

A Systematic Process to Prioritize Prevention Activities

Sustaining Progress Toward the Reduction of Military Injuries

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Background: To sustain progress toward injury reduction and other health promotion goals, public health organizations need a systematic approach based on data and an evaluation of existing scientific evidence on prevention. This paper describes a process and criteria developed to systematically and objectively define prevention program and policy priorities.

Methods: Military medical surveillance data were obtained and summarized, and a working group of epidemiology and injury experts was formed. After reviewing the available data, the working group used predefined criteria to score leading military unintentional injury causes on five main criteria that assessed factors contributing to program and policy success: (1) importance of the problem, (2) effectiveness of existing prevention strategies, (3) feasibility of establishing programs and policies, (4) timeliness of implementation and results, and (5) potential for evaluation. Injury problems were ranked by total median score.

Results: Causes with the highest total median scores were physical training (34 points), military parachuting (32 points), privately-owned vehicle crashes (31 points), sports (29 points), falls (27 points), and military vehicle crashes (27 points).

Conclusions: Using a data-driven, criteria-based process, three injury causes (physical training, military parachuting, and privately owned-vehicle crashes) with the greatest potential for successful program and policy implementation were identified. Such information is useful for public health practitioners and policymakers who must prioritize among health problems that are competing for limited resources. The process and criteria could be adapted to systematically assess and prioritize health issues affecting other communities.

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Introduction

Historically, public health policy development has been largely driven by ad hoc, often high-visibility and emotion-invoking, issues of public concern.¹ While responding to these issues is a necessary component of public health practice and policy, sustained progress toward the reduction or prevention of leading health problems requires a more systematic approach based on a review of available epidemiologic data and evaluation of the scientific evidence on existing or potential prevention strategies.^{2,3} As stated in the IOM report, *The Future of Public Health*, public health policy development would benefit most from “a careful assess-

ment of existing knowledge, establishment of priorities based on data, and allocation of resources according to an objective assessment of the possibilities for greatest impact."¹

In the injury prevention field, expert opinion has been the foundation for priority setting in the past.⁴⁻⁶ At least one scoring system has been developed for use in defining injury prevention priorities that provides an objective, quantitative assessment of injury based on the frequency of emergency department visits by mechanism of injury and the severity of the injury based on the Injury Severity Score.⁷ However, in public health policy development, frequency and severity are only part of what must be considered when deciding what programs and policies to implement. Information on the effectiveness of prevention strategies, gathered from existing studies or systematic reviews, should also be considered. Additionally, political, social, and economic factors influence the success or failure of a public health program or policy. While many of these factors have been incorporated into suggested criteria to evaluate injury programs and policies,^{8,9} there are no prioritization processes that have combined all of these factors, nor are there published descriptions of applications of processes that combine all of these factors.

This paper describes the application of a prioritization process that includes the review of fatal and nonfatal injury epidemiologic data with the use of predetermined criteria and scoring to obtain an objective, quantitative assessment of the degree to which the leading causes of military injuries are likely to have successful program and policy implementation in the U.S. Department of Defense (DoD). This work builds on two prior injury prioritization efforts: one that generated injury prevention priorities for the U.S. Army Center for Health Promotion and Preventive Medicine's Injury Prevention Program^{3,10} and another that produced injury prevention priorities for the DoD.¹¹ Rationale and background on the development of this process are explained in detail by Jones et al.² The purposes of the prioritization initiative described in this paper were to (1) refine previous prioritization efforts by utilizing input from experts with public health training and experience evaluating epidemiologic data and the scientific literature; and (2) to apply predefined criteria to identify top DoD injury causes most amenable to implementation of prevention programs and policies.

Methods

This initiative began in April 2006 with the formation of the Military Injury Epidemiology and Prevention Priorities Working Group (MIEPPWG), established under the Mili-

tary Training Task Force of the Defense Safety Oversight Council.¹² The working group consisted of 18 faculty and graduate student volunteers from the Uniformed Services University of the Health Sciences (USUHS). Its mission was to review and assess existing nonbattle medical surveillance and field investigation data to identify the largest and most preventable DoD unintentional injury problems that, if addressed, had the greatest potential to rapidly reduce military injury rates.

