Evidence Summary: Lacrosse

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BC INJURY research and prevention unit

The British Columbia Injury Research and Prevention Unit (BCIRPU) was established by the Ministry of Health and the Minister's Injury Prevention Advisory Committee in August 1997. BCIRPU is housed within the Evidence to Innovation research theme at BC Children's Hospital (BCCH) and supported by the Provincial Health Services Authority (PHSA) and the University of British Columbia (UBC). BCIRPU's vision is *to be a leader in the production and transfer of injury prevention knowledge and the integration of evidence-based injury prevention practices into the daily lives of those at risk, those who care for them, and those with a mandate for public health and safety in British Columbia.*

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Evidence synthesis tool

SPORT:	Lacrosse	**Target Group:**	Youth, High School, Collegiate
Injury Mechanisms:	Youth: Most injuries in youth lacrosse are either due to stick contact, player contact, or ball contact. High School and Collegiate: The most common injury mechanism for both sexes is player contact, contact with the playing equipment (e.g. stick, ball) and ground, and non-contact.		

Incidence/Prevalence	**Risk/Protective Factors**	**Interventions**	**Implementation/Evaluation**	**Resources**
Youth Lacrosse Rates of injury in youth lacrosse has been estimated at 3.4/1000 AEs (athletic exposures) for girls and 8.7-12.98/1000 AE for boys (Lincoln et al., 2014; Kerr et al., 2016). The incidence of game-related concussion in boys is reported between 1.6-1.72/1000 AE, and when game and practice exposures are combined, the overall incidence of concussion is estimated at 0.84/1000 AEs (95% CI 0.32-1.36) (Kerr et al., 2016; Lincoln et al., 2014). **High School** The incidence of injury in high school boys is 2.26-2.89/1000 AEs and 1.54-2.54/1000 AEs in girls (Hinton et al., 2005; Xiang et al., 2014). The incidence of head, face, and eye injuries from game play in boys is 1.10/1000 AE and in girls is 1.21/1000 AE (Lincoln et al., 2007). **Collegiate** At the collegiate level, injury	**Playing Environment** Both males and females are more likely to be injured in games than practices (Vincent et al., 2015; Kerr et al., 2016). **Sex** Males are more likely to be injured than female players at both the high school and collegiate level, specifically to the shoulder, arm, and upper leg (potentially due to rule differences between boys and girls lacrosse) (Kerr et al., 2015; Vincent et al., 2015; Xiang et al., 2014; Hinton et al., 2005). Boys are more likely to be injured in competition than in practice (Kerr et al., 2016). Although boys have 3-5 times the risk of sustaining a fracture compared to girls in competition and practice, women are more likely to sustain a fracture to the head and hand (Vincent et al., 2015). Men appear to be at a lower risk of ACL injury than women (McCulloch & Bach, 2007). **Hand Grip** Hand grip of the lacrosse racquet has	**Policy Changes** In 2005, US Lacrosse mandated protective eyewear for female high school lacrosse players. One study found that this change resulted in an 84% reduction in the odds of eye injuries and 56% reduction in the odds of head/face injuries. (Black et al., 2017; Black et al., 2017; Lincoln et al., 2012; McGuine, 2006)	There were no studies found that examined the implementation or evaluation of lacrosse interventions.	**Websites** US Lacrosse: http://www.uslacrosse.org/safety/equipment/approved-eyewear-list

incidence during competition has been estimated at 6.5-12.58/1000 AE for men and 5.8-7.15 for women, and were higher than practice injury rates (men 3.24/1000 AE; women 3.30/1000 AE) (Dick, Lincoln, et al., 2007; Dick, Romani, Agel, Case, & Marshall, 2007; Kerr et al., 2015; McCulloch & Bach, 2007). **Hospital Data** According to a report of lacrosse injuries arriving at the emergency room in Vancouver between 1992 and 2005, the incidence rate in lacrosse is 4.1 injuries per year (Pakzad-Vaezi, 2011). **Common Injuries** Regardless of age group or sex, the ankle, knee, hand, and wrist are common regions of injury (Vincent et al., 2015). Specific to Canadian emergency room data, the most common injury locations included the forearm(15%), wrist (13%), and head (13%) (Pakzad-Vaezi, 2011).	been suggested as a potential risk factor for thumb injury (Vincent et al., 2015). **Artificial Turf** Turf burn and prepatellar bursitis has been observed more frequently when playing on artificial turf than natural grass, and may be more common in players that take face-offs (McCulloch & Bach, 2007).			
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Review of Sport Injury Burden, Risk Factors and Prevention

Lacrosse

Incidence and Prevalence

Youth

Research investigating injuries in youth lacrosse is not as well established as injury research at the high school and collegiate levels. Rates of injury in youth lacrosse has been estimated at 3.4 injuries per 1000 athletic exposures (AE) for females and 8.7 injuries per 1000 AE for males (an estimated rate of 6.3 injuries per 1000 AEs combined) (Lincoln et al., 2014). Although a more recent study, which included a larger sample size, estimated the incidence of injury in males to be 12.98 injuries per 1000 AE (95% CI: 10.93-15.02) (Kerr, Caswell, Lincoln, Djoko, & Dompier, 2016).

