The Failure of Youth Sports Concussion Laws and the Limits of Legislating Health Education

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Abstract:

Legislatures have increasingly turned to education-based strategies to address significant public health challenges, despite unclear efficacy of statutory mandated education. In this Article, we examine the recent and rapid adoption of youth sports concussion laws as a lens to explore the limits of education-based legislative intervention models. In less than 10 years, all 50 states adopted a youth sports concussion statute—and each law mandates concussion education for coaches and/or student-athletes. This expansive, expensive intervention was designed to reduce concussion incidence and improve concussion care. But based on a review of 54 peer-reviewed studies, we argue that concussion education has not, and likely will not, produce the desired public health outcomes. The data largely demonstrate that, at most, concussion education can produce short-term changes in knowledge, but that these gains are unlikely to translate into measurable behavior changes that reduce the incidence and risk of concussion in sport. The Article uses public health perspectives to explore the reasons why top-down education interventions from legislatures may fail to have their

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intended effect. Given these limitations, the Article argues for a new type of concussion education intervention that better aligns with incentives to win, focuses on primary prevention, and promotes culture change in concussion reporting.

TABLE OF CONTENTS

INTRODUCTION

Sports-related concussion (SRC) is a high-profile public health challenge.[1] Concussion stories are frequently headline news on ESPN[2] and sports concussions are a growing concern for athletes, parents, and legislators.[3]

Given this interest in brain health for youth athletes, the law has responded. In 2008, no state had a youth sports concussion law. Today, all 50 states have passed such legislation.[4] This rapid adoption of concussion laws is indicative of the priority states have placed on addressing the risk, impact, and prevention of sports concussion.

In crafting these concussion laws, states deliberately avoided creating new civil liability, and often chose not to mandate rule changes.[5] Rather, the central tenet of current concussion legislation is an information-based model of concussion education. While states vary in their language and degree of intervention, each state law requires that youth sports coaches complete concussion training, and/or that concussion information be provided to athletes and parents.[6]

The success of these laws rests on the assumption that more and better education will result in fewer concussions and better care for concussions that do occur.[7] These goals are aligned with the public health principles of primary, secondary, and tertiary prevention, which recommend preventative strategies for before, during, and after an injury is sustained.[8] The aim is to prevent injury

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1. Douglas J. Wiebe et al., *Concussion Research: A Public Health Priority*, 17 INJ. PREVENTION 69 (2011).

2. Kevin Seifert, *NFL Concussions Continue to Rise*, ESPN (Jan. 26, 2018,), http://www.espn.com/nfl/story/_/id/22226487/nfl-concussions-rise-highest-level-league-began-sharing-data.

3. Linda Flanagan, *How Students' Brains Are in Danger on the Field*, THE ATLANTIC (Aug. 14, 2017), https://www.theatlantic.com/education/archive/2017/08/how-students-brains-are-in-danger-on-the-field/536604/.

4. Sungwon Kim et al., *Legislative Efforts to Reduce Concussions in Youth Sports: An Analysis of State Concussion Statutes*, 27 J. LEGAL ASPECTS SPORT 162, 166 (2017); Hosea H. Harvey, *Reducing Traumatic Brain Injuries in Youth Sports: Youth Sports Traumatic Brain Injury State Laws, January 2009–December 2012*, 103 AM. J. PUBLIC HEALTH 1249, 1249 (2013).

5. Francis X. Shen, *Are Youth Sports Concussion Statutes Working?*, 56 DUQ. L. REV. 7, 10-13 (2018).

6. Kelly L. Potteiger et al., *An Examination of Concussion Legislation in the United States*, INTERNET J. ALLIED HEALTH SCI. & PRAC., Apr. 2018, at 1, 8 (2018).

7. Kerri McGowan Lowrey, *State Laws Addressing Youth Sports-Related Traumatic Brain Injury and the Future of Concussion Law and Policy*, 10 J. BUS. & TECH. L. 61, 61-64 (2015).

8. Charles H. Tator, *Concussions and Their Consequences: Current Diagnosis, Management*

before it occurs in the first place; improve early detection of an injury once it occurs; and improve management and reduce negative long-term outcomes after the injury is sustained, respectively.[9]

In this Article, we assess whether this assumption holds in practice through a comprehensive review of the known evidence on the relationship between concussion education interventions and outcomes.[10] We examine 54 studies and conclude that current concussion education programs may improve concussion knowledge in the short-term, but that without additional interventions, concussion education is unlikely to change athlete attitudes towards concussion or their behaviors during play. We further argue that to improve effectiveness, both the surrounding incentive structures and the culture of contact sports need to be fundamentally revisited.

Our findings speak directly to the on-going and high-profile debates over youth SRC, but they also have implications for public health law more generally. Federal and state governments are increasingly turning to public health education to change individual behavior.[11] These include campaigns to reduce smoking, increase seatbelt use, reduce texting while driving, and improve the utilization of vaccines.[12] Yet there is significant variation in the effectiveness of information-based public health campaigns.[13]

The limited effectiveness of youth sports concussion laws suggests three general lessons for legislatively mandated public health education regimes. First, reactionary rather than proactive policy development may be too focused on a single issue while missing the more foundational problems. In the context of youth SRC, the laws focus primarily on return to play after a concussion is sustained and fail to address the primary prevention of concussion. Second, additional education is unlikely to be effective when the underlying incentive structure remains designed to discourage concussion prevention and reporting. Third, top-down education initiatives may fail when a "one-size-fits-all" approach is applied. In youth SRC policy, concussion education has often failed to consider unique cultural aspects of specific sports, athlete groups, age, and gender.

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and Prevention, 185 CAN. MED. ASS'N J. 975, 977 Box 3 (2012).

9. *Id.*

10. *See* discussion *infra* Part IV.

11. Lawrence O. Gostin, *Health Promotion: Education, Persuasion, and Free Expression*, *in* PUBLIC HEALTH LAW AND ETHICS: A READER 335, 337-38 (Lawrence O. Gostin ed., 2002).

12. PUBLIC HEALTH COMMUNICATION: EVIDENCE FOR BEHAVIOR CHANGE (Robert C. Hornik ed., 2002).

13. Robert C. Hornik, *Public Health Communication: Making Sense of Contradictory Evidence*, *in* PUBLIC HEALTH COMMUNICATION: EVIDENCE FOR BEHAVIOR CHANGE 1 (Robert C. Hornik ed., 2002).

In developing a solution, we apply these lessons and suggest a path forward that aligns sport-specific and individualized incentives with concussion educational interventions; addresses primary prevention; and makes greater use of trained medical professionals.

The Article proceeds as follows. In Part I, we discuss the legislatively mandated concussion education requirements. In Part II, we present a comprehensive review of the scientific literature on the effects of concussion education on concussion reporting and incidence in youth sports. In Part III, we discuss the legal and policy implications of these findings and argue that education programs as currently designed are not likely to significantly improve concussion prevention and care. In Part IV, we discuss several potential solutions that are more likely to produce better youth sports concussion outcomes. Part V concludes.

I. LEGISLATING CONCUSSION EDUCATION

With over 44 million youth participating in organized sports annually,[14] youth SRC is a significant public health concern. The Centers for Disease Control and Prevention (CDC) estimates that between 1.6 and 2.8 million SRCs occur each year in the United States, accounting for nearly 30% of total youth concussions.[15]

Concussion is a traumatic brain injury induced by biomechanical forces, typically resulting in short-lasting neurological impairment.[16] The word concussion is derived from the Latin word *concussus*, which means to shake violently.[17] Concussion, at present, is primarily diagnosed based on symptoms, which presents the clinician with significant diagnostic challenges.[18]

Improper management of concussion can result in prolonged symptoms, long-term neurological impairment, or even death.[19] Given the incidence of

14. NAT'L COUNCIL OF YOUTH SPORTS, NCYS REPORT ON TRENDS AND PARTICIPATION IN ORGANIZED YOUTH SPORTS 7 (2008) *available at* https://www.ncys.org/pdfs/2008/2008-ncys-market-research-report.pdf.

15. Jameson D. Voss et al., *Update on the Epidemiology of Concussion/Mild Traumatic Brain Injury*, 19 CURRENT PAIN & HEADACHE REP. 32, 36 (2015).

16. Paul McCrory et al., *Consensus Statement on Concussion in Sport—The 5th International Conference on Concussion in Sport Held in Berlin, October 2016*, 51 BRIT. J. SPORTS MED. 838, 839 (2017).

17. Carly Rasmussen, Sydney Diekmann, Christine Egan, Tyler Johnson & Francis X. Shen, *How Dangerous are Youth Sports for the Brain? A Review of the Evidence*, 7 BERKELEY J. ENT. & SPORTS L. 67, 81 (2018).

18. Paul McCrory et al., *What is the Definition of Sports-Related Concussion: A Systematic Review*, 51 BRIT. J. SPORTS MED. 877, 877-87 (2017).

19. *Id.*

concussion in youth sports, and the severe consequences of improper management, youth sports concussion legislation aims to promote timely identification and management of concussion.

This Part describes how the 50 states have operationalized concussion education via statutory mandates. Section A describes how concussion education fits into a public health risk prevention model and Section B summarizes the current concussion legislation. Appendix Table A1 presents the precise statutory language from each state's concussion education provision.[20]

A. Concussion as a Public Health Risk

Youth SRC laws are a public health legislative intervention.[21] Such interventions, like much public policy, are typically precipitated by a "focusing event."[22] This may be a tragic incident that is heavily covered or sensationalized by the media.[23] Media coverage and citizen demand may often lead to new government regulation.[24] After an initial state takes the lead, policy diffusion occurs and additional states enact similar policies.[25]

This framework of focusing events and policy diffusion readily applies to the concussion legislation context. The recent surge in sports concussion laws can largely be attributed to high profile concussive injuries in youth sport populations, particularly the case of 13-year-old football player Zachary Lystedt. Lystedt experienced debilitating neurological symptoms after being prematurely returned to play during a football game.[26] In response, the state of Washington developed legislation based on a three-tenet system for concussion management

22. *See* SYDNEY DIEKMANN, ET AL, APPENDIX A1. ANNOTATED SUMMARY TABLE OF STATE CONCUSSION STATUTE EDUCATIONAL MANDATES (2020), http://www.fxshen.com/DiekmannEganRasmussenShen_2020_ConcussionEducationAppendixTableA2_FINAL.pdf [hereinafter DIEKMANN, ET AL, APPENDIX A1].

21. Hosea H. Harvey et al., *The Four Stages Of Youth Sports TBI Policymaking: Engagement, Enactment, Research, And Reform*, 43 J.L. MED & ETHICS 87, 87 (2015) (comparing concussion laws to legislative interventions triggered by other public health crises, including HIV/AIDS prevention and seatbelt use in automobiles).

22. Thomas A. Birkland, *Agenda Setting in Public Policy: Theory, Politics, and Methods*, *in* HANDBOOK OF PUBLIC POLICY ANALYSIS 63, 73-74 (Frank Fischer, Gerald J. Miller & Mara S. Sidney eds., 2007); John W. Kingdon, AGENDAS, ALTERNATIVES, AND PUBLIC POLICIES (1984).

23. M.R. Oakley, *Agenda Setting and State Policy Diffusion: The Effects of Media Attention, State Court Decisions, and Policy Learning on Fetal Killing Policy*, 90 SOC. SCI. Q. 164, 167 (2009).

