



# SPORTS INJURY SURVEILLANCE SYSTEMS

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Injury Surveillance Systems (ISSs) provide the foundation for effective injury prevention efforts, rules and equipment changes, focused treatment alternatives, and interventional assessments. Injury surveillance information now plays a critical role in determining our subspecialty's clinical, administrative, and financial priorities. All members of the sports orthopaedic community should have an understanding of the basic concepts of injury surveillance and the currently active ISS programs. This article will overview these concepts, discuss the most recognized ISS programs, and suggest how clinicians and researchers may partner with these entities to develop research and practice building opportunities.

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As sports participation in the United States continues to grow the healthcare burden associated with athletic related injury increases proportionately. Annually, sports related injuries to children and young adults result in nearly three million ER visits, 30,000 hospitalizations, and billions in healthcare expenditures.<sup>1,2,3</sup> Currently hot topics such as the mechanisms and rates of sports related concussions, catastrophic injuries in cheerleading, appropriate pitch counts in youth baseball, and game specific head and face protection in women's lacrosse all have their genesis in information gathered from ISS efforts. Information gathered on injury types, rates, mechanisms, and risk factors in large populations of athletes allow an objective assessment of the risks of sports participation. Such information provides the insights for us to partner with the sporting community to make athletic participation safer at all levels of play.

There are a number of well established injury surveillance systems in the United States which are contributing to this effort. Historically, early injury surveillance efforts focused on catastrophic injury in singular sporting groups or activities. Today's injury surveillance systems capture data on an expanded range of injury severity and a wide scope of participants. Injury surveillance programs/data entry tools can now be coupled with software packaging that afford not only basic data injury for research but also allow administrative functions, outcomes assessments, and coordination of patient care. ISSs offer an opportunity for our subspecialty to participate in a growing area of sports medicine research. A combined team of sports medicine physicians, allied health professionals, epidemiologists, and health administrators provide the best opportunity to make injury surveillance efforts appropriately focused, pertinent to current clinical practice, and applicable to the real world of sports injury.

### Basic Concepts

Injury surveillance consists of an ongoing, standardized collection of data describing the occurrence of and risk factors associated

with injury in large population groups. It provides the who, what, where, when, and how information which is the basis of descriptive epidemiology. By its nature, data from ISS can be broad in scope, often missing uniform detail, and sometimes lacking context. This information needs

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to be tempered with a clinical mindset, focused research questioning, checked for real world relevance, and serve as one tool in a multifaceted approach to answering important health related questions.

Surveillance information is important for a number of reasons. First, it establishes the foundation of effective prevention efforts. Only with a true understanding of injury types and specific mechanisms can priorities be defined, resources appropriately allocated, and targeted prevention programs planned. ISS information can often bring some much needed “objective light” to long held misconceptions, isolate injury clusters, or individual experiences regarding sporting injuries. Once prevention programs are underway, data collection must continue to demonstrate a program's effectiveness and cost efficiency.

Second, ISS information helps define the injury risk and burden associated with various type of sports participation. This is important in issues such as deciding which sports to play, relative safety of one sport versus another, overall health benefits of sports participation versus injury risk, and risk of team or individual sports versus other recreational activities.

The success of any injury surveillance program is dependent upon the utilization and understanding of standardized, reliable, and valid methodology; most importantly pertaining to definitions of injury occurrence, severity, exposure, and at risk populations. Readers and researchers must be aware of the nuances of ISS databases when reviewing results and conclusions.

There is not yet full consensus on the definition of a reportable injury. In the NCAA ISS a reportable injury is defined as one that occurs as a result of participation in an organized intercollegiate practice or competition, requires medical attention by a team certified athletic

trainer or physician and results in restriction of the student athlete's participation or performance for one or more calendar days beyond the day of injury.<sup>4</sup>

Other surveillance programs may utilize a more inclusive approach defining injury as any incident which has the athlete interface with medical professionals be it physician or athletic trainer, whether time is lost from participation or not. These two definitions would obviously result in different pictures of injury priorities and common injuries in the same sport.

