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13. ABSTRACT (Maximum 200 words) This paper outlines the five steps in the public health prevention model and applies them to the problem of injury morbidity and mortality in the U.S. Armed Forces. The five steps are (1) determine the existence and magnitude of the problem, (2) identify the causes of and risk factors for the problem, (3) determine what prevents the problem, (4) implement prevention strategies and programs, and (5) monitor and evaluate the effectiveness of prevention efforts. The paper applies these five steps to the problem of injuries in the military.				
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CHAPTER 9

CONCLUSIONS AND RECOMMENDATIONS OF THE DoD INJURY SURVEILLANCE AND PREVENTION WORK GROUP

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Section I. Introduction

While we have known for some time that injuries in the U.S. Armed Forces are a significant problem, the full magnitude of the impact has not been defined. As this atlas reveals, injuries represent a far greater hazard to the health and readiness of the U.S. Armed Forces than any other medical threat. Since injuries represent the outcome of a sequence of probabilistic events, it is possible to quantitatively define events and design strategies to intervene at modifiable points. To prevent and control injuries, the military services must:

- Systematically collect and monitor surveillance data on injuries.
- Analyze the data to better understand the nature and causes of injuries.
- Establish intervention programs based on the analysis of this data.
- Follow up with evaluation research on intervention programs and outcomes.

This atlas demonstrates that abundant, high-quality data exists for all the services. Furthermore, the military's own success in reducing aviation and motor vehicle-related injuries clearly illustrates that the frequency and severity of injuries can be reduced. Additional strides must be made that capitalize on both the extraordinarily abundant data sources available to the military and the recent technological and methodological advances in injury prevention and control.

This final chapter:

- Outlines conclusions that summarize the findings of the DoD Injury Surveillance and Prevention Work Group regarding sources of information that illuminate the incidence and causes of injuries.
- Provides recommendations about how to use the information available on injuries in the U.S. Armed Forces to more effectively prevent their occurrence.

Section II. The Five-Step Public Health Approach

Whenever possible, established methodologies should be used to first understand and then counteract a given health threat. One methodology that can be used to prevent and control injuries is the five-step public health approach, shown in **Figure 9-1**. The appropriate activities for each step are also shown.

Five Steps of the Public Health Approach	
Steps	Appropriate Activities
1. Determine the existence and magnitude of the problem.	Surveillance
2. Identify the causes of and risk factors for the problem.	Research
3. Determine what prevents the problem.	Research/Intervention Trials
4. Implement prevention strategies and programs.	Policy, Behavioral Changes, and Equipment
5. Monitor and evaluate the effectiveness of prevention efforts.	Surveillance and Research

Figure 9-1. The Public Health Approach

Adapted from Mercy, J.A., M.L. Rosenberg, K.E. Powell, C.V. Broome, and W.L. Roper. "Public Health Policy for Preventing Violence." *Health Affairs*, Winter 1993:7-29, and Jones, B.H., and J.J. Knapik. "Physical Training and Exercise-Related Injuries: Surveillance, Research and Injury Prevention in Military Populations." *Sports Medicine*, 27(2):111-125, 1999.

The work group's conclusions and recommendations on the prevention and control of injuries are presented within the framework of this five-step approach. The work group was chartered to inventory and understand available data with injury surveillance potential. For this reason, the atlas and the conclusions outlined in this chapter focus on the first three steps of the process. The recommendations focus on general ways to use this information to implement more effective prevention programs (step 4). Finally, the atlas suggests how available data can be used, and to some extent is being used, to monitor the effectiveness of prevention strategies.

Section III. Conclusions

The work group's conclusions are outlined in this section. The outline follows the sequence of steps 1, 2, and 3 of the public health approach (see Figure 9-1).

Step 1. Determine the Existence and Magnitude of the Problem.

- Injuries are the leading cause of death (see Table 9-1).
- Deaths have decreased substantially from FY 1980-1995 primarily due to decreases in unintentional injury (accidental) deaths (see Table 9-2).
- Musculoskeletal (orthopedic) conditions are the leading cause of disability (see Table 9-3).
- As the leading cause of disability, musculoskeletal (orthopedic) conditions account for a large proportion of DoD disability costs (see page 9-9).
- Musculoskeletal (orthopedic) conditions are the leading cause of Veterans Administration disability payments (see Table 9-4).
- Injuries and musculoskeletal sequelae are the leading causes of hospitalization (see Table 9-5).
- Injuries are a major cause of morbidity associated with vigorous physical training (see page 9-11).

