session will be sent to you at least two weeks before the training course because self-study is required prior to the instructor-led training.

Session II. Assess Injury Data Sources and Describe the Injury Problem
Before developing an effective injury surveillance system, public health professionals must understand the status, usefulness, and quality of existing data sources. This session addresses potential injury data sources, how to identify the strengths and weaknesses of each, and how to calculate basic indicators that describe the injury problem.

Session III. Build a Coalition to Support the Injury Surveillance System and Prevention Activities
A successful surveillance system requires the cooperation and effort of many individuals and organizations, which can be achieved through a coalition, an alliance of organizations working together to achieve a common purpose. A coalition can also provide intervention channels within a community (e.g., health care system, schools, and work sites). This session addresses how to identify partners and build, manage, and maintain a coalition to support an injury surveillance system.

Session IV. Determine the Appropriate Methodology for the Surveillance System
The events, variables, types of surveillance systems, and factors to consider when planning for injury data collection will be examined in this session. These factors include collection frequency, data collection instruments, data entry, and quality control of data. Key staff and positions to operate the system are described as well.

Session V. Define and Develop an Analysis Plan for the Surveillance Data
Data analysis is an important step in a surveillance system. Raw statistics are usually insufficient to fully describe a problem. Typically, the raw data is analyzed and interpreted to identify the most important problem areas and to present information in a way that is easy to understand. In this session, participants will calculate basic indicators such as: crude, specific and adjusted rates and YPLL. The session also addresses geographical analysis of events and etiological factors, creation of maps, calculation of public health indicators, development of a plan to disseminate results, and the basic contents of a surveillance report.

Session VI. Use Injury Surveillance Data to Inform Injury Prevention
Public health practitioners use surveillance system data to respond effectively to the injury problem. Surveillance data can guide injury prevention actions such as the development of new policies and strategies or the improvement of existing ones. In this session, participants will learn how to use surveillance data to identify priority injuries, etiological factors, and methods to select appropriate prevention activities. Haddon Matrix, Ecological Model and Decision Matrix will be used with this purpose.

Session VII. Define an Evaluation Plan for the Surveillance System and Monitor Prevention Activities
Once the surveillance system is operational, it should be evaluated to confirm that it is accomplishing its purpose. In this session, you will learn to apply the Centers for Disease Control and Prevention (CDC) evaluation criteria when evaluating a surveillance system. The session also addresses how to monitor prevention activities using surveillance system data.

A. Participant Prerequisites

1. Experience in giving public presentations;
2. Experience in report writing;
3. Familiarity with local injury data and demographic data to be used in the workshop, such as:
    - Country population by age and sex;
    - Causes of death (from public health and vital statistics offices);
    - Injury deaths by intention, such as: homicide, suicide, motor vehicle-related, other injury deaths, domestic violence, child maltreatment (from police departments, forensic medicine, district attorneys, coroners/medical examiners, transportation offices, and public health offices); and
    - Nonfatal injury data (from public health offices or hospital discharge records, if available).
4. Knowledge of basic principles of epidemiology; and
5. Knowledge of basic principles of public health surveillance.

B. Recommended Reading (to be completed before the course begins)

- Session I of the manual, "Understand the Conceptual Framework of Injury Prevention" (to be provided two weeks before the workshop)
- *Principles of Epidemiology*—CDC course #3030 (www.phf.org)
- World Health Organization (WHO) *World Report on Violence and Health* (www.who.org)
- WHO *World Report on Road Traffic Injury Prevention* (www.who.org)
- *Injury Surveillance Guidelines. Geneva. World Health Organization, 2001*
- *Guidelines for the Epidemiological Surveillance on Violence and Injuries. Pan-American Health Organization. 2001*

C. Evaluation Forms

- **Learner Evaluation (Pre- and Post-Course Test):**
  A pretest will be administered to participants at the beginning of the first day to establish a baseline of previous knowledge. The same test will be administered at the end of the workshop to evaluate student progress. The participants will have 15 minutes to complete each test.
- **Session Evaluation:**
  A session evaluation form will be distributed to participants at the end of each session to determine if the objectives were met.
- **Workshop Evaluation:**
  An evaluation form will be distributed to participants at the end of the workshop to determine its overall success and to evaluate the instructor, materials, and length of sessions and workshop.

Course Outline

Session I. Understand the Conceptual Framework of Injury Prevention

1. Injury Definition.
2. Injury classification.
3. The global burden of injuries.
4. The cost of injuries.
5. Conceptual models for understanding and preventing injury:
The public health approach to injury prevention;
The Epidemiological Triad;
The Haddon Matrix;
The Ecological Model.
6. Development of an Injury Surveillance System.
7. Ethical considerations.

Session II. Assess Injury Data Sources and Describe the Injury Problem

1. Identify strengths and weaknesses of injury data sources.
2. Determine the jurisdiction, data collection method, and data flow used by each data source.
2.1 Describe data collection method and data flow.
3. Identify the data sources to include in the surveillance system.
4. Describe the size of the injury problem:
4.1 Determine the frequency of the leading causes of death;
4.2 Determine the frequency of the leading causes of injury deaths.
5. Compare the frequency of injuries calculated with data from different sources.

Session III. Build a Coalition to Support the Injury Surveillance System and Prevention Activities

1. Identify partners to include in the coalition.
1.1 Determine recruiting strategies to involve Coalition Partners
2. Identify local, national, or international organizations working in injury prevention and control in the region.
3. Determine the existing political, social, and legal framework within which the surveillance system and prevention strategies will be established.

Session IV. Determine the Appropriate Methodology for the Surveillance System

1. Define the events to include in the surveillance system.

2. Determine data elements to include in the system: Variables, Case Definition, and Codes

- **2.1** Define the variables;
- **2.2** Define the codes to use in the system;
- **2.3** Review the case definition.

3. Develop data collection instruments and determine data collection frequency.

4. Determine the type of surveillance system.

5. Plan for systematization, maintenance, and data security.

6. Describe the staff and key positions necessary to operate the system.

Session V. Define and Develop an Analysis Plan for the Surveillance Data

1. Calculate frequency and percentage of injury deaths (homicide, suicide, motor vehicle-related, and other unintentional deaths):

- **1.1** Calculate injury rates: How to Get Appropropriate denominators;
- **1.2** Calculate crude rates for injury deaths;
- **1.3** Calculate specific rates for injury deaths by age group;
- **1.4** Calculate adjusted rates using direct method.

2. Calculate years of potential life lost (YPLL).

3. Describe the geographical analysis of data.

4. Define a plan to disseminate and communicate the results;

4.1 Define the basic elements to include in an injury surveillance system report

4.1.1 Recipients.

4.1.2 Delivery method.

Session VI. Use Injury Surveillance Data to Inform Injury Prevention

1. Identify priority injuries.

2. Identify potential etiological factors of the priority injuries in the region or city:

- **2.1** Use the Haddon Matrix to help identify and organize potential etiological factors for unintentional injuries;
- **2.2** Use the Ecological Model to identify and organize potential etiological factors for violence-related injuries.

3. Review effective injury prevention strategies.

4. Identify and select potential interventions to prevent priority injuries:

- **4.1** Use the Haddon Matrix to identify possible interventions for unintentional injuries;
- **4.2** Use the Ecological Model to organize possible interventions to prevent violence-related injuries.

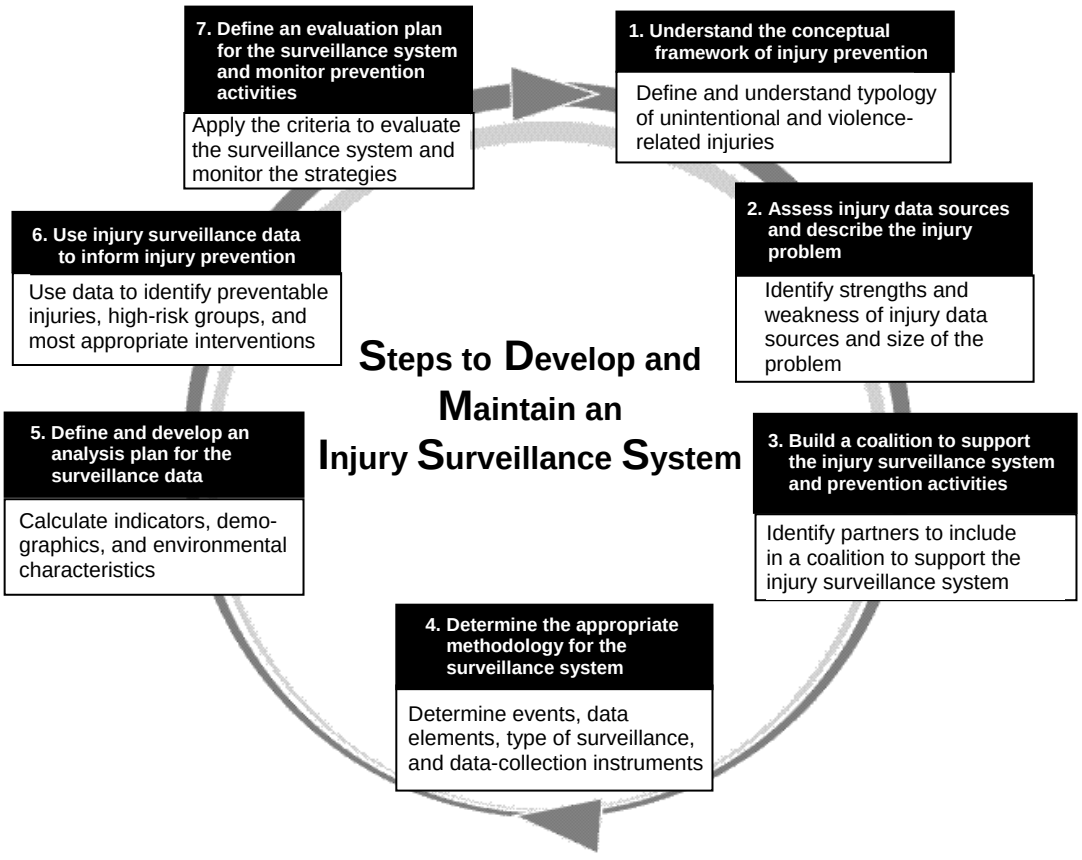
5. Use the Decision Matrix to identify the most appropriate intervention for the injuries in your region.

Session VII. Define an Evaluation Plan for the Surveillance System and Monitor Prevention Activities

1. Know the steps for evaluating an injury surveillance system:
- **1.1** Engage stakeholders in the evaluation;
- **1.2** Describe the surveillance system to be evaluated;
- **1.3** Focus the evaluation design;
- **1.4** Gather credible evidence about the surveillance system's performance.
- **1.5** Justify and state conclusions and make recommendations.
- **1.6** Use evaluation findings and share lessons learned.

2. Review public health indicators proposed to monitor injuries
- **2.1** Basic indicators
- **2.2** Developmental indicators
- **2.3** Research indicators.

3. Use injury surveillance data to monitor prevention activities.



Appendix 1
Pretest

Length: 10 minutes

City/Country: _____

Date: ___ / ___ / ____

1. Which of the following items are components of the injury definition?
    a) Damage to a person caused by exposure to physical agents in amounts that exceed the threshold of human tolerance.
    b) Damage to a person caused by a sudden lack of essential agents (oxygen or heat).
    c) Psychosocial trauma which results in emotional injury.

2. For each type of injury, place a check mark under the appropriate injury classification:

	Violence-related injuries	**Unintentional injuries**	**Other type of injuries**
Types of injuries			
Child abuse			
Assault by firearm			
Poisoning with pesticide			
Pedestrian injury			
Intimate partner violence			
Suicidal behavior			

3. Place the following etiological factors in the appropriate phase of the Haddon Matrix:

Etiological factors	**Pre-event**	**Event**	**Post-event**
Impaired driving laws			
Quality of medical services			
Speed of the vehicle at impact			
Seat belt use			
Speed limit laws			
Brakes and tires of the vehicle involved			
Pedestrian walking in the roadway			
Recovering areas in case of emergency			

4. Select potential partners for a coalition that supports the injury surveillance system and prevention activities:

Potential Partners	**YES**	**NO**
Health (hospital and health center directors, ministries of health)		
Justice (forensic medicine, coroners/medical examiners, courts, prosecutors)		
Security (police, security companies, homicide investigators)		
Transportation (transportation department offices or officers)		
Administration (planning officers)		
Education (academic directors)		
Community (community organizations, youths, mothers)		
Private organizations (NGOs, human rights groups)		
Political (national, regional, or local authorities)		
Other (mention which one)		

5. Place the following factors for intimate partner violence in the appropriate level of the Ecological Model:

Factors	Individual	Relationship	Community	Societal
Absent or rejecting father				
Acceptance of violence as a way to resolve conflict				
Isolation of women and family				
Witnessing marital violence as a child				
Marital conflict				
Norms related to male authority over women				

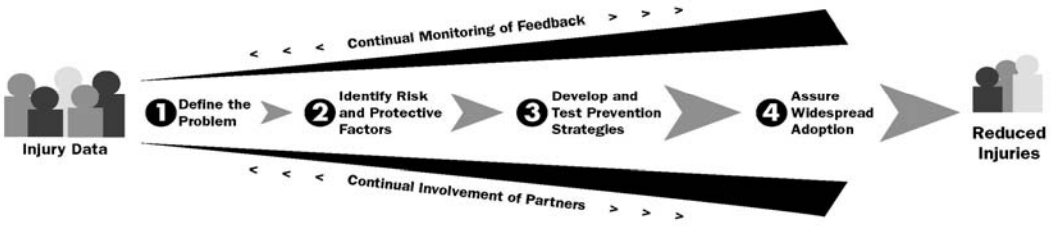
Sessions

INJURY SURVEILLANCE TRAINING MANUAL

PARTICIPANT GUIDE

SESSION I

UNDERSTAND THE CONCEPTUAL FRAMEWORK OF INJURY PREVENTION



Source: National Center for Injury Prevention and Control

Developed with the support of the
National Center for Injury Prevention and Control
Division of International Health, Epidemiology Program Office
Centers for Disease Control and Prevention
Atlanta, GA

SESSION I

UNDERSTAND THE CONCEPTUAL FRAMEWORK OF INJURY PREVENTION

Learning Objectives

- Understand concepts, definitions, and classification of injury.
- Know the differences between violence-related and unintentional injuries.
- Describe the global burden and cost of injuries.
- Know the conceptual models for understanding and preventing injury.
- Know the steps to develop an injury surveillance system.
- Review ethical considerations.

Introduction

This session reviews key concepts of injury prevention. You are encouraged to review these concepts before the training course. The definition of injury and its varied classifications are reviewed in the first part of the session; the magnitude of the injury problem worldwide is covered in the second part. Conceptual models for understanding and preventing injury (Epidemiological Triad, Haddon Matrix, and Ecological Model) are also covered. Afterwards, the steps to develop and maintain an injury surveillance system are discussed. Finally, ethical considerations are mentioned.

1. Injury Definition

An injury is caused by acute exposure to physical agents such as mechanical energy, heat, electricity, chemicals, and ionizing radiation interacting with the body in amounts or at rates that exceed the threshold of human tolerance (Baker et al. referenced Gibson 1961 and Haddon 1963). In some cases (for example drowning and frostbite), injuries result from the sudden lack of essential agents such as oxygen or heat. About three-fourths of all injuries, including most vehicle crashes, falls, sports, and shootings, are caused by mechanical energy.[1]

"Injury" Versus "Disease"

Some definitions of injury include a relationship between the time of exposure and appearance of an injury, usually classified as "short."[1] Some experts consider that the interval between exposure and the appearance of injury can be relatively long, such as in poisoning from carbon monoxide, alcohol abuse, or heavy metals. The distinction between injury and disease is a related issue. Consider the following examples:[2]

Injury	Disease
A construction worker fractures his toe while using a jackhammer.	Another worker is diagnosed as having tendonitis of the elbow from the chronic vibrations of the jackhammer.
An operator at a nuclear power plant is burned severely when a fuel rod breaks open.	A fisherman develops thyroid cancer 20 years after fallout from an aboveground nuclear test that blanketed his boat with radiation.
A child is bitten by guard dog and requires 10 stitches to his leg.	A child dies of rabies after a bat bite.

In each of the preceding examples, we would say the first victim suffered from an "injury," while the second suffered from a "disease." Acuteness is certainly a factor: the shorter the time from exposure to a hazard to its physical effects, the more likely we are to call the resulting condition an "injury" rather than a "disease."

Other experts have added to this discussion: "It is the acuteness of exposure that differentiates injury from disease. Thus, acute smoke inhalation is generally classified as an injury, whereas chronic damage from substances such as lead and cigarette smoke are excluded as injuries because toxic effects often occur slowly. This distinction is somewhat arbitrary and certainly not rigid, but it is conceptually useful for classification, research, and policy purposes."[3]

Interval from Appearance of Injury to Death

The interval from the appearance of injury to death could be immediate, or as long as months or years. For instance, in the United States, a death can be linked to an injury at any time. It is classified as "injury sequelae" if one year or more has elapsed since the injury. In the Fatality Analysis Reporting System (FARS) of the U.S. National Highway Traffic Safety Administration, for vehicles traveling on public roads, all injuries resulting in the death of the victim within 30 days of the event are considered motor vehicle-related death. Another example is the Fatal Injury Surveillance System in Cali, Colombia,[4] that classifies a death as injury-related regardless of the length of time between the injury and death. In some cases, this period could exceed one year. The situation in other countries may be different.

"Injury" Versus "Accident"

"Accident" is often used to mean an unintentional event that produces, or has the potential to produce, an injury. Sometimes, the word "accident" is used synonymously with "injury." However, many experts in public health believe that widespread use of the term "accident" has not only caused semantic confusion, but has inhibited efforts to reduce injuries.

This is because many people think of an "accident" as being something unpredictable or "an act of God" (Holder et al. referenced Haddon 1968). In actuality, events that injure people are not random and have identifiable risk factors. These events involve interactions among people, vehicles, equipment, processes, and the physical and social environment. For these reasons, the word "accident" should be avoided.[5]

2. Injury Classification

Injuries can be classified by the intention of the act into two groups: **unintentional injuries** and **violence-related injuries** (also called *intentional injuries*). The first group includes injuries related to transportation and traffic incidents, or occurring at home, in the workplace, in public places, and in natural disasters. The second group includes injuries related with interpersonal, collective, terror-related, and self-inflicted violence.

Unintentional Injuries

Unintentional injury is defined as:

1. Physical damage to the body;
2. Damage resulting from excessive energy applied to the body (physical, radiant, etc.); or from exposure to external agents (e.g., poisons); or from the absence of essentials (warmth, oxygen);
3. The application, exposure, or deprivation not done deliberately to oneself or by another person.

Unintentional injuries occur by a number of mechanisms, including falls, road traffic, water hazards, fire and hot liquids, and poisonings.[3] The energy that causes injury may be:

- Mechanical (an impact with a moving or stationary object such as surface, knife, or vehicle);
- Radiant (ultraviolet radiation);
- Thermal (air or water that is too hot or too cold);
- Electrical (lightning strike, electric shock);
- Chemical (a poison or mind-altering substance such as drugs or alcohol).[6]

Unintentional injuries account for about two thirds of all injury deaths in the United States. Almost half are attributable to motor vehicle-related incidents. In Table 1, the mechanism of injury is matched with the place of injury occurrence. Shaded boxes indicate locations where the injury occurs most often.

Table 1. Unintentional Injuries

Mechanism of Injury	Place of Occurrence				
	Home	Sports/ Leisure	Work-places	School Facilities	Public Places
Burns/Scalds From electrical appliances, cooking mishaps, cooking stoves with open flame, radiators, home fires, fireworks	■		■		
Cuts/Lacerations Toys, sports, playgrounds, furniture, household gadgets, gadget blades, occupational hazards	■	■	■	■	
Drowning At pools and beaches or from floods, falls into ponds and wells, water transport	■	■	■	■	■
Impact Injury Falls from rooftops, windows or furniture; falls related to agriculture, construction, recreation, sports, or transportation (automobiles, cyclists, pedestrians, motorcyclists)	■	■	■	■	■
Electric Shock From household gadgets, toys, and substandard or hazardous wiring; improper use of and substandard electrical gadgets	■		■		
Poisoning From medicines, household chemicals, cooking fuels, seeds	■		■		
Suffocation/Asphyxia From infant and toddler furniture, clothes and toys, plastic bags, swallowing of seeds or toys	■				
Firearms Unintentional use	■	■	■	■	■
Insect and Animal Bites From dogs, snakes, scorpions, etc.	■	■	■	■	■

Adapted from: Mohan D, Romer J. Accident mortality and morbidity in developing countries. In: *The Epidemiological Approach*. New York, NY: Oxford University Press; 1998.

Violence-Related Injuries (Intentional Injuries)

The World Health Organization (WHO) defines violence as:

> The intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community, that either results in or has a high likelihood of resulting in injury, death, psychological harm, maldevelopment, or deprivation.[7]

The three categories differentiate among violence a person inflicts upon oneself (self-directed); interpersonal violence inflicted by another individual or by a small group of individuals; and violence inflicted by larger groups such as states, organized political groups, militia groups, and terrorist organizations.

Each broad category is subdivided into specific types of violence. Self-directed violence includes suicidal behavior and self-abuse. Interpersonal violence includes two subcategories: violence between family members and intimate partners, and community violence between individuals who are unrelated (usually in a place other than the home). Collective violence is subdivided into social, political, and economic violence. The social violence category includes, for example, crimes of hate committed by organized groups, terrorist acts, and mob violence. Political violence

includes war and related violent conflicts, state violence, and similar acts carried out by large groups. Economic violence includes attacks by large groups motivated by economic gain. Clearly, acts committed by large groups can have multiple motives.

A violent act can also be classified by its nature. The four categories are physical violence, sexual violence, psychological violence, and violence involving deprivation or neglect. These four types of violent acts occur in each of the broad categories described above—*except* self-directed violence. For example, violence against children can include physical, sexual and psychological abuse, or neglect.

In the *World Report on Violence and Health*,[7] violence is divided into three categories according to the person who commits the violent act and into four categories according to the nature of the violence. The horizontal array shows who is affected, and the vertical array describes how they are affected (Table 2).

Table 2. A Typology of Violence

Nature of Violence	Self-Directed		Interpersonal					Collective		
	Suicidal Behavior	Self-Abuse	Family/Partner			Community				
			Child	Partner	Elder	Acquaintance	Stranger	Social	Political	Economic
Physical										
Sexual										
Psychological										
Deprivation or Neglect										

Adapted from: Krug EG, Dahlberg LL, Mercy JA, Zwi A, Lozano R, eds. *World Report on Violence and Health.* Geneva: World Health Organization; 2002.

According to WHO, an estimated 1.6 million people worldwide died in 2000 as a result of self-inflicted, interpersonal, or collective violence. Nearly half of these deaths were suicides; one third were homicides; and one fifth were war related. International estimates on physical and sexual assaults are lacking, as systems for reporting and compiling these data are absent in many countries, or are still being developed. There are often cultural and social pressures to keep violence behind closed doors or to accept it as a natural facet of human relations. Even in areas where surveillance systems are in place, victims may be reluctant to report violent experiences.[7]

3. The Global Burden of Injuries

Every day around the world, almost 16,000 people die from injuries, according to WHO. For every person that dies, several thousand more are injured, some of them with permanent sequelae. Motor vehicle-related injuries are the eleventh leading cause of mortality worldwide (Table 3).

Table 3. Leading Causes of Mortality Worldwide, Both Sexes — 2002

Rank	Causes	Percentage of Total
1.	Ischemic Heart Disease	12.6
2.	Cerebrovascular Disease	9.6
3.	Lower Respiratory Infections	6.6
4.	HIV/AIDS	4.9
5.	Chronic Obstructive Pulmonary Disease	4.8
6.	Perinatal Conditions	4.3
7.	Diarrheal Diseases	3.1
8.	Tuberculosis	2.8
9.	Trachea, Bronchus, Lung Cancers	2.2
10.	Malaria	2.1
11.	Road Traffic Injuries	2.1
12.	Diabetes Mellitus	1.7

Source: Peden M, Scurfield R, Sleet D, et al. *World Report on Road Traffic Injury Prevention*. Geneva: World Health Organization; 2004.

In 1998, road traffic injuries were the leading cause of unintentional injury deaths in the world. Suicides were the leading cause of violence-related injury deaths and the third leading cause of injury overall (Table 4).

Table 4. Injury-Related Mortality Worldwide — 1998

Injury Deaths	Number of Deaths	Mortality Rate (per 100,000)	Percentage
Unintentional			
Road Traffic Injuries	1,170,694	19.9	20.3
Drowning	495,463	8.4	8.5
Falls	315,633	5.4	5.4
Burning	282,178	4.8	4.8
Poisoning	251,881	4.3	4.3
Other Unintentional Deaths	977,259	16.6	16.9
Violence-Related			
Suicide	947,697	16.1	16.4
Homicide	735,972	12.5	12.7
War	588,050	10.0	10.2
Total	**5,764,825**	**97.9**	**100.0**

Source: Krug E, ed. *Injury: A Leading Cause of the Global Burden of Disease*. Geneva: World Health Organization; 1999.

Age and Sex of Victims

According to WHO, an estimated 520,000 homicides occurred in 2000, with an adjusted rate of 8.9 per 100,000 population. Nearly 80% of the homicides were males, with a rate of 13.6 per 100,000, three times higher than for females, for which the rate was 4.0 per 100,000. Males aged 15 to 29 years had the highest rates of homicide of all age groups (19.4 per 100,000)[7] (Table 5).

Table 5. Estimated Global Homicide and Suicide Rates by Age Group and Sex — 2000

Age Group (years)	Homicide Rate*		Suicide Rate*	
	Males	Females	Males	Females
0–4	5.8	4.8	0.0	0.0
5–14	2.1	2.0	1.7	2.0
15–29	19.4	4.4	15.6	12.2
30–44	18.7	4.3	21.5	12.4
45–59	14.8	4.5	28.4	12.6
60+	13.0	4.5	44.9	22.1
Total **	13.6	4.0	18.9	10.6

* Rates per 100,000 population
** Age standardized

Source: WHO Global Burden of Disease Project for 2000. Version 1. In: Krug E, Dahlberg L, Mercy J, Zwi A, Lozano R, eds. *World Report on Violence and Health.* Geneva: World Health Organization; 2002.

High- Versus Low-Income Countries

Analysis of mortality causes by region reveals important characteristics (Table 6). In high-income countries, self-inflicted injuries are the twelfth leading cause of injury mortality, and road traffic injuries are the fourteenth leading cause. In low-income countries, road traffic injuries are the tenth leading cause of death.[8]

Table 6. Leading Causes of Mortality in High- and Low-Income Countries, Both Sexes — 2002

High-Income Countries Rank Causes	Percentage of Total	Low-Income Countries Rank Causes	Percentage of Total
1. Ischemic heart disease	17.0	**1.** Ischaemic heart disease	11.8
2. Cerebrovascular disease	9.8	**2.** Cerebrovascular disease	9.6
3. Trachea/bronchus/lung cancers	5.8	**3.** Lower respiratory infections	7.0
4. Lower respiratory infections	4.4	**4.** HIV/AIDS	5.7
5. Chronic obstructive pulmonary disease	3.9	**5.** Chronic obstructive pulmonary disease	5.0
6. Colon/rectum cancers	3.3	**6.** Perinatal conditions	5.0
7. Alzheimer and other dementias	2.7	**7.** Diarrheal diseases	3.6
8. Diabetes mellitus	2.6	**8.** Tuberculosis	3.2
9. Breast cancers	1.9	**9.** Malaria	2.5
10. Stomach cancer	1.8	**10. Road traffic injuries**	**2.2**
11. Hypertensive heart disease	1.6	**11.**Trachea/bronchus/lung cancers	1.6
12. Self-inflicted injuries	**1.6**	**12.** Hypertensive heart disease	1.6

Source: Peden M, Scurfield R, Sleet D, et al. *World Report on Road Traffic Injury Prevention*. Geneva: World Health Organization; 2004.

Unintentional Injuries

The major types of unintentional injury have similar rates in most countries. However, the nature and extent of injury varies widely by geographic, cultural, urban/rural, and other factors. In Table 7, the major causes of severe injury in high-income countries are compared with those of low-income countries. Once the differences are understood, appropriate data can be gathered and effective preventive measures can be instituted.