Next is the concept of injury severity. Many databases now include concepts of injury severity based on time lost from participation in practice or play. However, the same injury may not result in lost play time for one athlete as opposed to another given their specific demands. For an example, a metacarpal fracture which could be splinted and played with for a soccer player, causing minimal days of lost time may result in significant long-term loss of play with a baseball catcher. Other markers for severity have included not only time lost from play, but injuries that have resulted in ER visitation, hospitalization, or surgical intervention.

Risk exposure is another basic concept. This is in an attempt to define the amount of time in which an athlete is exposed to potential injury. The NCAA ISS defines it as one student athlete participating in one practice or competition in which he or she was exposed to the possibility of injury, regardless of the time associated with that participation. Only participants with actual

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playing time are counted as having game exposures, but the actual amount of “active” participation time in a game or practice is not accounted for. Other databases have utilized the concept of a set number of hours of exposure, to try to address the issue that different sports may have different length practices.

Injury reports without the number of at risk population as a denominator data are really only transferring frequency data. Injury rates cannot be generated without knowledge of the exposed population. Injury rate is a measure of the number of injuries in a particular divided by the number of athletic exposures. Injury rates are often generated for game situations and practice situations for a given team and the vast majority of sports show a significantly higher rate of injury in games versus practices.

Another important consideration is data entry and quality controls. Data entered by medical professionals is of higher quality than that entered by coaches or parents. Also there is the sense that data entered as part of a job description or as part of an administrative database also tends to have higher quality than data entered for research purposes alone. Data that can also be entered on a real time or daily basis rather than an accumulated weekly or monthly basis shows improvement. Data that can be entered in an online or computerized format certainly has higher long-term quality than requiring paper applications. Another issue is the tracking of injury versus illness. Definable discrete injuries are easier to track with regard to mechanism, time, player and team activity versus ongoing subacute or chronic medical conditions.

There is also an issue of athletes being tracked by an ISS experiencing symptoms during play as the result of an injury incurred outside of team play or during athlete free time. The quality of data concerning injury mechanism, specific body areas, and specific definition or injury types also is significantly improved if there is regular review of the data, quality management of the data or if the data is being used for specific research queries.

### **Athletic Data Management Tools (SIMS, NEXTT, ATS)**

Currently available athletic training injury management software such as the SIMS, NEXTT and ATS (see table on page 7) not only allow for injury surveillance data entry but couple this with administrative, outcomes, and practice management tools. These providers also function as export engines to the Datalys managed NCAA Injury Surveillance System in which relevant injury surveillance data can be directly downloaded from their system rather than having to be separately entered into the Datalys Web-based system. This does away with the need for “double” data entry.

SIMS is a division of Flantek located in Iowa City, Iowa. It is an advanced injury documentation and management software application designed to streamline the recording requirements in athletic training rooms and other sports facilities. It allows comprehensive data entry with regard to injury type, location, severity, and mechanism.

NEXTT Solutions in South Bend, Indiana, is a sports technology software company with services tailored specifically for sport franchises and athletic organizations. The software involves a highly intuitive complete athletic health recording system, focuses on overall work flow in the typical day in the athletic training room, allows multi-site and multi-web use. It allows the incorporation of MRIs and other imaging studies, is Internet based and allows for follow-up treatment sessions, a master calendar and reports generation.

Athletic Training Services (ATS) is based in Grove City, Pennsylvania and is an information system designed to be flexible and customizable in assisting athletic trainers and other health professionals to track and report information relating to athletes, students and their employees. This information has most to do with injuries but also includes evaluation, rehabilitation, drug testing and purchasing orders.

### **Example of Current Injury Surveillance Systems**

#### **NCAA/Datalys**

The NCAA has maintained a nationally representative (but not random sample) injury surveillance system for intercollegiate athletics since 1982. This covers a wide variety of both men’s and woman’s sports. A primary focus has been the collection and assessment of relevant injury data to drive appropriate injury prevention health policy and evidence based decision making with regard to health and safety issues. Participation in the NCAA ISS is voluntary but all NCAA institutions are invited to participate. Athletic trainers at selected schools have been responsible for data collection and entry.<sup>4</sup> The NCAA has recently outsourced its ISS system to Datalys, a national nonprofit organization which conducts injury research, specific to injury surveillance and sport research. Datalys houses and manages the data which remains the property of the NCAA. Datalys also works with other organizations, to provide injury surveillance data information, including the Fairfax County Public School system discussed on the next page.

