CONCUSSION AND HEAD PROTECTION IN LACROSSE

Taking Care of America’s Fastest Growing Sport

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DISCLOSURES

• Financial disclosures
  • I have no financial disclosures pertinent to this talk

• Membership disclosures
  • Member, US Lacrosse Sports Science and Safety Committee
LACROSSE

• Oldest and fastest growing team sport in America

• Unique men’s, women’s and youth games

• Played by all age groups

• Combination of speed, stick, ball, and contact make for a unique set of injury mechanisms, types, and preventive efforts
LACROSSE SPORTS MEDICINE: PARTNERSHIP

• **US LACROSSE:**
  The national governing body for men’s, women’s, and youth lacrosse
US LACROSSE: SPORTING SUCCESS

- Positive Games Experience
- Honoring the Game
- Focus on Youth and Recreational
- Health and Safety a Priority
- Can this Model Succeed?
SPORTING SUCCESS IN AMERICA
The Entertainment Sports Complex

- Overused Entertainers and Overweight Spectators
- Focus on the Top
  - Professional Model
  - Club vs. Scholastic Play
- Multiple Secondary Gain Issues
  - The “It” Factor
  - College Admission and Scholarships
  - Club vs. Scholastic Play
  - Learning Life’s Lessons and having Fun?
- Posse / Drop Off Mentality
- Increased Injury Exposure
US LACROSSE
Health and Safety Priorities

- National standards for gender and age specific rules, coaching, and officiating
- **One sport: two games**
- **Concussion and head, face, eye injuries for women’s, men’s, and youth lacrosse**
- ACL tears and other lower extremity injuries
- Sudden cardiac death
- Youth specific rules
- Specific conditions: hand fractures and testicular injuries
ONE SPORT: TWO GAMES
Differences in Men’s and Women’s Lacrosse

• Games share
  • Full field, free flowing play
  • Speed, quick change of direction
  • Passing, shooting, stick work

• Men’s game
  • Purposeful collision sport

• Women’s game
  • Incidental contact

• Game specific
  • Equipment Requirements
  • Injury Prevention Strategies
  • Culture and History

• Women playing Men’s Lacrosse
CONCUSSION AND HEAD PROTECTION IN LACROSSE

Injury & Disease Surveillance
Problem Identification
Establish Extent of Injury Problem
(Data Collection)

Risk Factor Identificaton
Establish Etiology and Mechanisms of Sports Injury

Implementation, Feedback and Assessment
Full Scale Implementation & Effectiveness

Develop Intervention/Potential Solutions
Develop, Introduce & Revise Preventive Measures

Assess Effectiveness
in controlled environment

Step 1

Step 2

Step 3

Step 4

Step 5
# Sports Injury Surveillance Systems

<table>
<thead>
<tr>
<th>System</th>
<th>Administrator</th>
<th>Pros</th>
<th>Cons</th>
<th>Example study</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCAA Injury Surveillance System (ISS)</td>
<td>Datalys Center</td>
<td>• Web-based&lt;br&gt;• High capture rate&lt;br&gt;• National sample</td>
<td>• Variability in data coding(?)&lt;br&gt;• Limited # of participating colleges</td>
<td>Validity of Soccer Injury Data in NCAA (2011)</td>
</tr>
<tr>
<td>Injury Treatment &amp; Tracking System (ITTS)</td>
<td>Fairfax County (VA) Public Schools</td>
<td>• Daily electronic capture of 25 high schools &amp; 27 sports&lt;br&gt;• Includes time-loss and no time loss injuries</td>
<td>• Representative of a single geographic area/school district</td>
<td>Trends in concussion incidence in high school sports (2011)</td>
</tr>
<tr>
<td>Reporting Information Online (RIO)</td>
<td>Nationwide Children’s Hospital</td>
<td>• Web-based&lt;br&gt;• 100 participating high schools with AT&lt;br&gt;• National sample of 12 sports</td>
<td>• Variability in data coding(?)</td>
<td>Sex Differences in Concussion Symptoms of High School Athletes (2011)</td>
</tr>
<tr>
<td>National Center for Catastrophic Sport Injury Research</td>
<td>University of North Carolina at Chapel Hill</td>
<td>• Death and permanent disability sports injury data that involve brain and/or spinal cord injuries</td>
<td>• Based on reports of catastrophic/fatal injuries</td>
<td>Catastrophic Football Injuries Annual Report (2011)</td>
</tr>
</tbody>
</table>
OVERALL INJURY RATES FOR NCAA SPORTS

Figure illustrates the average injury rates for 25 sports from 2004-05 to 2008-09 unless otherwise noted below.