Step 2. Identify the Causes of and Risk Factors for the Problem.

- Vehicle accidents are the leading specific cause of death (see Table 9-6).
- Athletic or sports injuries, falls, and physical training are significant contributors to the occurrence of nonfatal injuries (see page 9-13).

Step 3. Determine What Prevents The Problem.

- Surveillance systems, research, and safety programs contribute to the prevention of injuries (see page 9-14).
- Data have been used to identify causes and to prevent injuries (see pages 9-14 and 9-15).

The prevention process begins with the determination that a problem exists. Routine surveillance is a critical starting point. Comprehensive medical surveillance, such as the military services are capable of, not only serves to identify health problems but provides the foundation for prioritizing prevention and research activities. Data in this atlas unequivocally show that injuries are the leading health hazard confronting military personnel. This deserves great attention from commanders and safety, research, and medical personnel, among others.

Step 1. Determine the Existence and Magnitude of the Problem.

Injuries are the leading cause of death.

The conclusion that injuries are the leading cause of death—specifically deaths caused by accidental injuries and violent injuries (suicides and homicides combined)—is supported by data provided in Chapter 2 and summarized in Table 9-1.

Table 9-1. Injuries are the Leading Cause of Death in the U.S. Armed Forces

Casualty Types	Army	Navy	Marine Corps	Air Force
Accidental Injuries	• Accidental injuries account for 49% of all deaths.	• Accidental injuries account for 48% of all deaths.	• Accidental injuries account for 57% of all deaths.	• Accidental injuries account for 47% of all deaths.
Violent Injuries (Suicides and Homicides Combined)	• Violent injuries account for 27% of all deaths: suicides - 18%; homicides - 9%.	• Violent injuries account for 28% of all deaths: suicides - 20%; homicides - 8%.	• Violent injuries account for 29% of all deaths: suicides - 20%; homicides - 9%.	• Violent injuries account for 30% of all deaths: suicides - 26%; homicides - 4%.
Combination of Accidental and Violent Injuries	• Accidental and violent injuries account for 76% of all deaths.	• Accidental and violent injuries account for 76% of all deaths.	• Accidental and violent injuries account for 86% of all deaths.	• Accidental and violent injuries account for 77% of all deaths.

Sources: Atlas Chapter 2, tables 2-4, 2-7, 2-9, 2-11, and 2-12.

Deaths have decreased substantially from FY 1980-1995 primarily due to decreases in accidental (unintentional injury)* deaths.

The conclusion that deaths decreased from FY 1980-1995 due to substantial decreases in accidental deaths is supported by data provided in Chapter 2 and summarized in **Table 9-2**.

Table 9-2. Decrease in Deaths in the U.S. Armed Forces from FY 1980-1995

	Army	Navy	Marine Corps	Air Force
Deaths	• Deaths decreased 34%.	• Deaths decreased 52%.	• Deaths decreased 55%.	• Deaths decreased 44%.
Accidental Deaths	• Accidental deaths decreased 46%.	• Accidental deaths decreased 68%.	• Accidental deaths decreased 54%.	• Accidental deaths decreased 60%.

Sources: Atlas Chapter 2, figures 2-11, 2-12, 2-15, 2-16, 2-19, 2-20, 2-23, and 2-24.

* While the terms "accident" and "accidental injuries" are commonly used in the military by the casualty office and safety community, public health officials in the U.S. recommend using the term "unintentional injury." The reason for this recommendation is to emphasize that injuries are not random, uncontrollable events (i.e., accidents), but can be predicted and prevented.

Musculoskeletal (orthopedic) conditions are the leading cause of disability.

The conclusion that musculoskeletal (orthopedic) conditions are the leading cause of disability is supported by data provided in Chapter 4 and summarized in **Table 9-3**.