David Klossner, NCAA Director of Health and Safety, feels this relationship has resulted in improved oversight and data integrity and will lead to improved collaboration and data access in the future.<sup>5</sup> AOSSM leadership has also served on the Board of Directors for Datalys. Datalys has recently instituted a Web-based program for data entry which has streamlined the data collection and entry process. A new addition is the concept of an export engine in which athletic trainers can download injury surveillance directly from their existing commercial athletic training room software applications (see above).

Advantages of the NCAA injury surveillance system is that it is a long-standing system which allows comparison of injury rates and trends over a 10–20 year period. It has well-defined injury occurrence, severity, and exposure methodology. It is a nationally representative study of Division I,

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II and III NCAA schools and tracks a wide range of men's and women's sports. Disadvantages are that it only tracks athletes at the intercollegiate level and it does not follow club, intramural or recreational athletes in the college setting. Currently there are some issues with regard to ease of data access. Some databases such as NEISS are easily accessible on the Web. The NCAA and Datalys maintain a tighter hold on the data and require research partners to go through a Web application process reviewed by both partners. Application for Data Request forms are available at [www.disc.datalyscenter.org](http://www.disc.datalyscenter.org). Applications are initially reviewed by Datalys and if approved sent to NCAA for second level of review. If approved NCAA data 2004–2009 which is housed online at DISC (Datalys Injury Statistics Clearinghouse) is made available. Annual summary reports on individual sports are no longer provided to the general public but are utilized within the NCAA. Example studies utilizing the NCAA ISS include: Head, face, and eye injuries in scholastic and collegiate lacrosse<sup>6</sup> and comparing the incidence of ACL injury in collegiate lacrosse, soccer, and basketball players: implications for ACL mechanism and prevention.<sup>7</sup>

#### **Center for Injury Research and Policy RIO — Reporting Information Online**

This is an Internet based surveillance system under the direction of Dr. Dawn Comstock at the Research Institute at the Nationwide Children's Hospital in Columbus, Ohio. The RIO system was developed in 2004 and is currently the only surveillance system of all time loss injuries and a national sample of U.S. high school athletic teams. It has been designed to closely duplicate the NCAA injury surveillance systems. High schools across the country are invited to participate on an annual basis. Approximately 100 schools currently do so.

The database is used to describe rates, patterns and trends of high school sport related injuries. It covers both a wide range of both boys and girls sports. It utilizes athletic trainers as data entry reporters. The database has been used for multiple



epidemiologic studies. Dr. Comstock and her staff are available to partner with potential researchers (see table on page 7). Annual summary reports are available online to the public. Researchers interested in more detailed data need to fill out a data utilization agreement with Dr. Comstock and research review and co-authorship is often utilized. Data can be pulled on specific areas such as specific body part, specific sporting activities or other demographic data and can be sent to potential researchers in SPSS or SAS format. Small data queries can be done by the RIO staff and RIO staff can also be subcontracted to work on specific projects.

A potential weakness of the RIO system is that it is primarily an injury surveillance data entry program and it does not couple with the export type engines that Datalys and NCAA now allow. It currently provides information only on high school athletes but in the future will strive to look at elementary and middle school aged children. Examples of studies utilizing the RIO ISS include: Shoulder injuries in U.S. high school baseball and softball athletes 2005–2008;<sup>8</sup> A comparison of high school sports injury surveillance data reporting by certified athletic trainers, coaches, and athletes;<sup>9</sup> Compliance with return to play guidelines following concussion in U.S. high school athletes 2005–2008.<sup>10</sup>

#### **Fairfax County Public School System Injury Surveillance Database**

This database has been run for the past ten years under the direction of John Almquist in Falls Church, Virginia. Fairfax County, Virginia has two certified athletic trainers at each of 25 high schools in the county. As part of their job description the athletic trainers utilize a modified SIMS computerized injury data collection system for administrative as well as injury surveillance data entry. More than 25,000 athletes participate each year in 27 different sports. Computerized injury tracking and an on-site research coordinator who oversees all data entry result in high quality data. Athletes are followed throughout their four year career and record keeping can be modified to incorporate specific research projects. The system has more than ten years of cumulative data representing more than 15 million athletic exposures. Mr. Almquist is available on a contractual basis to collaborate with research partners either in specific smaller query to the database or in accessing larger parts of the database (see table on page 7). The system has been used extensively to look at lacrosse injuries and concussive incidents in high school athletes.