* Available data from 2005-06 to 2008-09
** Available data from 2006-07 to 2008-09

If a sport is not included, it is because there was not enough data collected to report that sport.

February 18, 2015
NCAA CONCUSSION RATES

Figure 1: Rate of competition concussion injury in 14 NCAA sports

Number of injuries per 1,000 athlete-exposures

Data from 2004-2009. Overall practice and game injury rates for each sport can be found in Appendix C.
Epidemiology of Lacrosse Injuries in High School–Aged Girls and Boys

A 3-Year Prospective Study

Richard Y. Hinton,∗† MD, MPH, Andrew E. Lincoln,‡ ScD, MS, Jon L. Almquist,§ ATC, Wiemi A. Douoguih,† MD, and Krishn M. Sharma,† MD

From the †Department of Orthopaedic Surgery, The Union Memorial Hospital, Baltimore, Maryland, ‡Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland, and §Fairfax County Public Schools, Athletic Training Program, Fairfax, Virginia

American Journal of Sports Medicine, 2005
# COMMON INJURIES

## Scholastic Boys Lacrosse

<table>
<thead>
<tr>
<th>Rank Order</th>
<th>Body Part</th>
<th>Nature of Injury</th>
<th>Number of Cases</th>
<th>Incidence Rate(^a)</th>
<th>Median Days Lost</th>
<th>Total Days Lost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ankle</td>
<td>Ligament sprain</td>
<td>82</td>
<td>0.39</td>
<td>4.0</td>
<td>557</td>
</tr>
<tr>
<td>2</td>
<td>Head/face</td>
<td>Concussion</td>
<td>61</td>
<td>0.29</td>
<td>6.0</td>
<td>520</td>
</tr>
<tr>
<td>3</td>
<td>Knee</td>
<td>Ligament sprain</td>
<td>34</td>
<td>0.16</td>
<td>29.0</td>
<td>1880</td>
</tr>
<tr>
<td>4</td>
<td>Upper leg</td>
<td>Muscle-tendon strain</td>
<td>26</td>
<td>0.12</td>
<td>7.0</td>
<td>357</td>
</tr>
<tr>
<td>5</td>
<td>Head/face</td>
<td>Contusion</td>
<td>21</td>
<td>0.10</td>
<td>1.0</td>
<td>52</td>
</tr>
<tr>
<td>5</td>
<td>Wrist/hand</td>
<td>Fracture</td>
<td>21</td>
<td>0.10</td>
<td>19.5</td>
<td>379</td>
</tr>
<tr>
<td>7</td>
<td>Wrist/hand</td>
<td>Ligament sprain</td>
<td>20</td>
<td>0.09</td>
<td>3.0</td>
<td>127</td>
</tr>
<tr>
<td>8</td>
<td>Upper leg</td>
<td>Contusion</td>
<td>18</td>
<td>0.08</td>
<td>3.0</td>
<td>75</td>
</tr>
<tr>
<td>8</td>
<td>Back</td>
<td>Muscle-tendon strain</td>
<td>18</td>
<td>0.08</td>
<td>5.0</td>
<td>120</td>
</tr>
<tr>
<td>8</td>
<td>Knee</td>
<td>Inflammation</td>
<td>18</td>
<td>0.08</td>
<td>6.5</td>
<td>316</td>
</tr>
</tbody>
</table>
## COMMON INJURIES