Kerr et al. (2016) noted most youth injuries were game-related (60.0%) and resulted in no time loss from sport (83.9%). Although most injuries occurred in the under 13/15 age divisions (69.0%), the overall injury rate was higher in the under 9/11 divisions (RR=1.23; 95% CI: 1.05-1.44) (Kerr et al., 2016). Injuries were mainly to the lower extremities (45.2%) and were primarily diagnosed as either contusions (51.6%) or sprains/strains (20.0%) (Kerr et al., 2016), while the most common injury reporting to Canadian emergency departments were fractures (Fridman, Fraser-Thomas, McFaull, & Macpherson, 2013). The incidence of game-related concussion in males is reported between 1.6-1.72 injuries per 1000 AEs, (Kerr et al., 2016; Lincoln et al., 2014) and with game and practice exposures combined, the overall incidence of concussion is estimated at 0.84 concussions per 1000 AEs (95% CI 0.32-1.36) (Kerr et al., 2016). This estimate is higher than the calculated pooled estimate by Pfister et al., 2016, of 0.23 concussions per 1000 AEs (95% CI 0.21-0.26) (Pfister, Pfister, Hagel, Ghali, & Ronksley, 2016). It should be noted; however, that this meta-analysis' was based on inclusion criteria of both males and females up to 18 years of age. Only two studies have reported on the most common mechanisms of injury and found conflicting results. Lincoln et al. (Lincoln et al., 2014) reported player contact as the most common mechanism of injury. While, Kerr et al. (Kerr et al., 2016) reported most injuries in youth lacrosse were due to stick contact (35.5%), followed by player (18.1%), and ball contact (14.2%).

High School and Collegiate

At the high school level, the estimated incidence of injury in males is 2.26-2.89 injuries per 1000 AE and 1.54-2.54 injuries per 1000 AE in females (Hinton, Lincoln, Almquist, Douoguih, & Sharma, 2005; Xiang, Collins, Liu, McKenzie, & Comstock, 2014). The incidence of head, face, and eye injuries from game play in males is estimated at 1.10 injuries per 1000 AE and 1.21 injuries per 1000 AE in females (Lincoln, Hinton, Almquist, Lager, & Dick, 2007). The incidence of anterior cruciate ligament tears in high school players is 0.063 per 1000 AE (95% CI, 0.033-0.107), with no difference in the estimates of injury incidence between high school male and females (Gornitzky et al., 2016). The most commonly reported high school injuries were sprains/strains, contusions, and concussions (Hinton et al., 2005; Xiang et al., 2014). Injuries in

males were mostly caused from contact with another player followed by non-contact mechanisms, while injuries in females were mostly from non-contact mechanisms and contact with a playing apparatus/equipment (Hinton et al., 2005; Xiang et al., 2014).

At the collegiate level, injury incidence during competition is estimated at 6.5-12.58 injuries per 1000 AE for men and 5.8-7.15 injuries per 1000 AE for women. Competition injury rates are higher than practice injury rates (men 3.24/1000 AE; women 3.30/1000 AE) (Dick, Lincoln, et al., 2007; Dick, Romani, Agel, Case, & Marshall, 2007; Kerr et al., 2015; McCulloch & Bach, 2007). The primary mechanisms of injury include player contact, contact with the playing equipment/ground, and mechanisms reported as non-contact (Carter, Westerman, Lincoln, & Hunting, 2010; Dick, Lincoln, et al., 2007; Dick, Romani, et al., 2007). Female lacrosse players are reported to have more non-contact and overuse injuries than males (Vincent, Zdziarski, & Vincent, 2015). The rate of game-related injuries in collegiate women increased from 1988-2004 (Dick, Lincoln, et al., 2007).

Head and neck injuries are common in women's lacrosse, accounting for approximately 22% of game and 12% of practice injuries (Black, Eliason, Patton, & Emery, 2017). Specifically, nasal fractures (2.3% of injuries; IR 0.1/1000AE), eye contusions (1.2% of game-related injuries; 0.04/1000AE and 1.3% of practice-related injuries; 0.04/1000AE), and head lacerations (1.3% of game-related injuries; IR 0.09/1000AE) have been reported, with the majority caused by contact with the stick (56%) (Black, Eliason, et al., 2017). The most common mechanism of concussions was contact with another player, and was twice as common than being struck in the head by an illegal stick strike or by the ball (McCulloch & Bach, 2007).