Table 7. Major Causes of Severe Unintentional Injuries in High- and Low-Income Countries

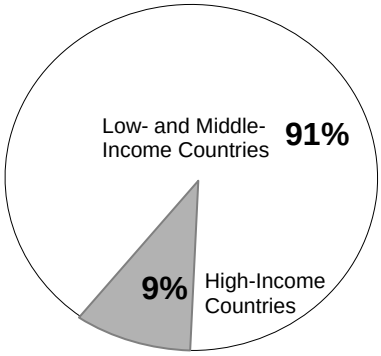
Low-Income Countries (causes not ranked)	High-Income Countries (causes not ranked)
Fire and Burns	
Fires in slums and squatter housing	House fires in private dwellings, especially in slum housing and mobile homes
Scalds from boiling water	Scalds from hot tap water, cooking gas, boiling water
Ignition of clothing from cooking on open fires, with kerosene lamps, or on pressurized stoves	Ignition of clothing by cigarettes, outdoor fires, portable heaters
Children falling into open cooking fires	Occupational burns from molten metals, gasoline-powered appliances/vehicles
Drowning	
Children falling into open wells	Children falling into home swimming pools
Floods	Leisure boat incidents
Public transport on waterways	Intoxicated persons near any body of water
Falls	
Workers falling from high trees (e.g., palm or coconut trees)	Construction workers
Children falling from rooftops, farm animals, or low trees (e.g., fruit trees)	Children falling from apartment windows
Home construction and repair	Children or elderly falling down stairs
	Incidents involving baby walker devices
Motor Vehicle-Related	
Vulnerable road users (pedestrians, bicyclists, etc.) struck by motor vehicles	Occupants of private automobiles involved in single- and multiple-vehicle crashes
Motorcycle crashes	Motorcycle crashes
People falling off transport vehicles; crashes of public transport vehicles (buses and trains)	Pedestrians (especially children and elderly) struck by cars
Truck drivers killed in crashes	Farm tractor rollovers
Laborers falling from open truck beds	Young people falling from recreational all-terrain vehicles (ATVs)

Adapted from: Berger L, Mohan D. *A Global View, Injury Control*. Delhi: Oxford University Press; 1996.

Violence-Related Injuries (Intentional Injuries)

Most violence-related deaths occur in low- to middle-income countries. Less than 10% of all violence-related deaths occur in high-income countries.[7] (See Figure 1.)

Figure 1. Proportion of Violence-Related Deaths



Source: Krug E, Dahlberg L, Mercy J, Zwi A, Lozano R. *World Report on Violence and Health.* Geneva: World Health Organization; 2002.

The Injury Pyramid

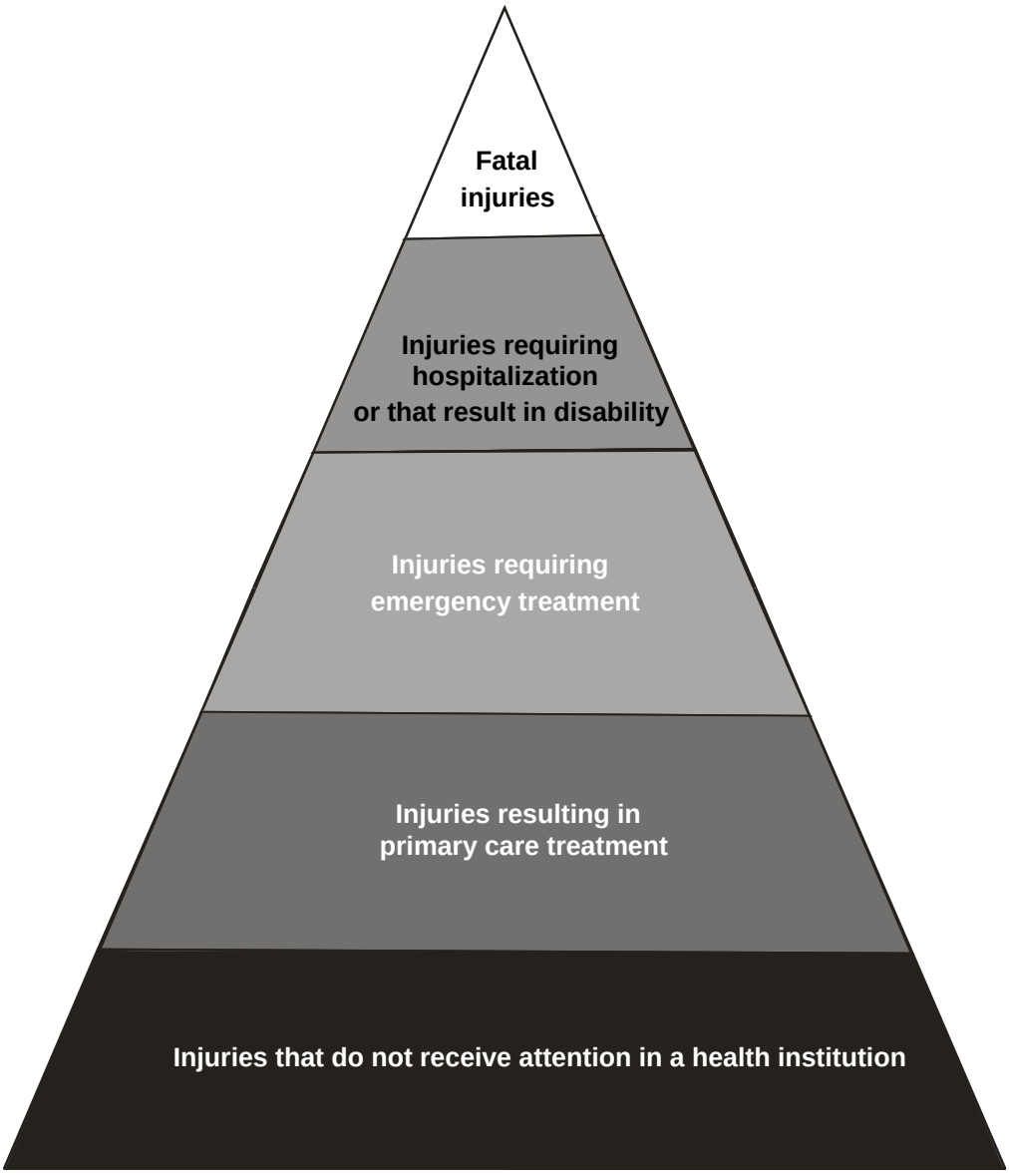
Mortality data are a powerful injury indicator, but deaths from injury comprise just a fraction of the impact of injuries on a population. For each death from injury, many more result in hospitalization, emergency department or general practitioner treatment, or treatment that does not involve formal medical care.

According to WHO, in the world's high-income countries, for every person killed by injury, 30 people are hospitalized, and 300 are treated in emergency rooms; even more are treated in other health care facilities. This does not reflect the situation in developing countries, which have fewer resources for prevention, treatment, and rehabilitation of injuries. In all countries, people of low income are especially prone to injury and are less likely to survive or recover from disability.[7]

The injury pyramid shown in Figure 2 helps illustrate this fact. The pyramid top is composed of deaths, which are fewer in number, but more visible. Following deaths are severe injuries resulting in hospitalization and disability, usually classified by health sector, public or private. The third category is less-severe injuries, requiring emergency treatment. Next are injuries treated in basic health facilities. At the bottom of the pyramid are injuries which do not receive attention in a health institution. Estimates of these injuries can only be obtained through surveys or special research. For instance, a survey conducted in Nicaragua of 10,000 households showed that only 1 in 10 injured persons visited a local hospital for treatment.[9]

In addition to the severity of an injury, a host of cultural and economic factors determine the level of treatment an injury victim receives. As a result, injury pyramids cannot be compared across countries and are thus provided here for illustrative purposes only.

Figure 2. The Injury Pyramid



4. The Cost of Injuries

The reliability and validity of estimated costs of various injuries are greatly affected by the completeness and detail of epidemiologic surveillance. Accurate reporting of death rates, hospitalization, and disability from specific injuries by age and sex provides a foundation for estimating the economic impact. If rates for a wide range of injury events and outcomes are not available, it is difficult to calculate injury costs.[10]

In 1992, direct and indirect annual costs due to gunshot wounds in the United States were estimated at $126 billion, with an additional $51 billion due to cutting or stab wounds.[10] In New Brunswick, Canada, the mean total cost estimate per suicide was over $849,000.[11] In Latin America, the Inter-American Development Bank sponsored studies of the impact of violence in six countries between 1996 and 1997. These studies found that the cost of violence, expressed as a percentage of the gross domestic product (GDP) was 1.9% of the GDP in Brazil, 5.0% in Colombia, 4.3% in Peru, and 0.3% in Venezuela.[12]

Although direct costs such as hospital and physician charges, medications, and transportation are the most easily measured, acquiring data on such costs can be difficult. The list of direct costs is extensive and the information is not always in a useable form (Table 8).

Table 8. Partial List of Direct Costs of Injuries

Emergency Services: Ambulance, emergency room, personnel (Emergency Medical Technicians/Paramedics, Physicians, Nurses, etc.)
Hospital Inpatient Costs: Physicians, operating room, drugs
Hospital Outpatient Services: Medications, appliances
Office-Based Services: Physicians, Nurses
Rehabilitation: Physical, occupational, speech and hearing therapy, prosthesis
Long-Term Care: Custodial care, modification of home environment (e.g., wheelchair ramps)
Home-Health Services: Nurses, Aides, Caregivers
Administrative Costs: Insurance companies, government medical agencies, vehicle, barrier, and other property damage
Legal Fees and Court Costs
Law Enforcement and Judicial Costs
Welfare and Human Services Costs: Social Workers, Medical Social Workers, support payments
Funeral and Medical Examiner Costs
Costs for Other Affected Persons: Witnesses time in court, family members

Adapted from: Berger L, Dinesh M. *A Global View, Injury Control*. Delhi: Oxford University Press; 1996.

5. Conceptual Models for Understanding and Preventing Injury

The Public Health Approach to Injury Prevention

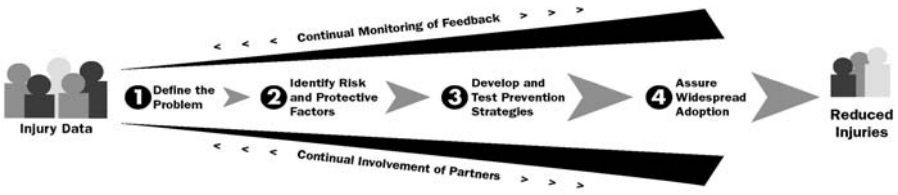
The public health model to prevention has been applied to a wide range of noninfectious and infectious public health problems, with a remarkable record of success.[13] Although many scientific disciplines have advanced the understanding of injury, public health brings something that has been missing to this field: a multidisciplinary scientific approach that is explicitly directed toward identifying effective methods of prevention.

This model is based on the following principles:

- **a.** Emphasis on primary prevention;
- **b.** Multidisciplinary in nature;
- **c.** Science-based;
- **d.** Population-based.

The public health approach begins by defining the problem through surveillance systems, surveys, and other sources. The second step is to identify associated risks and causes through research. The third step is to develop and evaluate interventions. The last step is to widely implement interventions that show promise. Although Figure 3 illustrates a linear progression through these four steps, in reality, many of these steps are likely to occur simultaneously.

Figure 3. Public Health Approach to Injury Prevention

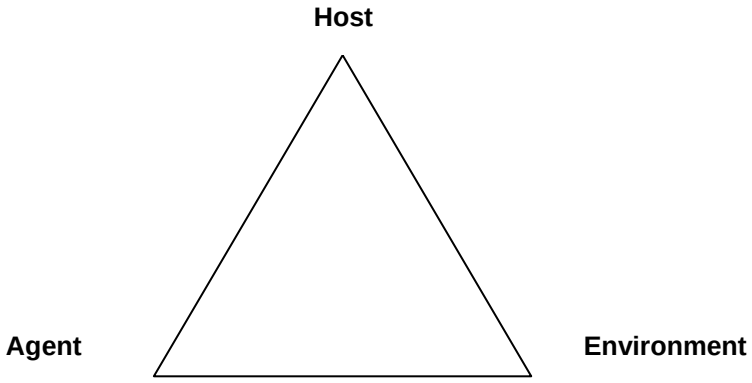


Source: National Center for Injury Prevention and Control

The Epidemiological Triad

William Haddon, the former director of the United States National Highway Traffic Safety Administration and the Insurance Institute for Highway Safety, played a leading role in bringing epidemiological principles to injury research and intervention programs. Haddon maintained that injuries could be easily examined from an epidemiological framework. In its classic sense, epidemiology considers the interaction of three factors in the development of disease: the *host*, the *agent*, and the *environment,* which is called the epidemiological triad (Figure 4).

Figure 4. Epidemiological Triad



The Haddon Matrix

Haddon applied the epidemiological triad primarily to unintentional injuries, and most often to injuries from motor vehicle crashes. As diagrammed in Figure 4, the host is the human being whose behavior is operation of the vehicle. Physical energy is the agent in injury events. For motor vehicle events, this translates into the physical energy involved with motor vehicles. The environment is the milieu in which the vehicle and the human interact—the type of road, the weather conditions involved, and so forth.[14]

Haddon extended the epidemiological triad even further to consider how these factors relate to the crash sequence. The crash sequence can be examined in terms of three elements: the circumstances surrounding the event prior to the crash; the circumstances of the crash; and those that follow the crash. The crash sequence interacts with human, environmental, and vehicular factors to define the frequency and severity of injury. Table 9 shows examples of the risk factors related to the likelihood of injury in motor vehicle crashes within the framework of the epidemiological triad and the Haddon Matrix.

Table 9. Factors Related to the Likelihood of Crash Injury: The Haddon Matrix

Phases	Factors		
	Human	**Vehicle**	**Physical and Social Environment**
Pre-Crash	Alcohol intoxication; Fatigue; Experience and judgment; Driver vision; Amount of travel	Brakes, tires; Center of gravity; Jackknife tendency; Ease of control; Load weight; Speed capability	Laws related to alcohol and driving; Visibility of hazards; Road curvature and gradient; Surface coefficient of friction; Divided highways, one-way streets, intersections, access control; Signalization; Speed limits
Crash	Seat belt use; Age; Sex;	Speed at impact; Vehicle size; Automatic restraints; Hardness and sharpness of contact surfaces; Load containment	Recovery areas; Guardrails; Characteristic of fixed objects; Median barriers; Roadside embankments
Post-Crash	Age; Physical condition; Disabilities	Fuel system integrity	Emergency communication and transport systems; Distance to and quality of medical services; Rehabilitation programs

Adapted from: Baker S, O'Neill B, Ginsburg M, Li G. *The Injury Fact Book.* 2nd ed. New York, NY: Oxford University Press; 1992.

The Haddon Matrix changed how injuries are viewed and provided a framework for the development of injury control interventions. Haddon demonstrated that an appropriate understanding of the factors affecting injuries in each cell of the matrix could lead to more effective interventions. By identifying which factors are important and their location in the crash sequence, it will be possible to understand where interventions may be most appropriate.[14]

Haddon identified the *pre-injury* phase as the period when primary prevention approaches, such as divided highways and speed limit enforcement, could be implemented. The *injury* phase focuses on secondary prevention such as the deployment of airbags or the installment of breakaway signposts. The *post-injury* phase emphasizes tertiary prevention such as effective emergency medical services and trauma rehabilitation. Haddon applied this matrix to several other unintentional injuries and to those from motor vehicle crashes. Barss et al. compared the application of these epidemiological methods to diseases and to injuries, with attention to the host, agent, and environment,[3] as shown in Table 10. This table also shows that equipment factors and activity at the time of the incident are essential considerations.

Table 10. Comparative Epidemiology of Disease and Injury: Malaria Versus Brain Damage to Motorcyclist

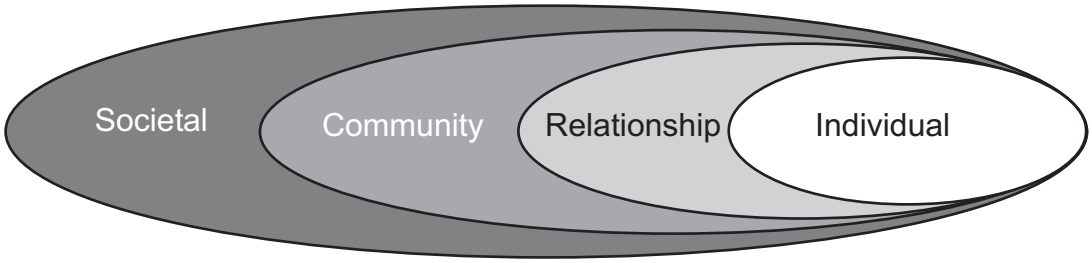
Variable	Health Condition	
	Disease	Injury
Pathology	Malaria	Brain damage
Incident	Mosquito bite	Crash into tree
Agent	Plasmodium parasite	Kinetic energy
Vector/Vehicle	Anopheles mosquito	Motorcycle
Activity	Sleeping	Motorcycle travel
Personal/Host Factors	Low immunity — young child	Alcohol intoxication; youth; male sex; inexperience; fatigue
Equipment Factors	Mosquito net; insect screening	Motorcycle helmet; guardrail
Environment Factors	Unscreened home near swamps; rain	Unprotected curve near tree; unsafe surface and incline; rain
Time/Visibility Factors	Night/Darkness	Night/Darkness

Source: Barss P, Smith G, Baker S, Mohan D. *Injury Prevention: An International Perspective (Epidemiology, Surveillance and Policy)*. New York, NY: Oxford University Press; 1998.

The Ecological Model

In the same way that the Haddon Matrix has been valuable for addressing prevention of unintentional injuries, there is also a model for understanding the prevention of violence. The Ecological Model examines the complex interplay of individual, relational, social, cultural, and environmental factors that increase or decrease the risk for violence.[7] This model was first introduced in the 1970s and was initially applied to child abuse.[15] Subsequently it was applied to youth violence and, most recently, researchers have used it to understand intimate partner violence and abuse of the elderly[16] (Figure 5).

Figure 5. Ecological Model for Understanding Violence



Source: Krug E, Dahlberg L, Mercy J, Zwi A, Lozano R. *World Report on Violence and Health*. Geneva: World Health Organization; 2002.

The ecological model posits that (1) health and well-being are affected by a dynamic interaction among biology, behavior, and the environment, and that (2) this interaction changes over the life course.

Individual Factors: Characteristics of the individual that increase the likelihood of being a victim or a perpetrator of violence, such as:

- Impulsivity;
- Low educational attainment;
- Substance abuse (alcohol, drugs);
- Prior history of aggression and abuse.

Relationship Factors: Proximal social relationship (i.e., with peers or within family environments) that increase the risk for violent victimization and perpetration. Examples of relationship factors include:

- Harsh parenting practice;
- Association with peers involved in delinquent activities;
- Poor parental supervision.

Community Factors: Characteristics of context in which social relationships are embedded that are associated with being victims or perpetrators of violence, such as:

- Residential mobility;
- High-population density;
- Drug trafficking;
- High levels of unemployment;
- Social isolation;
- Few institutional supports.

Societal Factors: Factors that create an acceptable climate for violence, reduce the inhibitions against violence, and create and sustain gaps among different segments of society or tensions among different groups or countries. Examples of such factors include:

- Cultural norms that support violence as an acceptable way to resolve conflicts;
- Attitudes that regard suicide as a matter of individual choice instead of a preventable act of violence;
- Norms that give priority to parental rights over child welfare;
- Norms that entrench male dominance over women and children;
- Norms that support the use of excessive force by police against citizens;

- Access to health care;
- Educational inequality;
- Economic and social policies;
- High levels of economic or social inequality within groups or countries.[7]

6. Development of an Injury Surveillance System

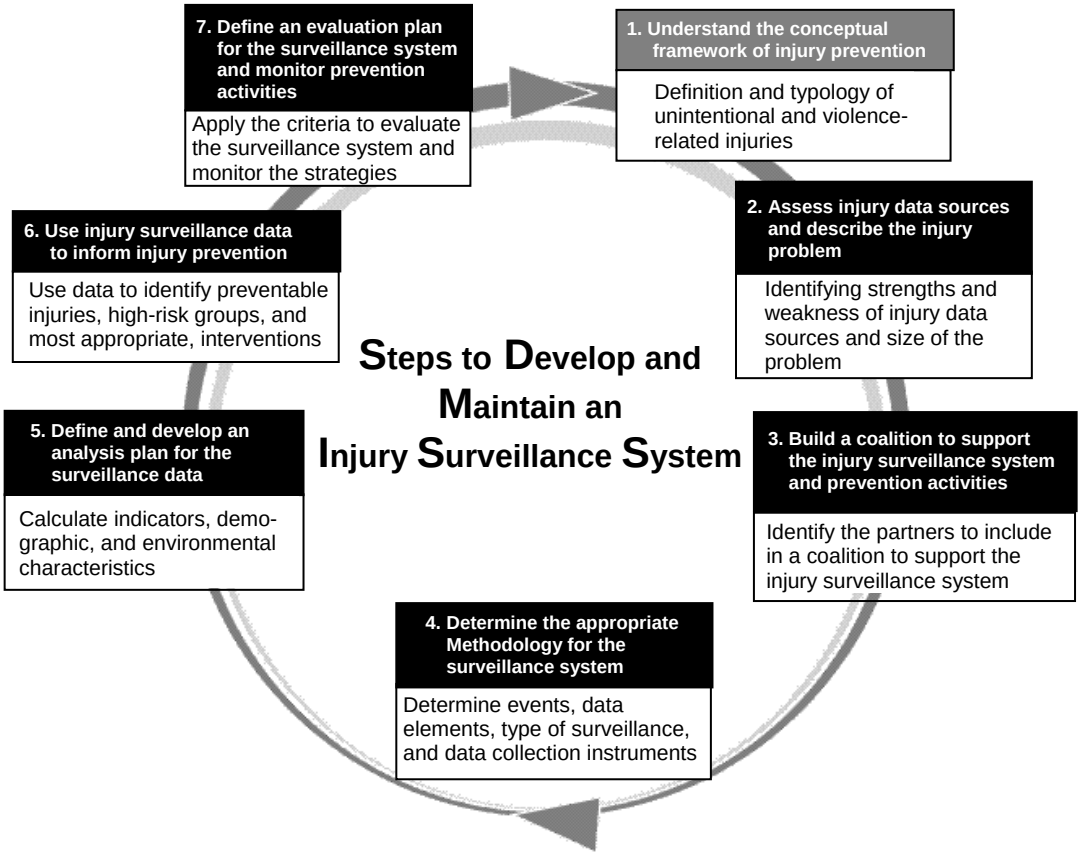
Injuries have been shown to account for a significant health burden on populations, regardless of gender, age, income, or geographic region. The historical neglect of injuries as accidents or random events is fading with the growing understanding that injuries are a preventable health threat that affect us all. The role of the epidemiologist is fundamental in this evolution. By conscientiously providing the public and policy makers with a steady stream of effectively gathered and correctly analyzed and interpreted surveillance data, epidemiologists can significantly contribute to effectively addressing this previously overlooked health issue.

Currently, surveillance for injury is similar to that for infectious or chronic diseases. However, some circumstances are unique to injury, such as the role of institutions outside the health sector, including police departments, district attorneys, forensic medicine, coroners and medical examiners, and transportation offices. Ethical considerations also come into play more often in violence-related injury, especially when the injury results from crime (e.g., homicide).

> **Injury surveillance** is defined as:
>
> "…the ongoing systematic collection, analysis, and interpretation of injury data, for use in planning, implementation and evaluation of prevention activities. Injury prevention programs use surveillance data to assess the need for new policies or programs and to evaluate the effectiveness of those that already exist."[17]

The steps for developing and maintaining an injury surveillance system follow. Notice that the process is considered *cyclical*; when you evaluate the system you will probably revisit the steps you completed earlier to make adjust-ments and to continually improve the quality of the system. For example, circumstances change, and the coalition members or operations team may need to be adjusted, or you may find you need to change your indicators. In addition, it is very likely that some of these steps occur simultaneously or in a different order. The first step is to know the conceptual framework of injury prevention, which is basic to developing the subsequent steps. The second step is to describe the size of the injury problem and the data sources. In the third step, some considerations about the coalition necessary to support the injury surveillance and prevention activities are described. The fourth and fifth steps specify the technical skills necessary to develop the surveillance system. Discussions of the methodology and analysis plans are also covered in

these sessions. The sixth step focuses on translating surveillance data into prevention activities. The last step involves defining an evaluation plan and monitoring activities. These steps draw upon other important documents and reports such as the *Injury Surveillance Guidelines*.[5, 18]



7. Ethical Considerations

Effective public health activities, including public health surveillance, depend on a trusting relationship between public health practitioners and the society they need to help.[19] Epidemiologists should consider any known or potential risks that individuals or populations may encounter as a result of their participation in surveillance activities. Consideration should be given not only to physical risks, but also to psychological, economic, legal, and social risks. Surveillance practitioners should be sensitive to the possible stigmatization of groups as a result of categorization in surveillance data.[20]

Protecting Confidentiality and Privacy

Privacy refers to the right of individuals to refuse to provide information about themselves. *Confidentiality* refers to the obligation of parties receiving such information to restrict access to it as stipulated by the individual in question. Except under unusual circumstances (e.g., when there is a need for follow-up counseling or treatment, or when release of information is mandated by a court of law), information obtained about participants in a surveillance project should be kept confidential. Protection of confidentiality is not only required by the ethical principle of respecting people (autonomy), but also because the disclosure of certain information to third parties or subsequent use of the data for a purpose other than that which motivated its initial collection may cause harm to an individual, such as discrimination in employment, housing, or health insurance coverage.[21]

A successful reporting system will have clear policies that protect the privacy and confidentiality of information. Policies and procedures also need to protect sensitive or personally-identifying information from being disclosed. For instance, law enforcement agencies may be reluctant to divulge information that could even remotely compromise pending investigations. Law enforcement may be particularly sensitive about "legal" homicides or deaths that occur in the course of duty. The privacy rights of living suspects and alleged perpetrators associated with violent deaths include the right to be free from defamation. The duty of law enforcement agencies to thoroughly investigate homicides and to apprehend perpetrators requires agencies to protect information from disclosure in many open or pending cases. Protection of information on juveniles is even stronger: state statutes almost universally protect such information, based on the philosophy that juveniles should receive rehabilitation and services as opposed to punishment.[22]

8. Summary

Now that you have completed this session, you should be able to:

- Understand concepts, definitions, and classification of injury;
- Know the differences between violence-related and unintentional injuries;
- Describe the global burden and cost of injuries;
- Know the conceptual models for understanding and preventing injury;
- Know the steps to develop an injury surveillance system;
- Review ethical considerations.

Session II addresses the next step, assessing injury data sources and describing the injury problem.

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INJURY SURVEILLANCE TRAINING MANUAL

PARTICIPANT GUIDE

SESSION II

ASSESS INJURY DATA SOURCES AND DESCRIBE THE INJURY PROBLEM

Developed with the support of the
National Center for Injury Prevention and Control
Division of International Health, Epidemiology Program Office
Centers for Disease Control and Prevention
Atlanta, GA

SESSION II
ASSESS INJURY DATA SOURCES AND DESCRIBE THE INJURY PROBLEM

Learning Objectives

- Identify injury data sources and the strengths and weaknesses of each.
- Identify available data sources that can provide information to the surveillance system.
- Describe the size of the injury problem.
- Compare the frequency of injuries calculated with data from different sources.

Introduction

Data sources in an injury surveillance system may come from the health sector, law enforcement, and other sectors. Death certificates, one of the most important documents for fatal events, are usually filled out by physicians, medical examiners, coroners, pathologists, or in some rural areas, by lay people. Death certificates provide an accurate death count; however in some countries, death certificates do not contain information on underlying cause of death, victim's occupation, or the context where death occurred. In such cases, the police report is more accurate for collecting information related to the context or circumstances and the aggressor.

In some developing countries, health information systems are not sufficient to cover all regions of the country. These systems often lack reliable data on the local incidence of health conditions or even on the leading causes of death. The magnitude of the problem of injuries is inadequately documented in such countries except by special surveys or data sources outside the health sector. Sometimes the only deaths recorded are those that occur in hospitals and for which a death certificate is completed. Most deaths that occur at home in rural areas are unreported. Even the records of deaths that occur in hospitals may be relatively useless for public health purposes and coding may be inadequate.[1]

An adequate investigation of the external cause and circumstances of injury deaths that occur in communities involves police, coroners, pathologists, the national statistical office, and the transportation office. Poor communications infrastructure, underreporting of deaths, long delays before reported deaths are investigated, staff shortages, inadequate laboratory tests, and lack of transportation to remote areas all hinder the investigation of injury deaths and reduce the reliability and validity of injury mortality.