### Girls Scholastic Lacrosse

<table>
<thead>
<tr>
<th>Rank</th>
<th>Body Part</th>
<th>Injury Type</th>
<th>Cases</th>
<th>Percentage</th>
<th>Episodes</th>
<th>Episodes Per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ankle</td>
<td>Ligament sprain</td>
<td>79</td>
<td>0.54</td>
<td>7.0</td>
<td>972</td>
</tr>
<tr>
<td>2</td>
<td>Knee</td>
<td>Inflammation</td>
<td>30</td>
<td>0.21</td>
<td>2.5</td>
<td>619</td>
</tr>
<tr>
<td>3</td>
<td>Head/face</td>
<td>Contusion</td>
<td>23</td>
<td>0.16</td>
<td>1.0</td>
<td>55</td>
</tr>
<tr>
<td>4</td>
<td>Knee</td>
<td>Ligament sprain</td>
<td>21</td>
<td>0.14</td>
<td>16.0</td>
<td>581</td>
</tr>
<tr>
<td>5</td>
<td>Head/face</td>
<td>Concussion</td>
<td>14</td>
<td>0.10</td>
<td>4.0</td>
<td>83</td>
</tr>
<tr>
<td>6</td>
<td>Wrist/hand</td>
<td>Contusion</td>
<td>13</td>
<td>0.09</td>
<td>2.0</td>
<td>38</td>
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<tr>
<td>6</td>
<td>Hips</td>
<td>Muscle-tendon strain</td>
<td>13</td>
<td>0.09</td>
<td>7.0</td>
<td>107</td>
</tr>
<tr>
<td>8</td>
<td>Upper leg</td>
<td>Muscle-tendon strain</td>
<td>12</td>
<td>0.08</td>
<td>2.5</td>
<td>72</td>
</tr>
<tr>
<td>9</td>
<td>Wrist/hand</td>
<td>Fracture</td>
<td>11</td>
<td>0.08</td>
<td>31.0</td>
<td>439</td>
</tr>
<tr>
<td>10</td>
<td>Back</td>
<td>Muscle-tendon strain</td>
<td>9</td>
<td>0.06</td>
<td>2.0</td>
<td>39</td>
</tr>
</tbody>
</table>

[Source: MedStar Health Research Institute]
Trends in Concussion Incidence in High School Sports

A Prospective 11-Year Study

Andrew E. Lincoln,*† ScD, Shane V. Caswell,‡ PhD, ATC, Jon L. Almquist,§ VATL, ATC, Reginald E. Dunn,* BA, Joseph B. Norris,‖ MD, and Richard Y. Hinton,‖ MD, MPH, PT

Investigation performed at MedStar Health Research Institute, Baltimore, Maryland
LACROSSE CONCUSSION RATES
Scholastic Boys and Girls

[Graph showing concussions per 1000 athletic exposures for boys and girls in lacrosse over school years 1990 to 2008]
Video Incident Analysis of Head Injuries in High School Girls’ Lacrosse

Shane V. Caswell,*† PhD, VATL, ATC, Andrew E. Lincoln,‡ ScD, Jon L. Almquist,§ VATL, ATC, Reginald E. Dunn,‡ BA, and Richard Y. Hinton,‖ MD, MPH, PT
Investigation performed at Sports Medicine Assessment, Research and Testing Laboratory, George Mason University, Manassas, Virginia

American Journal of Sports Medicine, 2012
Video Incident Analysis of Concussions in Boys’ High School Lacrosse

Andrew E. Lincoln,ScD, Shane V. Caswell,PhD, ATC, Jon L. Almquist,VATL, ATC, Reginald E. Dunn,MS, and Richard Y. Hinton,MD, MPH, PT
Investigation performed at MedStar Sports Medicine Research Center, Baltimore, Maryland
# CONCUSSION MECHANISM

## Scholastic Boys and Girls Lacrosse

<table>
<thead>
<tr>
<th>Table 1.</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level of play</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Varsity</td>
<td>22 (65%)</td>
<td>14 (100%)</td>
</tr>
<tr>
<td>Junior varsity</td>
<td>12 (35%)</td>
<td>0</td>
</tr>
<tr>
<td><strong>Concussion mechanism</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body check</td>
<td>32 (94%)</td>
<td>1 (7%)</td>
</tr>
<tr>
<td>Stick (unintentional)</td>
<td>0</td>
<td>5 (36%)</td>
</tr>
<tr>
<td>Stick (intentional)</td>
<td>0</td>
<td>3 (21%)</td>
</tr>
<tr>
<td>Collision (unintentional)</td>
<td>2 (6%)</td>
<td>3 (21%)</td>
</tr>
<tr>
<td>Ball</td>
<td>0</td>
<td>1 (7%)</td>
</tr>
<tr>
<td>Undetermined</td>
<td>0</td>
<td>1 (7%)</td>
</tr>
<tr>
<td><strong>Penalty called</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>8 (24%)</td>
<td>2 (14%)</td>
</tr>
<tr>
<td>No</td>
<td>25 (73%)</td>
<td>10 (71%)</td>
</tr>
<tr>
<td>Unknown</td>
<td>1 (3%)</td>
<td>2 (14%)</td>
</tr>
</tbody>
</table>
Effectiveness of the Women’s Lacrosse Protective Eyewear Mandate in the Reduction of Eye Injuries

Andrew E. Lincoln, ScD, Shane V. Caswell, PhD, ATC, Jon L. Almquist, VATL, ATC, Reginald E. Dunn, BA, Mark V. Clough, MD, Randall W. Dick, and Richard Y. Hinton, MD, MPH, PT