24. *Id.*

25. Charles R. Shipan & Craig Volden, *The Mechanisms of Policy Diffusion*, 52 AM. J. POL. SCI. 840, 841-44 (2008); Charles R. Shipan & Craig Volden, *Policy Diffusion: Seven Lessons for Scholars and Practitioners*, 72 PUB. ADMIN. REV. 788, 788-93 (2012).

26. Lowrey, *supra* note 7, at 63.

that was subsequently adopted by nearly all states.[27]

Public health interventions generally operate at one (or more) of three levels.[28] "Primary prevention" interventions, such as implementing rule changes to reduce contact or reducing the number of contact practices in a season, aim to prevent an injury from being sustained in the first place.[29] "Secondary prevention" interventions, such as educating coaches about the signs and symptoms of concussion to allow for quicker recognition, aim to detect the injury earlier.[30] "Tertiary prevention" interventions, such as ensuring that a concussed athlete sees a healthcare professional after an injury, aim to reduce the severity of an injury after it has occurred.[31]

With several exceptions, state laws address the secondary and tertiary effects of concussion, but often do not target primary prevention.[32] Central to those prevention efforts is concussion education for coaches, referees, parents, and athletes.

B. Legislative Response

In October of 2006, middle school football player Zachary Lystedt suffered a head injury while playing in a football game.[33] Despite exhibiting symptoms of concussion, including memory problems and headache, he was returned to play by his coaches following the injury. He collapsed at the end of the game.[34] After undergoing life-saving brain surgery to relieve intracranial pressure, Lystedt experienced debilitating neurological disability.[35] In response to this tragedy, the state of Washington implemented the Lystedt law, which was designed to remove concussed athletes from play and prevent return to play until after recovery has occurred.[36]

Beginning in 2009 with the passage of the Lystedt law, individual states passed youth sports concussion legislation to increase awareness of sport-related concussion and promote proper management and return to play.[37] By 2014, all 50

27. *Id.*

28. Charles H. Tator, *Sport Concussion Education and Prevention*, 6 J. CLINICAL SPORT PSYCHOL. 293, 297 (2012).

29. *Id.*

30. *Id.*

31. *Id.*

32. Harvey et al., *supra* note 20, at 88; Lowrey, *supra* note 7, at 67.

33. Richard H. Adler & Stanley A. Herring, *Changing the Culture of Concussion: Education Meets Legislation*, 3 PM&R S468, S468 (2011).

34. *Id.* at 468.

35. *Id.*

36. *Id.* at 469-70.

37. Lowrey, *supra* note 7, at 63.

states had passed sports concussion legislation.[38] There is variation in the laws,[39] but in general, the existing state laws "are organized around three central provisions: education of athletes, parents, and coaches; immediate removal of play of concussed athletes; and medical clearance before returning to play."[40]

For example, in Minnesota, schools and youth sports organizations are required to make information accessible to all participating coaches, officials, and youth athletes and their parents or guardians about the nature and risks of concussions, including the effects and risks of continuing to play after receiving a concussion, and the protocols and content, consistent with current medical knowledge from the Centers for Disease Control and Prevention.[41]

All coaches and officials are required "to receive initial online training and online training at least once every three calendar years . . . consistent with the . . . Concussion in Youth Sports online training program available on the Centers for Disease Control and Prevention Web site."[42]

Following the "first wave" of concussion legislation, states are revisiting the issue to determine what policies work, what policies do not, and what additional reforms are needed.[43] Since initial passage, 22 states have amended their laws.[44] The "amendments generally fall into three types: (1) expanding coverage of the law (e.g., to include younger grades or recreational sports leagues), (2) tightening or clarifying existing requirements," and (3) attempting to improve primary and secondary prevention of concussion.[45]

Even with these amendments, many scholars argue that the statutes are in need of further scrutiny.[46] Our focus here is specifically on whether the education

38. *Id.* (although states have continued to modify their laws, the education provision remains in all 50 states).

39. Kim et al., *supra* note 4, at 163-64.

40. Kerri McGowan Lowrey & Stephanie R. Morain, *State Experiences Implementing Youth Sports Concussion Laws: Challenges, Successes, and Lessons for Evaluating Impact*, 42 J.L. MED. & ETHICS 290, 291 (2014).

41. MINN. STAT. §121A.37 (2017).

42. *Id.*

43. Kerri McGowan Lowrey, *Revising the Game Plan: Primary Prevention, Early Detection, and the Future of Concussion Laws*, THE NETWORK FOR PUBLIC HEALTH LAW (Jul. 21, 2014, 2:57 PM) ("Now that many of these laws have been in effect for a few years, legislatures are revisiting them and making changes according to developments in the field.").

44. Lowrey, *State Laws*, *supra* note 7, at 66.

45. *Id.* at 66 (footnotes omitted).

46. Hosea H. Harvey, *Refereeing the Public Health*, 14 YALE J. HEALTH POL'Y, L., & ETHICS 66, 87 (2014) ("The focus of legislative efforts on a more narrowly defined problem, following passage of the Lystedt Law was shaped, in part, by the NFL's early and visible involvement. Given this proactive effort by an interested and influential private for-profit interest group, it is not surprising that subsequent TBI legislation in many states exhibited remarkable uniformity based on the NFL's suggestions."); Douglas E. Abrams, *Concussion Safety in Children's Sports: A Central*

provision in these laws is working. As summarized in Appendix Table A1, the education provisions vary along several dimensions.[47] Although every state mandates education, the content of that education varies.[48] Nine states either mandate that information must be consistent with agency guidelines or designate specific agencies to assist with the development of such information.[49] Other states pass on the duty of designing a program to a third party such as a state department of health,[50] sport governing body,[51] or interscholastic activities association.[52]

There is also significant variation in the audience for concussion education (see Table 1). Most states require parents (48 states), athletes (47 states), and coaches (45 states) to receive information about sports concussion. However, only 10 states require that referees or officials be educated,[53] and only 9 states require that specific healthcare providers be educated. Even fewer states require education for medical professionals like athletic trainers (6 states) and nurses (5

Role for the "Power of the Permit", 10 J. BUS. & TECH. L. 1, 5 (2015) (arguing that "[i]n states where concussion legislation does not reach private youth sports organizations that use public facilities, local government should approve private use only by organizations that agree to adhere to the three statewide core mandates."); Taylor Adams, *The Repercussions of Concussions in Youth Football Leagues: An Analysis of Texas's Concussion Law and Why Reform Is Necessary*, 18 SCHOLAR: ST. MARY'S L. REV. & SOC. JUST. 285, 343 (2016); Chris Lau, *Leaders and Laggards: Tackling State Legislative Responses to the Youth Sports Concussion Epidemic*, 85 FORDHAM L. REV. 2879, 2886 (2017).

47. *See* DIEKMANN ET AL, APPENDIX A1, *supra* note 22.

48. Iowa, Minnesota, Oklahoma, and Pennsylvania identify which educational program should be used to educate constituents about concussion. Iowa and Minnesota specify the CDC as their educational resource, while Oklahoma and Pennsylvania utilize either the CDC or the NFHS training courses.

49. Idaho, Illinois, Louisiana, Maryland, Massachusetts, New Hampshire, Rhode Island, South Carolina, and Tennessee all fall within this category.

50. *E.g.*, LA. REV. STAT. ANN. § 40:1089.5 (2016) (" . . . The office of public health within the Louisiana Department of Health shall promulgate and make available to all public and private middle schools, junior high schools, and high schools, private clubs, public recreation facilities, and each athletic league which sponsors youth athletic activities information which informs of the nature and risk of concussion and head injury, including the risks associated with continuing to play after a concussion or head injury.").

51. *E.g.*, ALA. CODE § 22-11E-2 (2018) ("Each local school system and governing body of each sport or recreational organization shall develop guidelines and other pertinent information and forms to inform and educate youth athletes and their parents or guardians in their program of the nature and risk of concussion and brain injury").

52. *E.g.*, FLA. STAT. ANN. § 1006.20 (2017) ("The FHSAA shall adopt guidelines to educate athletic coaches, officials, administrators, and student athletes and their parents of the nature and risk of concussion and head injury.").

53. *Eg.*, MONT. CODE ANN. § 20-7-1303 (2017) ("Each coach and official participating in organized youth athletic activities shall complete the training program at least once each year.").

states).[54]

Notably, the lack of provisions concerning youth sports leaves a sizeable gap in concussion education. The majority of youth participating in sports are participating in non-school sanctioned activities.[55] Yet there is little to no education provided for these volunteer parents, who typically run practices and games without the benefit of athletic trainers nearby.[56]

Given the central role that concussion education plays in these statutes, we need to carefully consider the empirical question: what do we know about the effectiveness of concussion education? We answer this question in the next Part.

54. *E.g.*, N.Y. EDUC. LAW § 305(42) (McKinney 2017) ("requiring a course of instruction relating to recognizing the symptoms of mild traumatic brain injuries and monitoring and seeking proper medical treatment for pupils who suffer mild traumatic brain injuries. Such course of instruction shall be required to be completed on a biennial basis by all school coaches, physical education teachers, nurses and athletic trainers.").

55. Rasmussen et al., *supra* note 17, at 80 Fig. 2.

56. *Id.* at 97-99.

TABLE 1: ANALYZING CONCUSSION EDUCATION PROVISIONS IN STATE LEGISLATION

✓ = Legislation requires this group to receive concussion information

✗ = Legislation does NOT require this group to receive concussion information

	School-sponsored sports			*Youth (non-school) sports*				*Medical Professionals*		
State	Parents	Athletes	Coach	Parents	Athletes	Coach	Referees	Athletic trainers	Nurses	Physicians
AL	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗
AK	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗
AZ	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗
AR	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗
CA	✓	✓	✗	✗	✗	✗	✗	✗	✗	✗
CO	✗	✗	✓	✗	✗	✓	✗	✗	✗	✗
CT	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗
DE	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗
DC	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗
FL	✓	✓	✓	✗	✗	✗	✓	✗	✗	✗
GA	✓	✓	✗	✓	✓	✗	✗	✗	✗	✗
HI	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗
ID	✓	✓	✓	✗	✗	✗	✓	✓	✗	✗
IL	✓	✓	✓	✗	✗	✗	✓	✓	✓	✓
IN	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗
IA	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗
KS	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗
KY	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗
LA	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗
ME	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗
MD	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗
MA	✓	✓	✓	✗	✗	✗	✗	✗	✓	✓
MI	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗

MN	✓	✓	✓	✓	✓	✓	✓	×	×	×
MS	✓	×	×	×	×	×	×	×	×	×
MO	✓	✓	✓	×	×	×	×	×	×	×
MT	✓	✓	✓	✓	✓	✓	✓	×	×	×
NE	✓	✓	✓	✓	✓	✓	×	×	×	×
NV	✓	✓	×	×	×	×	×	×	×	×
NH	✓	✓	✓	×	×	×	×	×	×	×
NJ	✓	✓	✓	×	×	×	×	✓	×	✓
NM	✓	✓	✓	✓	✓	✓	×	×	×	×
NY	✓	✓	✓	×	×	×	×	✓	✓	×
NC	✓	✓	✓	×	×	×	×	×	✓	×
ND	✓	✓	×	×	×	×	×	×	×	×
OH	✓	✓	✓	×	×	×	✓	×	×	×
OK	✓	✓	✓	✓	✓	✓	✓	×	×	×
OR	×	×	✓	×	×	×	×	×	×	×
PA	✓	✓	✓	×	×	×	×	×	×	×
RI	✓	✓	✓	×	×	×	×	×	✓	×
SC	✓	✓	✓	×	×	×	×	×	×	×
SD	✓	✓	✓	×	×	×	×	×	×	×
TN	✓	✓	✓	✓	✓	✓	×	×	×	×
TX	✓	✓	✓	×	×	×	×	✓	×	✓
UT	✓	✓	✓	✓	✓	✓	×	×	×	×
VT	✓	✓	✓	×	×	×	✓	×	×	×
VA	✓	✓	✓	×	×	×	×	×	×	×
WA	✓	✓	✓	×	×	×	×	×	×	×
WV	✓	✓	✓	×	×	×	×	×	×	×
WI	✓	✓	✓	✓	✓	✓	×	×	×	×
WY	✓	✓	✓	×	×	×	×	✓	×	×

Table 1 presents a state-by-state comparison of which stakeholder groups are legislatively mandated to receive concussion information. Coaches, athletes, and parents in school-sanctioned sports are most commonly targeted, while youth (non-school) populations generally are not. Data for this table was collected through September 1, 2018. For citations and text of state statutes, see Appendix Table A1.