Police reports are also a potential source of information about injuries, especially road traffic injuries and violence-related injuries. Often the police have an office in charge of investigating the circumstances surrounding violent deaths. This information can be very useful for determining the context in which the injury occurs.

Records of occupational injuries are sometimes available from sources such as departments of labor or occupational hygienists working in industrial settings.

Local newspaper accounts of deaths and injuries are also potentially valuable sources of information. Newspaper accounts often include details about the age and sex of victim and the cause and agent of injuries. For certain types of unintentional injuries, such as drowning and fires, these stories can be relatively complete and contain more useful details about preventable factors for injury deaths than do coroners' reports.

The utility of existing data can be enhanced significantly by establishing data linkages across jurisdictions. Such linkages can overcome the limitations of separate databases and aid in the development of comprehensive information about an event, its circumstances, the occurrence and severity of the injury, the type and cost of treatment received, the outcome in terms of both mortality and morbidity, and the administrative or legal outcome.

Linking disparate data sources is a good strategy for assessing the true magnitude of the injury problem. However, significant barriers may be encountered when establishing linkages:

1. Limited access to databases (in some cases, relevant data are collected but not computerized and, if computerized, are not readily available because of data release policies, concerns about confidentiality, and interagency politics);
2. High costs and limited resources for developing and maintaining databases;
3. Technical difficulties.

When the databases to be linked use similar unique identifiers, linkage is relatively easy. However, most databases have been stripped of unique identifiers to protect confidentiality. To address this barrier, probabilistic matching software has been developed and used to link data-bases when unique identifiers are not available and to deal with the inevitable discrepancies related to spelling, data entry errors, or similar problems.

In the United States, for example, the National Highway Traffic Safety Administration (NHTSA) has fostered development of linked databases by funding several states to develop Crash Outcome Data Evaluation Systems (CODES). CODES were initially designed to develop comprehensive data for determining the impact of seat belt and motorcycle helmet use on the incidence and severity of

injuries, health care costs, and outcome. The implementation of CODES required the linkage of police crash reports with death certificates or medical examiner data and health care data (including emergency medical service data, emergency department data, hospital discharge data, and occasionally data from insurance claims). The CODES database is now being used to address a variety of motor vehicle injury research and evaluation questions at the local, state, and national levels. Similar linkages are needed for other types of injuries.[2]

The U.S. National Violent Death Reporting System (NVDRS), implemented by Centers for Disease Control and Prevention (CDC) in 2000, was developed to provide a census of violent deaths that occur in the United States. Information documented by coroners and medical examiners, vital records registries, law enforcement, and crime laboratories for violent deaths is gathered at the local level, linked in a standardized database, stripped of individual identifiers, and forwarded to the national database.[3]

In Colombia, the use of linkage data has been implemented in the Fatal Injury Surveillance System, which is in operation in Cali and Bogotá. Data from different sources are linked in a database to support prevention strategies.[4]

This session emphasizes the use of injury information from multiple data sources. The exercises and examples will be performed using mortality data. Morbidity data, such as hospitalizations, visits to emergency departments, or admissions to rehabilitation facilities, can be used if they are available. Such data provide information on the frequency and the severity of nonfatal injuries. In this session, you will learn to identify injury data sources in your region, calculate and compare basic indicators using data from different sources, describe the size of the injury problem, and define the most appropriate data sources for providing information to the surveillance system.

1. Identify Strengths and Weaknesses of Injury Data Sources

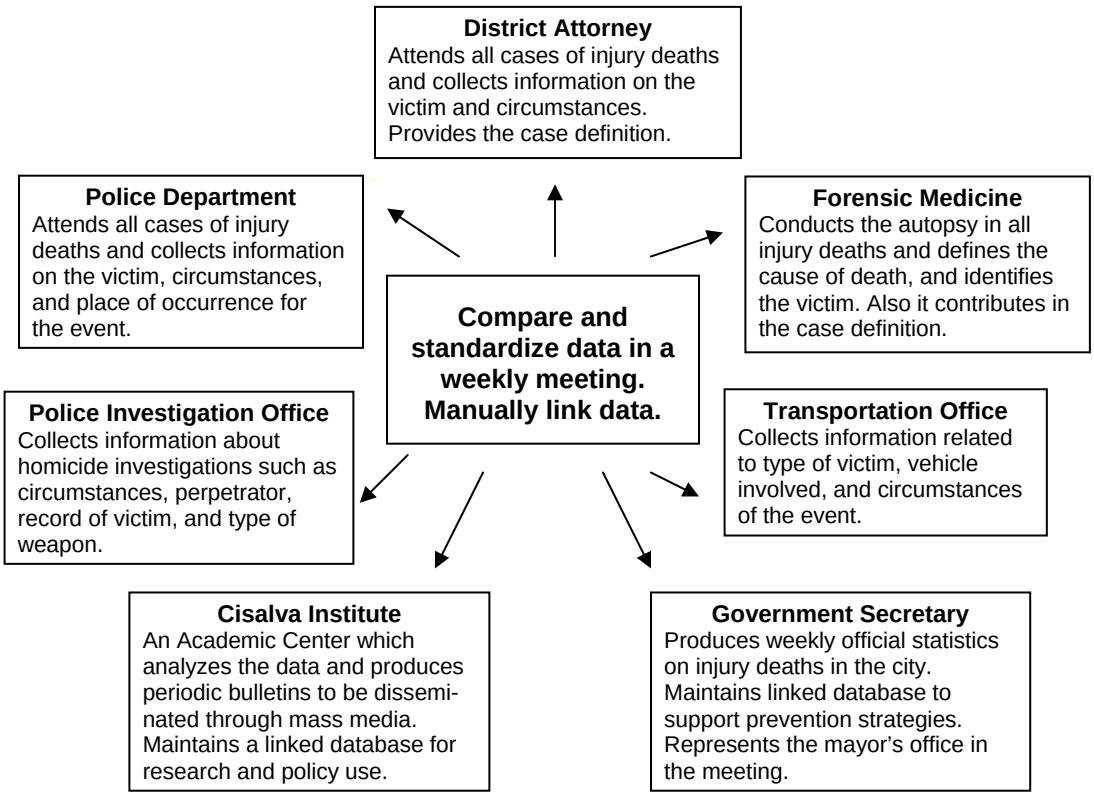
Each institution collects injury mortality data that supports its mission, which may vary from country to country. However, there are some commonalities. The health sector maintains information on injuries and deaths collected by health institutions. This focus is often on the injury itself more so than the circumstances surrounding it. Medical providers in emergency rooms, for example, have more interest in saving the life of the victim than in knowing if the injury was unintentional or violence related. The health sector uses the International Classification of Diseases (ICD) to assign a code for each disease or cause of death.

For instance, police generally record their findings about road traffic crashes and injuries in collision or accident reports. The police definition of what constitutes a traffic injury can have a major impact on traffic injury data. Studies have shown that the completeness and accuracy of police reporting is adequate for deaths, moderately useful for serious injuries, and usually poor for less-severe injuries.

Additionally, police are more likely to misreport serious injuries as slight injuries when the occurence involves vulnerable road users rather than vehicles.[2]

Example:
The data sources used in the Fatal Injury Surveillance System in Cali, Colombia, are presented in Figure 1. Data are linked manually to a common database, through a weekly meeting to compare and standardize the information.[5]

Figure 1. Data Sources for the Fatal Injury Surveillance System Cali, Colombia



Exercise: Discuss the strengths and weaknesses of data sources in your region.

2. Determine the Jurisdiction, Data Collection Method, and Data Flow Used by Each Data Source

In an injury surveillance system using different data sources, the reported data may correspond to different geographical areas, which may cause differences in the registries.

For road traffic injury, for example, the victim could die at the site, on the way to the hospital, or in the hospital. At the hospital the victim could die that day or many days later. Police records usually contain information about the victims who die in the street, but not always. The transportation office often reports the event, but usually only when an official is at the scene. Also, the time of the event collected by each data source could vary. Even in the hospital, if the injured person is admitted, there may be a discrepancy between the initial and final diagnoses.

The health sector maintains records of deaths occurring in the hospitals. If the victims die at the scene and do not reach the hospital, their deaths are not registered by the hospital. For instance in San Salvador (El Salvador), only 25% of the homicides that occurred in the city in 2002 were registered in the public hospitals.[6]

Vital statistics offices often collect information from the death certificates. If the death certificates are incomplete or underreported, the result will be statistically unreliable. The data published by these offices are classified by place of residence, which is helpful in calculating rates by residence. However, records of deaths by place of occurrence are necessary for developing prevention strategies.

Example:
A comparison was made using data from forensic medicine offices and police departments for some cities in Colombia. For all municipalities, the number of cases reported by forensic medicine was higher than those reported by police.

An analysis of the discrepancy in numbers indicated that data from forensic medicine offices are administrative in nature and reflect the number of necropsies done on homicides in each municipality, regardless of the event's place of occurrence.

In contrast, data from the police department indicate the number of homicides in each city classified by place of occurrence. This example shows how published data can sometimes be misleading (Table 1).

Table 1. Number of Homicides in Cities of Colombia — 1999

City	Forensic Medicine	Police Department
Palmira	185	95
Buga	106	81
Tulua	166	87
Cartago	210	83
Buenaventura	312	131
Roldanillo	94	85
Zarzal	65	63

Source: Forensic Data for Life, National Police Bulletin. Prepared by: Espitia V., Espinosa R., and Vergara M. for the Office of the State Public Health Secretary's Sivivi Project, 2000.

Exercise: Answer the following questions.

If one person is hospitalized because of an injury and later dies in another hospital in another city or state:

- **a.** Where must the death certificate be filed?
- **b.** Where should the investigation about the perpetrator and circumstances be conducted?
- **c.** Where must the case be counted?

2.1 Describe Data Collection Method and Data Flow

Data collection methods vary among institutions because each uses its own forms to collect information at the scene. This information is entered into databases and analyzed to produce periodical reports. For example, the police usually prepare reports of cases known to them (some are restricted, but most are public); forensic medicine and public health officials frequently prepare annual reports of cases they treat. Data collection methods and data flow can vary among institutions depending on the human and techonological resources available in each place.

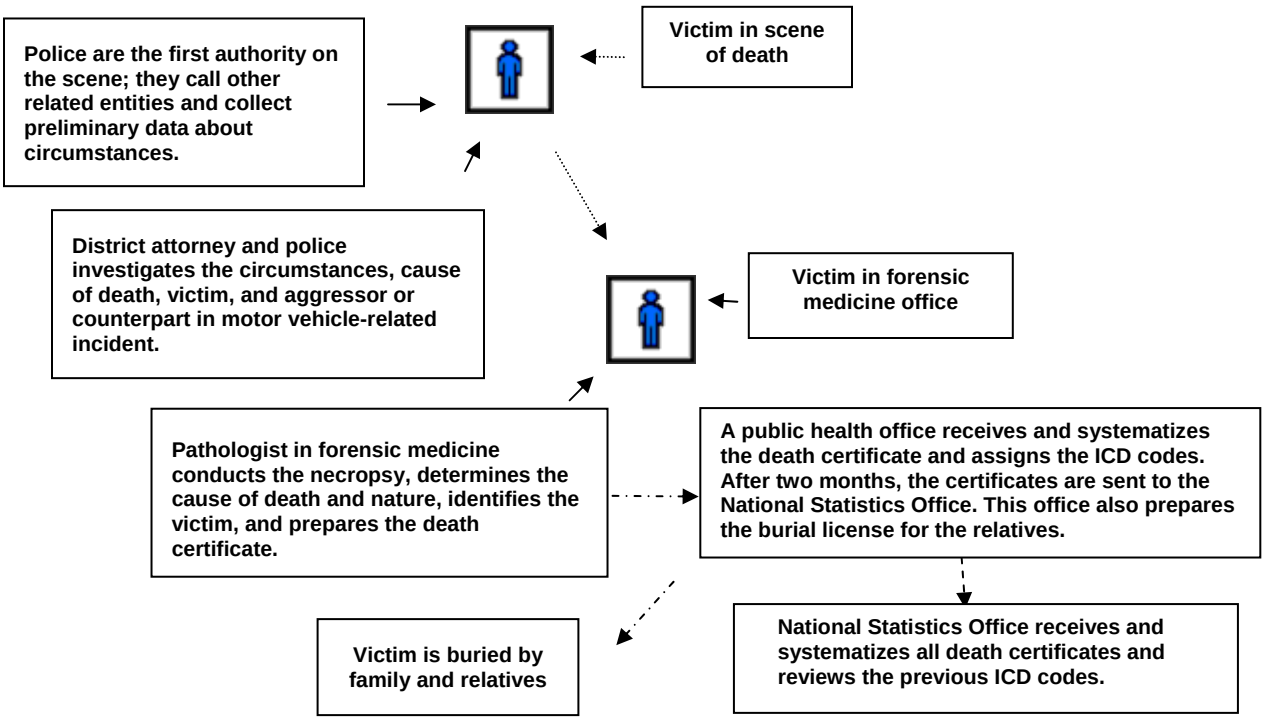
In the United States, for instance, when a death occurs, the funeral director obtains information from the family about the decedent's education, occupation, birthplace, racial identity, etc. The local coroner/medical examiner (C/ME) supplies cause-of-death and basic information about the context of death. The certificate is then filed with the local or state health department. In most states, a nosologist at the state health department registry of vital records assigns the ICD cause-of-death codes, usually with software assistance. There are three types of state death certificate data:

1. Death certificate—usually available within a few weeks after the death; includes cause of death and nature of injury, but not necessarily in coded format.
2. Preliminary electronic data—either in electronic form or a hard copy printout; sometimes these preliminary electronic data are available within weeks of the certificate being filed.
3. Final death certificate data—cleaned and fully coded; this level of data may not be available for a long time, as much as a year and half after the close of a data year.[3]

C/MEs are responsible for investigating violent or sudden deaths and for providing an official determination of the cause of death. They are in charge of (a) determining the circumstances surrounding the death; (b) investigating the scene; (c) arranging for or conducting postmortem exams or autopsies; (d) toxicology testing; and (e) certifying the cause of death. Twenty percent of deaths in the United States, typically those due to homicide, suicide, or unintentional injury, are investigated by C/ME offices.[3]

The process of investigating an injury death in Cali, Colombia is shown in Figure 2. Police officers patrolling the streets are the first authority present on the scene. They send data about injuries and crimes by radio or fax to their central office and to the district attorney's office. The police officer in charge of the investigation attends the scene with the district attorney, who collects information related to the victim, circumstances, and possible aggressor. They investigate homicide, suicide, other unintentional deaths, and motor vehicle-related deaths. Pathologists in the forensic office await the body, which is transported by the district attorney and police. The forensic medicine office collects information on a specially designed form, the necropsy report. All data about the body of the victim is registered on this form. The death certificate, which contains information on cause, nature of death, and identification of victim, is filed. The public health office receives and systematizes the death certificate and sends it to the National Statistics Office.[5]

Figure 2. Injury Death Investigation Process in Cali, Colombia



Exercise: Draw on the board the process to follow when an injury death occurs in a city. Answer the following questions:

1. What do the police do?
2. What does the forensic medicine office do?
3. What does the health sector do?
4. What does the district attorney do?
5. What does the coroner/medical examiner do?
6. What do the relatives do?

3. Identify the Data Sources to Include in the Surveillance System

The injury events that will be included in a surveillance system determine which data sources are necessary to provide information to the surveillance system. The availability and quality of data are important criteria when selecting data sources. Table 2 shows possible data sources for a surveillance system according to event and availability of data. The shaded boxes indicate the best data source for a given type of information. This is only an example, however, and the availability of data and sources may vary in each country.

Table 2. Probable Data Sources in an Injury Surveillance System

Data Sources								
Events	**District Attorney**	**Police Office**	**Forensic Medicine**	**Public Health**	**Transport Office**	**Family Community**	**Non-government Offices**	**Media**
Fatal Injuries								
Homicide								
Suicide								
Transport - Related deaths								
Other Unintentional Deaths								
Nonfatal Injuries								
Homicide Attempt								
Suicide Attempt								
Transport-Related Injuries								
Other Unintentional Injuries								
Domestic Violence								
Child Maltreatment								
Elderly Abuse								

Exercise: Identify a data source for each event in Table 2. One group will work with fatal injuries; the other group will work with nonfatal injuries.

4. Describe the Size of the Injury Problem

The availability of reliable health statistics generally reflects a country's level of development. In some countries, reliable data on the local status of health conditions, or even on the leading causes of death, are not available. Preliminary estimates of basic indicators like number and percentage of injuries will begin to give you an idea about the problem of injuries in the region.

The purpose of this part is to guide participants in reviewing mortality data such as the frequency of the twenty leading causes of death by cause and frequency of injury deaths by intention. If morbidity data are available (such as hospital discharge data by cause), these data can be used to broaden the understanding of the problem.

4.1 Determine the Frequency of the Leading Causes of Death

Deaths are commonly used to describe and compare public health problems, in part, because deaths are well defined and detailed mortality data are often available. Data on fatalities (particularly homicide, suicide, and war-related deaths) and on motor vehicle and other unintentional injuries can provide an indication of the extent of the injury problem in a particular community or country. These data can also be used for monitoring changes over time in injury rates, identifying groups and communities at high risk of injury, and making comparisons within and among countries. These data are also useful for motivating stakeholders to support injury prevention and to build a coalition. Knowing the leading causes of death makes it possible to rank injuries by frequency.

In Table 3, for instance, the 15 leading causes of death in the United States are shown. Unintentional deaths, suicide, and homicide were among the 15 leading causes of death in 2000.

Table 3. Total Deaths for the 15 Leading Causes of Death, U.S. Population — 2000

Rank	Cause of Death (Based on ICD-10 Revision, 1992)	Frequency
1	Heart Disease	710,760
2	Malignant Neoplasms	553,092
3	Cerebrovascular Diseases	167,661
4	Chronic Lower Respiratory Diseases	122,009
5	**Unintentional Injuries**	**97,902**
6	Diabetes Mellitus	69,301
7	Influenza and Pneumonia	65,313
8	Alzheimer's Disease	49,558
9	Nephritis, Nephritic Syndrome, and Nephrosis	37,251
10	Septicemia	31,224
11	**Suicide**	**29,350**
12	Chronic Liver Disease and Cirrhosis	26,552
13	Essential (primary) Hypertension and Hypertensive Renal Disease	16,073
14	**Homicide**	**16,765**
15	Pneumonitis due to solids and liquids	16,636
	All other causes	391,904
Total		**2,403,351**

Adapted from: *National Vital Statistics Report*, Vol. 50, No 15; September 16, 2002.

Exercise: Using local data, develop a table showing the frequency of the 10 or 15 leading causes of death (similar to Table 3).

4.2 Determine the Frequency of the Leading Causes of Injury Deaths

After the leading causes of death are known, the next step is to determine the leading causes of *injury* deaths. The following examples can be used to initiate discussion about the characteristics of injury death by intention.

Example 1:
In the United States, 148,209 people died of injuries in 2000. Of these deaths, 97,900 were classified as unintentional and 46,474 as violence-related (Table 4). Death certificates provided the data for these figures, and the information was obtained through CDC's Web-based Injury Statistics Query and Reporting System (WISQARS) (www.cdc.gov/ncipc/wisqars/default.htm).

Table 4. Injury Deaths Among U.S. Residents — 2000
All Races, Both Sexes, All Ages

Intent	Cause of Injury Deaths	Frequency
Unintentional Deaths (97,900 Total)	Overall Motor Vehicle	43,354
	Other Unintentional Deaths	54,546
Violence-related Deaths (46,474 Total)	Homicide	16,765
	Suicide	29,350
	Legal Intervention-Related	359
Undetermined Intent		3,819
Total		**148,209***

* Includes 16 deaths associated with operations of war and its sequelae (ICD codes Y36–Y89.1). Source: Centers for Disease Control and Prevention. Web-based Injury Statistics Query and Reporting System (WISQARS) [Online]. (2002). National Center for Injury Prevention and Control, Centers for Disease Control and Prevention (producer). Available from: URL: www.cdc.gov/ncipc/wisqars. [2003 May 15].

Example 2:
In Cali, Colombia, over a 10-year period (1993–2002), a total of 19,479 homicides, 1,106 suicides, 4,403 motor vehicle-related deaths, and 1,269 other unintentional deaths were registered by the Fatal Injury Surveillance System[5] (Table 5).

Table 5. Frequency of Injury Deaths in Cali, Colombia, 1993–2002

Intent	Cause of Injury Deaths	Frequency
Unintentional Deaths (5,672 Total)	Motor Vehicle-Related	4,403
	Other Unintentional Deaths	1,269
Violence-Related Deaths (20,585 Total)	Homicides (includes legal intervention)	19,479
	Suicides	1,106
Total (not including undetermined intent)		**26,257**

Source: Fatal Injury Surveillance System. Data from: Police department, forensic medicine, district attorney, transportation office.

Exercise: Compare injury deaths in the United States and Cali. Answer the following questions:

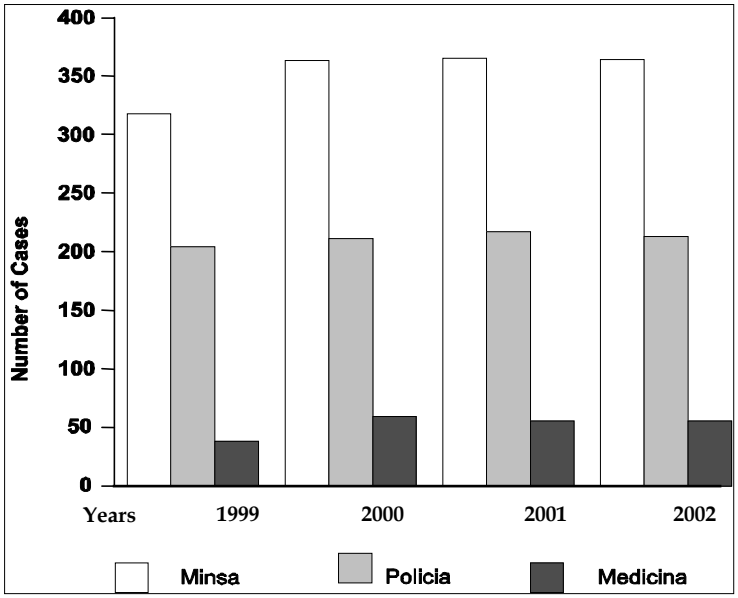
1. Are there differences in injury mortality characteristics?
2. Are the data comparable?
3. Which indicator(s) will you use to compare these data?

5. Compare the Frequency of Injuries Calculated with Data from Different Sources

Injury data are commonly collected for different purposes according to the mission of each institution. Identifying the goal behind each and comparing the goals with the objectives of the surveillance system will help explain the differences in the numbers.

For instance, in Nicaragua, when a suicide mortality comparison was performed among three different data sources, the Ministry of Health (minsa), the police (policia), and forensic medicine (medicina), differences were found among the data sources. Forensic medicine only reported data for deaths occurring in Managua, the capital city. The police did not investigate all cases of suicide, and the health sector provided information from hospital deaths and death certificates in the country[7] (Figure 3).

Figure 3. Suicide Reported by Different Data Sources in Nicaragua, 1999–2002



Source: Prado F, Rocha J. Injury Surveillance Workshop, 2003.

Another comparison among injury data sources was conducted in El Salvador. The absence of information seen in some categories reflected the lack of interest or timely data for specific types of death. For instance, suicides and other unintentional deaths are not reported by the police, since their interest is in homicides and motor vehicle-related deaths. Forensic medicine reports data for all injury deaths. More motor vehicle-related deaths and homicides are recorded by forensic medicine than by the police. Public health collects data on homicide and suicide, but the frequency is lower than the previous two sources because public health only reports hospital deaths[8] (Table 6).

Table 6. Total Cases of Injury Mortality Reported by Different Data Sources in El Salvador — 2001

Type of Injury	Forensic Medicine	Police Department	Public Health
Frequency of Unintentional Injuries			
Motor Vehicle-Related Deaths	1,629	886	No data
Other Unintentional Deaths	933	No data	No data
Frequency of Violence-Related Injuries			
Homicide	2,696	2,341	543
Suicide	815	No data	222

Source: Forensic medicine, police department, and public health. Injury Surveillance Workshop; 2002.

Exercise: Calculate injury frequency using local death data. Summarize the data by the major injury categories (i.e., homicide, suicide, motor vehicle-related, and other unintentional deaths). Compare the different indicators and discuss, keeping in mind the following topics:

1. Are there some differences among the data from different sources?
2. Which events have more discrepancies?
3. If discrepancies are found, explain why there may be differences.

6. Summary

Now that you have completed this session, you should be able to:

- Identify injury data sources and the strengths and weaknesses of each;
- Identify available data sources that can provide information to the surveillance system;
- Describe the size of the injury problem;
- Compare the frequency of injuries calculated with data from different sources.

Session III addresses the next step, which is to build a coalition to support the injury surveillance system and prevention activities.

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INJURY SURVEILLANCE TRAINING MANUAL

PARTICIPANT GUIDE

SESSION III

BUILD A COALITION TO SUPPORT THE INJURY SURVEILLANCE SYSTEM AND PREVENTION ACTIVITIES

Developed with the support of the
National Center for Injury Prevention and Control
Division of International Health, Epidemiology Program Office
Centers for Disease Control and Prevention
Atlanta, GA

SESSION III
BUILD A COALITION TO SUPPORT THE INJURY SURVEILLANCE SYSTEM AND PREVENTION ACTIVITIES

Learning Objectives

- Identify partners to include in the coalition and recruiting strategies for involving them.
- Identify local, national, and international organizations working in injury prevention and control in the region.
- Define the existing social, legal, and political framework in which an injury surveillance system and prevention activities may be established.

Introduction

Exercise: Answer the following questions:

1. What does "coalition" mean to you?
2. What are some other names for coalition?
3. Do you think it is important to have a coalition to support the injury surveillance and prevention activities?

A coalition is *an alliance of organizations working together to achieve a common purpose*. A successful injury surveillance system requires the cooperation and effort of many individuals from different sectors. The expertise of professionals from multiple disciplines must be integrated to develop the most effective and efficient solutions for specific injury problems. For certain types of injuries, such as traffic injuries, drownings, or sports injuries, departments or organizations other than those involved with public health may be more efficient in coordinating prevention activities by multiple organizations. Public health epidemiologists can provide technical assistance to these groups in the development of surveillance and research.

Although circumstances vary from one community to the next, these issues must be addressed to ensure that the coalition will include the necessary partners, address pertinent health issues, and implement one or more successful programs or interventions. Some of these keys to success include:[1]

- Commitment of lead agency;
- Effective core planning group;
- Planned recruitment of coalition members;
- Functional coalition structure;
- Clearly defined staff roles;
- Formally accepted mission and goals;
- Respected leadership;
- In-depth education of coalition members;
- Ownership and commitment by coalition members;
- Successful implementation of a pilot project;
- Recognition of coalition members.

1. Identify Partners to Include in the Coalition

In addition to helping define prevention strategies, a coalition can provide the surveillance system with political and financial support. The stakeholders, authorities, data sources, communities, religious groups, nongovernment offices (NGOs), and other community groups organized around prevention should be represented in this group.

Also involve authorities that approve funding, lead programs and projects, and launch control laws. Health personnel are especially sensitive about prevention issues because they are directly affected by the consequences. Justice and security officials also have a vested interest because they attend to victims as well. Personnel in transportation offices who respond to traffic accidents may also want to participate in the coalition. Elementary and high school teachers are important to involve in this process because they face violence-related problems every day. Involving community organizations and mass media will be helpful in the development of prevention strategies and the dissemination of information.

Example:
Table 1 identifies potential partners to include in an intersectorial coalition for creation of an injury surveillance system (guidelines for the epidemiological surveillance of violence and injuries[2]). At least 10 sectors have been identified, along with the institutions and participants' profiles.