Investigation performed at MedStar Sports Medicine Research Center, Baltimore, Maryland

<table>
<thead>
<tr>
<th>Body Part</th>
<th>2000-2003 Frequency</th>
<th>Rate (per 1000 AEs)</th>
<th>2004-2009 Frequency</th>
<th>Rate (per 1000 AEs)</th>
<th>Rate Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye</td>
<td>22</td>
<td>0.10</td>
<td>5</td>
<td>0.016</td>
<td>0.16 (0.06-0.42)</td>
</tr>
<tr>
<td>Head/face</td>
<td>33</td>
<td>0.15</td>
<td>21</td>
<td>0.07</td>
<td>0.44 (0.26-0.76)</td>
</tr>
<tr>
<td>Concussion</td>
<td>38</td>
<td>0.18</td>
<td>86</td>
<td>0.28</td>
<td>1.6 1-2.3</td>
</tr>
<tr>
<td>All injuries</td>
<td>406</td>
<td>1.9</td>
<td>543</td>
<td>1.8</td>
<td>0.93 (0.82-1.1)</td>
</tr>
</tbody>
</table>

Figure 3. Head/face injuries by area of head and face, before and after introduction of mandated eyewear. Values inside the graph bars indicate number of injuries.
“Why are hard helmets and mounted face masks not required in women’s lacrosse?”
Hard helmets/facemasks have not been required or deemed necessary in women’s lacrosse because:

• The nature of women’s lacrosse is an incidental contact sport

• The risk of head/face injury is on par with other sports

• Administrative controls (rules) and educational programs have been created for players, coaches, and officials to teach the nature of the game and reduce exposures

• Unique history and culture of the women’s game
ASTM STANDARDS FOR GAME SPECIFIC WOMEN’S LACROSSE HEAD PROTECTION

- ASTM – Consensus Based Standards Setting
  Includes NGB, Manufacturers, Consumers, Interested Parties…

- On ballot for 2014
  - Testing to include
    - Drop test (duplicate stick checking)
    - Cannon ball test
    - Flexibility (safety for other players) testing

- Relatively soft head protection (game specific)
  - Two piece
  - Single piece with goggles mounted
HELMET SENSOR DATA IN MEN’S LACROSSE


- G Force Tracker
- Linear Acceleration and Rotational Velocity
- 9 games, 39 practices
- 17 Div I Male Lacrosse Players
- Total Impacts, Threshold Impacts
- Video Pairing
HELMET SENSOR DATA

- Avg. # Impacts
  - 23 games
  - 8.7 per practice
- Vast majority low impact 10 – 30 g
- 3% >70 g

- ~ 80 % related to body to body contact
- > 70 g impacts are in loose ball situations
- > left side hits for right handed players
- Position specific
HEAD IMPACTS IN MEN’S LACROSSE
HEAD IMPACTS IN MEN’S LACROSSE

[Bar chart showing the number of impacts for different roles: Goalie, Defense, Face Off, Midfield, Attack.]
HEAD IMPACTS IN MEN’S LACROSSE

Face Off Specialists

<table>
<thead>
<tr>
<th>Location</th>
<th>Number of Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>front</td>
<td>180</td>
</tr>
<tr>
<td>back</td>
<td>160</td>
</tr>
<tr>
<td>bottom</td>
<td>140</td>
</tr>
<tr>
<td>top</td>
<td>120</td>
</tr>
<tr>
<td>right</td>
<td>100</td>
</tr>
<tr>
<td>left</td>
<td>80</td>
</tr>
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</table>

Attack

<table>
<thead>
<tr>
<th>Location</th>
<th>Number of Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>front</td>
<td>400</td>
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<tr>
<td>back</td>
<td>350</td>
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<tr>
<td>bottom</td>
<td>300</td>
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<tr>
<td>top</td>
<td>250</td>
</tr>
<tr>
<td>right</td>
<td>200</td>
</tr>
<tr>
<td>left</td>
<td>150</td>
</tr>
</tbody>
</table>
SUMMARY

• Concussion, head, face, and eye injuries are priority issues for men’s, women’s, and youth lacrosse
• Injury mechanisms, types, and rates are age and gender specific
• Injury prevention strategies, including head protective devices must be game specific to be effective
• Women’s and men’s lacrosse are two different sports and have unique health and safety issues
• US Lacrosse has been exceptionally proactive in lacrosse health and safety
THANK YOU

MedStar Sports Medicine

US Lacrosse