Shoulder injuries accounted for the most frequently injured body part during games in men's collegiate lacrosse (McCulloch & Bach, 2007). The incidence of shoulder injuries in men was estimated at 0.59 injuries per 1000 AE (95% CI, 0.56-0.62), with a higher incidence during competition [1.89/1000 AE (95% CI, 1.76-2.02)] than practice [0.35/1000 AE (95% CI, 0.33-0.38)] (Gardner, Chan, Sutton, & Blaine, 2016). Though players are required to wear shoulder pads, there is concern that these pads do not adequately protect the chest and ribs from injury as rib contusions and fractures can occur (McCulloch & Bach, 2007). Relative to other men's throwing sports, lacrosse has lower rates of shoulder impingement and elbow epicondylitis (McCulloch & Bach, 2007). The incidence of hand injuries in men is reported as 0.27 injuries per 1000 AE (thumb injuries accounted for 0.16/1000 AE), while the women's rate of hand injuries is 0.11 injuries per 1000 AE's (thumb injuries 0.05/1000 AE) (Bowers, Horneff, Baldwin, Huffman, & Sennett, 2010). The primary mechanism of hand and finger injury in men's and women's lacrosse is offensive stick hits (52.5%) (Vincent et al., 2015). As no equipment is worn on the lower extremities during play, abrasions and contusions to the legs are common (McCulloch & Bach, 2007). Knee injuries have been reported to represent 10-15% of all injuries (McCulloch & Bach, 2007). Ankle sprains are common even during practises, and have been reported as causing the greatest days lost due to injury (McCulloch & Bach, 2007). Although extremely rare, commotio cordis (a potentially lethal disruption of the normal heart rhythm due to a precordial chest blow) has been reported in midfielders and goalies wearing proper chest protection, and is more likely to occur in adolescents when struck by a low-velocity impact (Vincent et al.,

2015). A transcricoid fracture caused from a high-speed lacrosse ball hitting the throat is also extremely rare, but has been reported in the literature (Vincent et al., 2015).

Risk and Protective Factors

A systematic review of musculoskeletal injuries in high school and collegiate lacrosse players suggests that, regardless of age group or sex, the ankle, knee, hand, and wrist were common regions of injury (Vincent et al., 2015). Males were more likely to be injured than female players at both the high school and collegiate level (Kerr et al., 2015; Vincent et al., 2015; Xiang et al., 2014), specifically to the shoulder, arm, and upper leg (Vincent et al., 2015). This is potentially due to rule differences between boys and girls lacrosse (girls lacrosse does not allow intentional body checking and stick checking to the head) (Hinton et al., 2005; Xiang et al., 2014). Both males and females were more likely to be injured in competition than in practice, though the game-to-practice injury ratio is 3 times higher for males than females (Vincent et al., 2015). Although boys have 3-5 times the risk of sustaining a fracture compared to girls in competition and practice, women were more likely to sustain a fracture to the head and hand (Vincent et al., 2015). Hand grip of the lacrosse racquet has been suggested as a potential risk factor for thumb injury in goalies (Vincent et al., 2015). It is also suggested that holding the lacrosse stick when landing and cutting constrains the arm position, which results in an increased valgus loading of the knee and may increase the risk of ACL injury (McCulloch & Bach, 2007). It is noted that collegiate men appear to have a lower incidence of ACL rupture than women (McCulloch & Bach, 2007). Turf burn and prepatellar bursitis has been observed more frequently when playing on artificial turf than natural grass, and may be more common in players that take face-offs (McCulloch & Bach, 2007).

Opportunities for Prevention: Effective Interventions, Cost-Effectiveness, Implementation and Evaluation

Mandatory eye protection has been examined in females and shown to be effective at reducing injuries (Black, Eliason, et al., 2017; Black, Patton, Eliason, & Emery, 2017; Lincoln et al., 2012; McGuine, 2006), and is required to meet relevant standards (currently ASTM 3077) (Lacrosse, 2017). Although mandatory eyewear in women's lacrosse reduces eye-related injury, it has been suggested that female players would benefit even further from wearing lacrosse helmets (Clark & Hoshizaki, 2016; Xiang et al., 2014). Although softshell helmets are available commercially for women's lacrosse, material property testing has suggested soft headgear is not as effective as hard-shell helmets in reducing head injury from high velocity ball impacts (Rodowicz, Olberding, & Rau, 2015). It has been noted that helmets should be inspected regularly for cracks or other signs of damage that may weaken the integrity (Bowman, Breedlove, Breedlove, Dodge, & Nauman, 2015). Newer helmet designs have begun to incorporate a longer chin protector which may better protect the throat region (Vincent et al., 2015). Mouth guards are recommended to be worn to prevent oral injuries (Black, Patton, et al., 2017). Shoulder pads with hanging rib protection and shoulder braces that limit ranges of motion have been recommended to reduce the number of rib/chest injuries and shoulder dislocations, respectively; however, there are concerns that this extra protection may restrict the player's mobility (McCulloch & Bach, 2007). Based on the United States Lacrosse insurance

data, 42% of all claims dollars were paid for knee injuries, and >50% of the claims were paid to injured high school players (McCulloch & Bach, 2007). Typically, many balls are used in practice and inadvertently stepping and slipping on a ball left on the ground has been suggested as a cause of ankle sprains. It has been suggested that reducing the number of balls used in practice may reduce the risk of this occurrence (McCulloch & Bach, 2007).

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