Table 1. Potential Partners in an Intersectorial Coalition for Creation of an Injury Surveillance System

Sector	Institutions	Participants
Health	Ministry of Health Hospitals Health Centers Health Posts	Epidemiologists, doctors, nurses, health educators, health promoters, paramedics, and other health workers
Justice	Forensic Medicine Offices (Coroner/Medical Examiner) Courts Public Defenders' Offices Prosecutors' Offices Family Services or Counseling	Forensic pathologists, judges, public defenders, prosecutors or their assistants, directors or professional staff of family services or family counseling
Security	Police (Homicide Investigation Office) Security Companies	Regional or local police chiefs, statistical officers
Transportation	Transportation Departments and Offices	Department directors or traffic police, statistical officers
Administration	Planning Departments National and Provincial Statistical Departments	Statisticians, geographers
Education	Universities Colleges Schools	Researchers, professors, and student leaders
Community	Community Organizations Youth and Mothers' Organizations	Community leaders, youth leaders, community groups
Private Organizations	Nongovernmental Organizations Human Rights Groups Insurance Aagencies	Spokespersons and leaders of private organizations, statisticians
Political	National, Regional, and Local Authorities	Staff in the president's, governor's, or mayor's offices
Media	Television, Radio, Newspapers	Journalists and personnel working in mass media

Source: Concha-Eastman A, Villaveces A. *Guidelines for the Design, Implementation, and Evaluation of Epidemiological Surveillance Systems on Violence and Injuries*. Washington, DC: Pan American Health Organization; 2001.

1.1 Determine Recruiting Strategies to Involve Coalition Partners

A good strategy to begin the recruiting process is to hold a meeting with stake-holders and potential partners to involve in the coalition. The meeting may be held before or at the initiation of the surveillance system to promote support among participating agencies, to recruit expertise, and to address objections and concerns that stakeholders may have before these become obstacles (e.g., why they should be interested in the surveillance system and how it will benefit them or the community). The stakeholder informational meeting can occur in a variety of settings. For example, it could be part of a larger conference about violence or could be a dedicated meeting. A neutral location for the meeting, such as a local college or hotel conference room, is a good idea. Potential investors must be included in this meeting as well. All attendees should be provided with injury data showing the big

picture: the lives that can be be saved and the social and economic costs that can be avoided. Provide concrete examples from a local community and ask the question, "Could this personal tragedy have been avoided?" Suggest the steps to develop an injury surveillance system and the prevention activities.[3]

Aside from government staff, invite knowledgeable people who are interested in recommended data sources and injury issues (e.g., law enforcement, criminal justice, health, and mental health). They can become valuable advocates for the surveillance system. A possible agenda for this meeting may be developed from the discussion topics which follow:

- Describe what is known and not known about the problem of injuries in your city or community. Use the injury data prepared in Session II to show the problem's magnitude.
- Discuss the opportunities an injury surveillance system offers to combat myths and misunderstandings, to learn about the size of the problem, and to develop, define, and monitor prevention strategies.
- Describe potential challenges, obstacles to success, and key contacts and resources.
- Establish a list of next steps for participants, including the development of an advisory board.[4]

Each participant in the coalition must have a clear role on the team. Politicians are often involved in funding for prevention programs and must approve legislation on prevention. Because politicians are usually not epidemiologists or public health officers, they are often driven more by economic pressures than by the human health issues and suffering that motivate health professionals. Thus, health and other sectors should collaborate with economists to clearly and forcefully document the short- and long-term economic impact of injuries. This will involve analysis of the direct and indirect costs of premature mortality and morbidity, including temporary and permanent disabilities.

Success Story:
In 1987, in Oklahoma City, the State Department of Health launched surveillance of burn injuries. The absence of a functional smoke alarm was identified as a major risk factor for fire fatalities. A partnership was formed among a number of community agencies and volunteers, including the state and local health departments, the local chapter of the American Red Cross, and the Oklahoma City Fire Department. The Lifesavers Program was established in 1990. Free smoke alarms were distributed in the area. Fire-related injury rates decreased 81% in the target population.[4] Some recruitment strategies used to involve the partners follow:

- Identification of institutions or organizations with similar goals that were working in the target community. For instance, the Red Cross gives temporary shelter to people who have lost their homes; consequently, it is important that the Red Cross participate in prevention activities.

- Preparation of an educational plan for partners based on statistical data, including what steps can be followed to prevent fire fatalities.
- Identification of opinion leaders (e.g., clerics, actors, and professional athletes) who can motivate community participation in the program.

2. Identify Local, National, or International Organizations Working in Injury Prevention and Control in the Region

Since injury prevention is often most successful at the local level, where specific injury problems can be addressed, coalition building at all levels, including the local level, is crucial to strengthening the response to the injury problem. Financial and technical assistance is needed from federal and state government agencies and from the private for-profit and nonprofit sectors.[5] Injury prevention is a goal that offers common ground for parties who might not otherwise agree about issues involving injuries, especially firearm violence or motor vehicle-related injuries.

There may be organizations working at the local level in injury prevention such as health care providers, police, educators, social workers, employers, and government officials. Small-scale pilot programs and research projects are usually developed at the local level to try out new ideas.[5]

At the national level, a variety of government ministries—not just those concerned with law enforcement, social services, and health, but others as well—can make important contributions to preventing injury. Education ministries, for instance, are an obvious partner, given the importance of intervention in schools. Religious leaders and organizations have a role to play through their pastoral work and, in appropriate cases, can mediate problems.[6]

At the global level, a variety of international donors, bilateral programs, nongovernmental organizations, and religious organizations are already involved in violence prevention activities around the world. These include the World Health Organization, United Nations, World Bank, Interamerican Development Bank, High Commissioner for Refugees, the United Nations Children's Fund, and others.[5]

Success Story:
In the United States, a successful local community organization effort in injury control is the Injury-Free Coalition for Kids initiative, which started with the Harlem Hospital Injury Prevention Program in New York City. In the mid-1980s, injury surveillance was used to identify the causes of injury to children and adolescents living in the low-income neighborhoods surrounding Harlem Hospital. In response to compelling evidence of an injury problem, a multidisciplinary lay-professional coalition was formed to develop and implement prevention programs.

The coalition included health professionals, parents, and community members. Strategies included development of safe play areas and provision of supervised activities for children. From 1983 to 1995, hospital admissions due to injury decreased by 55% overall (46% for pedestrian injuries; 50% for playground injuries; 46% for violence-related injuries).[7]

Exercise: Answer the following questions:

1. What institutions in your region are working in injury prevention and control?
2. What kinds of programs or projects do they have?

3. Determine the Existing Political, Social, and Legal Framework Within Which the Surveillance System and Prevention Strategies Will be Established

To establish an injury surveillance system or an injury prevention program, political considerations such as the importance of the problem to the authorities, the political situation in the country or region, and the timing of elections must be considered. These factors could positively or negatively influence the establishment of a surveillance system. It is important to know the legal framework. For example, are helmet and seat belt laws and drinking and driving bans needed in the region prior to initiating the surveillance system or the prevention program? Finally, it is important to understand the social norms in the area where the surveillance system will be established, like knowing if is socially acceptable for a person to drive a car after drinking alcohol. If it is acceptable, then the measure of blood alcohol concentration (BAC) levels of injured persons may be an important element to include in the surveillance system.

Exercise: Identify aspects of the political, legal, and social environment that can affect the ability to establish the injury surveillance system and injury prevention acrivities.

1. Is it socially acceptable for a husband to hit his wife?
2. What is the relationship between the mayor and the health authorities, security authorities, and communities?
3. Are motorcyclists and cyclists required to wear helmets?
4. How is drunk driving viewed?
5. Is there a regulation that applies to gun ownership?
6. Are authorities interested in establishing an injury surveillance system in their jurisdiction?
7. In which category would you include this photo? Why would someone display this bumper sticker?

4. Summary

Now that you have completed this session, you should be able to:

- Identify partners to include in the coalition and recruiting strategies for involving them;
- Identify local, national, and international organizations working in injury prevention and control in the region;
- Define the existing social, legal, and political framework in which an injury surveillance system and prevention strategies may be established.

The next step, in Session IV, will be to determine the appropriate methodology for developing and maintaining the surveillance system.

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INJURY SURVEILLANCE TRAINING MANUAL

PARTICIPANT GUIDE

SESSION IV

DETERMINE THE APPROPRIATE METHODOLOGY FOR THE SURVEILLANCE SYSTEM

Developed with the support of the
National Center for Injury Prevention and Control
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SESSION IV
DETERMINE THE APPROPRIATE METHODOLOGY FOR THE SURVEILLANCE SYSTEM

Learning Objectives

- Define the injury events and data elements (variables, case definition, and codes) to be included in the system.
- Develop data collection instruments and determine data collection frequency.
- Determine the type of surveillance system.
- Plan for systematization, maintenance, and security of the data.
- Describe the staff and key positions necessary to operate the system.

Introduction

When selecting a methodology for an injury surveillance system, several factors must be taken into account, including data needs and existing resources. The key elements that must be addressed include injury events, variables, instruments, systematization of data, and required staff. All are described in this session.

The following criteria can help you select the appropriate methodology for your surveillance system:[1]

Objective: Clearly define what you want to accomplish with the surveillance system by considering questions such as:

- Why do you and other stakeholders want an injury surveillance system?
- Should the surveillance system be comprehensive (i.e., cover all types of injuries)? Should it also or solely focus on particular injuries?

Size and Type of Injury Problem: The magnitude and type of injury problem is one key element to determining which injury events to monitor. Basic indicators, as calculated in Session II, should be used to determine the size of the problem.

Available Data Sources: You must identify the source of information for the surveillance system. In the previous session, you developed the skills to identify such data sources.

Feasibility of Getting Information: Consider how feasible it is to get needed data. Which institutions are collecting these data? For instance, if you want to include

child maltreatment in the surveillance system, but none of the identified institutions collect this information, you may decide to exclude this outcome or include another data source in the system.

Political Priorities: Involving stakeholders and authorities in the development of the surveillance system will keep them informed and will help you understand their priorities.

Potential for Defining Interventions: The ultimate goal of an injury surveillance system is to identify appropriate interventions, based on the data analysis. Data collection and analysis should not be allowed to consume resources if action does not follow.[2]

1. Define the Events to Include in the Surveillance System

Because different data sources will be used in the surveillance system, one of the first steps is to establish cooperative and mutually-beneficial relationships with data providers and organizations that will serve as data sources. Once contact is made, set up a meeting either in person or over the phone to discuss the type of injury events and data elements needed, how data confidentiality will be protected, how the data can be collaboratively used, and the form in which the data are available (electronic files or hard copy reports). Sharing a list of required injury events and data elements with the data sources in advance will help them determine if they will collect their data on a standardized form, or just provide their data to the surveillance system on their own forms.

Some data sources may not have a database designed to collect information. They may only have counts on spreadsheets. Offering assistance in creating a database to collect the information may motivate some sources to participate in the surveillance system. However, some data sources, for instance, police departments and district attorneys, may want to include other events in the system, such as robbery or kidnapping, even if no one was injured. In this case, you should get an agreement over the key events and data elements to include in the surveillance system. For this reason, it may be appropriate to include more than the minimum variables needed for injury surveillance.

Identifying multiple-victim incidents is a problem in many injury surveillance systems. Linking victims who die in a multiple-victim incident is a challenge since most data sources are victim-based, and not incident-based. There are several ways to link cases, none of which are foolproof. In some cases, the police report collects the information indicating if the victim died in a single- or multiple-victim incident. Linkage is more difficult when only electronic data are available from data sources. Querying the data for cases that occur in the same city on the same day can sometimes reveal missed linkages.[3]

Other additional criteria can guide selection of the types of injury events to include in an injury surveillance system:

- Based on the intentionality: violence-related injuries or unintentional injuries;
- Based on the result: fatal injuries, nonfatal injuries, or disabilities;
- Based on the nature: physical, sexual, psychological, deprivation, or neglect.

Example:
In the United States, there are 12 state health departments that voluntarily participate in a new surveillance effort. These health departments use the six categories listed below to monitor injury events. The process of selecting these events was based on the availability of data sources and their willingness to share the information. In this model, the states are collecting nonfatal, fatal, unintentional, violence-related, and self-reported injuries:[4]

1. All injury hospitalization;
2. Traumatic brain injury;
3. Motor vehicle crashes;
4. Self-reported motor vehicle crashes;
5. Drowning;
6. Fire-related injuries and deaths.

2. Determine Data Elements to Include in the System: Variables, Case Definition, and Codes

Data elements are the variables needed for each event, such as demographic variables (name, age, sex, education level, employment, alcohol consumption); time variables (date, time of event occurrence, time of death); place variables (where the event occurred, residence of victim, and where the victim died); circumstance variables (relationship between victim/aggressor, mechanism used [type of weapon], context surrounding the event, and criminal history of victim). The case definition and codes are included as data elements as well.

2.1 Define the Variables

Frequently, the injury surveillance system collects variables related to: (1) the person who has a fatal or nonfatal injury; (2) the time and place where the event ocurred; and (3) the characteristics or context surrounding the event.

Demographic Variables

Name: Some injury surveillance systems do not collect the name of the injured person, just an identifier, which is necessary if the data are linked. In some cases (i.e., a pedestrian is injured by a hit and run driver), the identity of the person is unknown.

Age and sex: These are variables frequently included in the surveillance system and for which the information is usually available.

Race or ethnic group: In some places or regions, defining this variable is difficult. Race/ethnic group are not collected frequently.

Education level: This variable is not often collected.

Employment: It is an important variable, especially for occupation related-injuries.

Blood alcohol concentration (BAC) : Although very important, a BAC test result is rarely available because either the test is not taken or the result is not timely. BAC testing of the aggressor is critical, especially in transportation-related injuries; however, it is difficult to get as well. Collection of this variable has several limitations: cost related with having the test available for all cases; authorization to conduct the test; and legal implications of test results.

Place of residence of the injured person: This variable is considered as demographic if the purpose is to know the socioeconomic status of the person according to the place where he or she lives. Traditionally, epidemiologic studies use the victim's place of residence, while criminological studies use the place of occurrence.[3] This variable could be included with the purpose of performing geographical analysis or distribution of the case.

Time-related Variables

Date and time of event, of health care (if provided), and of death (if it occurs): These moments could be different, and usually data sources register just one, according to their interest.

Place-related Variables

Date and time of the event, of health care (if provided**), of death** (if it occurs), and **of residence**. The place where the event occurs could be considered in two dimensions: one is the place where the person was at the moment of injury (i.e., home, street, school); the other dimension is the

exact address, which is useful to perform geographical analysis. On the other hand, the place of death could be different from the place of occurrence or the scene where health care was practiced. Some deaths are investigated at the scene, whereas others are investigated where the victim lives. Information about the place of occurrence is needed to define prevention activities.

Variables Related to Event Circumstances (Characteristics)

Relationship victim/aggressor: This variable is useful for the analysis and for defining prevention activities, especially instances of domestic violence or child maltreatment. However, this information is difficult to collect, even with information from law enforcement.

Mechanism: This variable is usually collected by the injury surveillance system, and it indicates the method or instrument that caused the injury.

Context: If possible, the collection of this variable is key to defining prevention activities. Police are often able to collect this information.

Criminal history of victim and aggressor: Although these variables are important to understanding the problem, seldom are criminal histories available. To obtain this information, it may be necessary to use other methods (surveys or special research).

Other variables included in the injury surveillance systems are the nature, severity, and result of the injury. These variables may be collected in hospital-based systems.

Example:
The World Health Organization's (WHO) *Injury Surveillance Guidelines*[1] propose two types of variables. The first group is called the "core set" and the second group the "optional data set.

Guidelines from the Pan American Health Organization (PAHO)[5] are in the form of a table that depicts the relationships between variables, definitions, type of measurement, sources, and usefulness.

The fatal injury surveillance system in Cali, Colombia,[6] includes 12 similar variables.

These three proposals are shown in Table 1. Shaded boxes indicate the common variables among the three examples.

Table 1. Variables Included in Injury Surveillance Systems

WHO Guidelines		PAHO Guidelines	Fatal Injury Surveillance System Cali, Colombia
Core	**Optional**		
DEMOGRAPHIC VARIABLES			
Identifier			Name
Age		Age	Age
Sex		Sex	Sex
		Marital status	
Activity		Employment	Employment (only in cases of suicide and other unintentional deaths)
		Socioeconomic status (SES)	SES
		Education level	
	Other psychoactive substances	Alcohol level	Alcohol level
	Race/Ethnicity		
TIME VARIABLES			
	Date of injury	Date of act	Date of event
	Time of injury		Time of occurrence
PLACE VARIABLES			
		Neighborhood	Place of occurrence – Neighborhood and SES
Place of occurrence	Place of residence	Location of the act	Place of residence – Neighborhood and SES
CHARACTERISTICS			
Mechanism of injury		Type of weapon	Mechanism of injury
		Motive for the act	Context
		Relationship victim/aggressor	Aggressor known / unknown
		Special category of people or risk group	Special category of people or risk group
Intention			Intention (homicide, suicide, transport-related, other unintentional deaths)
Nature of injury	ICD codes, Severity, Disposition		
			For motor vehicle-related injuries: mode of transport, type of victim, and vehicle involved

2.2 Define the Codes to Use in the System

Standard codes are required to accurately compare state, local, or international data to assess the magnitude and distribution of injuries as a public health problem. In Public Health Sector, mortality data on death certificates are coded using the International Classification of Diseases (ICD) codes. In 1999, the tenth revision of ICD codes (ICD-10) replaced the ninth revision (ICD-9), which had been the standard since 1979. In the ICD-9, external causes of death were coded with a supplementary set of codes (commonly known as E-codes). E-codes indicated the mechanism causing death (e.g., a motor vehicle traffic crash) and the injuries resulting from the external causes (e.g., fractures, open wounds), both of which were listed as contributing causes on the death certificate. In the ICD-10, external causes are classified under a series of alphanumeric codes, V01–Y98.[7] (For a list of ICD-10 codes, see: Ftp://Ftp.cdc.gov/pub/Health_Statistics/NCHS/Publications/ICD10/).

When a death or injury is the result of an external cause, the assigned ICD-10 or ICD-9 external cause code is defined as a combination of the manner of the death or injury and the mechanism of the event. Manner of death is classified as unintentional or accidental, suicide or self-inflicted, homicide or assault, intent not determined, legal intervention, or act of war. Examples of the mechanism of the event would be firearm injury or motor vehicle crash. The primary difference between the assignment of codes for mortality and morbidity is that for mortality, the external cause is the underlying cause of death (the event that led to the chain of events resulting in death) and for morbidity, the external cause of the injury is the event that was related to the patient's admission to the hospital.[7]

In the United States, CDC's National Center for Health Statistics (NCHS) formed the Ad Hoc Workgroup on the Classification of Death and Injury Resulting from Terrorism. Based on the efforts of this group, NCHS has developed a set of new codes within the framework of the ICD-10 and ICD-9 that will allow the identification of deaths from terrorism reported on death certificates through the National Vital Statistics System and injuries and illnesses from terrorism reported on medical records used for statistical purposes and for reimbursement.[8] Recognizing that investigation and tracking of terrorism is in the domain of the U.S. Federal Bureau of Investigation (FBI), the Ad Hoc Workgroup agreed to use the FBI definition of terrorism:

> "Injuries resulting from the unlawful use of force or violence against person or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives."[8]

"U-codes" have been adopted to classify injuries related to terrorism. For instance, the classification for mortality is *U01 Assault (homicide), which includes assault-related injuries resulting from the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives.

***U02** Sequelae of Terrorism
***U03** Intentional Self-harm (Suicide)

The classification for morbidity related to terrorism follows:

E 979—Terrorism includes injuries resulting from the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives.

E 999—Late effect of injury due to war operations and terrorism

E 999.0—Late effect of injury due to war operations

E 999.1—Late effect of injury due to terrorism

Example:
WHO's *World Report on Violence and Health* presents a typology of violence, based on the victim/aggressor relationship and nature of violence. The cells in Table 2 have been filled out with the appropriate ICD-10 codes categories from Chapters V, XIX, and XX. Other data sources must be used to complete the boxes.

Table 2. A Typology of Violence Using ICD-10 Codes

Nature of Violence	Self-Directed		Interpersonal					Collective		
			Family/Partner			Community				
	Suicidal Behavior	Self-Abuse	Child	Partner	Elder	Acquaintance	Stranger	Social	Political	Economic
Physical	F10–F19 Mental and behavioral disorders due to psychoactive substance use	X60–X84 Intentional self-harm; Y87.0 Sequelae of intentional self-harm	Y07 Other maltreatment syndromes P04.2–4	Y07.0 Other maltreatment syndromes	Y07 Other maltreatment syndromes	X85–Y09 Assault; Y87.1 Sequelae of assault; Y08 Assault by other specified means; Y09 Assault by unspecified means		Y35-Y36 Legal intervention and operations of war		
Sexual			Y07 Other maltreatment syndromes	Y05 Sexual assault by bodily force	Y07 Other maltreatment syndromes	Y05 Sexual assault by bodily force. Includes rape (attempted), sodomy (attempted)				
Psychological		F10–F19 Mental and behavioral disorders due to psycho-active substance use	Y07 Other maltreatment syndromes	Y07 Other maltreatment syndromes	Y07 Other maltreatment syndromes					
Deprivation or Neglect			Y06 Neglect and abandonment: By spouse or partner, by parent, by acquaintance or friend, by other specified persons, by unspecified person							

In addition to ICD-10, other tools exist in the public health sector to classify the circumstances in which injuries occur. One such tool is the *International Classification of External Causes of Injury (ICECI).* It is a Related Classification in the World Health Organization's Family of International Classification of Diseases and Related Health Problems (www.who.int/classifications/icd/adaptations/iceci/en/index.html). It complements Chapter XX, External Causes of Morbidity and Mortality of ICD-10. The ICD-10 Framework: External Cause of Injury Mortality Matrix (www.cdc.gov/nhcs/about/otheract/ice/matrix10.htm) has been adopted to bridge ICECI and ICD-10, making it possible to compare aggregated injury data classified according to either system.

Another classification is the ICD-9-CM, which is a clinical modification of WHO's *Manual of the International Classification of Diseases, Injuries, and Causes of Death, 9th Revision (ICD-9).* ICD-9-CM codes are widly used to code external causes of injury for visits in hospitals, emergency departments, and ambulatory care settings across the United States. However, within the next few years, the ICD-9-CM classification system will be replaced with the 10th revision of the clinical modification of the ICD classification system, which is currently under development. The National Center for Health Statistics (NCHS), is coordinating the effort to develop an ICD-10-CM coding system, including expansion of external-cause-of injury codes. When implemented, ICD-10-CM will allow for more detailed coding of the external cause of injury based on information in the medical record about injury circumstances (e.g., intentionality, mechanism, place of occurrence, and activity at the time of injury).

Exercise: Describe how to classify and code the following examples.

If a person falls down the stairs and strikes his head on a metal door:

1. What is the principal diagnosis and the reason for admission at the hospital?
2. If a person falls, as in the previous example, but *dies* as a result of the fall, what is the immediate cause of the injury and the underlying cause of death?

2.3 Review the Case Definition

How do you define "a case"? It depends on the objectives of your surveillance system. For instance, if the objective is to monitor the burden of care on a given service, then a "case" will be any visit (first or repeat) to that service by an injured person or by a person who only suspects that he/she was injured. If the objective is to monitor the incidence of different types of injury, then a "case" will be an injury presented by one person for the first time. In this instance, repeat visits for treatment of the same injury will not count as separate cases;

otherwise, you would be counting the same injury more than once. Non-injuries, such as *suspected* but not actual concussion or bone fracture, do not count as cases. If one person has dual or multiple injuries, each injury counts as a case. If the objective is to monitor the incidence of injured persons, then a "case" will be the first visit of one person, irrespective of whether that person has one injury or multiple injuries. Repeat visits and visits by non-injured persons do not count as cases.[1]

Determining a case definition is not always as simple as it seems. For example, from a legal standpoint, a case in which a criminal dies as a result of police action during a robbery can be differentiated from a case in which the robber himself kills a policeman. The first case will be classified as a legal intervention, and the second case as homicide, even though in both cases the intent of the action is the same, to kill the opponent.[5]

In some injury surveillance systems, the "gold standard" for defining the cause of death is the death certificate. Because almost all death certificates need a registration, using the state's vital records office to identify cases is one way to ensure that intentional deaths are captured. However, as was mentioned earlier, in some countries not all deaths have death certificates, especially those occurring in rural areas.

In selecting a case definition for the injury surveillance system, you could use ICD-10 codes, which are used by public health sector. If you decide to include other data sources, for example law enforcement, you must keep in mind that these sources use different definitions. In the case of motor-vehicle related injury, the transportation office often uses its own definitions as well.

A comparison between ICD codes and codes used by U.S. law enforcement show that in the ICD-10, homicides are called "assault," whereas the FBI uses the term "criminal homicide." ICD-10 mentions only the mechanism and does not specify when a homicide is legal intervention.

Using the FBI definitions, "justifiable homicide" is similar to legal intervention, but no "operations of war" counterpart exits. Manslaughter by negligence, using the FBI definition, could be considered similar to "Neglect and Abandonment Y06" in ICD-10."Aggravated assault" could be considered similar to "Assault (X85–Y09) in ICD-10" (Table 3).

Table 3. Case Definition for Violence-Related Injuries: Public Health versus Law Enforcement

Public Health (ICD-10)*	Law Enforcement**
Assault (X85–Y09): Includes homicide and injuries inflicted by another person with intent to injure or kill, by any means. Excludes: Legal intervention and operations of war. Assaults are classified by mechanism; a four-digit code is used for place of occurrence of the event and for activity of the victim.	**Criminal Homicide:** Murder and no negligent manslaughter: the willful killing of one human being by another. **Aggravated Assault:** An unlawful attack by one person upon another for the purpose of inflicting severe or aggravated bodily injury. This type of assault is usually accompanied by the use of a weapon or by means likely to provide death or great bodily harm. **Other Assaults:** Assaults and attempted assaults in which no weapons are used and do not result in serious or aggravated injury to the victim.
Legal Intervention (Y35): Includes legal intervention according to the mechanism: Involves firearm discharge, explosives, gas, blunt object, sharp objects, legal execution, other means, and unspecified.	**Justifiable Homicide (Not a Crime):** Killing of a felon by a law enforcement officer in the line of duty. The killing of a felon, during the commission of a felony, by a private citizen.
Neglect and Abandonment (Y06): Classified according to the perpetrator: Spouse or partner, parent, acquaintance or friend, other specified persons, unspecified person.	**Manslaughter by Negligence:** The killing of another person through gross negligence.
Operations of War (Y36): Includes: injuries to military personnel and civilians caused by war and civil insurrection and injuries due to operations of war occurring after cessation of hostilities (for instance, injuries by explosion of bombs or mines placed in the course of operation of war are classified as Y36.8).	

* *International Statistical Classification of Diseases and Related Health Problems* (ICD-10)

** *National Incident-Based Reporting System Volume 1: Data Collection Guidelines* (Uniform Crime Reporting—FBI), available at: www.fbi.gov/ucr/nibrs/manuals/v1all.pdf.

Examples:

1. At an injury surveillance system workshop held in Nicaragua in 2002, participants (who represented the health sector, police, forensic medicine, department of transportation, and government authorities) identified at least five different classifications for homicide based on police data:

    - Assassination;
    - Homicide;
    - Parricide;
    - Infanticide;
    - Manslaughter.

    This classification is based on several criteria: (1) the relationship between the victim and the aggressor (parricide, infanticide); (2) the intention (homicide versus manslaughter); and (3) the context (assassination), which is taken into account when the homicide was premeditated. According to the law in this country, each category has a different sentence. All categories are considered to be homicide or assault according to ICD-10.

2. In the fatal injury surveillance system of Cali, Colombia, the case definition for violence-related injuries is given by the district attorney and forensic medicine. For motor vehicle-related injuries, transportation office case definitions are used, which causes some differences among the data sources. For instance, when a vehicle driver dies, the district attorney classifies it as unintentional injury. In contrast, if the passenger dies, this office classifies it as intentional injury. The transportation office classifies all such deaths as vehicle occupant death, categorized as driver or passenger deaths.

3. Develop Data Collection Instruments and Determine Data Collection Frequency

Develop or Select Data Collection Instruments: Once you have decided which data elements to include in the surveillance system, the next step is to develop or select the data collection instruments or forms.

Whether you decide to built on an existing system or establish a new system, WHO guidelines[1] recommend some steps to take in creating the collection forms:

- Seek input from all stakeholders and staff who will actually be filling out the forms once the surveillance system is in place. Their experience of handling injury cases and extracting information from patients will be invaluable.