Table 9-3. Musculoskeletal (Orthopedic) Conditions are the Leading Cause of Disability in the U.S. Armed Forces

Disability	Army	Navy and Marine Corps	Air Force
Musculoskeletal (Orthopedic) Conditions (VASRD Codes 5000-5300)	Musculoskeletal (orthopedic) conditions account for 53% of all disabilities.	Musculoskeletal (orthopedic) conditions account for 63% of all disabilities.	Musculoskeletal (orthopedic) conditions account for 22% of all disabilities.
Mental Disorders (VASRD Codes 9200-9500)	Mental disorders are the second leading cause of disability, accounting for 14% of all disabilities.	Mental disorders are the second leading cause of disability, accounting for 10% of all disabilities.	Mental disorders are the second leading cause of disability, accounting for 21% of all disabilities.
Ratio	Musculoskeletal (orthopedic) conditions occur almost 4 times as often as mental disorders, the second leading cause of disability.	Musculoskeletal (orthopedic) conditions occur more than 6 times as often as mental disorders, the second leading cause of disability.	Musculoskeletal (orthopedic) conditions occur slightly more often as mental disorders, the second leading cause of disability.

Source: Atlas Chapter 4, tables 4-3 and 4-9.

As the leading cause of disability, musculoskeletal (orthopedic) conditions account for a large proportion of DoD disability costs.

The conclusion that injuries are costly to DoD and the leading cause of musculoskeletal (orthopedic) conditions is supported by data in Chapter 4 and summarized below.

- The costs of injuries are great, in terms of both manpower losses and monetary expenditures.
- The DoD pays over \$1.5 billion per year to disabled service members. Musculoskeletal (orthopedic) conditions account for 40-50% of this amount.

Musculoskeletal (orthopedic) conditions are also the leading cause of Veterans Administration disability payments.

The conclusion that musculoskeletal (orthopedic) conditions are the leading cause of Veterans Administration disability payments is supported by data provided in Chapter 4 and summarized in **Table 9-4.**

- The Department of Veterans Affairs pays disability compensation in excess of \$12 billion per year (\$1 billion per month), with musculoskeletal (orthopedic) conditions accounting for 45% of all disability cases and 34% of disability payments (based on December 1994 data).

Table 9-4. Injuries are the Leading Cause of Veterans Administration Disability Payments

Disability	Disability Compensation Costs	
	% of Total	Millions of Dollars
Musculoskeletal (Orthopedic) Conditions (VASRD Codes 5000-5300)	• Musculoskeletal (orthopedic) conditions account for 34% of all disability compensation costs.	• Musculoskeletal (orthopedic) conditions account for a third of all disability costs—\$346.8 million per year.
Mental Disorders (VASRD Codes 9200-9500)	• Mental disorders account for 26% of all disability compensation costs.	• Mental disorders account for a quarter of all disability costs—\$265.2 million per year.
Ratio	• Musculoskeletal (orthopedic) conditions occur 1 1/3 times more often than mental disorders, the second leading cause.	• Musculoskeletal (orthopedic) conditions cost 1 1/3 more than mental disorders.

Source: Atlas Chapter 4, Table 4-12.

Injuries and musculoskeletal sequelae are the leading causes of hospitalization.

The conclusion that injuries—specifically chronic or late musculoskeletal system conditions and acute injuries—are the leading causes of hospitalization is supported by data provided in Chapter 5 and summarized in **Table 9-5**.

Table 9-5. Injuries and Musculoskeletal Sequelae are the Leading Causes of Hospitalization in the U.S. Armed Forces

Principal Diagnosis Groups	Army	Navy	Marine Corps	Air Force
Musculoskeletal System (ICD-9 Codes 710-739)	Musculoskeletal system accounts for 18% of all hospitalizations.	Musculoskeletal system accounts for 22% of all hospitalizations.	Musculoskeletal system accounts for 28% of all hospitalizations.	Musculoskeletal system accounts for 14% of all hospitalizations.
Injury (ICD-9 Codes 800-999)	Injury accounts for 10% of all hospitalizations.	Injury accounts for 2% of all hospitalizations.	Injury accounts for 3% of all hospitalizations.	Injury accounts for 8% of all hospitalizations.
Combination of Musculoskeletal System and Injury	Musculoskeletal system and injury account for 28% of all hospitalizations.	Musculoskeletal system and injury account for 24% of all hospitalizations.	Musculoskeletal system and injury account for 31% of all hospitalizations.	Musculoskeletal system and injury account for 22% of all hospitalizations.

Source: Atlas Chapter 5, Table 5-21.

Injuries are a major cause of morbidity associated with vigorous physical training.