Advantages of the database are high quality data control, 25 high schools within the same school system which decrease variables across the system as far as

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interventional studies. A potential concern is that it is limited to a single geographic area in Virginia. Example of studies utilizing the Fairfax ISS include: Epidemiology of lacrosse injuries in high school aged girls and boys: a 3 year prospective study<sup>11</sup> and Trends in concussion incidence in high school sports: a prospective 11 year study.<sup>12</sup>

#### **National Center for Catastrophic Injury Research**

This program is based in Chapel Hill North Carolina and is under the direction of Fred Mueller. The center collects and disseminates data on death and permanent disability sports injury data that involved brain and/or spinal cord injuries. The center partners with the NCAA, the American Football Coaches Association and the National Federation of High School Associations. Research has been conducted since 1965. Annual reports are administered on catastrophic sport injury and catastrophic football injury. Reports are available online at no cost. Dr. Mueller is available to discuss research questions (see table on page 7). His staff can run limited queries and they are available to discuss any of the online data. Data is gathered on catastrophic injuries from information provided from the National High School Federation, NCAA ISS, United States Lacrosse, print newspaper services and Google searches. By its nature data is limited to catastrophic injuries and doesn't represent a full picture of all injuries in any single sport. Cases are typically followed up by phone conversation

or questionnaire to track more detailed information. Potential HIPPA or litigation issues can sometimes limit access to pertinent medical information. Recall bias can be an issue when following up cases long-term. Example studies from the catastrophic injury database are: Catastrophic head injuries in high school and college football players<sup>13</sup> and Catastrophic cheerleading injuries.<sup>14</sup>

#### **U.S. Product Consumer Product Commission National Electronic Injury Surveillance System — NEISS**

For the past 30 years the U.S. Consumer Product Safety Commission has operated surveillance systems of U.S. emergency rooms. Data is gathered from approximately 100 hospitals. Data is triggered by emergency room admissions and has historically involved some type of consumer product. Recent changes in the database have expanded data collection to include injuries which do not include specific products. There is demographic data, data concerning the injury type/severity/location, product involved, and vignette information concerning the mechanism of injury. Periodically the NEISS is redesigned to update improved sample and to reflect improved product coding. If longitudinal studies are planned one must make sure that the product codes go across the time interval investigated. The NEISS data is available online. The NEISS product code drop down at the website also provides all product coding information. Queries can be made based on a given product

or demographic information. The database is currently directed by Thomas Schroeder (see table for contact information)

Dr. Schroeder and his staff are available to answer any questions concerning the data which is available online or to discuss projects and to also assist in data queries.

Limitations of the Consumer Product Safety data are the fact that it is triggered by emergency room visitation, so it gives a skewed view of sport injury in any given sport. Data is often not available from the narrative sections or varies quite a bit in quality in the narrative section with regards to injury mechanisms. It is often hard to determine whether the injuries occurred during organized sporting events, unorganized sporting events or activities of daily living i.e. a baseball bat may result in injury in many different scenarios. Strengths are that it provides a nationally representative sample and it can be followed in a longitudinal fashion. Examples of studies from the NEISS include: Football related injuries among 6 to 17 year olds treated in U.S. emergency departments 1990–2007<sup>14</sup> and Basketball related injuries in school aged children and adolescents from 1997–2007.<sup>15</sup>

#### **Conclusion**

Sports orthopaedic surgeons can partner with the above or other injury surveillance systems to build research and practice outreach opportunities. Many of these databases are available online and most have helpful, interested directors and staff which are available to assist you with your research queries and interest. Injury surveillance is playing a significantly increased role in prioritizing the financial, administrative, and clinical priorities of sports medicine and sports orthopaedics. Partnering with a local school system or other organization to implement injury surveillance programs can serve as a practice builder by helping those entities address medical/legal concerns, administrative issues, streamline athletic training care and position you as a knowledgeable partner in providing high quality medical care for athletes.

