Journal of Athletic Training 2007;42(2):171–172

www.journalofathletictraining.org

Public Health Surveillance and the Prevention of Injuries in Sports: What Gets Measured Gets Done

Stephen B. Thacker, MD, MSc

Every athlete and every coach recalls at least one injury that has affected the outcome of an athletic event. The first questions were probably ''How badly is she or he hurt? What should I do for the athlete and for the team? Why did this have to happen now?'' The questions that also should be asked are ''How could have this been prevented, and what can we do to prevent future injury?'' The Injury Surveillance System (ISS) maintained by the National Collegiate Athletic Association (NCAA) provides a database that can be used to answer the latter questions, to set prevention priorities, and to drive both research and practice that will lead to both fewer injuries in athletes and better athletic programs.

Surveillance is the cornerstone of public health practice. Public health surveillance has been defined as the routine, ongoing collection, analysis, and dissemination of data to those responsible for preventing and controlling disease and injury.[1] The connection of surveillance to prevention programs is essential to the effective use of these data to prevent and control disease and injury. Surveillance is not intended to replace the clinical and epidemiologic studies that provide the evidence base for prevention programs. Good injury surveillance provides the following:

- Data needed to assess the status of the injury problem in the population
- Early warning of injury problems to guide immediate control measures
- A quantitative basis to specify prevention objectives
- Information to design and plan prevention programs
- Measures to evaluate interventions
- A quantitative basis to plan a research agenda
- Data archives to describe the natural history of an injury problem

Potential sources of data for injury surveillance include not only routine reports from athletic programs as observed in the NCAA ISS but also information from physicians' offices, hospitals, emergency departments, student health services, and vital records and surveys that are particularly useful for the monitoring of risk factors in specific populations. For national data, the National Health Interview Survey[2] or, for state-level and community-level data, the Behavioral Risk Factor Surveillance System[3] can be adapted for special survey modules, and athletic injuries might be considered. Sometimes, for intervention and control of certain injuries, a surveillance system is augmented with more detailed information from a large group of clinicians or institutions (eg, sentinel practices in orthopaedics and sports medicine could be recruited to report injuries after high schools in a state introduce a new sport, such as girl's lacrosse, or a new technology, such as artificial turf in football or soccer). Also, systems might be designed for special events such as the Olympics or the National Boy Scout Jamboree.[4]

Data analysis begins with the basic questions of descriptive epidemiology: time, place, and person. When did the injury occur (eg, early in the game or season)? Where did it occur (eg, on grass or artificial turf)? Who was hurt (eg, the running back or the linebacker)? Rates of injury are important measures of comparative risk (eg, ankle sprains per 100 hours of practice time), whereas absolute numbers can be used to measure effect (eg, the total number of games missed in a season by pitchers with rotator cuff injuries in NCAA schools). Then one asks more sophisticated questions about risk. Was the athlete wearing protective equipment (eg, a helmet or ankle brace)? Was the athlete acclimatized for the summer heat? Were breakaway bases used in baseball and softball programs to reduce the risk of sliding-associated injuries? With this line of questioning, girls were noted to have increased rates of anterior cruciate ligament injuries compared with boys, an observation that stimulated research into both causes and prevention.[5] Finally, statistical methods such as time series analysis can be used to forecast injury numbers so as to be able to identify any disparities between expected and actual, which can lead to early detection of problems or can allow monitoring of the effects of new interventions.

Beyond data collection and analysis, one must not lose sight of the importance of communicating the information collected for surveillance. Certainly it is critical to provide information to those who need to know—coaches, athletic trainers, clinicians, and anyone else who can intervene to prevent further injury. Timely feedback to data providers fosters their continuing participation. It is also crucial to think carefully about how data are displayed to communicate the essential message effectively. To epidemiologists and researchers, tabular data are appealing. However, simple graphs, charts, and maps can demonstrate more effectively an unusual occurrence, such as an epidemic. The growing problem with obesity in the United States was dramatized most effectively by a series of maps over time that used surveillance data to show the spread of the obesity epidemic throughout the nation.[6]