The conclusion that injuries are a major cause of morbidity resulting from strenuous training activities is supported by data in Chapter 6 and summarized below.

- Studies of Army basic training populations have shown that 23-27% of men and 42-67% of women are injured during the 8-week basic training cycle.
- Among men and women in Army basic training, injuries result in more days of limited duty than illnesses.
- In a sample of trainees in Navy boot camp (1995), 11% of the men and 22% of the women were injured during the 9 weeks of basic training.
- In a sample of Marine recruits (1995), 25% of the men and 29% of the women were injured during the 11-13 weeks of basic training.
- In both Army and Navy recruit populations, overuse injuries account for 70-80% of all injuries sustained during training.
- Among men and women in Air Force basic training, 15% of the male trainees and 33% of the female trainees were injured at least once during the 6 weeks of training.

Step 2. Identify the Causes of and Risk Factors for the Problem.

Vehicle accidents are the leading specific cause of death in the U.S. Armed Forces.

The conclusion that vehicle accidents are the leading specific cause of death in the U.S. Armed Forces is supported by data provided in chapters 2 and 3 and summarized in **Table 9-6**.

Table 9-6. Vehicle Accidents are the Leading Specific Cause of Death in the U.S. Armed Forces

Cause of Death	Army	Navy	Marine Corps	Air Force
Leading Specific Cause of Death	Vehicle accidents account for 32% of all deaths.	Vehicle accidents account for 32% of all deaths.	Vehicle accidents account for 41% of all deaths.	Vehicle accidents account for 31% of all deaths.*
Second Leading Specific Cause of Death	Gunshots account for 21% of all deaths.	Gunshots account for 19% of all deaths.	Gunshots account for 20% of all deaths.	Suicides account for 30% of all deaths.†
Ratio	Vehicle accidents occur almost 1½ times as often as deaths by gunshot.	Vehicle accidents occur more than 1½ times as often as deaths by gunshot.	Vehicle accidents occur more than 2 times as often as deaths by gunshot.	Vehicle accidents occur only slightly more often than suicides.

* Vehicle accidents for the Air Force include POV auto, motorcycle, pedestrian, and other.

† Air Force data provided did not separate gunshots as a category.

Sources: Atlas Chapter 2, tables 2-5, 2-7, 2-9, 2-11, and 2-14; Chapter 3, tables 3-4, 3-8, 3-11, and 3-14.

Athletic or sports injuries, falls, and physical training are significant contributors to the occurrence of nonfatal injuries.

- Army Safety Center data indicate that sports are the largest contributor to the personnel injury category for Class A to C mishaps.
- Cause of injury data from hospitalization records show that athletic and sports injuries were the leading and third highest causes of injury, respectively, for both the Army and Air Force.
- Hospital data also show that falls are an important cause of morbidity.
- Army data show that physical fitness parameters, such as slow initial physical fitness test run time (low aerobic fitness levels) and behavioral factors such as smoking, are potentially modifiable risk factors for injury during training.
- Excessive physical training is itself a primary but modifiable cause of injury.

Step 3. Determine What Prevents The Problem.

Surveillance systems, research, and safety programs contribute to the prevention of injuries.

Data from the military service safety centers and medical research organizations illustrate the successful use of surveillance and the need for research in the prevention process. Safety data systems for all of the services have been critical to the great success of programs to prevent motor vehicle and aviation crash fatalities and injuries (source: Chapter 3). The safety centers have employed information from these systems to monitor rates and trends of motor vehicle and aviation crashes and to institute progressively more effective prevention programs.

Data have been used to identify causes and prevent injuries.

- Naval Safety Center data show that Navy and Marine Corps aviation fatality rates decreased 96% from 54 per 100,000 flight hours in FY 1951 to 2 per 100,000 flight hours in FY 1995. The Navy placed a sequence of programs into effect to successfully achieve the demonstrated improvements, ranging from redesign of carrier decks to intensive training for both ground and flight crews (source: Chapter 3).
- Air Force private motor vehicle fatality rates decreased 47% from FY 1980-1994. The significant decrease in private motor vehicle fatality rates is attributed to a combination of factors, chief of which are the continued positive influence of the Standard Traffic Safety Course and Local Conditions Course, as well as intensive seasonally focused safety campaigns and strong commander emphasis. The Army employed similar strategies and their rates have similarly declined (source: Chapter 3).