II. THE EFFECTIVENESS OF CONCUSSION EDUCATION: A COMPREHENSIVE REVIEW

The success of SRC legislation reviewed in Part I rests upon the assumption that legislatively-mandated concussion education will improve health outcomes. In this Part, we present a comprehensive examination of the published research literature to evaluate what is known about the effects of concussion education and training interventions.

We arrive at three central conclusions. First, there is mixed evidence connecting concussion education to a reduction in concussion incidence. Second, there is little evidence suggesting that concussion education will produce lasting changes in relevant behaviors, such as athlete reporting of suspected concussions. Third, there is limited evidence suggesting that concussion education will change concussion attitudes, but much evidence that concussion education can improve short-term knowledge about concussion. Taken together, the research literature suggests that—as currently implemented—legislatively-mandated concussion education is failing to achieve its desired public health goals.

Section A describes in detail the methods we used to search the research literature and identify studies for inclusion in our review. Section B summarizes research on the links between education interventions and actual incidence of concussion. Section C examines the relationship between education and other relevant concussion behavior, such as how long athletes were held out before returning to play. Section D reviews the effect of concussion education on concussion attitudes and concussion knowledge. Appendix Table A2 provides a detailed summary of each of the 54 studies reviewed.[57]

A. Identifying Relevant Studies on the Effect of

57. *See* SYDNEY DIEKMANN, ET AL, APPENDIX A2. ANNOTATED SUMMARY TABLE OF RESEARCH STUDIES ON CONCUSSION EDUCATION INTERVENTIONS (2020), http://www.fxshen.com/DiekmannEganRasmussenShen_2020_ConcussionEducationAppendixTableA2_FINAL.pdf.

Concussion Education

To identify relevant studies for inclusion in the review, we focused on research that answered either of two questions: (1) What is the relationship between concussion education interventions and the incidence of SRCs?; and (2) what are the demonstrated relationships between sports concussion education and outcomes such as concussion knowledge, concussion attitudes, and concussion-related behaviors?

Our search included publications through June 30, 2018. Our inclusion criteria for the review were as follows: (1) article was a peer-reviewed original research article; (2) article was available in English; (3) research was specific to SRC, at any age level and however it was defined in the article; and (4) study involved concussion education and/or a concussion training intervention.

To search for articles, we utilized the online databases Ovid Medline, EMBASE, PsycINFO, SPORT Discus, CINAHL, Web of Science, PubMed, and Cochrane Library. The specific search strategy used was: (concuss* OR "brain injur*") AND (sport* OR coach* OR athlete* OR "student-athlete*") AND (educat* OR train*), in addition to other related keywords or subject headings specific to each database. This search strategy was used to address the inclusion criteria and was based on strategies used by previous reviews on a similar topic.[58]

Titles, abstracts, and full texts of relevant articles were reviewed to determine if the article met the inclusion criteria.[59] The references of relevant articles and review articles were also examined to determine additional articles not identified by the search strategy. In total, fifty-four articles were identified that met the inclusion criteria.[60]

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58. Jeffrey G. Caron et al., *An Examination of Concussion Education Programmes: A Scoping Review Methodology*, 21 INJ. PREVENTION 301, 302 (2015); Michael R. Fraas & Jessica Burchiel, *A Systematic Review of Education Programmes to Prevent Concussion in Rugby Union*, 16 EUR. J. SPORT SCI. 1212, 1213 (2016); Martin Mrazik et al., *A Qualitative Review of Sports Concussion Education: Prime Time for Evidence-Based Knowledge Translation*, 49 BRIT. J. SPORTS MED. 1547, 1548 (2015); Christine F. Provvidenza & Karen M. Johnston, *Knowledge Transfer Principles as Applied to Sport Concussion Education*, 43 BRIT. J. SPORTS MED. 68, 68 (2009); Sam Gleadhill et al., *Engagement by Education for Action: Recommendations for Educational Interventions to Prevent Concussion in Sport*, 3 J. FITNESS RES. 8, 12 (2014).

59. The search strategy produced 3,814 unique results.

60. Studies were excluded if they involved an intervention not specific to concussion prevention or if they studied a population not in a sports setting. *See, e.g.*, Edward A. Neuwelt et al., *Oregon Head and Spinal Cord Injury Prevention Program and Evaluation*, 24 NEUROSURGERY 453 (1989); Alice E. Avolio et al., *Evaluation of a Program to Prevent Head and Spinal Cord Injuries: A Comparison Between Middle School and High School*, 31 NEUROSURGERY 557 (1992); Sara P. Chrisman et al., *Physician Concussion Knowledge and the Effect of Mailing the CDC's "Heads Up" Toolkit*, 50 CLINICAL PEDIATRICS 1031 (2011); Karen A. McLaughlin et al., *Web-Based Training in Family Advocacy*, 28 J. HEAD TRAUMA REHABILITATION 341 (2013); Geoffrey L.

Studies varied in the quality of their research design and data. For instance, randomized controlled trials (RCTs)[61] are often considered to be the "gold standard" of experimental design because they allow for causal inferences to be made.[62] However, well-designed observational studies, such as those that include a case-control design, can also produce meaningful and comparable results.[63] Thus, for the purposes of this review, we include both RCT and non-RCT studies.[64]

Most of the studies we review employed one of two research designs. Within-subject studies evaluated subject knowledge/behavior before and after the concussion education intervention. Between-subject studies compared subject knowledge/behavior between the concussion education treatment and control groups. With regard to the particular educational intervention, a large variety of concussion education modalities have been deployed.[65]

Concussion education is often provided through an online training course. For example, the CDC *Heads Up* Initiative consists of a series of free, 30–45-minute educational videos targeted towards different groups, including coaches, athletes, parents, officials, and healthcare providers.[66] These trainings consist of several modules designed to educate groups about the nature and risks of concussion, recognizing concussion symptoms, implementing safe return-to-play and return-to-school policies, and preventative efforts. These online education modules typically include a pre- and post-training knowledge assessment and provide a certificate of training completion.

However, there are many other modalities of concussion education on the market. Concussion education programs currently being used include:

Heyer et al., *High School Principals' Resources, Knowledge, and Practices Regarding the Returning Student with Concussion*, 166 J. PEDIATRICS 594 (2015); David Salisbury et al., *Concussion Knowledge Among Rehabilitation Staff*, 30 BAYLOR U. MED. CTR. PROC. 33 (2017).

61. Randomized controlled trials are experiments in which participants are randomly assigned to either experimental or control groups, and conditional differences between these groups are (ideally) limited to the dependent variable (in this case, the educational intervention).

62. John Concato et al., *Randomized, Controlled Trials, Observational Studies, and the Hierarchy of Research Designs*, 342 NEW ENG. J. MED. 1887, 1892 (2000).

63. *Id.* at 1890.

64. In our discussion section we recognize the limitations of some study designs.

65. *See, e.g.*, Ellen K. Payne et al., *Investigation of the Concussion Goggle™ Education Program with Secondary School Athletic Team: A Pilot Study*, J. SPORTS MED. & ALLIED HEALTH SCI.: OFFICIAL J. OHIO ATHLETIC TRAINERS ASS'N 1, 3 (2017). This group created "concussion goggles" which replicate symptoms of concussion when worn. The Concussion Goggles™ were used as part of a larger 60-minute presentation based on concussion education materials provided by the CDC *Heads Up* program. However, a study of high school student-athletes found no improvement in concussion knowledge following the presentation.

66. *HEADS UP to Youth Sports*, CENTERS FOR DISEASE CONTROL AND PREVENTION, https://www.cdc.gov/headsup/youthsports/index.html (last updated Mar. 5, 2019).

- Government-developed educational materials, such as those provided by the CDC *Heads Up* Initiative[67]
- Organization- or institution-developed educational programs[68]
- Sport governing-body education programs, such as those utilized by USA Football[69]
- Online education modules[70]
- Videos[71]
- In-person lectures or presentations[72]
- Handouts and informational sheets
- Video games with concussion education content[73]

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67. *See, e.g.*, Jane Mitchko et al., CDC's *Approach to Educating Coaches About Sports-Related Concussion*, 38 AM. J. HEALTH EDUC. 99 (2007); Jessica Sarmiento et al., *Evaluation of the Centers for Disease Control and Prevention's Concussion Initiative for High School Coaches: 'Heads Up: Concussion in High School Sports'*, 80 J. SCHOOL HEALTH 112, 113-14 (2010); Tracey Covassin et al., *Educating Coaches About Concussion in Sports: Evaluation of the CDC's "Heads Up: Concussion in Youth Sports" Initiative*, 82 J. SCHOOL HEALTH 233, 234 (2012).

68. *See, e.g.*, Alexander F. Bagley et al., *Effectiveness of the SLICE Program for Youth Concussion Education*, 22 CLINICAL J. SPORT MED. 385, 386 (2012); Gillian Hotz et al., *The Challenges of Providing Concussion Education to High School Football Players*, 2 CURRENT RES: CONCUSSION 103, 104 (2015); Erin M. Parker et al., *Reach and Knowledge Change Among Coaches and Other Participants of the Online Course: "Concussion in Sports: What You Need to Know"*, 30 J. HEAD TRAUMA REHABILITATION 198, 199 (2015).

69. *See, e.g.*, Zachary Y. Kerr et al., *Comprehensive Coach Education Reduces Head Impact Exposure in American Youth Football*, 3 ORTHOPAEDIC J. SPORTS MED, Oct. 15, 2015 at 1, 3-4.

70. *See, e.g.*, Ann E. Glang et al., *The Effectiveness of a Web-Based Resource in Improving Post-Concussion Management in High Schools*, 56 J. ADOLESCENT HEALTH 91, 93 (2015); Quincy Conley & Willi Savenye, *Brainbook: An Impact Study of a Statewide Concussion Awareness Training for High School Athletes*, 56 PERFORMANCE IMPROVEMENT, 28, 29 (2017).