- Seek advice from a statistician, if possible. A statistician can help with form design and ensure that the information obtained is as easy as possible to collate and process.
- Make the form easy on the eye, easy to understand, and, above all, easy to complete.
- Decide whether or not to precode the forms. It is usually better to precode, in which case it is best to have as few opportunities as possible to enter "other" or "unknown" or to answer questions with unique words or phrases. There are, however, situations where it may be preferable to leave questions open-ended, allow staff to fill in whatever words seem appropriate to them, and then extract and code the information afterwards.

  Wherever possible, use numbers rather than letters or symbols to code information (i.e., numeric codes rather than character codes). Numbers are easier to process and less prone to entry errors.
- Test the form(s) before adopting them for general use. Arrange for the staff that will be filling out the forms regularly to use them on a trial basis. Note any difficulties that staff may have in understanding questions or recording responses, and be prepared to revise the forms, if necessary.

In the health sector, surveillance forms are completed while patients are being interviewed about their injury, either during triage, registration, or treatment. Every effort should be made to avoid duplication of work and to avoid asking patients to answer the same questions several times. Ideally, a member of the medical staff (e.g., a doctor, nurse, or paramedic) treating an injury case should complete the injury surveillance form, one copy of which becomes part of the patient's medical record, while another is used for surveillance purposes. A second option could be to designate a trained person, e.g., a triage officer, nurse, or psychologist. A third option is self-administration. However, this requires a high level of literacy and an understanding of the mechanism of injury, and is applicable in cases when the patient is concious.[1]

Example:
The forms to collect the data proposed in the WHO guidelines are especially useful for injury surveillance systems in health facilities such as emergency departments and hospitals, because these are the only institutions that collect information about the nature of the injury. [1] Table 4 shows a form that was adapted on the basis of WHO guidelines. Some variables like the address and context were added.

Table 4. Form to Collect Minimum Data for an Injury Surveillance System

Name or Identification Number:				
Age:	**Sex:**	Male	Female	Unknown
Address where the injury occurred: **# Street:** **City:** **State:** **Zip Code:**				
Place where the injury occurred: **1.** Home __ **2.** School __ **3.** Sport __ **4.** Other __ **5.** Unknown ___				
Time and date when the injury occurred:				
Mechanism (how the injury was inflicted):				
1. Traffic injury	**2.** Sexual assault	**3.** Fall		
4. Other blunt force	**5.** Stab/cut	**6.** Gunshot		
7. Fire, heat	**8.** Choking/hanging	**9.** Drowning		
10. Poisoning	**98.** Other (specify)	**99.** Unknown		
Intent:				
1. Unintentional	**2.** Intentional (self-inflicted)	**3.** Intentional (assault)	**4.** Unknown	
Context in which the injury occurred:				
Nature of injury (hospital injury surveillance):				
1. Fracture	**2.** Sprain/strain	**3.** Cut, bite, open wound		
4. Bruise	**5.** Burn	**6.** Concussion		
7. Organs system injury	**8.** Other (specify)	**9.** Unknown		
Motor vehicle related:	Mode of transport	Type of victim	Vehicle involved	

Adapted from: Holder Y, Peden M, Krug E, Lund J, Gururaj G, Kobusingye O, eds. *Injury Surveillance Guidelines.* Geneva: World Health Organization; 2001.

Example:

In the injury surveillance system used in emergency rooms in Central America and Colombia, the variables necessary for the system were included in the clinical record (Questionnaire #1). This method avoids the duplication of data. This document is used for both the records in the hospital and for the injury surveillance system.[9] A similar questionnaire was used in Argentina to assess the incidence of acute injuries through a surveillance system, based mainly in emergency departments (Questionnaire #2). This instrument is completed manually and then entered into a Web-based database that is sponsored by the Argentina Ministry of Health.[10] The questionnaires used in these systems are at the end of this session and also in the CD-ROM. The titles of the questionnaires are:

Questionnaire #1: Injury Surveillance System in Emergency Room Clinical Report

Questionnaire #2: Ministerio de Salud de la Nación, Republica de Argentina

Exercise: Answer the following questions about emergency room-based data collection instruments for injury surveillance systems in Central America and Argentina:

1. Are enough variables included in these forms for the Injury Surveillance System?
2. Are there any questions that interviewees may be reluctant to answer?
3. Is it possible to fill out this form in emergency rooms?

Frequency of Data Collection:
The criteria that you used in the development of the surveillance system will determine the appropriate frequency of data collection. The criteria may include items such as resources (economic, human, and physical), purpose of the system, and requirements of the stakeholders and recipients of the information. Another very important criterion is the magnitude of the injury problem in your region. For example, if you have no more than 20 injury deaths per month in your region, monthly data collection may be adequate; but if you have a larger number of cases, the data may need to be collected more frequently. The type of surveillance system is another relevant criterion. For instance, if the injury surveillance system is population-based, the data could be collected daily; but if it is based on surveys, the frequency will depend on when you are planning to conduct the survey.

One other consideration which may influence the frequency of data collection is the concept of active versus passive surveillance, which is addressed in WHO's *Injury Surveillance Guidelines*.[1]

Active Collection:
In this approach, injury cases are sought out and investigated and injured people are interviewed, with follow up. Active surveillance of child abuse cases, for example, would involve identifying and locating cases through a variety of sources such as police reports, social service agencies, and educational authorities. The next step might be to seek out the abused children, their parents or guardians, or appropriate authorities to conduct initial and follow-up interviews. Active surveillance usually requires large expenditures of human and financial resources.

Passive Collection:
In this approach, relevant information is collected in the course of doing other routine tasks. That is, the generation of data is not necessarily the primary function of the system that yields the data. For example, doctors are routinely required to fill out death certificates for legal purposes, but it is possible to extract information entered on those certificates to obtain data on death from injuries. Similarly, forms filled out by doctors or nurses for medical insurance purposes can serve a dual function, as the medical information entered on insurance forms can also be used for surveillance purposes.

4. Determine the Type of Surveillance System

Guidelines for the epidemiological surveillance of violence and injuries from PAHO[5] describe several ways of setting up injury surveillance depending on the coverage needed; the objective to be met; the budgetary, human, and organizational resources of the locality; and the interest of government or nongovernment agencies. The six types of surveillance are mentioned below.

Surveillance Definitions:

1. ***Universal surveillance*:** The total number of cases occurring within a defined population is included in the system. This population-based surveillance accounts for all cases that occur. This is the preferred method of monitoring the occurrence of fatal injuries because rates of injuries and injury risk factors can be calculated and generalized to the population.
2. ***Surveillance based on samples of cases*:** The information is obtained from a portion of the total number of cases or events. The sample must be representative so that inferences can be made regarding all possible cases occurring in the population. This method can be used to collect information about nonfatal injuries.
3. ***Surveillance based on a review of institutional registries*:** Institutional registries are reviewed periodically to analyze and identify variables of interest. When using this method, it is important to properly identify the institutions and the sources within institutions, such as clinical and emergency records, hospital discharges, or complaints filed with police or family welfare institutions. It is useful for monitoring specific injuries, such as eye injuries.
4. ***Survey-based surveillance:*** Information is obtained through questionnaires focused on a specific topic, within a predefined period of time, and at predefined intervals. In the United States, for example, self-reported seat belt and safety seat use is measured at the state level by household surveys conducted for the Behavioral Risk Factor Surveillance System (BRFSS), by school-based surveys conducted for the Youth Risk Behavior Surveillance System (YRBSS), and by direct observation of passenger vehicle occupants for the National Occupant Protection Use Survey.[11]
5. ***Sentinel surveillance*:** One or more institutions are chosen to monitor trends, target surveillance activities, and suggest preventive interventions. In general, surveillance systems of this type are not representative of the population, but are useful for calling special attention to risk situations and thus fulfill a key function for injury prevention decision-making. One example of this type of surveillance is the approach taken by child death review teams, which gather and analyze data on the circumstances surrounding all causes of child deaths. Sentinel surveillance systems complement other sources of information for injury prevention.

6. ***Others*:** Laboratory surveillance can collect information from, for example, blood alcohol levels in victims of injuries or homicides, or toxicological information in case of suicides or injuries. Crime labs can provide information about weapons used in violent injuries.

Examples:

- The fatal injury surveillance systems in Cali and Bogota, Colombia,[12] are population-based because all cases of injury death are included in the system.
- The surveillance projects in Central America and Colombia are sentinel-type surveillance systems because in each city, one or two hospitals have been selected to monitor the injuries in emergency rooms. [9]
- In Cali in 1995, the Injury Surveillance System in Emergency Rooms[13] was implemented. This system was based on samples of injury victims taken on special weekends when event occurrences were expected to be higher than on other weekends.

5. Plan for Systematization, Maintenance, and Data Security

The next step is to develop an electronic database for inputting and managing surveillance information. If you have possibilities to collect data using Internet resources, the information will be timely and the process easy, but it can be expensive. Alternatively, you can use free software to build the database, for example, CDC's Epi Info 2002 program created by CDC (available at www.cdc.gov/epiinfo). Epi Info is IBM-compatible software that is available in the public domain. It includes a word processor, database manager, and data analysis tools. A statistician, epidemiologist, or programmer may be able to help you build the database. Remember to devise a way to present and analyze the information.

Data maintenance, the next step, should focus on the following activities:

1. Reducing errors that are introduced through flaws in design and changes in content (e.g., changes in the list of notifiable conditions).
2. Improving the system's scope and services through routine maintenance, emergency maintenance, and fulfillment of requests for special reports, and system improvements. An effective maintenance program includes the following steps:
    - Back up data and system files according to an established schedule; maintain records in a secure environment.
    - Require that requests for emergency maintenance be made in writing and entered into a log.
    - Assign priorities to special requests on the basis of urgency of need and time and resources required.

- Institutionalize routine maintenance such as procedures associated with changing to a new reporting year.
- Document maintenance as it is conducted.

To maintain the integrity of a computer system, only one person should have the authority to access the system and to assign and change the password. This same rule must apply to accessing the physical computer files. If possible, a second computer should be available for testing changes to the system so that the computer used for the surveillance information system can be reserved for production only. The second computer could also serve as a backup computer, should the primary computer fail. The numerous risks to the security of a database include mechanical failure, human carelessness, malicious damage, crime, and invasion of privacy. Therefore, backup copies of the database should be kept securely off-site to ensure that the system cannot be deliberately or unintentionally destroyed. Updating of the off-site copies should be done on a routine basis, and new diskettes or other storage media should be used to make backup copies at least once each year. If a valid copy of the current system is available, a monthly total-system back up is recommended. Data files that are changed during the day should be backed up at the end of the day. Protection against computer viruses should also be implemented, as these have become a threat to database and computer-system security.[14]

Successful surveillance projects will have clearly written procedures for securing physical and electronic records and for controlling access to and production of records. Procedures may include limiting access to those involved in data collection and analysis. Rules for data storage can be as basic as locking cabinets containing records, instituting a sign-out sheet for researchers who are using case files, using password protection for computer files, or regularly backing up computer database files.[14]

Example:
The system back up of the Cali, Colombia, database for fatal injury surveillance is performed every Monday. Each month, the database is cleaned to detect inconsistencies. [12]

6. Describe the Staff and Key Positions Necessary to Operate the System

Ideally, a surveillance system would have a core staff (part time or full time). This group could include a program manager, data manager, research analyst, and coordinator. The composition of the core staff will vary from system to system. In some cases, one or more staff members may perform a variety of duties. At a minimum, the core staff should include two people: the program manager, who will coordinate system activities and establish contact with the stakeholders and data sources, and the data manager, whose responsibility is data entry, quality control, analysis, and preparation of the reports. For research analysis, it might be possible to collaborate with an academic center or university in your region.

The program manager is responsible for organization, supervision of the process, and management of data collection. The program manager also serves as the spokesperson and interacts with the coalition team, mass media, authorities, and community members. If possible, an epidemiologist or public health officer should be in this position. The program manager is also responsible for selecting the other members of the core staff, those who will be responsible for collecting the information, analysis, and report preparation.

An advisory board or advisory group may offer technical advice, strategic planning, and support for the reporting system's success. The goal of an advisory board is to advise about the establishment and scientific integrity of a injury reporting system, act as a vehicle for disseminating information, and help to leverage the support of new organizations and resources.

Advisory board members should include people who are associated with and knowledgeable about the data sources, are interested in using/analyzing the information, have expertise in data collection, are willing to come to meetings, represent local/state agencies, and can influence agency decisions and cooperation (or effectively report system concerns back to the decision makers).

Ideally, the advisory board should include leaders from the following domains:

- Law Enforcement;
- Coroners/Medical Examiners;
- Vital Registrars;
- Health Care;
- Policy Makers and Advocacy Groups;
- Business;
- Community Organizations;
- Researchers/Educators.

The advisory board may:

- Provide the data necessary for the injury surveillance system;
- Review and advise on policies and procedures for data collection, linkage, publication, and mechanisms for implementation of the reporting system;
- Provide technical advice;
- Identify the best uses of the data;
- Strategize about how to remove obstacles and inefficiencies—whether political, legal, or technical;
- Provide speaking opportunities with professional organizations;
- Obtain or sign data-sharing agreements;
- Serve as evidence of broad, high-level support for the system.[3]

The stakeholders include government officials, public health authorities, law enforcement authorities, transportation officials, etc. These stakeholders typically define the activities and strategies to prevent injuries.

Exercise: Define the criteria to establish a fatal injury surveillance system in your region, as follows:

Group 1: Variables

Codes and case definition

Group 2: Data collection instruments and frequency

Type of surveillance system

Personnel necessary to operate the system

7. Summary

Now that you have completed this session, you should be able to:

- Define the injury events and data elements (variables, case definition, and codes) to be included in the system;
- Develop data collection instruments and determine data collection frequency;
- Determine the type of surveillance system;
- Plan for systematization, maintenance, and security of the data;
- Describe the staff and key positions necessary to operate the system.

The next step, which will be addressed in Session V, is to define and develop the analysis plan for the injury surveillance data.

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INJURY SURVEILLANCE TRAINING MANUAL

PARTICIPANT GUIDE

SESSION V

DEFINE AND DEVELOP AN ANALYSIS PLAN FOR THE SURVEILLANCE DATA

Developed with the support
of the National Center for Injury Prevention and Control
Division of International Health, Epidemiology Program Office
Centers for Disease Control and Prevention
Atlanta, GA

SESSION V
DEFINE AND DEVELOP AN ANALYSIS PLAN FOR THE SURVEILLANCE DATA

Learning Objectives

- Calculate injury indicators such as frequencies, percentages, and crude, specific, and adjusted rates.
- Calculate years of potential life lost (YPLL).
- Describe the geographical analysis of the data.
- Define a plan to disseminate and communicate the results.

Introduction

The analysis and interpretation of surveillance data establishes the foundation for many observational studies, placing surveillance at the forefront of the spectrum of descriptive epidemiology. Surveillance has a myriad of uses such as: to detect epidemics, to suggest hypotheses, to characterize trends in disease or injury, to evaluate prevention programs, or to predict future public health needs. Data from surveillance must be analyzed carefully and interpreted prudently. Data from surveillance systems do not come from a designed study or a randomized trial. Moreover, the analysis (and subsequent interpretation) proceeds from the specific elements of the process in which the assembly of individual units eventually produces a more general picture of health-related conditions in a population. Analysis should be implemented as part of a routine surveillance program.

You should keep in mind the following recommendations when analyzing surveillance data:[1]

- It is tempting to immediately examine trends over time using surveillance data. However, gaining an intimate knowledge of the day-to-day strengths and weaknesses of the data collection methods and the reporting process can provide a "real-world" sense of the trends that emerge.
- Although surveillance data are collected individually, one part of the analysis is to have a global image of the problems under surveillance.
- Proceed from the simplest to the most complex analyses. Begin with questions such as: How many cases were reported by week, month, or year? How many cases were reported by sex? How many cases were reported by age group? These questions must be answered using the surveillance data.[1]

In this session you will learn to determine the most common types of analysis for surveillance data. The following indicators will be calculated:

- Frequency and percentage;
- Crude, specific and adjusted rates;
- Years of potential life lost (YPLL).

Injury mortality data will be used to calculate measures of frequency and indicators. An introduction to geographical analysis of surveillance data and a plan to disseminate the results are included in this session.

1. Calculate Frequency and Percentage of Injury Deaths (Homicide, Suicide, Motor Vehicle-Related, and Other Unintentional Deaths)

Determining frequencies is the first step in the analysis process. The number and percentage of events allow one to describe the size of the problem. The second step is to calculate other kinds of indicators, such as rates, in which the frequency of the event and the affected population are used as well. Rates are presented using a standard denominator, for example, deaths per 100,000 persons, and for a standard time period, often one year. In small populations, several years of deaths may be pooled as the numerator for the rate and person-years of exposure used as the denominator; such rates are often referred to as incident density.

Data from an injury surveillance system provide information about the number of cases in a given event. For instance, in El Salvador 2,696 homicides occurred in 2000.[2] In Cali, Colombia, in 2002, 1,961 homicides occurred.[3] These data represent just one aspect of the size of the problem.

A comparison between these two numbers indicates that the magnitude of the homicide problem is higher in El Salvador than in Cali. The percentage is the proportion of the cases of the total. For instance, in El Salvador, homicides accounted for 44.3% of the total injury deaths. In Cali this proportion was 74.9% (Table 1).

Table 1. Injury Mortality in El Salvador and Cali — 2000

Cause of Death	El Salvador*		Cali**	
	Number	Percentage	Number	Percentage
Unintentional Deaths				
Motor Vehicle-Related	1,629	26.8 %	467	17.9 %
Other Unintentional Deaths	933	15.4 %	104	3.9 %
Violence-Related Deaths				
Homicides	2,696	44.3 %	1,961	74.9 %
Suicides	815	13.5 %	85	3.3 %
Total	**6,073**	**100 %**	**2,617**	**100 %**

* Injury Surveillance Workshop in El Salvador—2003. Data from forensic medicine.
** Fatal Injury Surveillance System in Cali. Data from forensic medicine, district attorney, police department, and transportation office.

If we have only this information, all we can say is that the number of injury deaths in El Salvador is 2.3 times higher than in Cali, and the percentage of injury deaths due to homicide in Cali is higher than in El Salvador (74.9% vs. 44.3%). Motor vehicle-related deaths and suicides appear to be a bigger problem in El Salvador than in Cali. However, percentages can be deceiving. Comparisons between a city and a country also are not appropriate. The next step is to calculate the rates.

Exercise: Calculate frequency and percentage of injuries using local injury data. The first group will calculate frequency and percentage for violence-related deaths (homicide and suicide). The second group will calculate the same indicators for unintentional deaths (motor vehicle-related and other unintentional deaths).

1.1 Calculate Injury Rates: How to Get Appropriate Denominators

Rates enable one to make more appropriate, informative comparisons of occurrence in a population over time, among different subpopulations, or among different populations at the same time, since the size of the population and the period of time are accounted for in the calculation of rates. Calculating and analyzing rates is critical in epidemiologic investigations, not only for formulating and testing hypotheses about causes, but also for identifying risk factors for disease and injuries. To determine rates, one must have reliable numerator and denominator data; however, the latter is generally more difficult to obtain in most epidemiologic investigations.[1]

A rate measures the frequency of an event in a population. A crucial aspect of a rate is the specification of the time period under consideration. An optional component is a multiplier, such as a power of 10, that is used to convert awkward fractions to more workable numbers. The general form of a rate is shown below:

$$\text{Rate} = \frac{\text{Number of people injured in a specific period}}{\text{Average or mid-interval population at risk of the event}} \times 10^{n}$$

The denominator represents the size of the population during the specified time period in which the events occur. The size of "n" usually ranges from 2 to 6 (i.e., the number at risk varies between 100 and 1,000,000). The selection of "n" depends on the incidence or prevalence of the event. Many different rates are employed in standard public health practice. These measures are calculated in many ways and may have different connotations.

Special distinction should be made among the terms rate, ratio, and proportion. A *ratio* is any quotient obtained by dividing one quantity by another. The numerator and denominator are generally distinct quantities, neither of which has to be a subset of the other. No restrictions exist on the value or dimension of a ratio. A *proportion* is a special type of ratio for which the numerator is a subset of the denominator population. Although all *rates* are ratios, in epidemiology, a rate may be a proportion (e.g., prevalence rate).[1]

Denominators in Motor Vehicle-Related Injuries

To calculate rates for motor vehicle-related injuries, the most common denominator to use is the population affected—for city, region, or country. However, other types of denominators can also be useful, such as number of vehicles or number of vehicle miles traveled. The best denominator to use depends on the situation. For instance, to calculate rates of injuries to motorcyclists, the best denominator would be the number of motorcyclists exposed. This is more difficult to obtain than the overall population, but one number that might be available is the number of motorcycles registered in the transportation office. One potential problem with this approach, however, is that the numerator may include injured motorcyclists who are registered in surrounding cities, and thus are not reflected in the denominator. Obtaining an appropriate denominator when you have pedestrians in the numerator is more difficult because statistics on the number of people who walk rather than drive are usually not available.

As a nation's economy grows, the number of motor vehicles increases. This means death and injury from road traffic is likely to increase as well, especially if measures are not taken to mitigate the problem.[4] In Table 2, a comparison of the different indicators for motor vehicle-related injuries is shown. Notice how the choice of denominators affects the international comparison. Information about the number of vehicles by country, traveled miles, etc., may be found by visiting www.worldroadstatistics.org.

Table 2. Indicators for Motor Vehicle-Related Deaths Using Different Denominators

Country	Vehicles/1,000 Inhabitants	Injuries/100,000 Population	Deaths/100,000 Population	Deaths/10,000 Vehicles
Bangladesh	3.8	2.7	**1.7**	**44.0**
Bhutan	19.6	2.0	**0.8**	**4.0**
India	31.2	32.5	**6.3**	**20.0**
Pakistan	18.0	6.7	**3.2**	**17.0**
Sri Lanka	42.0	91.9	**10.5**	**25.0**
United Kingdom	408.0	538.8	**6.1**	**1.2**
United States	787.0	1,281.3	**14.8**	**1.9**

Source: *Estimating Global Road Fatalities.* World Bank, Department for International Development; 2000.

Denominators in Cases of Suicides

When calculating rates for suicides, the denominator will usually include the total population. However, some experts believe that children less than 5 years old should be excluded from the denominator because they are not believed capable of understanding the concept of taking one's own life and, therefore, are not capable of committing suicide.

Denominators in Cases of Violence-Related Injuries

Crude rates often are calculated using the total number of deaths or injuries in the numerator and the affected population in the denominator. Sometimes you will encounter difficulties with available denominator data. For example:

- If you are using mortality data from a country, the denominator will be the population of this country. However, in some countries population estimates are not available for intercensal years.
- In some areas, it is difficult to match the geographic area for which injury data is available with the geographic area for which population estimates are available.
- If you are using injury data from a hospital emergency room, the population in the numerator and denominator could be different. For instance, a trauma hospital may receive cases referred from other hospitals and other cities. Also, residents of the city may go to other hospitals for care. For the denominator, use the population of the city where the trauma hospital is located (if most cases come from the same city). Or, use the city population but exclude nonresidents from the numerator. If most patients are from other cities, try using denominators such as total number of visits to the emergency room for all causes. Then, the indicator will be a proportion, not a rate.

1.2 Calculate Crude Rates for Injury Deaths

Computation of crude rates is the initial step in analysis because information about entire populations must be obtained and compared. (See Table 3 to calculate crude rates.)

- Number of events, in this case, injury deaths in El Salvador.
- Population at risk, in this case, the population of El Salvador.
- Ratio, calculated by dividing Column 1 by Column 2.
- Quotient, calculated by dividing Column 1 by Column 2.
- Constant used to multiply each result of the fraction; in this case the constant is 100,000.
- The rate is the final result. It is expressed using "per," for instance, 25.9 per 100,000 population, which means that for every 100,000 inhabitants in El Salvador, an average of 25.9 persons have died in motor vehicle-related events.

Table 3. Steps to Calculate Crude Rates Using El Salvador Data

Cause of Death	El Salvador*					
Unintentional Deaths	**Number (1)**	**Population (2)**	**Ratio (3) [(1) / (2)]**	**Quotient (4)**	**Constant (5)**	**Rate per 100,000 (6) [(4) x (5)]**
Motor Vehicle-Related	1,629	6,276,037	1,629 / 6,276,037	0.0002595	100,000	25.9
Other Unintentional Deaths	933	6,276,037	933 / 6,276,037	0.0001486	100,000	14.9
Violent Deaths						
Homicides	2,696	6,276,037	2,696 / 6,276,037	0.0004295	100,000	42.9
Suicides	815	6,276,037	815 / 6,276,037	0.0001298	100,000	13.0
Total	**6,073**	6,276,037	6,073 / 6,276,037	0.0009676	100,000	96.8

* Source: Injury Surveillance Workshop in El Salvador—2003. Data from forensic medicine.

These data indicate that homicides in El Salvador are the leading cause of injury death. Motor vehicle-related deaths are the second place. The crude world rate for homicide in 1998 was 12.5, the rate in El Salvador is almost 4 times higher. The rate of motor vehicle deaths in the world was 19.9; the rate in El Salvador is clearly higher. Other unintentional deaths in El Salvador have a rate higher than the world rate, which is 7.9 (Table 4).

Table 4. Number, Percentage, and Crude Rates of Injury Mortality in El Salvador (2000) and Worldwide (1998)

Cause of Death	El Salvador*			World**
Unintentional Deaths	**Number**	**Percentage**	**Rate per 100,000 Population**	**Rate per 100,000 Population**
Motor Vehicle-Related	1,629	26.8 %	25.9	19.9
Other Unintentional Deaths	933	15.4 %	14.9	7.9 (approximately)
Violent Deaths				
Homicides	2,696	44.3 %	42.9	12.5
Suicides	815	13.5 %	12.9	16.1
Total	**6,073**	**100 %**	**96.8**	**97.9**

* Injury Surveillance Workshop in El Salvador—2003. Data from forensic medicine.

** Krug E, ed. *Injury: A Leading Cause of the Global Burden of Disease*. Geneva: World Health Organization; 1999.

Exercise: Using local injury data calculate crude rates for homicide, suicide, and motor vehicle-related and other unintentional deaths.

1.3 Calculate Specific Rates for Injury Deaths by Age Group

The rate at which a particular health event occurs may not be constant throughout the entire population. For example, suicides are not considered to affect children under 5 years of age. The risk of dying in motor vehicle crashes increases for teenagers when they are first starting to drive. To examine the differences, the population is partitioned into relevant specific subpopulations, and a specific rate is calculated for each subset. For example, if one calculates death rates by age group, the resulting rates are termed age-specific death rates. Variation of rates among population subgroups results from several factors: natural history of the health problem, differential distribution of susceptibility or causes, and genetic differences among subpopulations. For example, in the United States, injury mortality rates are generally higher among men than women and higher among Blacks than whites. The distribution of subgroups within the population may also be so disparate that the overall rate may not convey useful information. Therefore, the magnitude of an overall rate depends on the magnitude of the rates of the subpopulations as well as on the demographics of the entire population. These variations in rates across a population would remain unknown if only overall rates were calculated.[1]

Death rates from injuries vary considerably by age and sex. Awareness of such differences can guide development of programs for prevention among groups at increased risk. For this reason, it is important to have available age- and sex-specific mortality rates for specific injuries. However, the calculation of age- and sex-specific rates requires reasonably accurate information about the composition by age of the population and not just the total number of people at risk. Census data are used to obtain the numbers of individuals in different age and sex groups or strata of the population. Such data may not be available at all or may be available only for selected study populations. In developing countries adult males of working age tend to be at high risk, often because of exposure to environmental (including road traffic) and occupational hazards and, in some countries, to violence. In most countries, the elderly have high mortality rates from non-motor vehicle unintentional injuries and, in some countries, from suicide. Young adult females are at high risk of suicide in the rural areas of some developing countries.[5]

The steps necessary to calculate specific rates are shown, using homicide data from Cali, in Table 5:

1. Age groups: distribution by 5-year age groups.
2. Number of homicides in each age group: number of homicides by age group in Cali in 2000.
3. Population in each age group: Cali population distribution by 5-year age groups.
4. Ratio (obtained by dividing Column 2 [number of homicides in each age group] by Column 3 [population in each age group]).
5. Quotient (obtained by dividing Column 2 by Column 3).
6. Constant used to multiply each result (in this case, 100,000).
7. The rate is the final result, which means in this case that there were 189.3 or 190 homicides in the group of 20–24 year olds per each 100,000 population in this group. Another way to express this result is to say that about 2 out of every 1,000 persons in this age group died by homicide in Cali in 2000.