- Safety center data show decreases in—
 - Accidents/mishaps and accident/mishap-related fatality rates for all services (source: Chapter 3).
 - Motorcycle-related deaths by approximately 60% for the Army and Navy over a 13- to 15-year period, respectively (source: Chapter 3).
 - Privately owned motor vehicle fatality rates from 38-58% over a 14-15 year period for the Army, Navy, and Air Force (source: Chapter 3).

Military medical research programs have identified a number of potentially modifiable risk factors for injuries and have successfully tested a number of interventions. Recent research by the U.S. Army Research Institute of Environmental Medicine (USARIEM) and the Naval Health Research Center (NHRC) has identified a number of areas where programs have worked to prevent injuries (source: Chapters 6 and 8). Examples of research contributing to prevention of injuries include:

- Research identified physical training and vigorous operational activities as the most common causes of injuries requiring patient care and limited duty (source: Chapter 6).
- Army research in the 1980s suggested that there are thresholds in the amount of running above which physical fitness does not improve but injury rates continue to climb (source: Chapter 6).
- Research on Marine Corps recruits by the NHRC shows that reductions in the amount of running and gradual progression of intense physical training can effectively reduce the incidence of stress fractures without sacrificing physical fitness (source: Chapter 6).

- Research on Army Airborne School candidates showed that an outside-the-boot ankle brace could reduce the incidence of parachute jump-related ankle sprains by as much as 85%. The annual cost avoidance if braces are worn by all Army jumpers would exceed \$2.5 million* (source: Chapter 6).
- Subsequent research has shown that outside-the-boot ankle braces can effectively prevent ankle injuries among Army rangers during tactical operations without impeding mission success (not yet published).
- Studies of seat belt use in the Army indicate that soldiers who always wear their seat belts are 50% less likely to be hospitalized than soldiers who buckle up less than half the time (source: Chapter 8).
- Other studies identify modifiable risk factors that could potentially be used to design intervention strategies. Some of these findings include:
 - Basic trainees who have the lowest levels of fitness on entry to the military are at greater risk of injury during basic training (source: Chapter 6).
 - Trainees who are the least physically active prior to entering the service are at greater risk of injury during basic training (source: Chapter 6).
 - Basic trainees who smoke cigarettes experience significantly more injuries than those who do not (source: Chapter 6). This has been shown to be true for infantry soldiers as well.†
 - Soldiers with certain knee injuries are at substantially higher risk of disability discharge (source: Chapter 4).

Medical research also illustrates why it is so important to test unproven strategies to prevent injuries. In 1985, the Marine Corps felt that recruits were experiencing an epidemic of stress fractures and that shock absorbent boot insoles would prevent the problem. A rigorous randomized intervention trial showed that injury incidence was the same among Marines who wore insoles as compared to those who did not. The insoles were shown to be ineffective at preventing injuries, thus saving the Marine Corps an unnecessary expense.

* Amoroso, Paul J. et al. "Braced for Impact: Reducing Military Paratroopers' Ankle Sprains Using Outside-the-Boot Braces." *Journal of Trauma: Injury, Infection, and Critical Care* 45(3):575-580, 1998.

† Reynolds, K., H.A. Heckel, C.E. Witt, J.W. Martin, J.A. Pollard, J.J. Knapik, and B.H. Jones. "Cigarette Smoking, Physical Fitness, and Injuries in Infantry Soldiers." *Am. J. Prev. Med.* 10:145-160, 1994.

Section IV. Recommendations for Future Surveillance, Prevention of Injuries, and Monitoring Program Successes

The work group recommendations relate to how the data and data sources reviewed should be used in the process of implementing prevention programs (Step 4) and monitoring and evaluating the efficiency/success of the programs (Step 5) (see Figure 9-1).

Step 4. Implement Prevention Strategies and Programs.

- Use surveillance to routinely prioritize prevention and research targets (see page 9-18).
- Enhance the Defense Medical Surveillance System capabilities to routinely conduct injury and other surveillance (see page 9-18).
- Ensure adequate injury research to support prevention programs (see page 9-19).
- Get surveillance and research information to those who can act to prevent injuries (see page 9-20).
- Establish an Injury Advisory Council (see page 9-21).
- Establish a DoD Injury Research Center (see page 9-21).
- Mobilize support of commanders and policy makers (see page 9-21).