71. *See, e.g.*, D. J. Cook et al., *Evaluation of the Thinkfirst Canada, Smart Hockey, Brain and Spinal Cord Injury Prevention Video*, 9 INJ. PREVENTION 361, 362 (2003); Michael D. Cusimano et al., *Effectiveness of an Educational Video on Concussion Knowledge in Minor League Hockey Players: A Cluster Randomised Controlled Trial*, 48 BRIT. J. SPORTS MED. 141, 142 (2014); Ann Glang et al., *Online Training in Sports Concussion for Youth Sports Coaches,* 5 INT'L J. SPORTS SCI. & COACHING 1, 2 (2010); Tamerah N. Hunt, *Video Educational Intervention Improves Reporting of Concussion and Symptom Recognition*, 10 ATHLETIC TRAINING EDUC. J. 65, 66 (2015).

72. *See, e.g.*, Matthew E. Eagles et al., *The Impact of a Concussion-U Educational Program on Knowledge of and Attitudes About Concussion*, 43 CAN. J. NEUROLOGICAL SCI. 659, 660 (2016); Emily Kroshus et al., *NCAA Concussion Education in Ice Hockey: An Ineffective Mandate*, 48 BRIT. J. SPORTS MED. 135, 137-38 (2014); Brad G. Kurowski, et al., *Impact of Preseason Concussion Education on Knowledge, Attitudes, and Behaviors of High School Athletes*, 79 J. TRAUMA & ACUTE CARE SURGERY S21, S23 (2015); Nancy J. Manasse-Cohick & Kathy L. Shapley, *Concussion Education for High School Football Players: A Pilot Study*, 35 COMM. DISORDERS Q. 182, 183 (2014).

73. *See, e.g.*, Jill Daugherty et al., *A Description and Evaluation of the Concussion Education Application HEADS UP Rocket Blades*, 20 HEALTH PROMOTION PRAC. 22, 26-28 (2018) (thirteen children played the gaming application called HEADS UP Rocket Blades while their parents

The great variety of education programs speaks to the urgency with which policymakers have attempted to address the challenge of sports related concussion. However, whether or not these interventions actually work is the question we now tackle.

B. Effects of Concussion Education on Concussion Incidence in Sports

Of the fifty-four articles included for review, five studies evaluated the effect of concussion education on concussion incidence. The results are mixed and suggest that the success of concussion education is contingent on additional factors beyond the educational components. While two studies (with smaller sample sizes) indicate that concussion education may reduce incidence,[74] results from larger case-control study designs[75] and a RCT suggest that educational interventions have no effect on concussion incidence.[76] While some of these studies feature larger sample sizes and/or a controlled experimental setting, the overall lack of thorough empirical investigation presents a significant gap in our understanding of the relationship between concussion education and its related outcomes. Given the importance of reducing concussion incidence as a first step in bottlenecking the downstream issues of improper concussion management that education attempts to address, additional study of this topic is warranted.

A study published in 2015 examined the relationship between exposure to the education program *Brain 101: The Concussion Playbook* and concussion incidence in high school athletes from high schools in Oregon.[77] The study encompassed twenty-five high schools: thirteen high schools were randomly assigned to receive the *Brain 101* treatment. In these thirteen schools, student-athletes and their parents viewed the *Brain 101* website materials, and athletic directors and principals in these high schools were asked to implement

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watched them play the game; a parent survey indicated that the application was a good learning tool and that the application presented concussion information in an easily understood way and a similar survey of children indicated that most correctly identified all of the learning objectives outlined by the application creators); David Goodman et al., *Video Gaming Promotes Concussion Knowledge Acquisition in Youth Hockey Players*, 29 J. ADOLESCENCE 351, 352-53, 355 (2006) (130 youth hockey players completed the computer game *Symptom Shock*, which involves matching concussion symptoms; those who played the game identified significantly more symptoms in a faster time span).

74. Simon Gianotti & Patria A. Hume, *Concussion Sideline Management Intervention for Rugby Union Leads to Reduced Concussion Claims*, 22 NEUROREHABILITATION 181, 183 (2007); Kerr et al., *supra* note 69, at 3-4.

75. Kerr et al., *supra* note 69, at 1-2; Kurowski et al., *supra* note 72, at S22-24.

76. Glang et al., *supra* note 70, at 94.

77. *Id.* at 92-93.

prevention policies recommended by *Brain 101*.[78] By contrast, twelve different high schools were randomly assigned to the control group, which viewed teen driving safety materials or teen job safety materials (unrelated to concussion) from the CDC.[79]

Athletic trainers at all twenty-five schools recorded the number of concussions that occurred in the fall sports season. Comparing the treatment and control groups, statistical analysis did not indicate a significant difference in the concussion incidence rate. This suggests that targeted education programs such as *Brain 101* do not reduce concussion incidence.[80]

Additional studies have examined whether concussion education, as compared to no education, would reduce concussion incidence. In 2015 in Ohio, researchers randomly assigned student-athletes in one high school to receive a concussion education lecture from the researcher at the beginning of their sport season.[81] Student-athletes in a different high school did not receive any form of concussion education.[82] At the end of the sport season, student-athletes from both schools self-reported the concussive symptoms they experienced during the season.[83] The percentage of student-athletes that self-reported concussion symptoms and the percentage of student-athletes that received a concussion diagnosis from a healthcare professional were not significantly different between the intervention and control groups.[84]

Another 2015 study examined the effectiveness of USA Football's *Heads Up Football* program and found little evidence of education effectiveness. *Heads Up Football* provides concussion education to youth football coaches.[85] Youth football leagues can choose whether to participate in the *Heads Up Football* program: in this study, the researchers compared outcomes from those leagues that utilized *Heads Up*, against leagues that did not use *Heads Up*.[86]

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78. *Id.* at 92-93 (these policies include starting a concussion management team, developing a concussion management policy, and offering support and accommodation for student athletes as they return to academics).

79. *Id.*

80. *Id.* at 94.

81. Brad G. Kurowski et al., *Impact of Preseason Concussion Education on Knowledge, Attitudes, and Behaviors of High School Athletes*, 79 J. TRAUMA & ACUTE CARE SURGERY S21, S22-23 (2015). Kurowski et al., *supra* note 71.

82. *Id.*

83. *Id.* at S23-24.

84. *Id.* at S24.

85. Kerr et al., *supra* note 69.

86. *Id.* at 2. Because some leagues became affiliated with Pop Warner football, a youth football organization that restricts player-to-player contact during practice and could thus affect concussion incidence, researchers further divided teams into those participating in both USA Football's *Heads Up Football* program and Pop Warner Football; those participating in only *Heads*

Athletic trainers attended the practices and games of all 100 teams participating in the study during one season to document concussion incidence.[87] There were no significant differences in concussion injury rates during games or practices between the teams that only used the *Heads Up Football* program, as compared with those that did not.[88]

However, teams that used *Heads Up—and* that were affiliated with Pop Warner Football (whose rules restrict contact)—produced significantly lower concussion rates than the teams that solely participated in the *Heads Up Football* program.[89] These results suggest that *Heads Up* may help reduce concussion incidence, but that it is more likely that institutional rule changes aimed to reduce player-to-player contact are the drivers of lower concussion incidence.[90]

There are, to be sure, mixed findings. A different study of *Heads Up Football* found positive benefits of coach education.[91] Comparing eight teams that did not participate in *Heads Up* with seven teams that did, the study found that there were six concussions reported in athletes playing in the group that did not participate in *Heads Up Football*.[92] There were no reported concussions in the group using *Heads Up*.[93] While suggestive of the positive effects of *Heads Up*, the small sample size limits the generalizability of these results.

Internationally, a concussion education program in New Zealand that distributed Sideline Concussion Check cards to coaches was found to be effective at preventing concussions.[94] There was a 10.7% decrease in the number of concussions incurred in rugby from before the implementation of the cards to after.[95] Additionally, other sports that implemented the Sideline Concussion Check cards saw decreases in the number of concussions following the cards' distribution while sports without the cards saw increases in the number of

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Up Football; and those not participating in either program. *Id.* at 2-3.

87. *Id.* at 3.

88. *Id.* at 4.

89. *Id.* at 4-5.

90. *Id.* at 7 ("We speculate that the HUF + PW group may have been more effective due to the PW practice contact restriction guidelines that specifically limited how much player-to-player contact time could occur.")

91. Zachary Y. Kerr et al., *Comprehensive Coach Education Reduces Head Impact Exposure in American Youth Football*, 3(10) ORTHOPAEDIC J. SPORTS MED, Oct. 15, 2015, at 2.

92. *Id.* at 3.

93. *Id.*

94. Simon Gianotti & Patria A. Hume, *Concussion Sideline Management Intervention for Rugby Union Leads to Reduced Concussion Claims*, 22 NEUROREHABILITATION 181, 183, 185 (2007) (Sideline Concussion Check cards provide information to coaches about how to manage a suspected concussion, including advice to seek medical help and return-to-play guidelines).

95. *Id.* at 185.

concussions across the same time period.[96] Thus, the Sideline Concussion Check cards may be an effective intervention.[97]

Taken together, these results show that the success of education interventions on concussion incidence is likely contingent on the implementation of additional interventions such as changing contact rules and sideline protocols.

C. Effects of Concussion Education on Coach and Athlete Behavior

In addition to reducing concussion incidence, concussion education is intended to change coach and athlete behavior.[98] For instance, with better concussion education, coaches might spot more concussion symptoms or modify their practice regimens,[99] and players might be more likely to report concussion symptoms.[100] As with the studies of concussion incidence, the evidence is mixed regarding the relationship between concussion education and resulting changes in behavior.

Of the fifty-four studies included for review, four studies concluded that concussion education resulted in a positive change in athlete and/or coach behavior. These studies found that concussion education programs may encourage athletes and coaches to engage in safer gameplay,[101] improve athlete

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96. *Id.*

97. *Id.* at 186-88.

98. Emily Kroshus, et al., *Concussion Reporting Intention: A Valuable Metric for Predicting Reporting Behavior and Evaluating Concussion Education*, 25 CLINICAL J. SPORTS MED. 243, 243 (2015).

99. Sarmiento et al., *supra* note 67, *Evaluation of the Centers for Disease Control and Prevention's Concussion Initiative for High School Coaches: "Heads Up: Concussion in High School Sports"*, 80 J. SCHOOL HEALTH 112, 115-16 ("More than one third of survey respondents (38%) reported making changes in how they prevented or managed concussions after using the tool kit.").

100. Charles H. Tator, *Sport Concussion Education and Prevention*, 6 J. CLINICAL SPORT PSYCHOL. 293, 296 (2012) ("It is possible that mandatory education will lead to a reduction in the incidence of concussions and improved compliance with reporting and management, thus preventing brain deterioration in both the short and long term.").