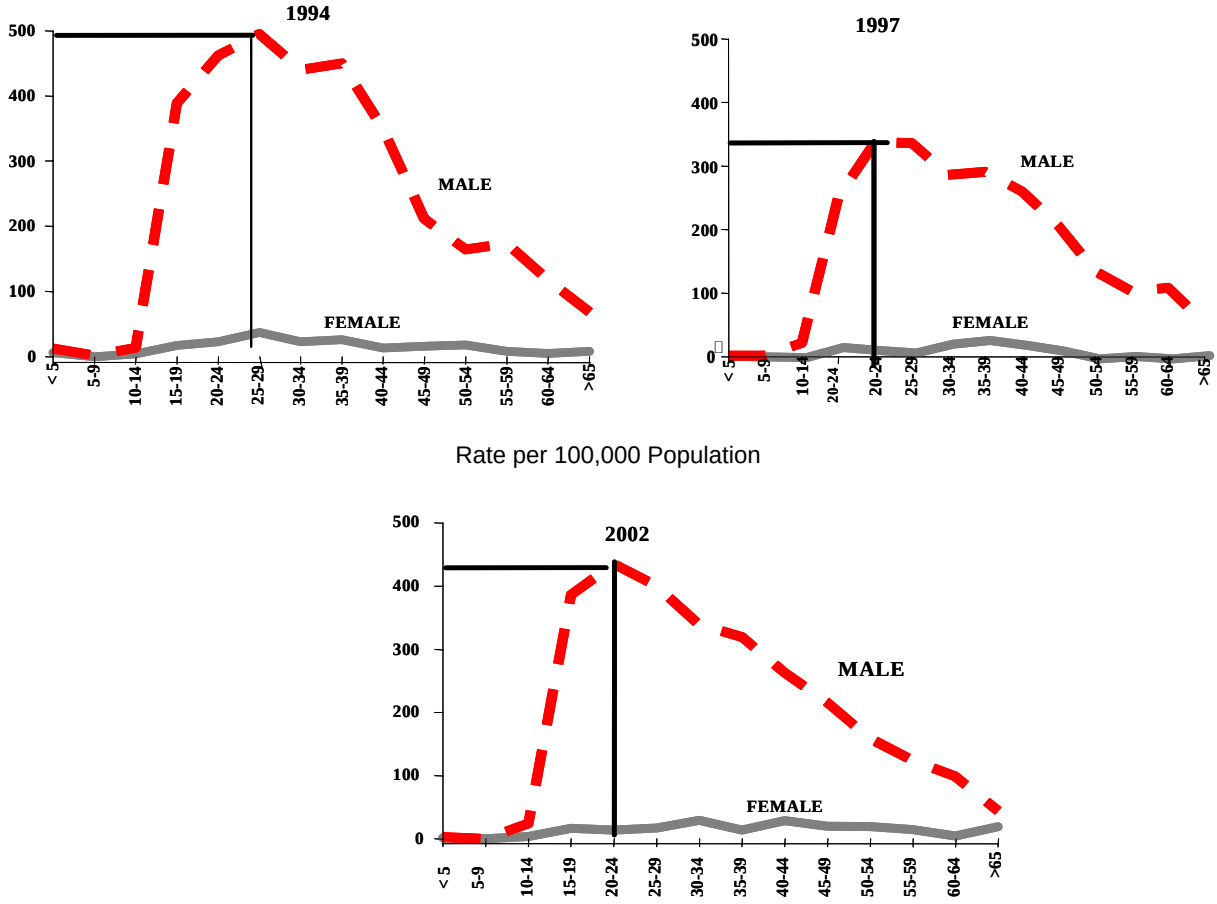
Table 5. Specific Rates of Homicide by Age Group in Cali — 2000

Age Group (1)	Number of Homicides (2)	Population in Each Group (3)	Ratio [(2) / (3)] (4)	Quotient (5)	Constant (6)	Rate per 100,000 Population [(5) / (6)] (7)
< 5	1	208,525	1/208,525	0.0000047	100,000	0.5
05–09	9	214,316	9/214,316	0.0000419	100,000	4.2
10–14	19	197,137	19/197,137	0.0000963	100,000	9.6
15–19	326	211,893	326/211,893	0.001538	100,000	153.9
20–24	426	224,986	426/224,986	0.001893	100,000	189.3
25–29	340	193,138	340/193,138	0.001760	100,000	176.0
30–34	252	158,849	252/158,849	0.001586	100,000	158.6
35–39	208	133,422	208/133,422	0.001558	100,000	155.9
40–44	146	96,238	146/96,238	0.001517	100,000	151.7
45–49	107	77,190	107/77,190	0.001386	100,000	138.6
50–54	53	66,829	53/66,829	0.0007930	100,000	79.3
55–59	31	50,994	31/50,994	0.0006079	100,000	60.8
60–64	17	39,753	17/39,753	0.0004276	100,000	42.8
65+	26	72,725	26/72,725	0.0003575	100,000	35.8
Total	**1,961**	**1,945,995**	**1,961/1,945,995**	**0.001007**	**100,000**	**100.8**

Source: Fatal Injury Surveillance Sytem in Cali, Colombia. Data from forensic medicine, district attorney, police department.

Example:
Specific rates by age group and sex have been calculated using Cali's homicide data for three different years: 1994, 1997, and 2002. In these three years, the specific rates for men have been higher than for women. The age group with highest rates is 20–29 years of age. Even when the rates decreased, these age groups continued to be the most affected (Figure 1).

Figure 1. Homicide Specific Rates by Age and Sex
Cali, 1994, 1997, and 2002



Source: Fatal Injury Surveillance System in Cali, Colombia. Data from: Police, Forensic Medicine, District Attorney, Transportation Office.

1.4 Calculate Adjusted Rates Using Direct Method

An important use of mortality data is to compare your data with data from other countries or regions. The mortality figures could be different solely because of differences in the distribution of the population by age or other demographic characteristics (e.g., race/ethnicity). Therefore, methods have been developed for comparing mortality in such populations while effectively holding constant characteristics such as age.

Two methods of adjustment exist. One method is the direct method of adjustment, whereby a "standard population" is created, and then the study population's mortality rates are applied to it, stratified by the demographic characteristic(s) of interest (most commonly age). By using a single standard population, we eliminate any possibility that observed differences in rates could be a result of age differences in the two populations. By applying each age-specific mortality rate from the study population to the population in each age group of the standard population, we derive the expected number of deaths that would have occurred in the standard population had those rates been applied. By dividing the total expected numbers of deaths by the size of the standard population, we can calculate the expected mortality rate for the standard population if the study population's age-specific rates have been applied.

This adjusted rate represents what the crude rate would have been in the study population if that population had the same distribution as the standard population with respect to the variable(s) for which the adjustment or standardization was carried out.

The other method is an indirect adjustment in which the Standardized Mortality Ratio (SMR) is calculated by totaling the observed number of deaths and dividing by the expected number of deaths. Multiplication by 100 is often done to yield results without decimals. The SMR is commonly used in occupational studies.

In this manual, adjusted rates are calculated using the direct method of adjustment. The following data must be available to use direct adjustment:

1. Specific rates for the study population;
2. Distribution for the selected standard population across the same strata as those used in determining the specific rates.[1]

The steps necessary to calculate adjusted rates are shown in Table 6, using data on homicides in Cali:

1. Age groups;
2. Number of homicides in each age group;
3. Cali population in each age group;

4. Quotient of number of homicides divided in the population, for each age group;
5. Standard population (this example uses the standard population for the United States in 2000);
6. Expected deaths in each age group, obtained by multiplying the quotient in Column 4 by the standard population in each age group;
7. Adjusted rate is the result of dividing the total of expected deaths by the total of standard population.

Table 6. Adjusted Rates for Homicides in Cali — 2000

Age Group (1)	Number of Homicides (2)	Cali Population by Age Group (3)	Quotient [(2) / (3)] (4)	Standard Population (U.S. 2000) (5)	Expected Deaths [(4) x (5)] (6)	Adjusted Rate for Cali Homicides [Total (6) / Total (5)] per 100,000
< 5	1	208,525	0.000005	18,987,000	91	
05–14	28	411,453	0.000068	39,977,000	2,720	
15–24	752	436,879	0.001721	38,077,000	65,542	
25–34	592	351,987	0.001682	37,233,000	62,621	
35–44	354	229,660	0.001541	44,659,000	68,838	
45–54	107	144,019	0.000743	37,233,000	27,663	
55–64	48	90,747	0.000529	23,961,000	12,674	
65+	26	72,725	0.000358	34,710,000	12,409	
Total	**1,961**	**1,945,995**	**0.001008**	**274,837,000**	**252,558**	**91.96**

Source: Fatal Injury Surveillance System in Cali, Colombia. Data from forensic medicine, district attorney, police department, and transportation office.

In this example, the adjusted rate is lower than crude rate, because the age distribution of Cali's population is different from that of the standard population. Cali has fewer elderly people than the United States. The lower homicide rates among the elderly take on more weight when Cali's rate is adjusted to this older population.

Exercise: Calculate adjusted rates using injury local data. You will need a standard population, and the population distribution by age group.

2. Calculate Years of Potential Life Lost (YPLL)

YPLL is a measure of the impact of premature mortality on a population. Because of the way in which YPLL is calculated, this measure gives more weight to deaths that occur at younger ages. A specific age is selected as an upper limit. The upper limit is usually the life expectancy in the country, but is sometimes the age at retirement or the age of 75 years.

The steps to calculate YPLL before 65 years are shown in Table 7 using data from Cali:

1. Distribution by age group of Cali population.
2. Midpoint in each age group, which is obtained by adding the first number in the category plus the second number and dividing by two. For instance, in the age group 25–34, the midpoint is: 25 + 34 = 59/2 = 29.5. (Some methods add 1 to the first part to make the numbers more manageable.)
3. The upper limit in this example is 65, minus the midpoint in each age group.
4. This column shows the number of homicides in each age group.
5. YPLL is calculated by multiplying the number of homicides in each age group (Column 4) by the result in Column 3.

Table 7. YPLL by Homicides in Cali, Colombia — 2000

Age Group (1)	Midpoint [Low + High / (2)] (2)	Life Expectancy (65) Minus Midpoint (3)	Homicides (4)	YPLL [(3) x (4)] (5)
1–4	2.5	65 – 2.5 = 62.5	1	62.5
5–14	9.5	65 – 9.5 = 55.5	28	1,554.0
15–24	19.5	65 – 19.5 = 45.5	752	34,216.0
25–34	29.5	65 – 29.5 = 35.5	592	21,016.0
35–44	39.5	65 – 39.5 = 25.5	354	9,027.0
45–54	49.5	65 – 49.5 = 15.5	107	1,658.0
55–64	59.5	65 – 59.5 = 5.5	48	264.0
65–74	NA	NA		
75–84	NA	NA		
85+	NA	NA	26	
Total			**1,961**	**67,797.5**

Adapted from: *Establishing an Injury Surveillance System. Instructor's Guide*. CDC/Epidemiologic Intelligence Service; 2000. Data from: Fatal Injury Surveillance System; Instituto Cisalva, Univalle; Cali, Colombia.

The results indicate that in Cali in 2000, homicides accounted for 67,797.5 YPLL. The highest number of YPLL, 34,216, was in the group of 15–24 year olds.

Exercise: Calculate YPLL using injury local data.

3. Describe the Geographical Analysis of Data

Maps can be used to graphically depict data using location and geographic coordinates. A map provides a clear, quick method for grasping data and is particularly effective for readers who are familiar with the physical area being portrayed. A few popular types of maps that depict incidence or distribution of health conditions are described below.[5] Currently, there are several different

software packages that can be used to create maps. Some are free, like Epi Map, which is part of the Epi Info software package (www.cdc.gov/epiinfo).

However if you do not have the necessary equipment, you can at least prepare a spot map, locating each case on a printed map. Another possibility is to prepare an area map, which uses frequency, percentages, or rates. The following are the most common type of maps:

Spot Maps

A spot map is produced by placing a dot or other symbol on the map where the injury occurred. Different symbols can be used for multiple events at a single location. Although a spot map is beneficial for displaying geographic distribution of an event, it does not provide a measure of risk, since population size is not taken into account.

Area or Chloropleth Map

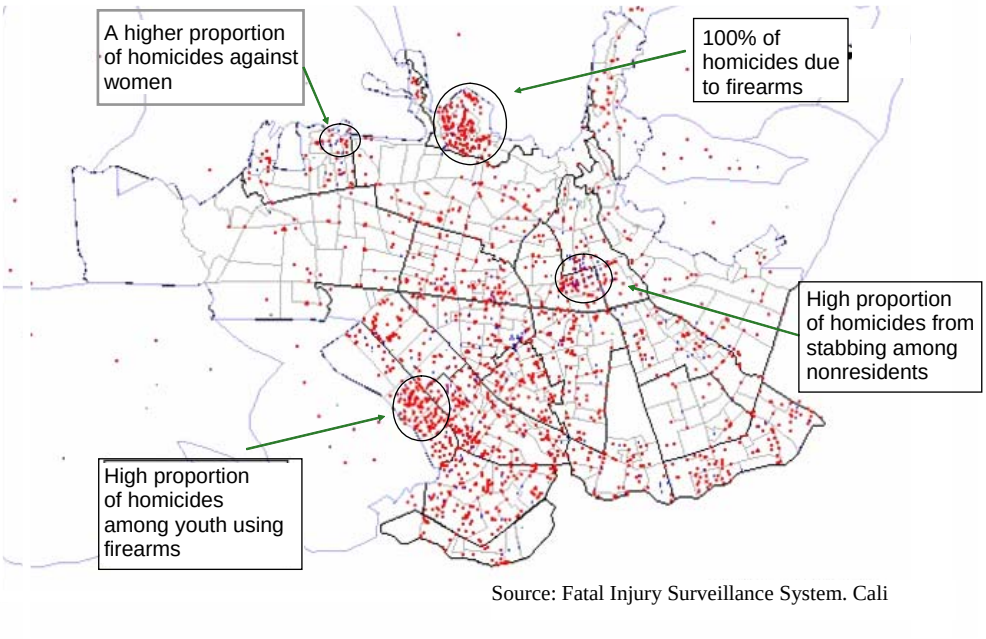
An area map, also called a shaded or chloropleth map, is a frequently used statistical map involving different types of shading, hatching, or coloring to portray range-graded values. Chloropleth maps are useful for depicting rates of injury in specific areas. These maps are actually superior to spot maps because the rates of risk are depicted.

Black Spots

To assess road traffic hazards, traffic engineers examine the location and other details of individual crashes. In the aggregate, this information helps to pinpoint specific hazards that can often be corrected in a cost-effective manner by straightforward engineering changes. Such data are increasingly being computerized by traffic authorities. In addition, printed crash maps that use colored pins to denote individual events are often maintained to locate "black spots," locations with higher than expected crash rates. Unfortunately, studies of black spots are based upon the use of crash data, and these may be subject to a high degree of underreporting. In developing countries, black spots analyses may be especially valuable to address the problem of injuries and deaths involving vehicle occupants, pedestrians, motorcyclists, and bicyclists. In Colombia, for instance, one strategy of the *Fondo de Prevencion Vial* (NGO) has been to draw a black/yellow star in the street where most pedestrian deaths occur.[6]

Example:
In the geographical distribution of homicides in Cali for 2001, shown in Figure 2, each dot represents one homicide and marks the place where it occurred. Homicide clusters with specific characteristics in particular areas of the city are highlighted.

Figure 2. Homicides in Cali — 2001



Exercise: Identify each type of map each and the information needed to prepare such a map.

4. Define a Plan to Disseminate and Communicate the Results

Surveillance and communication are processes that provide "information for action." Surveillance data must be presented in a manner that facilitates its use for public health action. Effective communication of public health surveillance results presents a critical link in the translation of scientific information into public health practices and policies. Information from the surveillance system must be disseminated to help decision makers understand the implications of the results and to facilitate implementation of public health action. It is important to present the information clearly and to know the intended audience.[1] Surveillance data is not presented in the same way to the general public as it is presented to public health professionals.

Dissemination of the results is a one-way process through which information is conveyed from one point to another. Communication is a collaborative process involving at least one sender and recipient. Steps in controlling and directing information dissemination follow:[1]

1. Develop the message;
2. Define the audience;
3. Select the channel;
4. Market the message;
5. Evaluate the impact.

Following are some suggestions for making the data presentation useful to the public:[7]

- Present data to the public in an appealing format.
- Use language the public understands (professional versus public language).
- Keep it simple: provide only the most important facts.

4.1 Define the Basic Elements to Include in an Injury Surveillance System Report

A report is the means by which the results of surveillance are conveyed to all stakeholders. The needs of stakeholders should be considered when making decisions about report design and production frequency.[8] Below is a sample outline you can use to prepare a report of the surveillance system:

Sample Outline for an Injury Surveillance System Report:

I. Introduction: Brief description of the injury surveillance system, the purpose, related prevention activities, and the objective of the report.

II. Leading causes of deaths, frequency and proportion, and rank of injuries among all causes of death.

III. Leading causes of injury mortality, frequency, proportion, and crude rates, emphasizing the highest indicators.

IV. Leading causes of injury morbidity, if the information is available.

V. Years of potential life lost (YPLL).

VI. Cost of injuries, comparing local data if available. If not, you could use data from studies in other places.

VII. Priority injuries identified in the region, summarizing those with the highest number, percentage, rate, costs, and YPLL.

VIII. Recommendations for prevention strategies. This is the most important step, because it helps stakeholders decide what actions to take.

Examples:
The injury surveillance system in Bogotá publishes a monthly bulletin with data analysis results, recommendations, and evaluation of strategies already implemented. This bulletin is available at www.suivd.gov.co.

Cisalva Institute prepares a report every three months based on data from the fatal injury surveillance system. This report is sent to mass media contacts and stakeholders in the city; it is available at: www.prevencionviolencia.org.co/sistemas/vigilesiones.htm

The injury surveillance system in emergency rooms in El Salvador produces a weekly bulletin of the system: www.hospitalbloom.gob.sv.

In Nicaragua, the injury surveillance system in emergency rooms has published articles on injury data on its website: www.minsa.gob.ni.

4.1.1 Recipients

Recipients of the surveillance report could include decision makers. Decision makers include institutions, particularly those providing data to the surveillance system. Recipients of the report could also include:

- Stakeholders: Government authorities, Law Enforcement Directors, Public Health Directors, Education Institutions Directors, etc.;
- Forensic Medicine Offices;
- District attorney offices;

- Hospitals and emergency departments;
- Health professionals in the scientific community;
- Personnel working with the surveillance system;
- Scientific/academic researchers;
- Grassroots organizations;
- Mass media directors.

4.1.2 Delivery Method

The means of delivering reports depends on available resources and equipment. One channel is via a website; however, only people with a computer and Internet access will be able to reach it. The following are some other means you can use to deliver your injury surveillance system report:

- Health department newsletters;
- Public service announcements (PSAs);
- Press releases;
- Scientific journal articles;
- Flyers;
- Periodicals or annual reports;
- Presentations and exhibits at scientific and stakeholder meetings;
- Newspapers;
- Websites.

The mass media are important partners for dissemination of injury surveillance data. Information about injuries is always important news in the city. By establishing an appropriate partnership with the mass media, you may be able to publish your results in the newspaper. This can also be a way to get the community involved. The mass media can also benefit from this relationship because the surveillance team can serve as a valuable ongoing local resource, not only for data, but also for opinions on interventions and political implications.

Exercise: Answer the following questions:

1. Which information is most important to present to stakeholders?
2. Which indicators would best show the size of the problem?
3. Do you think cost data is important to stakeholders?
4. Should you include recommendations about prevention strategies in your surveillance reports?

5. Summary

Now that you have completed this session, you should be able to do the following:

- Calculate injury indicators such as frequency, percentages, and crude, specific, and adjusted rates;
- Calculate years of potential life lost (YPLL);
- Describe the geographical analysis of the data;
- Define a plan to disseminate and communicate the results.

The next step, using injury surveillance data to inform injury prevention, is addressed in Section VI.

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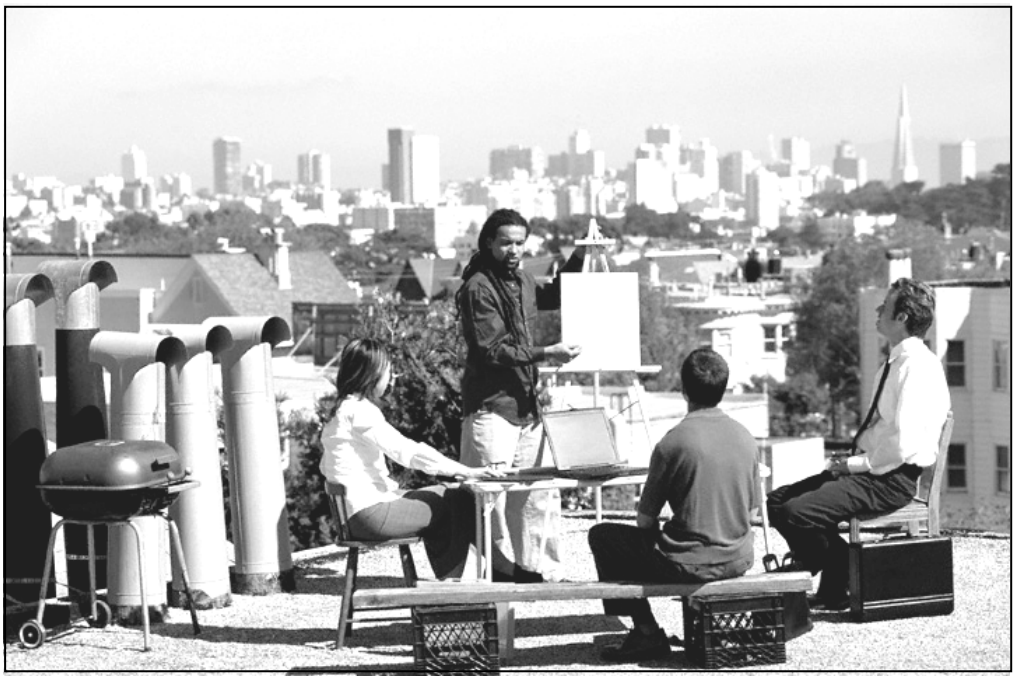
INJURY SURVEILLANCE TRAINING MANUAL

PARTICIPANT GUIDE

SESSION VI

USE INJURY SURVEILLANCE DATA TO INFORM INJURY PREVENTION



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SESSION VI
USE INJURY SURVEILLANCE DATA TO INFORM INJURY PREVENTION

Learning Objectives

- Use surveillance data to identify priority injuries in your region.
- Identify potential etiological factors of priority injuries.
- Review successful interventions for injury prevention.
- Identify the most appropriate interventions for the injuries in your region.

Introduction

An important aspect of prevention is to document the existence and magnitude of a health condition and the extent to which its burden is increasing or decreasing. In addition, to implement primary prevention, factors that contribute to the problem must be identified.[1]

Establishing injury priorities is a necessary and increasingly difficult task. Public health administrators and managers are often faced with an increasing range of pressing problems and decreasing resources. To define injury priorities, you need to keep in mind factors such as the magnitude of the problem, the disability that it causes, the direct and indirect costs, and the available resources for injury prevention.

Once you have defined the injury priorities in the population, you should identify some strategies to address them. In this session, you will learn to define injury priorities, to identify etiological factors for these injury priorities, and to identify potential interventions after reviewing successful experiences from other places.

Public health professionals play an important role in these aspects of prevention because they generally have received special training in methods for measuring the extent of disease and injuries; for identifying the associated circumstances, including underlying causes and high-risk groups; and for evaluating the effectiveness of prevention programs.[1]

1. Identify Priority Injuries

Various methods are available for prioritizing health events; typically, these methods include the following criteria:[2,3,4]

- Magnitude of the problem—Generally defined by injury mortality and morbidity indicators such as crude, specific, and adjusted rates for variables sucha as age, sex, place, and mechanism.
- Severity of the problem—Often determined by indicators of admitted rate, disability rate, and lethality for the group overall and for special groups. One criteria of severity could be the affected population (i.e., youth).
- Disability Adjusted Life Years (DALYs)—An indicator of the magnitude and severity that combines years of potential life lost due to premature mortalty with years of productive life lost due to disability. Instructions for calculating this indicator may be found at the WHO website (www.who.org).
- Trend of the event—Useful criteria for defining the problem's magnitude; for instance, events for which the trend increases over a period of at least 5 years must have a higher priority than those events with a decreasing or stable trend.
- Control possibilities or vulnerability—Relates to potential control with existing resources. Problems which can be prevented or controlled more easily or with less cost should be assigned a higher priority than those in which control and prevention is more difficult and expensive.
- Local interest and importance of the problem for the community and stakeholders—Information from community leaders and authorities that can be acquired in varied ways (i.e., meetings, surveys).
- Interests of international, national, and local organizations working in the prevention and control of the injury events—Areas in which international, national, or local cooperation is neccesary.
- Cost—Defined in two ways: (1) direct and indirect costs associated with patient care in health institutions and relatives of the injured person, and (2) intervention cost to prevent and control the problem, including research to ensure the efficacy and effectiveness.

Criteria to prioritize Health Events

Prevention and Control Capacity (possibilities for controlling, local interests, and other sectors' interests)		**Event Importance** (magnitude, severity, trend, cost)	
		HIGH	**LOW**
	HIGH	High importance and good control and prevention capacity = High priority for prevention and control	Low importance and good control and prevention capacity = Low priority for prevention and control
	LOW	High importance and low control and prevention capacity = High priority for research	Low importance and low control and prevention capacity = Not a priority

To apply this criteria, the following information must be on hand:

1. General information

- Leading causes of death;
- Number, proportion, and crude and adjusted injury rates;
- Years of potential life lost (YPLL) from injuries by intention;
- Trend of injuries (minimum of 5 years data).

2. Specific information

- Homicides (crude and adjusted rates by age group);
- Motor vehicle-related deaths (crude and adjusted rates by age group);
- Leading causes of injury morbidity (crude rates, lethality rates, admission rates, disability rates, etc.).

3. Costs

- Direct cost expended for patient care (i.e., hospital, health personnel, medicine, and transportation);
- Indirect cost (i.e., guards; environmental changes such as protective fencing or adding sidewalks to accommodate handicaps and pedestrians; insurance; lawyers and judges);
- Economic and human cost payable to relatives (i.e., job loss, maintenance).

4. DALYs, if available.

5. Activities to prevent and control injuries at local, national, and international levels.

Exercise: Using local injury local data, apply the prioritization criteria: The first group should focus on unintentional injuries; The second group should focus on violence-related injuries.

1. General information
   - **a.** Leading causes of death (frequency and crude rates), as prepared in Session II, Item 4.
   - **b.** Frequency, proportion, and crude rates of injury deaths by intention (i.e., homicide, suicide, motor vehicle-related, and other unintentional deaths). These were calculated in Session V, Item 1.
   - **c.** Trend of injury crude rates (minimum of 5 years data)

2. Specific information
   - **a.** Homicides: Specific rates by age group and sex (see Session V, Item 1.3).
   - b. Motor vehicle-related deaths: Rates by type of victim (pedestrian, vehicle occupant, motorcyclist, and bicyclist) and rates by age group and sex.
   - **c.** Trend of injury specific rates (minimum of 5 years data)

3. Leading causes of injury morbidity (if the information is available): injuries by age group and sex, intention, nature, etc. Lethality, admission and disability rates.

4. Costs and DALYs, if available.

5. Local, national, and international interests in injury prevention and control.

2. Identify Potential Etiological factors of the Priority Injuries in the Region or City

The Haddon Matrix and Ecological Model are used to help identify and to organize etiological factors for priority injuries. Although both models can be used for either intentional or unintentional injuries, the Haddon Matrix typically is used for unintentional injuries, whereas the Ecological Model is generally applied to violence-related injuries in which there is a chain of events instead of one unexpected event.