Step 5. Monitor and Evaluate the Effectiveness of Prevention Efforts.

- Use multiple data sources to track rates and trends of injuries and to monitor the effectiveness of interventions to prevent injuries (see page 9-22).
- Enhance injury evaluation research support (see page 9-22).
- Routinely monitor and evaluate efficacy of prevention programs (see page 9-23).

Step 4. Implement Prevention Strategies and Programs.

Use surveillance to routinely prioritize prevention and research targets.

- Focus on priority targets—motor vehicle accidents, training injuries, sports, falls, and other causes as they are identified.
- Use surveillance to determine the most important targets for prevention.
- Enhance surveillance of deaths to include specific medical causes and circumstances of death to identify preventable factors and prioritize prevention programs. This can best be accomplished through the establishment of a DoD Medical Mortality Registry to track medical and circumstantial information for all military deaths.
- Produce a prioritized list of injury targets for prevention and research (based on incidence/rates and severity/time loss).
- Where “off the shelf” prevention strategies exist, they should be employed. Where such ready solutions do not exist, research is the most appropriate response to serious problems.
- Determine adequacy of epidemiology, occupational health, industrial hygiene, ergonomic, and other services needed to support injury prevention efforts made by commanders, supervisors, and others.

Enhance the Defense Medical Surveillance System capabilities to routinely conduct injury and other surveillance.

- Integrate medical outcomes across the full spectrum of health from mild and moderate to severe and fatal.
 - Incorporate deaths and routinely code deaths and the nature and causes of injuries using ICD-9 or ICD-10 codes.
 - Incorporate disabilities.
- Improve outpatient data with better and more complete coding of diagnoses and addition of cause codes.

- Capture and integrate deployment data.
- Standardize data collection and coding across services.
 - Collect better primary data to include the minimum basic data set variables for intentional injuries ("cause data with associated events").*
 - Link Physical Evaluation Board and Medical Evaluation Board data to other medical databases (numerators) and population databases (denominators).
 - Improve cause-of-injury coding in the hospital system. Take better advantage of coding for duty-related injuries as well as free text fields describing injuries. Code cause and ICD-9, or a hybridized system with STANAG (for the military aspects (i.e., war coding)). Plan for transition to ICD-10 coding.
 - Standardize the way injuries get coded for reporting across services and databases.
 - Assure adequate collection of cause data to include possible external coding for musculoskeletal system conditions.
- Develop practical automated unit-based surveillance tools for commanders (injury profile/time loss tracking).
- Integrate hazard (agent/cause) and exposure/risk factor (environment and host) surveillance data with medical outcome and population data.

Ensure adequate injury research to support prevention programs.

- Research is needed to demonstrate what actually works to prevent injuries.
- Focus research on high-risk populations and environments with largest impact on readiness.
- Allocate and prioritize resources for research based on the magnitude and severity of medical problems—injuries clearly deserve greater priority.
- Allocate adequate resources to ensure viability of injury research programs within the medical departments.
- Maintain the capability to systematically conduct research on the most important injury threats (e.g., motor vehicle crashes, sports, falls, training injuries, work-related injuries, etc.), as well as newly identified or emerging threats.

* Armed Forces Epidemiological Board, Injuries in The Military: A Hidden Epidemic, 1996.

- Further broaden the research effort to include operational populations as well as basic training and infantry populations.
- Concentrate research on physical training practices and the intensity, frequency, and duration of training, as well as the type of activity.
- Continue to explore the association of injury with training practices, fitness, performance, smoking, alcohol use, and other risk-taking behaviors.
- Conduct research to develop biomechanically sound equipment (boots, shoes, parachute ankle braces, etc.).

Get surveillance and research information to those who can act.

- Coordinate the efforts of trained specialists in epidemiology, social and behavioral sciences, biomechanics and engineering, medicine, public health, statistics, law enforcement, occupational health, safety, military command, and others for effective and comprehensive surveillance, research, and safety program implementation.
- Use the safety network and the military chain of command to provide safety advice and information based on science (surveillance and research results). For example, both Army and Navy research on training populations suggests that poor entry-level aerobic fitness is a risk factor for injury. This scientifically based knowledge can be used by the chain of command to support efforts to reduce injuries by instituting interventions to better prepare individuals to withstand the rigors of military training.
- Make injury data on hospitalizations due to accidents routinely accessible to the safety centers.
- Provide surveillance data and expert consultation as decision support to those who can act to prevent injuries (commanders, supervisors, safety centers, and others) on a routine basis.
- Use the Internet as a means of enhancing data availability. Many organizations have already chosen to make data available from a web site.
- Develop feedback systems from safety centers and commanders to surveillance and research centers.