101. Simon M. Gianotti et al., *Evaluation of RugbySmart: A Rugby Union Community Injury Prevention Programme*, 12 J. SCI. & MED. SPORT 371, 374. Researchers found that educating coaches was associated with a significant increase in the percentage of players who self-reported the use of safer tackle and gameplay techniques after the program's implementation. Zachary Y. Kerr et al., *Comprehensive Coach Education Reduces Head Impact Exposure in American Youth Football*, 3(10) ORTHOPAEDIC J. SPORTS MED, Oct. 15, 2015, at 2-3. USA Football's *Heads Up Football* program educates coaches on safe tackling techniques, strategies to reduce player contact, and concussion awareness. Researchers placed accelerometers in athlete helmets to measure impact intensity during practices and games. They found that players on teams participating in the *Heads Up Football* program experienced significantly fewer moderate- and high-level head impacts in

reporting of concussion symptoms,[102] and make safer decisions regarding removal from play after a suspected concussion.[103]

It must be recognized, however, that the studies leave many questions unanswered. For instance, cultural differencse, for instance between rugby culture in New Zealand and American football culture in the United States may mediate the effect of concussion education.[104] A culture of high-stakes competition may limit the effects of concussion education on decision-making and behavior.[105]

To be sure, some studies regarding specific interventions come to conclusions that are less clear-cut, and the mixed results of these interventions are well illustrated by two different studies that evaluated the same intervention: ThinkFirst Canada's *Smart Hockey* video.[106] During the middle of the season, youth hockey players were randomly assigned to view either the concussion video or a control video. The athletes exposed to the concussion video showed significant improvements in concussion knowledge both immediately following the video and three months later.[107] This study was unique in that penalties were recorded by a researcher throughout the entire season.[108] Concussion education produced significantly fewer cross-checking and checking-from-behind penalties.[109] Since these types of penalties present a high risk of injury,[110] their

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practice, as measured by the accelerometer, than players on teams not participating in the *Heads Up Football* program. However, no difference in number of head impacts was seen during games.

102. Theresa L. Miyashita, et al., *The Impact of an Educational Intervention on College Athletes' Knowledge of Concussions*, 23 CLINICAL J. SPORT MED. 349, 350-51 (2013). In a study of fifty college soccer and basketball players, six athletes reported receiving a concussion during the season, and 50% of those athletes stated that the concussion education presentation impacted their timely reporting of their concussion and how they managed their concussion.

103. Brad G. Kurowski et al., *Impact of Preseason Concussion Education on Knowledge, Attitudes, and Behaviors of High School Athletes*, 79 J. TRAUMA & ACUTE CARE SURGERY S21, S24 (2015). In a study of high school athletes in Ohio, among athletes who reported having concussion symptoms during the season, significantly fewer athletes who received the presentation reported returning to play compared to athletes who did not receive the presentation. However, among athletes who were diagnosed with a concussion by a medical professional, there was no difference in the number of athletes reporting they returned to play while still having symptoms between those who had received the presentation and those who had not. Furthermore, the presentation did not affect concussion reporting or diagnosis.

104. *See* discussion *infra* Part III, discussing a New Zealand study in which rugby players self-reported using safer play techniques after the implementation of RugbySmart.

105. *See* Kerr et al., *American Youth Football*, *supra* note 102, at 4-5.

106. D. J. Cook et al., *supra* note 71, at 361-62.

107. *Id.* at 363.

108. *Id.* at 362 (showing the video mid-season allowed for longitudinal comparison in penalties pre- and post-intervention).

109. *Id.* at 363.

110. *Id.* at 363-64.

decline suggests that the *Smart Hockey* video may be effective in reducing risky concussion-promoting behaviors.

While these results are promising, a RCT study of the *Smart Hockey* video came to different conclusions.[111] Utilizing a similar design, ten- and fourteen-year-old youth hockey players were randomly assigned to view the video or to discuss injuries in hockey with the researcher.[112] There was no change in concussion attitudes or self-reported concussion-related behaviors for either group across time points.[113]

Finally, of the fifty-four studies included for review, six studies found no effects of concussion education on stakeholder behavior. These studies demonstrate that concussion education has no effect on identification of concussion symptoms[114] and athlete reporting of concussion symptoms.[115] There is also evidence that concussion education has little effect on concussion management and return to play. A study of 1,004 parents and 4,804 athletes from 25 Oregon high schools found that the *Brain 101* program did not affect return-to-play outcomes.[116] Among athletes who had received a concussion, there were no differences between the *Brain 101* schools and the control school in the average time for the athlete to return to play, the average time for the athlete to return to school, whether the athlete saw a healthcare professional, or whether the athlete received special accommodations at school.[117] Thus, the *Brain 101* program may result in knowledge gains but fails to change how concussion is

111. Cusimano et al., *supra* note 71.

112. *Id.* at 142-43.

113. *Id.* at 145 (concussion knowledge increased immediately, then returned to baseline within two months; however, fourteen-year-olds retained their knowledge after two months while the younger cohort did not).

114. Janie Cournoyer & Brady L. Tripp, *Concussion Knowledge in High School Football Players*, 49 J. ATHLETIC TRAINING 654, 656 (2014) (finding that concussion education for high school athletes was not associated with greater concussion symptom identification or improved recognition of long-term consequences of concussion; Frederick P. Rivara et al.,, *The Effect of Coach Education on Reporting of Concussions Among High School Athletes After Passage of a Concussion Law*, 42 AM. J. SPORTS MED. 1197, 1200, (2014) (finding that coach education did not affect whether or not coaches identify concussion symptoms in their athletes, although some educational modalities were more effective in improving awareness of symptoms than others).

115. Daniel M. Torres et al., *Sports-Related Concussion: Anonymous Survey of a Collegiate Cohort*, 3 NEUROLOGY: CLINICAL PRAC. 279, 282-83 (2013). A study of 262 collegiate athletes found that while 71% of athletes reported being formally educated about concussion, their intent to report symptoms remained low: 43% of athletes with a history of concussion reported that they had intentionally hidden concussion symptoms to remain in play, and 22% of athletes also reported that they were unlikely to disclose concussion symptoms to their coach or athletic trainer in the future.

116. Glang et al., *Web-Based Resource*, *supra* note 70, at 92-94.

117. *Id.* at 94.

managed by school staff, including coaches.[118] Other studies have come to similar conclusions that concussion education did not result in better concussion management behaviors, such as removal from play after a suspected concussion[119] and receiving follow-up medical care.[120]

D. Effects of Concussion Education on Coach and Athlete Attitudes and Knowledge

The majority of the studies in our review examined only self-reported attitudes toward and knowledge about SRC. This is understandable given the practical constraints of measuring behavioral outcomes. It is easier to solicit a response on a survey (e.g. "Do you think you would be more likely to report a concussion?") than it is to track concussion reporting over a full season. Given this methodological limitation, and our primary interest in behavioral rather than attitudinal change, we must proceed cautiously in assessing the literature on these attitudinal outcomes. Similarly, when evaluating studies of concussion knowledge, it is important to remember that we do not know (from the studies reviewed below) whether improved short-term knowledge of concussion leads to improved concussion care in the sports setting.

1. Effect on Coach Attitudes and Knowledge

Of the fifty-four articles included for review, nine studies evaluated the effect of concussion education on coaches' knowledge and attitudes.[121] The results of these coaches' studies are generally mixed. On one hand, concussion education programs may be helpful in promoting greater knowledge of concussion symptoms, in addition to increasing expressed intention to take appropriate action in managing concussion. On the other hand, it is unclear whether coach education will result in better concussion recognition or management protocols.

One study, which evaluated the efficacy of the *ACTive: Athletic Concussion*

118. *Id.* at 94-95.

119. Tracy McDonald et al., *Underreporting of Concussions and Concussion-like Symptoms in Female High School Athletes*, 23 J. TRAUMA NURSING 241, 243-44 (2016).

120. McDonald et al., *supra* note 117, at 243-44; Miriam Carroll-Alfano, *Mandated High-School Concussion Education and Collegiate Athletes' Understanding of Concussion*, 52 J. ATHLETIC TRAINING 689, 691-93 (2017).

121. In addition, one study has evaluated the effect of a concussion education intervention on sports medicine physicians. *See* Sara P. Chrisman, Melissa A. Schiff & Frederick P. Rivara, *Physician Concussion Knowledge and the Effect of Mailing the CDC's "Heads Up" Toolkit*, 50 CLINICAL PEDIATRICS 1031 (2011) (finding that physicians provided with concussion education were significantly less likely to recommend that a concussed athlete return to play the next day).

Training using a RCT study design, found that coaches in the *ACTive* group had greater improvement in general concussion knowledge, knowledge of concussion symptoms and misconceptions, confidence in taking the appropriate action when faced with a suspected concussion, and the intention to take the appropriate action compared to coaches who did not do the *ACTive* training.[122] While these results suggest that the *ACTive* training program was effective in improving knowledge about concussions in youth coaches, it remains unclear if this change in short-term knowledge produced lasting changes in concussion prevention and care.[123]

The most commonly studied concussion education program for coaches is the CDC *Heads Up* intervention, which was made available in September 2015 by the CDC following extensive internal development.[124] The final product was a series of educational toolkits and programs tailored to different target audiences, including high school coaches, youth coaches, and health care professionals.[125] Several studies have evaluated the effectiveness of the toolkit by surveying coaches about how they use the program. Studies that assessed the kit prior to its release found that while coaches found the kit easy to use[126] and learned something from the program,[127] most coaches reported only using it for educational purposes, and significantly fewer coaches reported that the program changed their concussion protocols.[128] While the results of these self-report survey studies are encouraging, because they are self-reported without objective verification of subsequent behavioral change, we do not know the actual impact of the CDC *Heads Up* materials.

Other studies have found that concussion education improves coach concussion knowledge[129] and the ability to recognize concussion symptoms and

122. Glang et al., *supra* note 70, at 4-6.

123. *Id.* at 7-8.

124. The preliminary CDC *Heads Up* toolkit included multimedia educational materials for coaches, athletes, and parents. During the development of the toolkit, focus groups indicated its potential usefulness, citing an increased awareness and knowledge of concussion and the intent to implement the toolkit's recommendations. *See* Mitchko et al., *supra* note 67, at 105.

125. Sarmiento et al., *supra* note 67, at 113-14. In the self-report survey, 34% of coaches reported that they learned something from the toolkit, 125. 38% reported that they changed their concussion protocols and practices, 125. and 68% reported that that they educated others about concussions after reviewing the toolkit. *Id.*

126. Richard J. Sawyer et al., *High School Coaches' Assessments, Intentions to Use, and Use of a Concussion Prevention Toolkit: Centers for Disease Control and Prevention's Heads Up: Concussion in High School Sports*, 11 HEALTH PROMOTION PRAC. 34, 38-41 (2010).

127. Covassin et al., *supra* note 67, at 234. Researchers found that 50% of the surveyed youth coaches self-reported that they learned something new from the toolkit, and 72% of coaches expressed desire to educate others about concussions. *Id* at 233.

128. *Id.*

129. The percentage of correct answers was higher on the post-test than the pre-test among the

understand concussion management, although variation exists across gender, sport type, and concussion history.[130]

2. Effect on Athlete Attitudes and Knowledge

Another twenty-eight studies evaluated the effect of concussion education programs on *athlete* knowledge and attitudes. As with coaches' education, the results of athlete education are mixed. Some evidence suggests that athlete education programs can produce short-term knowledge gains. However, these gains are age- and modality-dependent, long-term retention of information is unlikely, and changes in concussion reporting behaviors and attitudes are much harder to generate.

There is much evidence to support the claim that concussion education can, in the short term, improve athlete knowledge about how to identify and care for a sports concussion.[131]

133,764 participants who took the NFHS/CDC course for the first time during the data collection period. However, no formal statistical analyses were performed to determine if the observed effects were significant. Erin M. Parker et al., *Reach and Knowledge Change Among Coaches and Other Participants of the Online Course: "Concussion in Sports: What You Need to Know"*, 30 J. HEAD TRAUMA REHABILITATION 198, 201-02 (2015).