Standards always have been important in surveillance systems to ensure comparability of data from different data sources and over time. In today's world of electronic health records, the need for standards has broadened dramatically to enable interoperability of systems. Early investment in interoperability reaps tremendous rewards, not only in the timeliness of data availability but also in the quality of analysis and dissemination of results. Important but low-frequency events often take time to attain a critical threshold that leads to intervention, as illustrated by the recent recognition of deaths attrib-

utable to inadequate maintenance of defibrillators.[7] At the Centers for Disease Control and Prevention (CDC), the electronic reporting of laboratory results has detected outbreaks of infectious diseases that had gone undetected locally, and rapid investigation has identified the common vehicle of infection and has prevented localized epidemics around the country.[8] One could envision similar benefits from timely injury surveillance, because unintended consequences of new equipment, new rules, or new exercise practices might be detected early in an integrated national surveillance system. The National Center for Injury Prevention and Control at CDC recognizes this potential and has included specific language in its Injury Research Agenda to ''evaluate existing and develop new methods to obtain exposure and injury incidence data'' for sports, recreation, and exercise.[9]

Finally, it is essential to evaluate a surveillance system regularly to assess whether or not it is useful and should be maintained, expanded, or deemphasized. An explicit evaluation approach addresses the public health importance of a health outcome, the usefulness and cost of the system (ie, does it meet its goals and at what cost?), and explicit attributes of quality of the system (namely sensitivity, predictive value positive, representativeness, timeliness, simplicity, flexibility, and acceptability).[10] As noted in the ''Introduction and Methods'' article in this issue, data from the NCAA ISS have been used to make rule changes and equipment recommendations to reduce injuries, and the system can be used to monitor the effect of these changes over time.[11] At the same time, the ISS is a voluntary system; some types of schools might be underrepresented in the system, and some uncommon but important problems might be missed. In addition, the use of surveillance data by individual schools might demonstrate additional benefits of the ISS that warrant sharing with both member institutions and colleges outside the NCAA and with high schools that also could benefit from the findings.

Sports injury surveillance provides the data that will ensure a safer athletic experience at all levels. Continuing enhancement and evaluation of systems such as the ISS will make a good system even better and will serve as a model for similar systems at all levels of sports participation in this country and around the world. Ultimately, it will provide data that will enable coaches and athletic trainers to offer athletes the opportunity to perform at their highest levels and minimize the risk of injury. What gets measured gets done.

DISCLAIMER

The findings and conclusions in this article are those of the author and do not necessarily represent the views of the Centers for Disease Control and Prevention.

REFERENCES

1. Thacker SB, Berkelman RL. Public health surveillance in the United States. *Epidemiol Rev.* 1988;10:164–190.
2. Adams PF, Barnes PM. Summary health statistics for the US population: National Health Interview Survey, 2004. *Vital Health Stat 10.* 2006;229: 1–104.
3. Hughes E, McCracken M, Roberts H, et al. Surveillance for certain health behaviors among states and selected local areas: Behavioral Risk Factor Surveillance System, United States, 2004. *MMWR Surveill Summ.* 2006; 55:1–124.
4. Wetterhall SF, Waxweiler RJ. Injury surveillance at the 1985 National Boy Scout Jamboree. *Am J Sports Med.* 1988;16:534–538.
5. Thacker SB, Stroup DF, Branche CM, Gilchrist J, Goodman RA, Porter Kelling E. The prevention of knee injuries in sports: a systematic review of the literature. *J Sports Med Phys Fitness.* 2003;43:165–179.
6. Mokdad AH, Ford ES, Bowman BA, et al. Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. *JAMA.* 2003;289:76–79.
7. Shah JS, Maisel WH. Recalls and safety alerts affecting automated external defibrillators. *JAMA.* 2006;296:655–660.
8. Swaminathan B, Barrett TJ, Hunter SB, Tauxe RV; CDC PulseNet Task Force. PulseNet: the molecular subtyping network for foodborne bacterial disease surveillance, United States. *Emerg Infect Dis.* 2001;7:382–389.
9. National Center for Injury Prevention and Control. *CDC Injury Research Agenda.* Atlanta, GA: Centers for Disease Control and Prevention; 2002: 30.
10. Romaguera RA, German RR, Klaucke DN. Evaluating public health surveillance. In: Teutsch SM, Churchill RE, eds. *Principles and Practice of Public Health Surveillance.* 2nd ed. New York, NY: Oxford University Press; 2000:176–193.
11. Dick R, Agel J, Marshall SW. National Collegiate Athletic Association Injury Surveillance System commentaries: introduction and methods. *J Athl Train.* 2007;42:173–182.

Editor's Note: Stephen B. Thacker, MD, MSc, is the director, Office of Workforce and Career Development, Centers for Disease Control and Prevention, Atlanta, GA, and Assistant Surgeon General (Ret), United States Public Health Service.