- Provide feedback to DoD and service safety programs, commanders, and policy makers, etc., on successes and failures of prevention initiatives as documented by rates and trends of key injuries and diseases.
- Update relevant DoD directives and instructions to require the monitoring and use of the full spectrum of available injury data.

Establish an Injury Advisory Council.

- Include safety, research, surveillance, and other key representatives from each of the services.
- Meet routinely (at least annually) to review surveillance and current research data and evaluate progress toward key prevention goals as measured by monitoring outcome data (surveillance data) and programmatic assessments.

Establish a DoD Injury Research Center.

- Create a research center with the "critical mass" and diversity of scientific expertise necessary to understand and prevent the complex problems of injuries.
- Address cross-cutting injury problems of the services, such as motor vehicle crashes and physical training injuries.
- Address service-specific injury problems.

Mobilize support of commanders and policy makers.

- Using surveillance and research data, demonstrate that prevention of injuries can cut medical and disability costs, reduce lost duty time, and improve the readiness of troops.
- Convince commanders that prevention starts with them.
- Reinforce safety initiatives to incorporate risk management and prevention in all military operations.
- Establish a partnership among integrated surveillance systems; research communities/organizations; safety centers; and commanders, policy makers, and other decision makers.

Step 5. Monitor and Evaluate the Effectiveness of Prevention Efforts.

Use multiple data sources, such as those described in this atlas, to track rates and trends of injuries and to monitor the effectiveness of interventions to prevent injuries. For example:

- To get a broad, overall picture of injury fatality rates in each of the services, use the accidental death rates that are routinely tracked and reported by the Directorate of Information Operations and Reports (DIOR), Washington Headquarters Service (source: Chapter 2). These would be greatly enhanced if more detailed cause and circumstance of death information were collected.
- To track disabilities due to injuries, use the rates and trends of musculoskeletal (orthopedic) conditions available in the disability agency databases (source: Chapter 4).
- To monitor injuries due to specific causes, refer to the safety center databases or external cause-of-injury codes in hospitalization databases (source: Chapters 3 and 5).
- To determine the effect of an intervention on injury hospitalization rates, use injury and musculoskeletal system categories in the hospitalization databases (source: Chapter 5).
- To evaluate the effect of an intervention on a specific subset of the military population, use:
 - Research databases that provide historical injury rates to be compared to current injury rates.
 - Surveillance databases capable of identifying specific units (source: Chapter 6).

Enhance injury evaluation research support.

- Foster development of integrated DoD research databases such as the Total Army Injury and Health Outcomes Database (TAIHOD) to directly link personnel records, self-reported health habits, exposure data, and other factors to specific health outcomes, and to trace the interrelationship of these outcomes over time (e.g., Army personnel who sporadically or never use seat belts are twice as likely to be injured). Using carefully structured data queries, such databases would support epidemiological health research in injury control, occupational hazards, health promotion, and disease prevention (source: Chapter 8), and would permit evaluations of intervention effectiveness.

- Enhance research capabilities of existing military medical research organizations such as the NHRC and USARIEM (source: Chapter 8).
- Develop registries such as the Defense and Veterans Head Injury Program (DVHIP) to collect better, more complete data for serious and costly injuries (e.g., head injuries, spinal cord injuries, knee injuries, etc.). The DVHIP is a unique collaboration of the DoD, Department of Veterans Affairs, and Brain Injury Association (BIA). The DVHIP's mission is to ensure that all military and DVA traumatic brain injury (TBI) patients receive TBI-specific evaluation and follow-up, while at the same time collecting standardized patient outcome data. This data collection allows for the comparison of the efficacy and cost of various TBI treatment and rehabilitation strategies, and helps define optimal care for victims of TBI (source: Chapter 7).

Routinely monitor and evaluate efficacy of prevention programs.