130. *See* Tamara C. Valovich McLeod, Christian Schwartz & R. Curtis Bay, *Sport-Related Concussion Misunderstandings Among Youth Coaches*, 17 CLINICAL J. SPORT MED. 140 (2007); Emily Kroshus, Christine M. Baugh & Daniel H. Daneshvar, *Content, Delivery, and Effectiveness of Concussion Education for US College Coaches*, 26 CLINICAL J. SPORT MED. 391, 394 (2016); Erin M. O'Donoghue, James A. Onate, Bonnie Van Lunen & Connie L. Peterson, *Assessment of High School Coaches' Knowledge of Sport-Related Concussion*s, 1 ATHLETIC TRAINING & SPORTS HEALTH CARE 120, 129 (2009).

131. *See* Jae O. Koh, *Effect of Snowboard-Related Concussion Safety Education for Recognizing Possible Concussions*, 51 J. SPORTS MED. & PHYSICAL FITNESS 625, 628 (2011) (showing that concussion knowledge among 208 college students enrolled in a snowboarding course significantly increased immediately following a 30-minute concussion education presentation); Miyashita et al., *supra* note 103 (showing that after fifty NCAA athletes were given a 20-minute concussion education presentation, concussion knowledge significantly increased and the gain was maintained until the end of the season); Kurowski et al, *supra* note 72, at S22 (showing how 234 high school athletes who received a 20-minute presentation before their sports season began showed gains in concussion knowledge, attitudes, and intentions to report concussion symptoms, while a group of 262 control high school athletes did not; however, these gains regressed to baseline by the end of the season); Manasse-Cohick & Shapley, *supra* note 72, at 183 (showing how after receiving a concussion education presentation containing information CDC Heads Up initiative, 160 high school football players showed significantly improved concussion knowledge but displayed no changes in attitudes towards concussion); Jeffrey G. Caron et al., *Development, Implementation and Assessment of a Concussion Education Programme for High School Student-Athletes*, 36 J. SPORTS SCI. 48, 51-52 (2017) (showing how after a series of four different interactive oral concussion presentations administered weekly, 35 male high school athletes demonstrated significantly increased concussion knowledge which was maintained for two months; however, there were no significant change in attitudes towards concussion); Hunt, *supra*

Still, evidence remains mixed, even among studies that evaluate the same education program. For instance, two studies of the Sports Legacy Institute Community Educators (SLICE) concussion education program[132] found that students' concussion knowledge generally improved shortly after participation in the program,[133] but another study of a modified version of the same program found no improvement in knowledge.[134]

Short term gains have been found in evaluations of *Brain 101*;[135] the Barrow *Brainbook* online concussion education course;[136] the *Head Safety in Youth*

note 71, at 67, 70 (comparing 68 high school athletes who were randomly assigned to either watch a concussion education video or watch a video on nutrition; both groups exhibited significant improvement in concussion symptom identification but there was a greater increase for athletes who watched the concussion education video); Paul S. Echlin et al., *The Sport Concussion Education Project. A Brief Report on an Educational Initiative: From Concept to Curriculum*, 121 J. NEUROSURGERY 1331, 1331-36 (2014); Nancy R. Chinn & Paul Porter, *Concussion Reporting Behaviours of Community College Student-Athletes and Limits of Transferring Concussion Knowledge During the Stress of Competition*, BMJ OPEN SPORT & EXERCISE MED., at 1, 3-5 (2016) (showing prior concussion education in community college student-athletes was associated with greater concussion knowledge, and more concussion education sessions associated with higher knowledge); L. Sullivan, L. Pursell & M. Molcho, *Evaluation of a theory-based concussion education program for secondary school student-athletes in Ireland*, HEALTH EDUC. RES. (2018) (athletes who received the education inervention has significantly higher concussion knowledge post-intervention and compared to controls); Jessica Wallace, Tracey Covassin & Erica Beidler, *Concussion Bingo: Taking an active learning approach to concussion education with vulnerable populations*, HEALTH EDUC. J. (2018) (showing that athletes exhibited significantly higher concussion knowledge after a "Concussion Bingo" educational activity compared to pre-intervention).

132. The SLICE program is 40-60 minutes long and includes information about the signs and symptoms, long-term risks, and strategies for managing concussions. The modified SLICE program is a 30-minute PowerPoint presentation including similar content. *See* Bagley et al., *supra* note 68; Hotz et al., *supra* note 68, at 104. The 15-minute Uconcussion educational video is another derivative of the SLICE program. *See* Gillian Hotz, *Concussion: Video Education Program for High School Football Players*, 20 SPORT J. (2018).

133. Bagley et al., *supra* note 68, at 387 (showing that concussion knowledge among 599 students increased following the SLICE program, with a significantly higher quiz pass rate and higher mean quiz score); Hotz, *supra* note 68 (showing that concussion knowledge among 152 high school football player significantly improved after being shown the UConcussion educational video).

134. Hotz et al., *supra* note 68, at 105 (showing that 559 football players who underwent the modified SLICE program did not have higher concussion knowledge than a control group of 483 football players).

135. Glang et al., *supra* note 70, at 91-97 (showing that student-athletes randomly assigned to view the *Brain 101* concussion education material had larger gains in concussion knowledge, knowledge application and behavioral intention from pre- to post-test than student-athletes viewing CDC safety material; however, concussion management did not significantly differ).

136. Conley & Savenye, *supra* note 70, at 29 (11 students who reported completing the 50-minute online Barrow *Brainbook* concussion education course showed greater knowledge at a 6-month follow up than 12 students who had not taken the course).

Sports concussion education program;[137] and the *Concussion-U* presentation.[138] However, not all education programs guarantee knowledge gains, [139] and some evidence suggests that certain educational modalities are more effective than others.[140]

While concussion *knowledge* seems to generally improve, *attitudes* about concussion (e.g. the likelihood to report a concussion) are less malleable.[141] Studies in this field have indicated that concussion education is not associated with better concussion knowledge and attitudes,[142] concussion prevention

137. Ross-Jordan S. Elliott et al., *Pediatric Sport-Related Concussion Education: Effectiveness and Long-Term Retention of the Head Safety in Youth Sports (HSYS) Program for Youth Athletes Aged 11-16*, COGENT EDUC. Dec. 2, 2015 at 1, 3-5 (showing that 858 middle school students, most of whom participated in sports, exhibited significantly improved concussion knowledge following competition of the Head Safety in Youth Sports concussion education program).

138. Eagles et al., *supra note* 72, at 660 (showing that 43 youth hockey players who watched the 30-minute Concussion-U presentation demonstrated significantly increased concussion knowledge from pre-intervention baseline knowledge, which was maintained between four and six months later; concussion attitudes initially increased but dissipated between four and six months later).

139. Paul S. Echlin et al., *A Prospective Study of Concussion Education in 2 Junior Ice Hockey Teams: Implications for Sports Concussion Education*, 29 NEUROSURGICAL FOCUS E6, E7 (2010) (showing that 2 male junior hockey teams randomly assigned to watch the ThinkFirst educational DVD (n = 16), participate in an interactive concussion education computer module (n = 20), or to receive no concussion education (n = 22) did not significantly differ in concussion knowledge); Chris Bosshardt et al., *Does Concussion Education Have an Impact in Behaviours Amongst School-Age Rugby Players?*, 51 BRIT. J SPORTS MED. A15 (2017) (120 male high school rugby players did not demonstrate significantly higher concussion knowledge 2-3 months following a concussion education presentation, but did demonstrate significant improvement in the number of correct behavioral responses to a concussion scenario).

140. Tara Kobitowich & Martin Mrazik, *Concussion Education: A Randomised Trial with Undergraduate Students*, 51 BRIT. J. SPORTS MED. A62 (2017) (showing that when 162 undergraduates were randomly assigned to an Internet education group, presentation education group or control group, all three had significantly higher knowledge scores post-intervention and the presentation group had significantly higher post-intervention scores than the control and Internet group).

141. Manasse-Cohick & Shapely, *supra* note 72, at 184; Brit L Anderson et al., *High School Football Players' Knowledge and Attitudes About Concussions*, 26 CLINICAL J. SPORT MED. 206, 208 (2016) (prior concussion education was not associated with greater concussion knowledge or improved concussion attitudes for high school football players); Carol et al., *supra* note 132 (prior concussion education was not associated with significant changes in attitudes towards concussion in high school student athletes).

142. Emily Kroshus et al., *Pilot Randomized Evaluation of Publicly Available Concussion Education Materials: Evidence of Possible Negative Effect*, 42 HEALTH EDUC. & BEHAV. 153, 156-57 (2015). Junior league hockey players were randomly assigned to watch the *Concussions in Ice Hockey* video, watch the *Head Games* documentary, or to watch nothing. All players received the CDC's *Heads Up Concussion in High School Sport: A Fact Sheet for Athletes* handout; Brad Kurowski et al., *Factors that Influence Concussion Knowledge and Self-Reported Attitudes in High*

behaviors,[143] reporting self-efficacy,[144] and behavioral intention to report concussions.[145] Indeed, perhaps counterintuitively, athletes who watched *Head Games* actually exhibited increased *under*reporting of concussion symptoms to their coaches one month after viewing the video.[146] Finally, a study of 160 collegiate athletes suggests that favorable perceptions of concussion education may not be enough to promote better reporting.[147]

To be sure, some studies have found attitude change. In a focus group pretesting the CDC's *Heads Up* video, high school athletes self-reported that they were more likely to have a head injury examined and would be more likely to consider whether or not they had a concussion after a head injury.[148] In another study, high school athletes with concussion education had a greater intention to tell their coach about a potential concussion than athletes who had not received concussion education.[149] Another study of Irish student athletes found that some attitudes significantly changed following the intervention, such as perception of control over their concussion reporting behaviors, the need to immediately disclose concussion symptoms, and the athlete's intention to report, but that other attitudes did not, such as the athlete's perceived outcome of reporting a concussion or the athlete's subjective reporting norms.[150] However, only reporting intentions in athletes who completed the intervention significantly differed from control athletes with no exposure to the education program, which questions the effectiveness of the program.[151]

Overall, the pattern of findings in our review is clear: although there are

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School Athletes, 77 J. TRAUMA & ACUTE CARE SURGERY S12, S14 (2014).

143. Conley & Savenye, *supra* note 70, at 31.

144. Kroshus et al., *Pilot Randomized Evaluation*, *supra* note 143, at 155.

145. Kurowski et al., *supra* note 143; Kroshus et al., *Pilot Randomized Evaluation*, *supra* note 143, at 155.

146. Kroshus et al., *Pilot Randomized Evaluation*, *supra* note 143, at 153.

147. Liam Higginson et al., *The Evaluation of the Effectiveness of NCAA Concussion Education Legislation: 640 Board #55 May 28, 2, 2:00 PM – 3:00PM*, MED. & SCI. SPORTS & EXERCISE 162, Volume 46 Supplement 1, 2014, at 162. Researchers found that of fifty-four college athletes who sustained a concussion as a National Collegiate Athletic Association athlete, there was no significant difference in the perceived effectiveness of concussion education between those that reported their concussion and those who did not report their concussion.

148. Mitchko et al., *supra* note 67, at 101 (focus groups with twenty high school student athletes indicated that athletes were more likely to report they would see a healthcare professional following a head injury after viewing an educational video).

149. Harry Bramley et al., *High School Soccer Players with Concussion Education are More Likely to Notify Their Coach of a Suspected Concussion*, 51 CLINICAL PEDIATRICS 332, 334 (2012) (concussion education and athlete intention to report a potential concussion to a coach were significantly associated in a survey of sixty high school soccer players).