Available epidemiologic data were obtained. Aggregate data on nonfatal, non-deployment-related inpatient and outpatient medical encounters, as recorded in the Defense Medical Surveillance System (DMSS),¹³ were requested from the Armed Forces Health Surveillance Center (formerly, the Army Medical Surveillance Activity). Graphic representations and data summaries were prepared by the U.S. Army Center for Health Promotion and Preventive Medicine, examples of which are presented elsewhere.¹⁴ Summaries included descriptions of injury-related medical encounters in relation to other health problems, inpatient (hospitalization) and outpatient injury rates over time, and leading injury types and causes of hospitalizations among active duty military personnel (all Services) between 2003 and 2005. Given that activities and causes associated with outpatient injuries were not routinely coded in the medical data, cause of injury information from field investigations, where information on causes of outpatient visits were captured from medical record reviews, were also summarized.¹⁵⁻¹⁷ Frequencies of active duty service member fatalities by type (i.e., accident, illness, hostile action, other intentional) were obtained from the Office of the Armed Forces Medical Examiner for all Services for 2003 and 2004.

During a 1-day meeting, MIEPPWG members were presented with the epidemiologic data described above. Working group members then reviewed, discussed, and reached consensus on how they interpreted the previously established criteria for prioritizing injury programs and policies (Table 1).^{2,3,10,18} Following the meeting, working group members completed the prioritization process. Worksheets were completed independently, then submitted to the lead author (MCC) for compilation. Worksheets were completed for each of the following leading causes of military injuries: falls/jumps, crashes of privately owned motor vehicles (includes trucks, cars, motorcycles), physical training, sports, guns/explosives, military parachuting, twists/turns/slips without fall, military motor vehicle crashes, nontraffic motor vehicle incidents, and machinery/tools. These cause categories were consistent with the NATO military injury cause coding system,¹⁹ which is employed by the U.S. military health system to cause-code injury hospitalizations. Nine of these ten causes were identified from medical surveillance data as the leading causes of unintentional injury hospitalizations for the leading causes of DoD injury types among active duty military personnel in 2004.¹⁸ Physical training was included based on evidence that approximately half of

Table 1. Criteria for prioritizing injury causes amenable to prevention programs and policies

Criterion	Preliminary rating	Final score
A. Consistent with the mission of the agency/organization/working group	<input type="checkbox"/> YES <input type="checkbox"/> NO	If YES—Continue with scoring. If NO—Stop here.
B. Importance of problem to health and readiness (10 points) Considerations:		(10 points; 1=low, 10=high)
1. Magnitude of the problem (e.g., frequency, incidence)	1. <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	
2. Severity of problem (e.g., injury diagnosis, length of stay or recuperation)	2. <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	
3. Cost of the problem (e.g., medical, training, property, and personnel costs such as lost work time)	3. <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	
4. Size of population at risk	4. <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	
5. Degree of concern (e.g., leadership concern, public and Service member concern, visibility of problem)	5. <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	
C. Preventability of problem (10 points) Considerations:		(10 points; 1=low, 10=high)
1. Cause(s) are identifiable	1. <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	
2. Risk factors are modifiable	2. <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	
3. Proven prevention strategies that reduce existing injury rates exist ^a	3. <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	
4. Prevention strategies that reduce existing injury rates can be designed	4. <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	
5. Effect size	5. <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	
D. Feasibility of program or policy (10 points) Considerations:		(10 points; 1=low, 10=high)
1. Existence of infrastructure to support implementation and sustainability of the program or policy (e.g., medical staff and facilities, safety staff and resources)	1. <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	
2. Perceived adequacy of funding to support implementation and sustainability	2. <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	
3. Authority to implement and sustain the program or policy is held or obtainable by the implementing organization(s)	3. <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	
4. Program or policy will not undermine essential missions	4. <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	
5. Political and cultural acceptability of program or policy	5. <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	
6. Accountability and responsibility for implementation and sustainability exists or can be established	6. <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	
E. Timeliness (5 points) Considerations:		(5 points; 1=low, 5=high)
1. Implementation time ^b	1. <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	
2. Results time ^b	2. <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	
F. Evaluation of program or policy (5 points) Considerations:		(5 points; 1=low, 5=high)
1. Ability to evaluate effects of program or policy exists (i.e., if a metric is possible)	1. <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	
2. Benefits of program or policy outweigh the costs of implementation and sustainability	2. <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	
3. Collateral benefits as a result of implementation (e.g., increased readiness, decreased attrition, and decreased other health problems)	3. <input type="checkbox"/> Low <input type="checkbox"/> Medium <input type="checkbox"/> High	
Total score		

^aIf systematic reviews substantiate effectiveness of a prevention strategy, score as 10 points automatically.