- Determine adequacy of epidemiology, occupational health, industrial hygiene, ergonomic, and other investigative and prevention services needed to support injury prevention initiatives started by commanders, supervisors, and others (develop prioritization criteria).
- Once prevention strategies and programs are in place, employ surveillance systems and other quantitative tools for assessment to determine the effect of interventions on rates and trends of targeted medical outcomes. For example:
 - Confirm decrease in rates of death and hospitalizations due to motor vehicle crashes related to specific interventions.
 - Confirm lower rates of ankle injuries when parachute ankle braces are worn.
- Monitor and evaluate prevention program processes.
 - Improvement in knowledge and understanding of educational/training materials (e.g., principles of physical fitness and training injuries).
 - Greater use of prevention devices/strategies (e.g., percentage of service members using seat belts or percentage of airborne troops wearing ankle braces).

- Provide feedback to DoD and service safety programs, commanders, policy makers, etc., on successes and failures of prevention of routinely monitored rates and trends of key injuries.
- Appropriate funding for injury prevention programs commensurate with the magnitude of the problem.

Section V. Data Sources

This atlas demonstrates that a wide variety of databases exist that could be more effectively used to further prevent and/or reduce the impact of injuries on the health and readiness of the U.S. Armed Forces. Key information sources and systems used in the atlas data acquisition process include:

- Air Force Casualty Accountability System.
- Air Force Medical Support Agency, Medical Information Systems Division (AFMSA/SGSI).
- Air Force Mishap Information System (AFMIS).
- Air Force Personnel Data System.
- Ambulatory Data System (ADS).
- Army Casualty Information Processing System (ACIPS).
- Army Individual Patient Data System (IPDS).
- Army Medical Surveillance Activity (AMSA)/Defense Medical Surveillance System (DMSS).
- Army Physical Disability Case Processing System (PDCAPS).
- Army Safety Management Information System (ASMIS).
- Defense and Veterans Head Injury Program (DVHIP).
- Defense Manpower Data Center (DMDC).
- Directorate for Information Operations and Reports (DIOR), Washington Headquarters Service (WHS).
- DoD Worldwide Casualty System (WCS).
- Health Risk Appraisal (HRA) Data Set.
- Marine Corps Casualty Assistance Information System (CAIS).

- Marine Corps Ground Mishap Information System (GMIS).
- Naval Council of Personnel Boards.
- Naval Health Research Center (NHRC).
- Naval Medical Information Management System.
- Navy and Marine Corps Physical Evaluation Tracking System (PETS).
- Navy Automated Casualty Monitoring Program (ACMP).
- Navy Medical Evaluation Board.
- Navy Medical Information Management Center (NMIMC).
- Navy Safety Information Management System (SIMS).
- Total Army Injury and Health Outcomes Database (TAIHOD).
- U.S. Army Research Institute of Environmental Medicine (USARIEM).

Communication among all these systems should be improved and electronically integrated into a comprehensive medical surveillance system.

Section VI. Summary

The DoD Injury Surveillance and Prevention Work Group established these objectives at its first meeting in December 1992:

- Identify existing casualty, safety, medical, and personnel databases across all services.
- Collect and summarize data from these databases.
- Assess the value of these databases to injury surveillance.
- Document the magnitude of the injury problem—from outpatient visits to deaths—for all services.
- Present these data in a format that would demonstrate each database's utility as an injury and prevention surveillance tool.
- Make recommendations for future surveillance, research, and prevention of injuries.

In fulfilling its charter, the work group provided the data it collected to the Armed Forces Epidemiological Board (AFEB). The AFEB, in turn, chartered a work group of civilian experts to evaluate the data on injuries and to make recommendations for injury prevention. The AFEB Injury Work Group report, *Injuries in the Military: A Hidden Epidemic*, complements this *Atlas of Injuries in the U.S. Armed Forces*. The AFEB injury experts made specific recommendations for enhancing the surveillance and research capabilities of the services.

The AFEB report also influenced the establishment of a comprehensive DoD medical surveillance system that integrated many of the databases described in this atlas and that met Corporate Information Management system requirements.

This *Atlas of Injuries in the U.S. Armed Forces* fulfills the final objectives by defining the tremendous impact injuries have on the health and readiness of our military forces, and illustrates the wealth of data sources available for use in the injury prevention process. This final chapter provides insights into how they might be used to control the problem with injuries confronting the U.S. Armed Forces.