150. Sullivan, Pursell, and Molcho, *supra* note 132.

151. *Id.* at 499.

some education interventions that improve short-term knowledge, and even some that seem to promote longer-lasting behavioral change, the bottom line is that most interventions are not likely to achieve the public health goals of reduced concussion incidence, more robust concussion reporting, and improved concussion management. In the next Part, we discuss why concussion education is failing to achieve these goals.

III. DISCUSSION: WHY HAS CONCUSSION EDUCATION POLICY FAILED

Legislatures have mandated concussion education, and nearly 30 different types of concussion education interventions have now been studied. Although there are notable exceptions, the general findings of the studies reviewed in Part II are clear: the implementation of top-down concussion education interventions seem unlikely, on their own, to reduce concussion incidence, produce improvements in long-term knowledge, and change attitudes about concussion reporting. Clearly, legislatively-mandated education programs as they are currently designed and implemented are underperforming.

But why does concussion education fail? We believe there are four primary reasons, discussed below in order of likely importance. These are not mutually exclusive explanations, and they work in tandem to dampen the effectiveness of current concussion education programs.

A. Concussion Education Does Not Focus on Primary Prevention

Current state legislation is largely aimed at secondary, and not primary, prevention of concussion. Secondary prevention measures only help "mitigate the downstream effects of concussion," as opposed to preventing concussions from occurring in the first place.[152] These laws do not address the enabling factors for concussion, such as rules about contact, equipment safety, and so forth.[153] For instance, the education programs could have offered sport-specific recommendations for reducing head contact. Instead, education programs often focus on identification of symptoms *after* head contact, and how to manage

152. Lowrey, *State Laws*, *supra* note 7, at 67.

153. When interpreting concussion incidence research following an educational intervention, it is also important to note that an increase in incidence may reflect an increase in concussion diagnoses due to increased awareness or documentation, not necessarily due to an increased number of concussions. *See* Viviana Bompadre et al., *Washington State's Lystedt Law in Concussion Documentation in Seattle Public High Schools*, 49 J. Athletic Training 486, 491 (2014) (attributing the 2.26% increase in concussion documentation following the implementation of the Lystedt law to increased awareness or diligence among coaches, athletes, and parents to report concussion).

injury *after* a concussion is sustained.

Scholarly reviews have found that other facets of concussion management, such as return-to-play guidelines, actually do little to reduce incidence.[154] As suggested previously, perhaps this is to be expected. Return-to-play guidelines are a desirable intervention because they are an "easy, visible response to the problem of concussion that has virtually no impact on the way sports are played."[155] However, the emphasis of return-to-play guidelines as an all-encompassing solution "neglect[s] genuine reforms that would prevent concussions," which would require physically changing the way in which the sport is played.[156] We think a similar argument can be made for concussion education interventions.

B. Incentives to Improve Concussion Care are Not Aligned with Incentives to Win

Coaches and athletes can learn new lessons. Every off-season, for instance, coaches look to improve their game strategy. Athletes watch film and learn new drills to improve their skills. If new information is aligned with improving on-field performance, coaches and athletes are likely to change their behavior.

We believe that the most fundamental challenge facing concussion education is its perceived or real misalignment with the team's incentive to win and the individual athlete's incentive to contribute as much as possible to winning. Although athletes in youth sports report that the primary reason they play is to have fun,[157] winning remains paramount. The competitive drive to win is a valuable skill to develop, but it can run counter to concussion reporting and concussion care.

An athlete's decision to self-report a suspected concussion depends on many factors, only one of which is knowledge about the signs and symptoms of concussion.[158] Multiple studies have confirmed that athletes are wary of self-reporting concussions, even when they think they may have one.[159] These

154. L. Syd M. Johnson, *Return to Play Guidelines Cannot Solve the Football-Related Concussion Problem*, 82 J. SCHOOL HEALTH 180, 182-83 (2012).

155. *Id.* at 183.

156. *Id.* at 180.

157. Vern Seefledt et al., CARNEGIE COUNCIL FOR ADOLESCENT DEVELOPMENT, OVERVIEW OF YOUTH SPORTS PROGRAMS IN THE UNITED STATES 53 (1992).

158. Johna K. Register-Mihalik et al., *Using Theory to Understand High School Aged Athletes' Intentions to Report Sport-Related Concussion: Implications for Concussion Education Initiatives*, 27 BRAIN INJ. 878, 878-80 (2013).

159. *See* Paul Sean Echlin, *Concussion Education, Identification, and Treatment Within a Prospective Study of Physician-Observed Junior Ice Hockey Concussions: Social Context of This Scientific Intervention*, 29 NEUROSURGICAL FOCUS 2 (2010); Emily Kroshus et al., *Concussion*

athletes do not want to let their teammates down, and do not want to be perceived of as weak.[160] Indeed, some athletes in focus groups have stated that even though they learned about concussions through the presentations, they were not more likely to report them.[161]

Over 20 articles in this review concluded that concussion education produced short-term improvements in knowledge, but only three articles concluded that the educational intervention produced observed changes in athlete behavior. This disparity between knowledge and behavior may occur because education programs often fail to account for the culture of sport itself. Sports culture has typically "rewarded athletes who . . . feign toughness for the benefit of the team."[162] Moreover, coaches may be hesitant to remove a player out of concern that it could detrimentally affect the team's success.[163]

Athletes who sustain a concussion may ignore symptoms, oppose medical evaluation, or underreport symptoms when being evaluated. This may be part of a "cultural resistance" to disclosing injury, perhaps to appease the pressure placed on them by their coaches or parents or peers.[164] A study of 1,532 high school football players found that 54% of the 229 athletes who sustained a concussion during the current season did not report their symptoms; when asked why the concussion was not reported, 41% reported that they did not want to leave the game, and 22% reported that they did not want to let their teammates down.[165]

Furthermore, the intent to report a concussion heavily relies on the athlete's perception of the team atmosphere.[166] A study that assessed the perceived and objective reporting behaviors of 328 collegiate athletes and their teams found that

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Under-Reporting and Pressure from Coaches, Teammates, Fans, and Parents, 134 SOC. SCI. & MED. 66, 74-76 (2015).

160. Echlin, *Concussion Education, Identification, and Treatment*, *supra* note 161, at 2; Emily Kroshus et al., *Pilot Randomized Evaluation*, *supra* note 143, at 155, 158.

161. However, athletes did consider changing their behavior to prevent concussion altogether, although no measures of actual behavioral change were assessed. Caron et al., *Development, Implementation, and Assessment*, *supra* note 132, at 525.

162. Echlin, *Concussion Education, Identification, and Treatment*, *supra* note 161, at 2-4.

163. *Id.* at 2, 3.

164. *Id.*

165. Michael McCrea et al., *Unreported Concussion in High School Football Players: Implications for Prevention*, 14 CLINICAL J. SPORT MED. 13, 14-15 (2004); *see also* Jeffrey Scott Delaney et al., *Why Professional Football Players Chose Not to Reveal Their Concussion Symptoms During a Practice or Game*, 28 CLINICAL J. SPORT MED., 1, 1 (2018) (in a study of 454 professional football players in Canada, of the 82.1% of players who reported that they did not seek medical attention for a sustained concussion, nearly 40% reported that they did not seek medical attention because they either did not want to be removed from play or "risk missing future games").

166. Emily Kroshus et al., *Social Norms Theory and Concussion Education*, 30 HEALTH EDUC. RES. 1004, 1007-09 (2015).

athletes perceived their team's reporting behaviors to be worse than the actual tendency to report.[167] However, the athlete reporting behavior tended to align with this *perceived* team norm and not the *actual* team norm.[168] Therefore, if an athlete believes that their teammates would not report concussion symptoms, then the athlete would be less likely to report concussion symptoms, regardless of whether or not the teammates have an objectively high tendency to report.[169] Pressure from parents further compounds the problem because parents may not follow up with appropriate concussion management if they do not properly understand the potential severity of the injury.[170]

Just as players in the heat of a game are focused on staying in the game to compete, a coach in the middle of a big playoff contest is primarily thinking about how to win, not necessarily how to follow concussion education received months prior. Coaches may experience conflict between "the pressure to win and the protection of the long-term health interest of the player."[171] Coaches may resort to exerting pressure themselves to get their athletes to play: in a study of 789 athletic trainers and 111 team physicians, 64.4% of clinicians reported experiencing pressure from athletes to prematurely clear the athlete for return to play and 53.7% of these clinicians reported experiencing this pressure from coaches.[172]

Given the extent that athletes, coaches, and parents perceive that adherence to concussion protocols is not aligned with winning, the efficacy of concussion education is likely to be minimized. The variety of evidence reviewed above indeed suggests that incentives to win and incentives to improve concussion management are not optimally aligned.

C. Concussion Education is Not Targeted to Specific Sports, Ages, and Stakeholders

A third reason why legislatively-mandated concussion education has failed is that it has largely abided by a one-size-fits-all approach.[173] Concussion statutes were developed primarily with football in mind[174] and, likewise, concussion education has not typically been developed with other sports in mind. Moreover,

167. *Id.* at 1006-07.
168. *Id.* at 1008-09.
169. *Id.*
170. Echlin, *Concussion Education, Identification, and Treatment*, *supra* note 161, at 2, 3.
171. *Id.* at 3-4.
172. Emily Kroshus et al., *Pressure on Sports Medicine Clinicians to Prematurely Return Collegiate Athletes to Play After Concussion*, 50 J. ATHLETIC TRAINING 944, 946-47 (2015).
173. Harvey, *Refereeing the Public Health*, *supra* note 45, at 109.
174. *Id.* at 87.

little attention has been given to the ways that adults and children learn differently.

There is evidence that age matters in the effectiveness of concussion education. For instance, in a study of one concussion education video, the researchers found that knowledge retention was heavily influenced by age: the 14-year-olds who watched the video maintained their knowledge gains for up to two months while the younger cohort who watched the video did not.[175] Common sense suggests that communicating concussion information to fourth graders should be different than communicating the same information to high schoolers. Yet the existing concussion education interventions rarely require any specific programming, much less age-specific programming.

Age is not the only variable that matters. Community factors like socioeconomic status predict whether or not coaches receive education about concussions: a 2017 study found that communities below the poverty line have significantly lower percentages of football coaches that have taken the *Heads Up Football* concussion education course, with community-level poverty being the most significant predictor of course completion.[176] As we have argued elsewhere, concussion policy has generally overlooked dimensions of socioeconomic and racial inequality.[177]

Furthermore, active or multimodal methods of education may help students learn about concussion: a study of 48 students that participated in a "visual arts-based" concussion education program displayed *better* post-assessment knowledge gains (80%) at the 3-month follow-up point than *immediately after the intervention* (72.8%).[178] The two-week program, implemented in high school visual arts classes, utilized artwork created by the students and creative problem solving to communicate knowledge regarding concussion knowledge.[179]

In sum, the failure of concussion education is likely in part due to its inability to develop personalized group-specific, age-specific, sport-specific, and community-specific education programs. A one-size-fits-all approach may save money, but it fails to achieve significant public health improvements in sports concussion care.

D. Further Mixed Results, from NCAA Studies, on the

175. Cusimano et al., *supra* note 71, at 144.

176. Emily Kroshus et al., *Community-Level Inequalities in Concussion Education of Youth Football Coaches*, 52 AM. J. PREVENTATIVE MED. 476, 478-80 (2017).