^bAssign higher value to programs and policies with shorter implementation and time to desired results.

Instructions: Complete a scorecard for each injury problem under consideration. First, provide a preliminary rating for each of the *Considerations* listed under each criterion. Then, using the preliminary ratings as a guide, assign a final score for each criterion. For criteria B, C, and D, assign a final score from 1 to 10 (1=lowest score, 10= highest score). For criterion E and F, assign a final score from 1 to 5 (1=lowest score, 5=highest score). Adding the final scores will provide a total score, with a maximum of 40.

injuries occurring among active duty service members were lower extremity–overuse injuries,¹⁴ the majority of which in military populations are attributed to physical training.^{24,25} Medical surveillance data reports indicated that causes of injury hospitalizations did not vary substantially from 2000–2004.^{20–23}

Table 1 presents the complete worksheet and criteria used to rate each injury cause. The process first required consideration of whether adoption of programs or policies related to the injury issue was consistent with the mission of the agency applying the scoring criteria (i.e., the working group's mission). The medical surveillance and field investigation data provided to working group members were used to rate the importance of the problem (Criterion B). Preventability, feasibility of prevention, timeliness, and evaluation-potential (Criteria C–F) assessments relied on individual knowledge and experience. A preliminary score of low, medium, or high was assigned to 21 factors, or “considerations,” within the five main criteria (Criteria B–F). Working group members considered preliminary ratings of each “consideration” in determining a final numeric score for the main criterion. Main criteria given a higher “weight” in the process (importance of the problem, preventability, and feasibility) were scored from 1 to 10, and main criteria given a lower “weight” (timeliness and evaluation potential) were scored from 1 to 5. These weights were adopted from previous work.^{3,10,11}

Causes were ranked using the median total score of each injury cause. Median values were chosen for ranking in order to avoid the potential effects of scoring variability, as might be experienced with use of mean values. The higher the score, the stronger the indication that the injury cause was amenable to program and policy implementation.

Results

Nine members of the working group (50%) volunteered to participate in the full prioritization process. Nonparticipants, 44% of whom were graduate students, cited “lack of time” as the primary reason for not choosing to participate. Members who contributed to the prioritization process were all trained at the doctorate level in one or more of the following disciplines: behavioral science, preventive medicine/epidemiology, occupational medicine, family medicine, health services administration, internal medicine, orthopaedic surgery, sports medicine, or military medicine. Six of the nine were also formally trained in public health. Five participants were active duty military, two were retired military, and two were civilian academic researchers employed by the military.

The highest possible total median score was 40. Physical training received the highest score (34), followed by military parachuting (32), privately-owned vehicle crashes (31), sports (29), falls (27), and military vehicle crashes (27) (Table 2). Physical training and privately owned-vehicle crashes had the highest median score (9 points) for importance of the problem. Military parachuting had the highest median score (10 points) for preventability of the problem and evaluation potential (5 points). Physical training and tools/machinery had the highest median scores (8 points) for feasibility; physical training, military parachuting, and sports had the highest median scores (4 points) for timeliness.

Tools/machinery and nontraffic vehicle incidents, compared to all other causes, had the lowest median score

Table 2. Prioritization results: median scores for five main criteria, total score, and rank order by cause of injury

Causes of injury	Importance ^a median (IR)	Preventability ^a median (IR)	Feasibility ^a median (IR)	Timeliness ^b median (IR)	Evaluation potential ^b median (IR)	Total score ^c	Rank
Physical training	9 (8, 10)	9 (7, 10)	8 (6, 9)	4 (3, 5)	4 (4, 5)	34	1
Military parachuting	6 (3, 7)	10 (6, 10)	7 (5, 9)	4 (4, 5)	5 (4, 5)	32	2
Privately-owned vehicle crashes	9 (8, 9)	8 (7, 10)	7 (5, 8)	3 (2, 4)	4 (3, 4)	31	3
Sports	7 (7, 9)	7 (6, 8)	7 (5, 8)	4 (3, 4)	4 (4, 5)	29	4
Falls	7 (6, 8)	7 (5, 8)	6 (6, 7)	3 (3, 3)	4 (3, 4)	27	5
Military vehicle crashes	7 (7, 8)	7 (6, 9)	6 (4, 8)	3 (3, 4)	4 (3, 4)	27	5
Guns and explosives	7 (5, 8)	7 (6, 9)	6 (5, 8)	3 (3, 4)	3 (2, 5)	26	7
Tools and machinery	5 (5, 6)	6 (5, 9)	8 (5, 8)	2 (2, 4)	3 (3, 4)	24	8
Twists/turns (without fall)	6 (5, 7)	5 (3, 6)	5 (4, 7)	3 (2, 4)	3 (2, 3)	22	9
Nontraffic vehicle incidents	5 (5, 8)	6 (4, 8)	4 (3, 7)	2 (2, 4)	3 (2, 4)	20	10