2.1 Use the Haddon Matrix to Help Identify and Organize Potential Etiological Factors for Unintentional Injuries

William Haddon, Jr. made numerous contributions to the field of injury control through his research on various injury topics and his leadership of the National Highway Traffic Safety Administration and later, the Insurance Institute for Highway Safety. He is most well known for developing two complementary conceptual frameworks for understanding how injuries

occur and for developing intervention strategies. The first conceptual framework is known as the Haddon Matrix, and the second is his articulation of 10 countermeasure strategies for reducing injuries.[5] (Note: the 10 countermeasures are not reviewed in this manual.)

The Haddon Matrix is built using columns and rows. In the columns, Haddon identifies the following:

- *Host* (person affected by the injury);
- *Agent*, which he defines in terms of energy transferred to the host by either an inanimate vehicle (e.g., a firearm or automobile) or an animate vector (e.g., an assailant);
- *Environment*, consisting of both the physical and social environment.
    - The physical environment consists of those elements of the physical surroundings that contribute to the occurrence of potentially injury-producing events or to injury (e.g., the physical characteristics of the roadway, building, playground, athletic field, or factory).
    - The social environment refers to the sociopolitical milieu affecting the process, which could include cultural norms or mores (e.g., tolerance of corporal punishment or alcohol consumption); the political environment (e.g., willingness to adopt regulatory interventions that restrict the freedom of motorcyclists or gun owners); and the legal environment (e.g., the presence or absence of seat belt usage laws or prosecution of perpetrators of domestic violence or child abuse).

By filling in the cells of the matrix, one can identify a range of potential risk and protective factors or strategies for prevention that are directed at each of the factors (the columns) and have an influence during various phases (the rows).[5] The rows of the Haddon Matrix relate to the circumstances occurring before the event, during the event, and after the event. These circumstances interact with human, environmental, and vehicular factors to define the frequency and severity of injury. Primary prevention approaches can be implemented during the *pre-event* phase; secondary prevention focuses on the *event* phase, and tertiary prevention focuses on the *post-event* phase.

Example:
The Haddon Matrix has been used both to conceptualize etiological factors and to identify potential preventive strategies, making it a useful tool not only for guiding epidemiologic research, but also for developing interventions. In Table 1, an example of applying the matrix to identify factors related to motor vehicle crash injury is shown.

Table 1. Factors Related to the Likelihood of Crash Injury — The Haddon Matrix

Phases	Factors		
	Host (Human)	**Agent (Vehicle)**	**Physical and Social Environment**
Pre-Crash	Alcohol intoxication Fatigue Experience and judgment Driver vision Amount of travel	Brakes, tires Center of gravity Jackknife tendency Ease of control Load weight Speed capability	Laws related to alcohol and driving Visibility of hazards Road curvature and gradient Surface coefficient of friction Divided highways, one-way streets, intersections, access control Signalization Speed limits
Crash	Seat belt use Age Sex Osteoporosis	Speed at impact Vehicle size Automatic restraints Hardness and sharpness of contact surfaces Load containment	Recovery areas Guardrails Characteristic of fixed objects Median barriers Roadside embankments
Post-Crash	Age Physical condition	Fuel system integrity	Emergency communication and transport systems Distance to and quality of medical services Rehabilitation programs

Source: Baker S, O'Neill B, Ginsburg MJ, Li G. *The Injury Fact Book*. 2nd ed. New York, NY: Oxford University Press; 1992.

Exercise A: Using a blank Haddon matrix and Post-it note, place each of the statements related to Pedestrian Injuries. After each statement is placed in the matrix, ask the participants to discuss the statement's most appropriate placement.

The statements follow:

1. No crosswalks on the roadway
2. No laws related to alcohol and driving
3. Children crossing the street without supervision
4. Age, sex, and physical condition of the pedestrian
5. Size and shape of the vehicle involved
6. Speed of the vehicle involved at impact
7. Quality of emergency communications
8. Quality and availability of medical services
9. Preexisting pathologies in the injured person (i.e., osteoporosis, disabilities, diabetes)
10. Brakes and tires of the vehicle

Exercise B: Working in two or more groups and using the Haddon Matrix, define the etiological factors for the unintentional injuries identified as priorities in the first part of this session, using the Haddon Matrix. You may refert to the previous matrix to present the results.

2.2 Use the Ecological Model to Identify and Organize Potential Etiological Factors for Violence-Related Injuries

The Ecological Model helps to identify and organize the multiple levels of influence that affect behavior. Violence is considered the product of the interaction between these multiple levels. The strength of the model lies in its ability to distinguish among the multitude of influences on violence while at the same time providing a framework for understanding the interaction.

Individual. The first level of the Ecological Model focuses on the characteristics of an individual that increase the likelihood of being a victim or a perpetrator of violence (i.e., low level of education, substance abuse).

Relationship. The second level of the Ecological Model explores how proximal social relationships such as relations with peers, intimate partners, and family members can increase the risk for violent victimization and perpetration of violence. For example, in cases of interpersonal violence among youth, research shows they are much more likely to engage in negative activities when those behaviors are encouraged and approved by their peers.

Community. The third level of the Ecological Model examines the community contexts in which social relationships are embedded—such as schools, work-places, and neighborhoods—and seeks to identify the characteristics of these settings that are associated with being victims or perpetrators of violence. For instance, a high level of residential mobility, heterogeneity and high population density, drug trafficking, high levels of unemployment, and widespread social isolation are associated with some forms of violence.

Societal. The final level of the Ecological Model examines the larger societal factors that influence rates of violence. Included here are those factors that create an acceptable climate for violence, those that reduce inhibitions against violence, and those that create and sustain gaps among different segments of society or tensions between different groups or countries.[6]

Example:
For the Ecological Model applied to intimate partner violence, consider etiological factors at the individual level, either perpetrator or victim, and factors in each of the other levels.

Table 2. Ecological Model of Factors Associated with Intimate Partner Violence[7]

Level	Etiological Factors
Individual Perpetrator	Being male; witnessing marital violence as a child; absent or rejecting father; being abused as a child; alcohol or drug use
Individual Victim[8]	Being female; lack of full-time employment; physical abuse after report of earlier abuse
Relationship	Marital conflict; male control of wealth and decision-making in the family
Community	Poverty; low socioeconomic status; unemployment; isolation of women and family
Society	Norms granting men control over female behavior; acceptance of violence as a way to resolve conflict; rigid gender roles; inadequate legal protections

Exercise A: Using a blank Ecological Model matrix and Post-it note, place each of the statements related to Youth Violence. After each statement is placed in the matrix, ask the participants to discuss the statement's most appropriate placement.

Statements:[6]

1. Inequalities of gender, economics, access to health care, or education
2. Concentration of poverty
3. Peers involved in crime
4. Psychological and personality factors
5. Impulsiveness
6. Poor parenting practices
7. Local illicit drug trade
8. Weak police/criminal justice systems

Exercise B: Working in two or more groups and using the Ecological Model, define the etiological factors for the violence-related injuries identified as priorities in the first part of this session, using the Ecological Model. You may refer to the previous matrix to present the results.

3. Review Effective Injury Prevention Strategies

Once the injury priorities and the potential etiological factors have been identified, the next step is to identify potentially effective prevention strategies. It would be valuable to look at local, national, and international examples:

a. Review of strategies applied to prevent injuries in your local communities, nongovernmental offices (NGOs), or government;

b. National and international experiences applied in other cities of your country. You could find examples on the Internet or with the help of academic centers.

A compilation of recommendations to reduce injuries to motor vehicle occupants was published[9] and is included as an example in Table 3. These recommendations are the work of an independent, nonfederal Task Force on Community Preventive Services. The Task Force developed the *Guide to Community Preventive Services* (the *Community Guide*) with the support of the U.S. Department of Health and Human Services (HHS) and in collaboration with public and private partners. The Centers for Disease Control and Prevention (CDC) provided staff support to the Task Force for development of the *Community Guide*.

The *Community Guide* addresses the effectiveness of three community-based intervention strategies to prevent motor vehicle occupant injuries:

1. Increase proper use of child safety seats;

2. Increase the use of safety belts;

3. Reduce alcohol-impaired driving.

Remember, "insufficient evidence to determine effectiveness" does not mean that the intervention does not work, but instead indicates that additional research is needed to determine whether the intervention is effective.

Decision makers should consider these evidence-based recommendations in light of local needs, goals, and constraints when choosing interventions to implement (Table 3).

Table 3. Proven or Promising Strategies to Prevent Road-Traffic Injuries

Intervention	Recommendation
Interventions to Increase the Use of Child Safety Seats	
Child safety seat use laws	Recommended (Strong evidence)
Community-wide information and enhanced enforcement campaigns	Recommended (Sufficient evidence)
Distribution and education programs	Recommended (Strong evidence)
Incentive and education programs	Recommended (Sufficient evidence)
Education-only programs	Insufficient evidence of effectiveness
Interventions to Increase the Use of Seat Belts	
Seat belt use laws	Recommended (Strong evidence)
Primary enforcement laws (versus secondary enforcement laws)	Recommended (Strong evidence)
Enhanced enforcement programs	Recommended (Strong evidence)
Interventions to Reduce Alcohol-Impaired Driving	
0.08% blood alcohol concentration (BAC) laws	Recommended (Strong evidence)
Lower BAC laws for young or inexperienced drivers	Recommended (Sufficient evidence)
Minimum legal drinking age laws	Recommended (Strong evidence)
Sobriety checkpoints	Recommended (Strong evidence)
Server intervention training programs (face-to-face instruction with management support)	Recommended (Sufficient evidence)

Table 4 shows a compilation of prevention strategies to reduce violence-related injuries and to address youth and intimate partner violence and child abuse. This information was published in the *World Report on Violence and Health.*[6]

Table 4. Proven and Promising Violence Preventing Programs

Intervention	Recommendation
To Reduce Child Abuse and Neglect	
Home visits to new mothers	Promising strategy. It appears that visits by nurses are most effective.
School-based programs to prevent child sexual abuse	One recent meta-analysis concluded that programs to prevent victimization were fairly effective in teaching children concepts and skills related to protection against sexual abuse.[10]
To Reduce Antisocial and Aggressive Behavior in Children and Adolescents	
Improving competency and social skills with peers Promoting positive, friendly, and cooperative behavior	Demonstrated to be effective in reducing youth violence or risk factors for youth violence.
Warm and supportive relationship with a positive adult role model Mentoring Programs	Is thought to be a protective factor for youth violence.
To Reduce Abuse between Intimate Partners	
Training health workers to identify and respond to abuse between intimate partners	Active screening for abuse and questioning patients about their possible histories of suffering violence by intimate partners is generally considered good practice in this field. However, little systematic evaluation has been carried out on whether screening for abuse can improve the safety of women.[11]

Table 5 shows examples of prevention strategies classified by sector. Although not all strategies have been evaluated, such examples can provide a foundation for developing a prevention program.

Table 5. Strategies to Prevent Violence Classified by Sector[12]

Sector	Preventive Actions
Education	Carry out cognitive interventions (anger management, cognitive self control, moral reasoning, social perspective-taking) Improve school climate (properly handling students in classrooms, establishing school policies and rules, ensuring school safety, reducing bullying) Implement technical education or vocational programs to help reduce school dropout rates and provide improved opportunities for students entering the labor market
Health	Provide greater access to reproductive health care services and to programs that reduce drug and alcohol abuse
Justice	Create decentralized alternative dispute-resolution centers Incorporate violence prevention activities into sectoral judicial reform projects Enact laws or regulations to restrict the sale of alcohol at certain times of day and on certain days
Police	Implement community policing and/or problem-oriented policing Provide police training, including domestic violence and human rights components Organize voluntary programs for taking guns out of the hands of the civilian population Solve and prosecute more cases in an attempt to reduce impunity for the perpetrators of crime Improve information gathering, record keeping, and reporting of crimes
Social Services	Conduct workshops for couples on how to resolve conflicts in a nonviolent way Establish high-quality day care centers Organize mentoring programs for high-risk teens Create parenting programs (including setting limits for children's behavior, mediation, and nonviolent conflict resolution)
Media	Mount information campaigns to change norms regarding violence Reduce violence in TV programming, especially in children's programs Train journalist on how to report crime Provide media training programs on domestic and social violence
Housing and Urban Development	Incorporate safety issues in housing construction programs and neighborhood improvement programs (street lights, spatial configuration, parks, etc.) Build sports and recreational facilities Build facilities for neighborhood organizations
Civil Society	Provide training to nongovernment organizations to bring about greater cooperation with and monitoring of police reform efforts Generate private sector support of violence prevention initiatives Subsidize/fund nongovernmental organizations to provide early childhood development programs Implement programs for at-risk youth Involve the church and other community groups in efforts to change prevailing attitudes and socially acceptable norms regarding violence

Source: Adapted from Technical Note #5. Inter-American Development Bank.

In February 2005, the *American Journal of Preventive Medicine* published a supplement devoted to a systematic review of interventions to Reduce Injury and Death from Violence. The *Journal* presents findings from the Task Force on Community Preventive Services evaluation of three interventions: firearm laws, early childhood visitations, and therapeutic foster care.[13]

Example:
A multifaceted injury prevention strategy was applied in Bogotá, Colombia, from 1995 to 1997. During this period, 130 million (3.7%) of the city's budget was invested. The objective was to strengthen self-regulation of collective and individual behaviors by closing gaps between these types of behavior and legal repercussions. This strategy was based on the premise that the three systems regulating human behavior—law, culture (on a collective level), and morals (individual behavior)—were disconnected. During the same period, a reduction in the homicide rate was observed from 72 to 51 per 100,000 inhabitants. Table 6 presents the strategies and results.[14]

Table 6. Multifaceted Injury Prevention Strategy; Bogotá, Colombia

Strategies	Results
Voluntary disarmament with the collaboration of the church	2,538 weapons were turned in and melted down to make baby spoons under the voluntary disarmament campaign. Over the following three months common homicides dropped 23% to 30%.
Community workshops (*semilleros*) attended by citizens to raise consciousness about rules of civil coexistence and receive input for proposals to amend the city of Bogota's code of police behavior	Nearly 18,000 people participated in the community workshops (*semilleros*) and offered nearly 30,000 proposals that were summarized in a "Civil Charter" (*Carta de Civilidad).*
Restrictions placed on the use of fireworks	The number of children injured by fireworks at Christmastime was reduced to fewer than one third of the figure from previous years.
Education on the use of alcohol and the enactment of the dry law (*ley zanahoria*) which mandated that establishments serving alcoholic beverages close at 1:00 AM	A 9.5% reduction in the number of homicide victims who had alcohol in their blood was experienced during the first year of the program; a 26.7% reduction was experienced during the second year.

Source: Adapted from Technical Note #5. Inter-American Development Bank.

Example:
The Development, Safety, and Peace Program (*Programa de Desarrollo, Seguridad y Paz*), known by its Spanish acronym "DESEPAZ,"was developed in Cali, Colombia, in 1992, by initiative of the mayor, a public health professional. The program's objective was to decrease the high level of violence. During a period of 4 years, homicide rates in the city were reduced 30% (600 fewer homicides), from 124 homicides in 1994 to 86 homicides in 1997. Following are some of the strategies implemented in Cali: [15,,6]

- **Develop an injury surveillance system**. Identify groups at risk and risk areas to inform prevention activities.
- **Improve policing**. Provide education on civil rights and create community policing efforts.
- **Improve the criminal justice system.** Implement "Houses of Justice" ("*Casas de Justicia*"), an experiment to bring the criminal justice system closer to the citizen and thus improve efficiency and public perception of the courts. As yet, no formal evaluations of this experiment have been conducted; nevertheless, an increase in the number of cases handled by service providers has been reported.

- **Educate citizens about creating a culture of nonviolence**. Work has commenced to modify behavior through community-based education programs and a media campaign called "*el vivo-bobo.*"
- **Restrict sale of alcoholic beverages**. In an effort to reduce crime and traffic-related injuries, this strategy curfewed sales of alcohol between 1:00 AM and 2:00 AM. As yet, no formal evaluations have been conducted; nevertheless, a decrease in injuries, particularly those related to motor vehicles, has been observed.
- **Initiate gun control.** An evaluation showed a 14% reduction in the homicide rate when this strategy was applied.[16]

The following documents contain information related to injury prevention:

1. *World Report on Violence and Health* (WHO, 2002)
2. *World Report on Violence and Health* (Summary)(WHO, 2002)
3. *Handbook for the Documentation of Interpersonal Violence Prevention Programs* (WHO, 2004)
4. *The Economic Dimensions of Interpersonal Violence* (WHO, 2004)
5. *World Report on Road Traffic Injury Prevention* (WHO, World Bank, 2004)
6. *Guia Didactica para Municipios: Prevencion de la Delincuencia y la Violencia a Nivel Comunitario en las Ciudades de America Latina* (World Bank, 2003)
7. *Violence in Latin America and the Caribbean: A framework for Action IADB, 1999*
8. *Violence Against Women: The Health Sector Responds* (PAHO, 2003)[7]

The following websites present information related to injury prevention:

www.prevencionviolencia.org.co
www.cdc.gov/ncipc
www.surgeongeneral.gov/library/youthviolence
www.thecommunityguide.org
www.cdc.gov/mmwr
www.hwysafety.org
http://depts.washington.edu/hiprc
www.cpsc.gov
www.aap.org/family/tippmain.htm
www.alaska-ipc.org/
www.iadb.org
www.suicideinfo.org
www.nhtsa.dot.gov
www.madd.org

4. Identify and Select Potential Interventions to Prevent Priority Injuries

To identify and select potential interventions, have the following information at hand:

a. **Priority injuries** (require urgent attention, as identified previously). To define risk groups and characteristics, you will need the following:

- Homicides: crude and specific rates by age group and sex, and mechanism;
- Motor vehicle-related deaths: crude and specific rates by age group, sex, and road user (pedestrian, vehicle occupant, motorcyclist, or cyclist);
- Leading causes of injury morbidity: crude rates by age group and sex, nature of injury, lethality rate, admission rate, and disability.

b. **Potential etiological factors for those priority injuries.** The Haddon Matrix and Ecological Model were used to help identify and to organize etiological factors for priority injuries. Besides that, there are two statistics measures to identify the impact of a given intervention: (1) atributable risk, which measures the amount of disease or injury that would be eliminated if a risk factor was removed from a defined population; and (2) the prevented fraction (PF), which is the rate of injury occurrence in a population averted due to a protective risk factor or public health intervention. PF measures the impact of the intervention by comparing the incidence of the injury event in the population with and without intervention. More information about these statistics measures maybe found in this reference.[2]

c. Recommendations about proven and promising injury prevention strategies. (Some recommendations were reviewed in the third part of this session.)

The Haddon Matrix and Ecological Model will be used again to determine potential interventions for those injuries identified as high priority in your region.

4.1 Use the Haddon Matrix to Identify Possible Interventions for Unintentional Injuries

In this step, the Haddon Matrix will be filled with ideas about strategies for prevention that are directed at each of the factors (the columns) and have an influence during the different phases (the rows).

Example:
Here, the Haddon Matrix has been applied to identify prevention strategies for childhood injuries caused by dog bites.

Table 7. Haddon Matrix to Identify Strategies to Prevent Chilhood Injuries Caused by Dog Bites

	Host (Human)	Agent (Dog)	Physical Environment	Social Environment
Pre-Event	Teach kids about dogs: Don't go near a dog's food, unknown dogs, dogs in yards, mother dog with new puppies, etc. Teach children, parents, and caregivers how to respond in case of aggression	Teach dogs appropriate and acceptable behavior (socialization training) Spay and neuter dogs	Maintain dogs in fenced yards or enclosures or by electronic "invisible" means Use gate alarms to indicate when gate is opened	Increase community awareness of the problem and solutions Pass leash laws Pass of dangerous dog laws/ordinances (e.g., requiring impoundment, evaluation, and destruction, if necessary) Initiate and support animal control programs (i.e., evaluate reports of dangerous dogs and pick up strays/unleashed dogs) Establish spay/neuter and vaccination programs
Event	Don't run from dogs Stand still and yell for help Position bike, bag, or other obstacle between you and the dog. If knocked to the ground, protect head, neck and face	Identify risk situations before biting occurs (e.g., watch for signs of aggression like growling, hair raised, etc.) Muzzle dangerous dogs	Respond to alarm system sounding indicating gate is opened or dog has escaped	Apply consequences of dangerous dog laws/ordinances Enforce laws requiring impoundment of dangerous dogs
Post-Event	Provide first aid/trauma care and rabies vaccine if appropriate Provide psychological support if it is necessary	Evaluate dangerous dogs and destroy them if appropriate Impound dogs; observe for rabies	Use emergency medical service (EMS) systems, medical care system, and rehabilitation programs	Maintain community surveillance for dog bites Report dog bite incidents Repeat dog bite prevention messages

Adapted from: (a) AVMA Task Force on Canine Aggression and Human-Canine Interactions. A community approach to dog bite prevention. JAVMA 2001; 218:1732-1749. (b) Wallace LJD. National Center for Injury Prevention and Control (NCIPC), CDC [Personal communication] 2005.

Exercise A: Using a blank Haddon Matrix and Post-it note, place each of the statements related to Bicycle-related Injury Prevention. After each statement is placed in the matrix, ask the participants to discuss the statement's most appropriate placement. The following are the statements to be placed in the Haddon Matrix:

1. Separate bicyclists from other forms of traffic
2. Equip bike with lights, reflectors, and a horn or bell
3. Reduce size and weight of motor vehicles to decrease injury severity
4. Modify vehicle front ends to decrease injury severity
5. Teach safe bicycling practices, including use of a bicycle helmet
6. Control traffic with engineering
7. Enforce speed limits and limits on alcohol use while bicycling and driving
8. Wear bicycle helmet
9. Wear riding gloves
10. Use horns or bells when unable to stop
11. Maintain mechanical condition of bike
12. Teach cyclist to carry identification
13. Encourage use of reflective clothing
14. Provide emergency care
15. Provide adequate EMS
16. Penalize road users who broke the law
17. Inspect bicycle for safety problems

Exercise B: Working in two or more groups, define appropriate prevention strategies for local unintentional injuries, based on previously identified etiological factors, using the Haddon Matrix. You may refer to the previous matrix to present the results.

4.2 Use the Ecological Model to Organize Possible Interventions to Prevent Violence-Related Injuries

Example:

During the course of a person's life, behavior patterns may change—including those associated with violence. Adolescence and young adulthood are periods when violence and other types of risky behaviors are often more expressive. Understanding these conditions and behaviors can help to identify appropriate

interventions and policies. In the following example, the Ecological Model has been used to identify strategies for preventing youth violence.[6]

Table 8. Potential Interventions to Prevent Youth Violence[6]

Level	Potential Interventions
Individual	Programs to increase access to prenatal and postnatal care Preschool enrichment programs Perpetrator programs Victim care and support Building of social skills
Relationship	Home visitation Skill training programs on parenting Supportive relationship with a positive adult role model Home-school partnership programs to promote parental involvement Peer mediation of students helping other students resolve disputes
Community	Extracurricular activities Gang prevention programs Reducing the availability of alcohol
Society	Reducing income inequality Reducing media violence Having laws prohibiting illegal transfers of guns to adolescents Reforming educational system Strengthening and improving police and judicial systems

Exercise A: Using a blank Ecological Model matrix and Post-it note, place each of the statements related to Intimate Partner Violence Prevention. After each statement is placed in the matrix, prepare to discuss the statement's most appropriate placement. Following are the statements:

1. Women's crisis center and battered-women shelters
2. Criminalizing physical, sexual, and psychological abuse by intimate partners
3. Laws requiring mandatory arrest for domestic violence
4. Treatment programs for perpetrators of intimate partner violence
5. Training health workers to identify and respond to abuse
6. Outreach workers visiting victims of violence in their homes and communities
7. Efforts to reform the response of institutions
8. Family and social networks to support battered women
9. Inter-agency coordinating council

Exercise B: Working in two or more groups, define appropriate prevention strategies for local violence-related injuries, based on previously identified etiological factors, using the Ecological Model. You may refer to the previous matrix to present the results.

5. Use the Decision Matrix to Identify the most appropriate intervention for the Injuries in your region

The Intervention Decision Matrix [18] is a tool designed to help people identify and choose among intervention options. This matrix can also help identify long-term goals and intervention options, which must be considered together. This tool is applied after the priority injury problems have been identified. The original Decision Matrix has seven elements. For the purposes of this manual, the matrix has been adapted to include five elements, to make it more workable. The elements are:

1. Effectiveness,
2. Cost,
3. Sustainability,
4. Social and political acceptability,
5. Possible unintended consequences.

Table 9. Decision Matrix — Elements and Score

Elements	Score		
1. Effectiveness	**1.** Not proven effective	**2.** Moderately effective	**3.** Highly effective
2. Cost	**1.** High cost	**2.** Medium cost	**3.** Low cost
3. Sustainability	**1.** Low sustainability	**2.** Medium sustainability	**3.** High sustainability
4. Social and political acceptability	**1.** Low acceptability	**2.** Medium acceptability	**3.** High acceptability
5. Possible unintended consequences	**1.** Known consequences	**2.** Unknown or unclear whether there are consequences	**3.** No consequences

The scoring ranges from 1 for low, 2 for medium, and 3 for high. However, for some elements, the score must be applied in reverse order (see Table 9). Finally, the scores are summed. The strategy with the highest score should be the most viable.

Completed Decision Matrix

Elements	Examples
1. Effectiveness Is the intervention useful to preventing injuries? Has it been evaluated?	Child safety seats, when correctly installed and used, reduce the risk of death by 71% for infants and 54% for toddlers aged 1–4 years.
2. Cost Is the proposal affordable? Are there enough resources to develop the proposal? Is the investment justifiable?	Building a special path for pedestrians and bicyclists next to a high-traffic road is an effective strategy to reduce injuries in those groups; however, the cost could be high.
3. Sustainability How long will the intervention be applied after its implementation?	Seat belt laws could have a long-term impact in the reduction of injuries.
4. Social and Political Acceptability What is the current political context in which to develop the prevention strategy? Is the strategy accepted by communities and leaders?	A ban on riding in the back of a truck may not be accepted by the community.

Exercise: Working in two groups, select one or several interventions to prioritize injuries identified in the previous exercise (4.1) and to assign a score to each identifying the most appropriate one. Identify the intervention idea that best represents a good balance of decision matrix elements.

6. Summary

Now that you have completed this session, you should be able to:

- Use surveillance data to identify priority injuries in your region;
- Identify potential etiological factors of priority injuries;
- Review successful interventions for injury prevention;
- Identify the most appropriate interventions for the injuries in your region.

The next step, defining an evaluation plan for the injury surveillance system and monitoring prevention activities, will be addressed in Session VII.

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INJURY SURVEILLANCE TRAINING MANUAL

PARTICIPANT GUIDE

SESSION VII

DEFINE AN EVALUATION PLAN FOR THE SURVEILLANCE SYSTEM AND MONITOR PREVENTION ACTIVITIES

Developed with the support of the
National Center for Injury Prevention and Control
Division of International Health, Epidemiology Program Office
Centers for Disease Control and Prevention
Atlanta, GA

SESSION VII
DEFINE AN EVALUATION PLAN FOR THE SURVEILLANCE SYSTEM AND MONITOR PREVENTION ACTIVITIES

Learning Objectives

- Know the steps to evaluating an injury surveillance system.
- Review public health indicators proposed for monitoring injuries.
- Use surveillance data to monitor prevention activities.

Introduction

Evaluation has been defined as *systematic investigation of the merit, worth, or significance of an object*.[1] It is an essential organizational practice in public health; however, it is not practiced consistently across program areas, nor is it sufficiently well-integrated into the day-to-day management of most programs.

The highest-priority public health events should be monitored closely, and surveillance systems should meet their objectives as efficiently as possible. The overall purpose of evaluating public health surveillance is to obtain feedback about the operation of the system and to promote the most effective use of health resources. Performance of a surveillance system can be assessed using specific criteria and standards of performance. The evaluation of an operating surveillance system for a high-priority health event aims to increase the system's utility and efficiency. An evaluation may also compare two or more systems that involve the same health event. But, most importantly, an evaluation will determine whether the system is meeting its objectives, serving a useful public health function, and operating as efficiently as possible.[2]

In 1988, CDC published the *Guidelines for Evaluating Surveillance Systems* to promote the best use of public health resources through the development of efficient and effective public health surveillance systems. In 2001, updated guidelines were published in the MMWR.[3] The steps proposed in those guidelines are being followed in this session.