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## Injury Surveillance System Resources and Contacts

**Datalys Center for Sports Injury Research and Prevention**  
 Indianapolis, Indiana  
 Thomas P. Dompier, PhD, ATC, President  
 317/275-3666  
[www.datalyscenter.org](http://www.datalyscenter.org)

**Datalys Injury Statistics Clearing House (DISC)**  
[www.disc.datalyscenter.org](http://www.disc.datalyscenter.org)  
 Application for Data Request Form

**Center for Injury Research and Policy**  
 Reporting Information Online  
 Columbus, Ohio  
 Dawn Comstock, PhD, Director  
[highschoolrio@nationwidechildrens.org](mailto:highschoolrio@nationwidechildrens.org)  
[dawn.comstock@nationwidechildrens.org](mailto:dawn.comstock@nationwidechildrens.org)  
 617/722-2400

**Fairfax County Public School System Athletic Training Program**  
 Falls Church, Virginia  
 Jon Almquist, ATC, VATL, Director  
 571/423-1264

**National Center for Catastrophic Injury Research**  
 Chapel Hill, North Carolina  
 Frederick Mueller, Director  
[mueeller@email.unc.edu](mailto:mueeller@email.unc.edu)  
 919/962-5171

**Consumer Product Safety Commission NEISS**  
 Bethesda, Maryland  
 Thomas Schroeder, Director  
[clearinghouse@cpsc.gov](mailto:clearinghouse@cpsc.gov)  
 301/504-7431

## Athletic Data Management Software Provider

**Sports Injury Monitoring System (SIMS)**  
 Iowa City, Iowa  
 888/352-6824  
[support@flantech.net](mailto:support@flantech.net)

**Athletic Trainer Services (ATS)**  
 Grove City, Pennsylvania  
 724/458-5289  
[Athletictrainersystem.com](http://Athletictrainersystem.com)

**NEXTT**  
 South Bend, Indiana  
 547/233-6695  
[sates@nexttsolutions.com](mailto:sates@nexttsolutions.com)

## References

- Adirim TA. Overview of injuries in the young athlete. *Sports Med.* 2003. 33(1): 75-81.
- Bart CW. Emergency visits for sports-related injuries. *Ann Emergency Med.* 2001. 37(3): 301-8.
- Goldberg AS. Injury Surveillance in young athletes. *Sports Med.* 2007. 37(3): 265-78.
- Dick R. NCAA Injury Surveillance System Commentaries — Introduction and Method. *J Athletic Training.* 2007. Aril-Jan 42(2) 173-82.
- Lincoln AE, Hinton R. Head, face, eye injuries in scholastic and collegiate lacrosse. *AJSM.* 2007. Feb 35(2): 207-15.
- Mihata L. Comparing the incidence of ACL injury in collegiate lacrosse, soccer and basketball players: implications for ACL mechanism and prevention. *AJSM.* 2006. 34(6): 899-904.
- Krajnik S. Shoulder injuries in U.S. high school baseball and softball athletes. 2005-2008. *Pediatrics.* 2010. 125(3):487-501.
- Yard EE. A comparison of high school sports injury surveillance and other reporting by certified athletic trainers, coaches, and athletes. *J Athletic Training.* 2009. 44(6):645-52.
- Yard EE. Compliance with return to play guidelines following concussion in U.S. high school athletes; 2005-2008. *Brain Injury.* 2009. 23(11): 888-89.
- Hinton R. Epidemiology of lacrosse injuries in high school-aged girls and boys: a 3 year prospective study. *AJSM.* 2005. 33(9):1305-14.
- Lincoln AE. Trends in concussion incidence in high school sports: a prospective 11 year study. *AJSM.* 2011. 39(5): 958-63.
- Boden BP. Catastrophic head injuries in high school and college football players. *AJSM.* 2007. July. 35(7):1075-81.
- Boden BP. Catastrophic cheerleading injuries. *AJSM.* 2003. 31 (6):881-8.
- Nation AD. Football related injuries among 6 to 17 year olds treated in U.S. emergency departments 1990-2007. *Clin Pediatric.* 2011. 50(3): 200-7.
- Randazzo C. Basketball related injuries in school aged children and adolescents from 1997-2007. *Pediatrics.* 2010. 176 (4):27-33.