^aMaximum score=10

^bMaximum score=5

^cSum of median scores across criteria, maximum score=40
IR, interquartile range

for importance of the problem (5 points) and timeliness (2 points). Twist/turns had the lowest median score for both preventability and feasibility (5 points). Tools/machinery and nontraffic vehicle incidents had the lowest median score for timeliness (2 points), and four injury causes (guns/explosives, tools/machinery, twists/turns, nontraffic vehicle incidents) received the lowest median score for evaluation potential (3 points).

Discussion

This paper describes a process that produced a prioritized list of injury causes that can be used to inform and guide public health practitioners and policymakers who need to prioritize health problems that are competing for limited program resources. The results indicated that the top three injury causes most likely to have successful program and policy interventions in the DoD were physical training, military parachuting, and privately-owned vehicle crashes.

The emergence of physical training as the top priority for program and policy intervention is not surprising. Investigations of U.S. Army active duty populations have shown physical training-related injuries to be the leading cause of injuries, accounting for 25%–50% of all injury visits.^{15,17,26–29} Among Marine Corps recruits, higher frequencies of vigorous physical training have been correlated with higher musculoskeletal injury rates.²⁵ Among the other Services, surveillance of training-related, lower extremity overuse injuries has indicated that such injuries, which are largely training-related,^{24,25} account for approximately 50% of the Service-specific total injury burdens.¹⁴ These numbers suggest that the frequency and incidence of the problem is large. Given that all Service members must also maintain specified levels of physical fitness, the size of the population potentially affected by physical training-related injuries is also large. Preventability of physical training-related injuries was rated high because there are proven prevention strategies (e.g., avoiding overtraining, conducting agility-like training, use of mouthguards)³⁰ that could be adopted immediately to reduce physical training-related injuries. In the United States (U.S.) Army a standardized physical training program that avoids overtraining and utilizes agility-like training has been found to reduce physical training-related injuries while meeting desired physical fitness goals.^{31,32} Given that the ability to evaluate such programs has been previously demonstrated,^{31,32} the evaluation potential for physical training received the maximum score (5).

Military parachuting injuries, ranked second in this process, can be severe and numerous;³³ however, they affect a relatively small subset of the military and predominantly one Service (Army) only. As a result, this injury

cause scored lower than other causes on the importance of the problem. Evaluations have demonstrated that an effective prevention measure exists (i.e., an external parachute ankle brace), that would be expected to reduce the incidence of the most common injuries among airborne personnel, ankle sprains and fractures, by 50%–80%.^{34–36} This combination of factors led to high preventability and timeliness scores for “military parachuting.” Ankle injury risk has been shown to be 1.6 to 2.9 times higher among paratroopers who did not wear an ankle brace compared to those who did wear a brace.³⁷ These evaluations also demonstrate that it is feasible to implement and to evaluate the effects of this intervention in military populations, contributing to higher criterion scores in these areas. The high preventability, feasibility, timeliness, and evaluation scores in the prioritization process resulted in a high ranking for this injury issue.

Privately-owned vehicle crashes, which received the third-highest rank in the prioritization process, have historically been a leading cause of mortality and morbidity among military service members.^{38,39} Each year, “land transport” is noted as a leading cause of DoD injury hospitalizations, representing 9.1%–18.7% of all injury hospitalizations (2000–2006) with a valid injury cause code.^{20–23,40–42} Safety data have also indicated that 59%, 64%, 61%, and 55% of unintentional injury deaths for the U.S. Army, Navy, Marine Corps, and Air Force, respectively, were due specifically to privately-owned vehicle crashes.⁴³ Based on these and other statistics, privately-owned vehicle crashes scored high on importance of the problem. The availability of recent systematic reviews of prevention strategies such as graduated licensing, decreasing alcohol-impaired driving, and increasing seat belt use^{44–46} contributed to its high preventability score. High scores on both of these measures—importance and preventability—ultimately contributed to the high ranking of the privately-owned vehicle crashes in the prioritization process.