1. Know the Steps for Evaluating an Injury Surveillance System

1.1 Engage Stakeholders in the Evaluation

As mentioned in Session III, coalition partners and other stakeholders are the most important users of the injury surveillance results. These users, which includes local government, public health officers, representatives of affected communities, nongovernment offices (NGOs), mass media, and others, should be involved in the evaluation process. They can provide input to ensure that the evaluation of the injury surveillance system addresses appropriate questions and assesses pertinent attributes and that its findings will be seen as useful. They may help to define questions, and this can subsequently increase their ability to use the findings.

Example: In the first six months of the fatal injury surveillance system in Cali, Colombia, an evaluation was performed every month. A meeting with stakeholders and the operation team of the injury surveillance system was held to evaluate how well the system was working. This evaluation addressed the data collection process, the variables and categories, the presentation of the results, and other aspects of the system. During these months, some variables were dropped and others were added.[4]

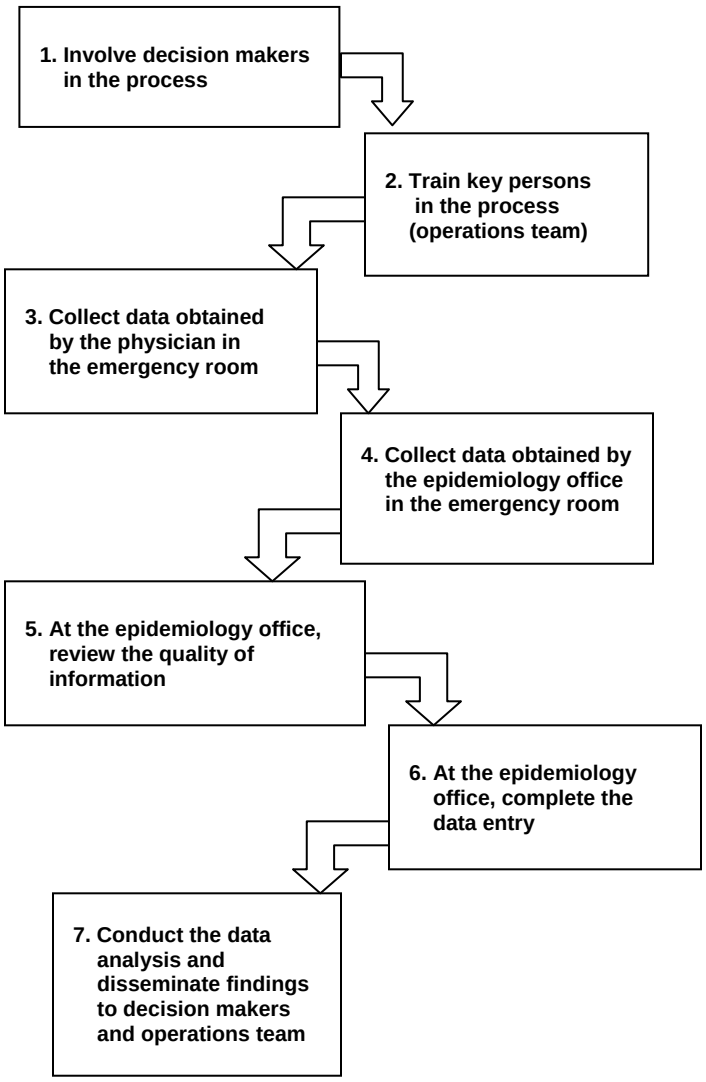
1.2. Describe the Surveillance System to be Evaluated

The second step in the evaluation process is to fully describe the surveillance system to be evaluated.

Activities: Describe the public health importance of the injury event under surveillance using measures such as indices of frequency, number, incidence, and mortality rates; years of potential life lost (YPLL); indices of severity; disparities or inequities associated with the health-related event; associated costs; preventability; and public interest (most of these measures were reviewed and calculated in Sessions II and V). Describe the purpose and operation of the system: list its objectives; describe the planned uses of system data; and describe the event under surveillance—including the case definition; describe the context in which the system evaluation is to be done; draw a flow chart of the system; and describe the system components. Also describe the resources used to operate the system, including personnel cost and financial resources.

Example:
An evaluation of the injury surveillance system in Central America was conducted in 2004. The flow chart in Figure 1 depicts the evaluation process. Note that the first step was to involve stakeholders in the process.[5]

Figure 1. Evaluation Process of the Injury Surveillance System in Emergency Rooms; El Salvador — 2004



1.3 Focus the Evaluation Design

The process of the evaluation must be planned to ensure that time and resources are used efficiently. This process involves stating the purpose of the evaluation; identifying stakeholders who will receive the results of the evaluation; stating what questions will be answered by the evaluation and how the results will be used; and defining the standards that will be used to assess the system.

1.4 Gather Credible Evidence about the Surveillance System's Performance

Indicate if the actions taken because of analysis and interpretation of the data have been useful in controlling the public health problem under surveillance. Each one of the following attributes must be described:

a. Simplicity: This refers to both the structure of the system and ease of operation. Surveillance systems should be as simple as possible while still meeting their objectives. A chart depicting the flow of data and the lines of response in a surveillance system can help assess the simplicity or complexity of the system. Simplicity is closely related to timeliness. Simplicity also affects the level of resources required to operate the system.

b. Flexibility: A flexible surveillance system can adapt to changing information needs and can accommodate changes in case definitions or technology and variations in funding or reporting sources. Flexibility is probably best evaluated retrospectively by observing how a system has responded to a new demand.

c. Data Quality: This reflects the completeness and validity of the data recorded in the public health surveillance system. Examining the percentage of "unknown" or "blank" responses to items is an easy measure of data quality. Data of high quality will have low percentages of such responses.

d. Acceptability: This measure reflects the willingness of people and organizations to participate in the surveillance system. To assess acceptability, the points of interaction between the system and its participants must be considered. The following criteria may be used to measure acceptability: subject or agency participation rate; interview completion rates and question refusal rates (if relevant); completeness of report forms; data source reporting rate; and timeline of data reporting.

e. Sensitivity: The sensitivity of a system can be considered on two levels. First, at the level of case reporting, sensitivity refers to the proportion of cases of a disease (or other health-related event) detected by the surveillance system. Second, sensitivity can refer to the ability to detect outbreaks or the ability to monitor changes in the number of cases over time. The primary emphasis in assessing sensitivity (assuming that most reported cases are correctly classified) is on estimating the proportion of the total number of cases in the population under surveillance being detected by the system, represented in Table 1 by A/(A+C).

Table 1. Calculation of the Sensitivity of a Surveillance System

Sensitivity = A / (A+C)

Injury Patients Detected by the Surveillance System	Injury Patients Detected by "Gold Standard"		
	Yes	**No**	
Yes	*True Positive* Injury patients correctly registered by the Surveillance System **A**	*False Positive* Patients incorrectly registered by the Surveillance System as injury patients **B**	**A+B**
No	*False Negative* Injury patients incorrectly not registered by the Surveillance System **C**	*True Negative* Patients correctly not registered by the system, because the cause was different than injury **D**	**C+D**
	A+C	**B+D**	**A+B+C+D** Total patients for all causes

The measurement of the sensitivity of a surveillance system requires collection of or access to data that are usually external to the system, to determine the true frequency of the condition in the population under surveillance, and linkage of surveillance system cases with true cases, to determine if the surveillance system cases are true positives.

f. Predictive Value Positive (PVP): This is the proportion of reported cases that actually have the health-related event under surveillance. In assessing PVP, the primary emphasis is to confirm cases reported through the surveillance system. To assess the PVP of the system adequately, calculating more than one measurement of PVP might be necessary. For example, PVP could also be determined for the system's individual data fields, for each data source or combination of data sources, or for specific health-related events (e.g., hospitalization for the condition). In Table 2, PVP is represented by A/(A+B).

Table 2. Calculation of Predictive Value Positive for a Surveillance System

Predictive Value Positive = A / (A+B)

Injury Patients Detected by the Surveillance System	Injury Patients Detected by "Gold Standard"		
	Yes	**No**	
Yes	*True Positive* Injury patients correctly registered by the Surveillance System **A**	*False Positive* Patients incorrectly registered by the Surveillance System as injury patients **B**	**A+B**
No	*False Negative* Injury patients incorrectly not registered by the Surveillance System **C**	*True Negative* Patients correctly not registered by the system, because the cause was different than injury **D**	**C+D**
	A+C	**B+D**	**A+B+C+D** Total patients for all causes

Example:

A hypothetical example (Table 3) compares data from a hospital statistics office (used as the gold standard) with data from an injury surveillance system based in the emergency rooms of the same hospital.

The statistics office in the hospital reported a total of 97,482 patients attended by all causes in emergency department in 2000. Of those, 28,311 were classified as injury patients.

The injury surveillance system reported 27,482 injury patients in the same year. Of those, 491 were incorrectly included as injury patients, and 1,320 injury patients were not registered by the system.

Table 3. Calculation of Sensitivity and Predictive Value Positive for a Surveillance System for Injury Visits to Emergency Rooms — 2002

Injury Patients Detected by the Surveillance System	Injury Patients Detected by "Gold Standard"		
	Yes	**No**	
Yes	*True Positive* **26,991** Injury patients correctly registered by the Surveillance System **A**	*False Positive* **491** Patients incorrectly registered by the Surveillance System as injury patients **B**	**A+B** **27,482**
No	*False Negative* **1,320** Injury patients incorrectly not registered by the Surveillance System **C**	*True Negative* **68,680** Patients correctly not registered by the system, because the cause was different than injury **D**	**C+D** **70,000**
	A+C	**B+D**	**A+B+C+D** **97,482** Total patients for all causes

Sensitivity = A/(A+C): 26,991/28,311 = 95.33
Predictive Value Positive = A/(A+B): 26,991/27,482 = 98.21

g. Representativeness: A public health surveillance system that has good representativeness is one that accurately describes the occurrence of a health-related event over time and its distribution in the population by place and person. Representativeness is assessed by comparing the characteristics of reported events to all such actual events. It could be examined through special studies that seek to identify a sample of all true cases and to compare these samples with reported cases. A system with 100% sensitivity is highly representative.

h. Timeliness: This measure reflects the speed between steps in a public health surveillance system. The interval usually considered first is the amount of time between the onset of a health-related event and the reporting of that event to the public health agency responsible for instituting control and prevention measures. The timeliness of a public health surveillance system should be evaluated in terms of availability of information for control of a health-related event. The need for rapid response in a surveillance system depends on the nature of the health-related event under surveillance and the objectives of that system. The increasing use of electronic data collection from reporting sources, via the Internet, and the increasing use of electronic data interchange by surveillance systems, might promote timeliness.

i. **Stability:** This measure assesses the reliability (i.e., the ability to collect, manage, and provide data properly without failure) and availability (the ability to be operational when it is needed) of the public health surveillance system. A lack of dedicated resources might affect the stability of a public health surveillance system. A more formal assessment of the system's stability can be made through modeling procedures. Stability largely reflects the dependability and robustness of data processing equipment.

1.5. Justify and State Conclusions and Make Recommendations

Evaluation conclusions can be reached through appropriate analysis, synthesis, interpretation, and judgment of the gathered evidence for performance of the public health surveillance system. Recommendations should address the modification or continuation of the public health surveillance system. Efforts to improve sensitivity, PVP, representativeness, timeliness, and stability can increase the cost of the system, although savings in efficiency with computer technology might offset some of these costs.

1.6. Use Evaluation Findings and Share Lessons Learned

Deliberate effort is needed to ensure that the findings from a public health surveillance system evaluation are used and disseminated appropriately. Strategies for communicating evaluation findings and recommendations should be tailored to relevant audiences, including those who provided data used for the evaluation.

2. Review Public Health Indicators Proposed to Monitor Injuries

An injury indicator describes a health outcome of an injury, such as hospitalization or death, or a factor known to be associated with an injury, such as a risk or protective factor, within a specified population.[6] Indicators are statistical measures used to monitor progress toward a desired outcome. There are a number of different indicators available to study the severity of the problem of injuries in a country or a region.[7]

The Inter-American Coalition for the Prevention of Violence, an alliance of seven agencies, has proposed a set of indicators to be used by countries of the Americas to monitor violence in the region.[8] The following organizations are involved in this coalition:

- Inter-American Development Bank (IADB)
- Pan American Health Organization (PAHO)
- World Health Organization (WHO)
- Centers for Disease Control and Prevention (CDC)

- United Nations Educational, Scientific, and Cultural Organization
- Organization of American States
- United States Agency for International Development

Two major components of violence, self-directed (suicides and parasuicides) and interpersonal violence, were considered for monitoring. Indicators were built on three objectively measurable outcomes of violence: death, illness, and violent behaviors, including crimes. Applying those indicators proposed by the Coalition is not always possible because few injury data are generated uniformly in these countries. Furthermore, the denominators needed to calculate some of these indicators usually are not available; or if available, the denominators may not be broken down by standard age categories. The indicators are classified as follows:

2.1 Basic Indicators

These indicators are considered basic because they can be generated from information systems that exist in all countries of the Americas. Data on deaths usually can be obtained from the health sector, police, forensic office, or national statistics office. This information and a standard population are necessary to calculate adjusted rates. The information related to assault, robbery, and kidnapping may be found in offices of the police, district attorney, human rights, etc. The basic indicators are:

- Age-adjusted suicide rate, per 100,000 population;
- Age-adjusted homicide rate among males aged 15–44 years, per 100,000 population;
- Age-adjusted homicide rate among females aged 15–44 years, per 100,000 population;
- Homicide rate among children aged 0–4 years, per 100,000 population;
- Reports of assault, per 1,000 population;
- Reports of robbery, per 1,000 population;
- Reports of kidnapping, per 1,000 population.

Developmental Indicators

The information needed for these indicators is not uniformly available in all countries of the Americas. For example, deaths due to intimate partner violence (IPV), child abuse, or elder abuse are hard to find because information about the relationship between the perpetrator and victim is not routinely collected in the information systems. Hospital discharge data is shared data and generally does not reflect context. Data for civil rights violations may be collected by NGOs or special offices in the government, but this information is hard to get. Information about child maltreatment and school fights might be found through surveys. Developmental indicators include both morbidity and mortality data to yield a

more balanced assessment of violence. The first level of indicators requires morbidity data that parallels basic mortality indicators and that should be available in a minimally functioning hospital information system. The second and third levels require increasingly more effort to collect the data.

Level I:

- Age-adjusted death rate due to IPV, per 100,000 population;
- Death rate due to child abuse, per 1,000 population;
- Death rate due to elder abuse, per 100,000 population;
- Age-adjusted homicide rate due to robbery, per 100,000 population;
- Age-adjusted hospital discharge rate due to suicide attempts per 100,000 population;
- Age-adjusted hospital discharge rate due to assault of males aged 15–44 years, per 100,000 population;
- Age-adjusted hospital discharge rate due to assault of females aged 15–44 years, per 100,000 population;
- Hospital discharge rate due to assault of children aged less than 5 years, per 100,000 population;
- Hospital discharge rate for assault of the elderly, per 100,000 population;
- Reported civil rights violations, per 1,000 population;
- Reported cases of child maltreatment, per 1,000 population aged less than 5 years;
- Reported cases of school fights, per 100,000 population of school-aged children, per year.

Level II:

- Age-adjusted hospital discharge rate for assault resulting from IPV, per 100,000 population;
- Hospital discharge rate for assault resulting from child abuse, per 100,000 population;
- Hospital discharge rate for assaults due to elder abuse, per 100,000 population.

Level III:

- Age-adjusted rate of emergency-room visits due to suicide attempts, per 100,000 population;
- Age-adjusted rate of emergency-room visits among males aged 15–44 years due to assaults, per 100,000 population;
- Age-adjusted emergency-room visit rates due to assaults resulting from IPV, per 100,000 population;
- Emergency-room visit rates due to assaults resulting from child abuse, per 100,000 population;
- Emergency-room visit rates for assaults due to elder abuse, per 100,000 population.

2.2 Research Indicators

Data to build research indicators are not routinely available; however, these data may be obtained through surveys or special research. Such data can include:

- Rate of suicide ideation, per 100,000 population;
- Rate of suicide attempts in past 12 months;
- Self-reported weapon-carrying rate among adolescents at school, per 100 school children;
- Self-reported fighting rate among adolescents at school, per 100 school children;
- Self-reported rate of IPV, per 100,000 respondents.

Exercise: Working in three groups, select basic, developmental, and research indicators for IPV. Answer the following questions:

1. In your region, is it easy to obtain data to build the selected indicators?
2. Do the indicators provide information that is useful to monitor this event?
3. How can you use these indicators to monitor public health issues in your country?

3. Use Injury Surveillance Data to Monitor Prevention Activities

Injury surveillance data provides information that can be useful to:

- Monitor the association of the implementation of prevention strategies with changes in the number, rate and characteristics of injury, which allows decision makers to decide whether or not to continue the prevention activities.
- Monitor changes in the trend of an event before and after a strategy is applied (i.e., helmet or seat belt law).
- Monitor the impact of strategies applied for purposes other than injury prevention that could positively or negatively affect the events under surveillance (i.e., firearm restriction during an election period).
- Possible over- or under-representation of certain groups in the population (elderly people, youth, men, women, etc.).
- Possible over or under presence of some types of events in areas of the city or region (clusters of events in specific areas).

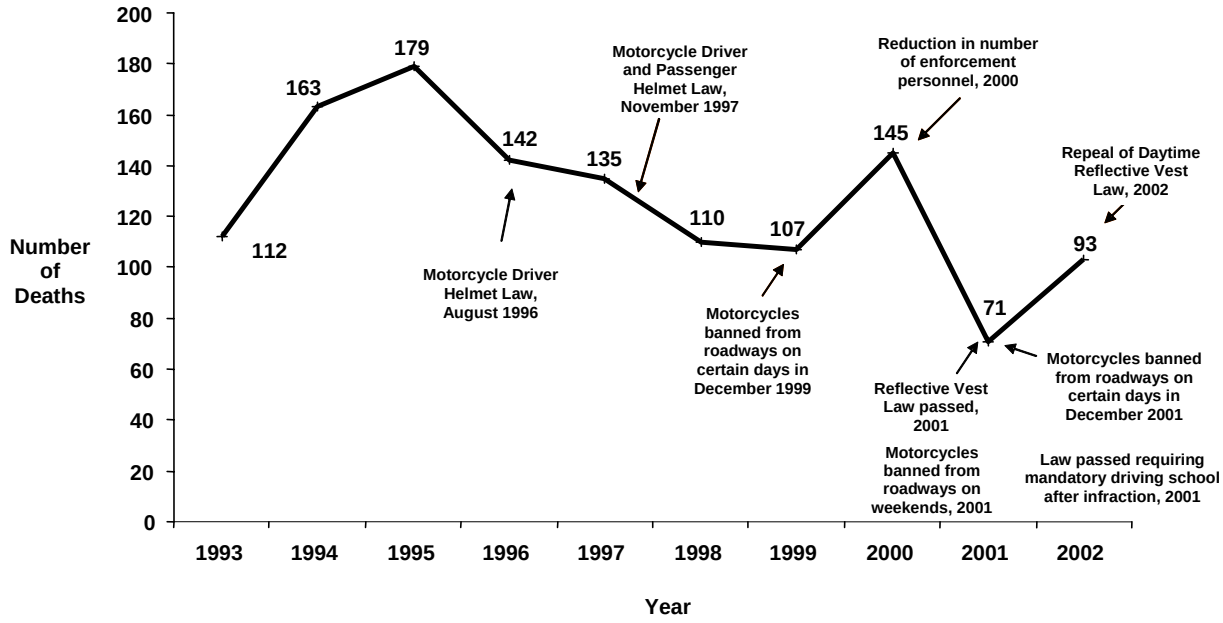
- **Examples:**

a. An evaluation of the impact of child-resistant drug packaging illustrates the usefulness of both multiple assessments and active or passive surveillance systems for monitoring trends. In this case, trend data from poison control centers documented steep declines in unintentional poisoning deaths and ingestions by children after new packaging policies were put into place. A review of annual mortality rates associated with unintentional ingestion of oral prescription drugs for children less than 5 years of age also showed that mortality rates declined 45% from the period before policy implementation through 1992.[9]

b. Motorcyclist deaths have been an important public health problem in Cali. Motorcyclists accounted for 30% of motor vehicle-related deaths during the past 10 years. Different strategies have been implemented to address this problem (Figure 3). The Fatal Injury Surveillance System established in

Cali has been useful for monitoring the trend of motorcyclist fatalities before and after each strategy was implemented.[10]

Figure 3. Motorcyclist Deaths and Interventions in Cali, Colombia, 1993–2002



Exercise: Working in two groups, give your opinions about the impact of prevention strategies applied in Cali and Samoa.

4. Summary

Now that you have completed this session, you should be able to:

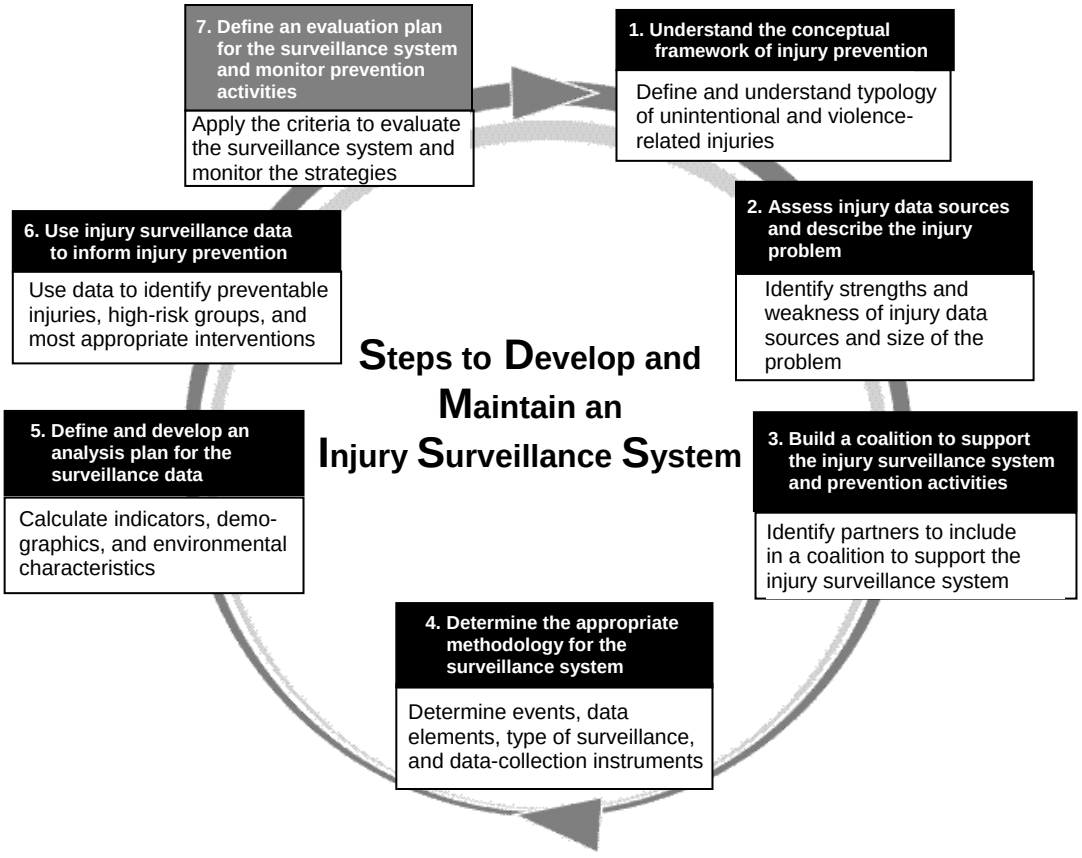
- Know the steps to evaluating an injury surveillance system.
- Review public health indicators proposed for monitoring injuries.
- Use surveillance data to monitor prevention activities.

You have completed the *Injury Surveillance Training Manual*! You are now able to:

- Understand the conceptual framework of injury prevention;
- Assess injury data sources and describe the injury problem;
- Build a coalition to support the injury surveillance system and prevention activities;
- Determine the appropriate methodology for the surveillance system;
- Define and develop an analysis plan for the surveillance data;
- Use injury surveillance data to inform injury prevention;
- Define an evaluation plan for the surveillance system and monitor prevention activities.

You are now ready to establish an injury surveillance system in your region or country.

Congratulations!


Steps to Develop and Maintain an Injury Surveillance System
1. Understand the conceptual framework of injury prevention
Define and understand typology of unintentional and violence-related injuries
2. Assess injury data sources and describe the injury problem
Identify strengths and weakness of injury data sources and size of the problem
3. Build a coalition to support the injury surveillance system and prevention activities
Identify partners to include in a coalition to support the injury surveillance system
4. Determine the appropriate methodology for the surveillance system
Determine events, data elements, type of surveillance, and data-collection instruments
5. Define and develop an analysis plan for the surveillance data
Calculate indicators, demo-graphics, and environmental characteristics
6. Use injury surveillance data to inform injury prevention
Use data to identify preventable injuries, high-risk groups, and most appropriate interventions
7. Define an evaluation plan for the surveillance system and monitor prevention activities
Apply the criteria to evaluate the surveillance system and monitor the strategies

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Appendixes

Appendix 1.1
Posttest

Length: 10 minutes

City/Country: _____

Date: ___ / ___ / ____

1. Which of the following items are components of the injury definition?
    a) Damage to a person caused by exposure to physical agents in amounts that exceed the threshold of human tolerance.
    b) Damage to a person caused by a sudden lack of essential agents (oxygen or heat).
    c) Psychosocial trauma which results in emotional injury.

2. For each type of injury, place a check mark under the appropriate injury classification:

	Violence-related injuries	**Unintentional injuries**	**Other type of injuries**
Types of injuries			
Child abuse			
Assault by firearm			
Poisoning with pesticide			
Pedestrian injury			
Intimate partner violence			
Suicidal behavior			

3. Place the following etiological factors in the appropriate phase of the Haddon Matrix:

Etiological factors	**Pre-event**	**Event**	**Post-event**
Impaired driving laws			
Quality of medical services			
Speed of the vehicle at impact			
Seat belt use			
Speed limit laws			
Brakes and tires of the vehicle involved			
Pedestrian walking in the roadway			
Recovering areas in case of emergency			

4. Select potential partners for a coalition that supports the injury surveillance system and prevention activities:

Potential Partners	**YES**	**NO**
Health (hospital and health center directors, ministries of health)		
Justice (forensic medicine, coroners/medical examiners, courts, prosecutors)		
Security (police, security companies, homicide investigators)		
Transportation (transportation department offices or officers)		
Administration (planning officers)		
Education (academic directors)		
Community (community organizations, youths, mothers)		
Private organizations (NGOs, human rights groups)		
Political (national, regional, or local authorities)		
Other (mention which one)		

5. Place the following factors for intimate partner violence in the appropriate level of the Ecological Model:

Factors	Individual	Relationship	Community	Societal
Absent or rejecting father				
Acceptance of violence as a way to resolve conflict				
Isolation of women and family				
Witnessing marital violence as a child				
Marital conflict				
Norms related to male authority over women				

Appendix 2
Session Evaluation

Length: 10 minutes

City/Country: _____

Date: ___ / ___ / ____

Use this form to evaluate workshop sessions. Check the appropriate box. Give this form to the instructor at the end of the workshop.

Sessions	Were session objectives met?		Was adequate time allowed for the session?		Did the instructor conduct the class well?		Did you learn something new in this session?	
	YES	**NO**	**YES**	**NO**	**YES**	**NO**	**YES**	**NO**
I								
II								
III								
IV								
V								
VI								
VII								

Additional comments (indicate the session)

_____

_____

_____

_____

_____

_____

_____

Appendix 3

Workshop Evaluation

Length: 10 minutes

City/Country: _____

Date: ___ / ___ / ____

Use this form to evaluate the workshop. Check the appropriate box. Give this form to the instructor at the end of the workshop.

	Agree	Neither agree nor disagree	Disagree
1. Workshop objectives were met			
2. Sessions progressed in a logical manner			
3. The instructor(s) were well prepared			
4. This workshop would adequately prepare someone to follow the steps for establishing an injury surveillance system			
5. I would recommend this workshop to anyone interested in establishing an injury surveillance system			

Additional comments:

Centers For Disease Control and Prevention
National Center for Injury Prevention and Control
4770 Buford Highway NE
Mail Stop K-65
Atlanta, Georgia 30341

Telephone: 770-488-1506
Fax: 770-488-1667

E-mail: ohcinfo@cdc.gov
Website: www.cdc.gov/injury