Of note, falls did not rank as one of the top three injury program and policy priorities, despite annual documentation showing falls to be the leading cause of active duty military injury hospitalizations, accounting for nearly one fifth of all injury hospitalizations each year.^{20–23,40–42} The lower ranking of falls as a prevention priority is partially explained by the dearth of descriptive and analytic epidemiology identifying modifiable causes and risk factors of falls in military and other working-age populations. As a consequence, there are also few evaluated interventions in the literature for the prevention of falls in military and other working-age populations.⁴⁷

The prioritization process described had a number of strengths. First, it attempted to minimize bias through use of quantifiable, objective measures. Objectivity was

built into the process by requiring the review of available epidemiologic data to rate the importance of the problem and by the use of a worksheet, which forced consideration of all predetermined criteria and enhanced the visibility of working group members' preliminary ratings and final scores. Second, as has been recommended,⁴⁸ the data reviewed were not limited to mortality data. Rather, working group members also reviewed and formulated their rating based on data on the more numerous nonfatal injuries and their causes. Third, the criteria were similar to those suggested or used elsewhere,^{8,9,49-51} and ensured consideration of key factors felt to influence the success or failure of program and policy efforts. Finally, the scoring system and analysis provided a simple and straightforward mechanism to weight and score those key factors. These criteria and weights could be easily modified to suit the specific needs and considerations of other communities. While a quantitative process may not be absolutely necessary,⁹ it was felt that the commitment to a weight and score forced participants to consider each factor during the process. In addition, while an alternative analysis method⁵² was considered, it was ultimately not reported, given the desire for a methodology that was easy to understand and apply in public health practice, and that there was no difference in the results obtained by this alternative, more complex method.

These criteria, worksheet, and process could also inform future enhancements of existing processes to prioritize prevention research.^{5,53,54} Criteria to prioritize research should include similar considerations, such as the magnitude and severity of the problem and adequacy of resources, but should also consider the existence of gaps in knowledge (i.e., the absence of "proven" prevention strategies) and availability of research partners.² Establishment of a public health research agenda (i.e., research priorities) that consider public health program and policy needs is needed to improve the effectiveness of our public health system.⁵⁵

Opportunities for improvements to the process include involving the raters earlier in the process, so that they have input into the final criteria and methods used. In addition, preventive medicine and public health, like clinical medicine, have become increasingly focused on the importance of identifying evidence-based practices prior to implementation.^{56,57} The rigor of the process could be further enhanced by requiring *de novo* systematic reviews of the literature on program effectiveness rather than relying on expert opinion to define preventability, feasibility, timeliness, and evaluation potential. However, systematic reviews are time-consuming and not always feasible in public health practice.⁹ The desire for evidence-based decisions must be balanced with the need for a timely response. Expedited review processes,

such as described by Bullock et al.,³⁰ could assist with striking this balance.

A limitation of the results of this process is its basis on causes of injury hospitalizations. At the time this prioritization process was conducted, outpatient injury cause coding was inconsistent and incomplete. The ability to quantify outpatient causes of injuries would alter the information available for ranking the importance of the problem (Criteria B). Improvements in outpatient injury cause coding would warrant repetition of this process, as prioritization results may differ with the addition of this information. Additionally, repetition of this process is recommended every 5–10 years, to account for other changes over time, such as additions to the medical and public health literature.

In summary, this process was designed to produce a list of injury prevention priorities through a systematic and objective rating of the degree to which the leading causes of DoD injuries were amenable to program and policy implementation. Its use is not limited to the military, however. In both military and civilian public health organizations, establishing data-driven prevention program and policy priorities can provide a focus for work and continued progress toward injury reduction goals when not responding to urgent public health concerns. The process also should not be limited to use in the injury prevention field; the criteria and worksheet could be adapted and applied to prioritize implementation of other public health programs and policies. Such systematic approaches to prioritizing scarce public health resources are necessary, as Dr. William Haddon, Jr. expressed, in order to avoid "inappropriate choices of emphasis" that "dissipate funds, time, and public concern that might be applied to more effective measures."⁵⁸

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