177. Rasmussen et al., *supra* note 17, at 115.

178. Mia T. Minen & Alexandra Boubour, *A Pilot Educational Intervention for Headache and Concussion: The Headache and Arts Program*, NEUROLOGY 90 e1799, e1801 (2018).

179. *Id.* at e1800-01.

Effects of Concussion Education

In this Article, we have primarily focused on youth sports, but the National Collegiate Athletic Association (NCAA) has also been active in concussion policy and education. It could be that concussion education is more effective when the athletes are older, or less effective as the competitive stakes become higher. To examine these possibilities, we conducted an additional review of research on NCAA concussion education. We found that the collegiate level also exhibits varying degrees of education effectiveness.

The NCAA implemented its concussion policy in 2010; much like youth sports concussion statutes, this policy requires that each member school adopt annual concussion education for athletes; immediate removal from play and evaluation of athletes suspected of sustaining a concussion by a medical professional; no return to play for the remainder of the day; and medical clearance before an athlete can return to play.[180]

Concussion education materials are widely distributed in college athletics,[181] though there is variation across schools.[182] There remains, however, improvement to be made regarding compliance.[183] A survey of 1,066 NCAA administrators and 97 member schools found that 76.1% of respondents reported some form of system for annual athlete education, despite 92.7% of respondents reporting that their school had a concussion management policy.[184] Moreover, about a third of respondents reported that better coach and athlete education is a necessary improvement (39.7% and 35.2%, respectively).[185]

Although widely disseminated, concussion education for collegiate athletes

180. Christine M. Baugh et al., *Concussion Management in United States College Sports: Compliance with National Collegiate Athletic Association Concussion Policy and Areas for Improvement*, 43 AM. J. SPORTS MED. 47, 48 (2015).

181. Zachary Y. Kerr et al., *Concussion-Related Protocols and Preparticipation Assessments Used for Incoming Student-Athletes in National Collegiate Athletic Association Member Institutions*, 50 J. ATHLETIC TRAINING 1174, 1176-77 (2015) (of 327 athletic trainers employed at NCAA member institutions, 95.4% and 90.2% of respondents reported that they provided annual concussion education to student-athletes and coaches, respectively).

182. Concussion management also differs in varying collegiate divisions, finding that Division I institutions could provide concussion education and comply with the NCAA concussion management best practices more so than Division III institutions. *See id.* at 1177.

183. Christine M. Baugh et al., *Requiring Athletes to Acknowledge Receipt of Concussion-Related Information and Responsibility to Report Symptoms: A Study of the Prevalence, Variation, and Possible Improvements*, 42 J.L. MED. & ETHICS 297, 299, 305, 308 (2014) (only 59.5% of 734 male NCAA football athletes reported that they were required to acknowledge that concussion education materials were provided to them).

184. Baugh et al., *supra* note 182, at 49-50, 52.

185. *Id.* at 51 tbl. 3.

does not appear to be tremendously effective.[186] In a study of collegiate hockey players, the provision of educational materials did not significantly change concussion knowledge; in fact, education actually slightly *decreased* athlete intention to report concussion symptoms during play.[187] Similarly, athletes who did recall receiving concussion information were significantly more likely to continue playing with a concussion.[188]

Much like the youth studies, there are mixed findings at the collegiate level. For instance, a study evaluating pre- and post-season knowledge of 70 NCAA soccer and basketball players found that concussion education improved post-season knowledge of concussion and that 50% of athletes who sustained a concussion reported that concussion education had a positive impact on their reporting of the concussion to an athletic trainer.[189]

Concussion education for coaches also appears to be potentially beneficial. A 2015 survey of 1,818 NCAA coaches found that education was beneficial for recognizing the signs and symptoms of concussion and developing appropriate concussion management protocols in the 67% of coaches who had received educational materials from their college.[190] In sum, there are mixed results of concussion education at the collegiate level, much like the youth level.

IV. LOOKING FORWARD: FIXING CONCUSSION EDUCATION

We have argued thus far that by itself, state-mandated concussion education has failed to significantly impact concussion-related outcomes. In this Part, we propose a path forward. In Section A, we contextualize our argument with a public health perspective. The primary lesson from decades of public health research is that providing information alone is not enough to spur complex behavioral change. Yet this is exactly what concussion education statutes attempt to do.

Section B lays out a vision for the future of concussion education. This education should be: (1) integrated into an incentive structure that concretely rewards concussion identification and management; (2) combined with efforts to improve sports culture; (3) accompanied by rule changes that focus on primary prevention; and (4) targeted to specific populations using evidence-based methods of knowledge transfer. Section C summarizes our vision for the future of concussion education.

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186. Kroshus et al., *NCAA Concussion Education*, *supra* note 72, at 138.
187. *Id.*
188. *Id.*
189. Miyashita et al., *supra* note 103, at 350-51.
190. Kroshus et al., *Content, Delivery, and Effectiveness*, *supra* note 131, at 391, 393-94.

A. Public Health Perspectives on Concussion Education

Since the 1970s, public health scholars have explored dimensions of "health literacy."[191] Health literacy is designed to allow one "to take responsibility for one's own health as well as one's family health and community health."[192] Legislatively-mandated concussion education can be understood as an attempt to improve "concussion literacy" for athletes, parents, and coaches.

The information-based approach in concussion education is, at face value, appealing. Educating consumers—parents and athletes—about the nature and risks of concussions would presumably allow them to make more informed market decisions about whether to play a sport and when to ask for removal from play for a suspected concussion. Educating coaches empowers them to make individual decisions about practices and games, rather than being required to follow a centralized set of protocols.

Yet in practice, we can see that an information-based approach faces serious challenges. As legal scholar Kelli Garcia has argued in the context of public health obesity campaigns, the "information-based, individual change approach taken by most federal programs to prevent obesity appeals to the American values of individualism and personal autonomy and to the skepticism about the role of government."[193] Although politically appealing, these campaigns are "rarely effective in modifying complex behaviors such as dieting and exercise."[194]

This finding has been seen in other information-based public health campaigns, and public health scholars now recognize that behavioral change requires more than just providing additional information:

> Early models of behavior change were based on the assumption of a relatively stable link between knowledge, attitude and behavior—if people were given relevant information (i.e., too much fat is bad for your health) from a credible source (nutritionist) they would change their attitudes towards their diet and, in turn, their behavior (reducing fat intake). Experience showed that this was not
> correct . . . .[195]

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191. Don Nutbeam, *Health Literacy as a Public Health Goal: A Challenge for Contemporary Health Education and Communication Strategies into the 21st Century*, 15 HEALTH PROMOTION INT'L 259, 260 (2000).

192. Kristine Sørensen et al., *Health Literacy and Public Health: A Systematic Review and Integration of Definitions and Models*, 12 BMC PUB. HEALTH 80, 80 (2012).

193. Kelli K. Garcia, *The Fat Fight: The Risks and Consequences of the Federal Government's Failing Public Health Campaign*, 112 PENN ST. L. REV. 529, 537 (2007).

194. *Id.* at 538.

195. FRAN BAUM, THE NEW PUBLIC HEALTH 323 (2d ed. 2002), *quoted in* Micah L. Berman, *A*

Behavior change to promote public health clearly requires more than just information. But what more is needed? We answer that question in the next section.

B. Improving Concussion Education

1. Primary Prevention Through Rule Changes

Few states have included provisions for primary prevention in their concussion legislation.[196] This is an opportunity for improving the efficacy of concussion education because education is likely more effective when combined with preventative interventions such as rule changes that reduce head trauma.[197]

Some youth sports organizations like Pop Warner football have attempted to implement rule changes to limit the amount of player-to-player contact in practices.[198] One study found that the Pop Warner football teams (with the limited contact rules) that had the *Heads Up Football* education program had a lower concussion incidence than similar teams that had the *Heads Up Football* education program, but no rule changes.[199] While more research is required, the results of this study preliminarily suggest that reduced exposure to risky gameplay reduces the risk of sustaining a concussion in ways that a purely information-based intervention does not.

Education might also be more focused on technique and technology. In football, for example, a variety of technologies have been developed to reduce helmet hits. One example is the TackleBar equipment, a harness that aims to teach athletes safer tackling techniques.[200] Another example is the Mobile Virtual

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Public Health Perspective on Health Care Reform, 21 HEALTH MATRIX 353, 365-66 (2011).

196. Lowrey, *State Laws*, *supra* note 7, at 67.

197. Tator, *Sport Concussion*, *supra* note 27, at 298 ("Although education can be an effective injury prevention measure, education must be supplemented by additional measures to effect a major reduction in the incidence of concussions.").

198. Anahad O'Connor, *Trying to Reduce Head Injuries, Youth Football Limits Practices*, N.Y. TIMES (Jun. 13, 2012), https://www.nytimes.com/2012/06/14/sports/pop-warner-football-limits-contact-in-practices.html ("forbidding all drills that involve full-speed, head-on blocking and tackling"); *see also* Lindsey Strauss, *Most States Now Limit Number and Duration of Full-Contact Practices in High School Football*, SMARTTEAMS (Aug. 24, 2016), https://concussions.smart-teams.org/despite-new-limits-on-full-contact-practices-in-high-school-football-effectiveness-in-reducing-risk-of-concussion-and-long-term-brain-injury-still-unknown/ (demonstrating that state high school athletic associations have begun implementing limitations on full-contact practices, although efforts have been primarily limited to amateur football).

199. Kerr et al., *Youth American Football*, *supra* note 69, at 7.

200. Amy Gill, *TackleBar trying to change youth football*, WPTA21.COM, Mar. 23, 2018, 3:37 PM http://www.wpta21.com/story/37797341/2018/03/Friday/tacklebar-trying-to-change-youth-football; *see also* TACKLEBAR, https://tacklebar.com/, (last visited Aug. 15, 2018).

Player (MVP), a tackling dummy that is now employed by Dartmouth College Football in lieu of tackle drills between players.[201]

While teaching safer techniques has the potential to improve health outcomes, if there is no incentive to play safer, athletes and coaches may continue riskier techniques if they are deemed more advantageous.[202] In order to avoid this outcome, additional rule changes are needed to modify the incentive structure.

A promising avenue for accomplishing this change in incentives is to directly link safety outcomes with winning.[203] The "Fair Play" model has been developed to do this, and has been implemented in sports such as hockey[204] and football.[205] One example of Fair Play implementation is a collaboration between Minnesota Hockey and the Mayo Clinic Sports Medicine Center.[206]

Teams participating in the Fair Play (FP) program are awarded points for sportsmanlike behavior and are deducted points according to the number of penalty minutes sustained each game.[207] Fair play points (FPPs) are added to game points that are counted for a team's overall season standing, which incentivizes teams to use sportsmanlike conduct during gameplay.[208]

A longitudinal study of the program was performed in 2016, where 1,514 youth hockey players on 99 teams were separated into two groups.[209] One group of teams played in tournaments using "intensified fair play" rules and the other group played in tournaments using normal rules.[210] While the total number of concussions sustained did not significantly differ between groups, the total

201. Elliott Kastner, *How a Robot Football Player Will Prevent Concussions*, THAYER SCHOOL OF ENGINEERING AT DARTMOUTH, Sept. 29, 2016, https://engineering.dartmouth.edu/news/how-a-robot-football-player-will-prevent-concussions.

202. Echlin, *Concussion Education, Identification, and Treatment*, *supra* note 161 at 2.

203. Daryl Siedentop, *What Is Sport Education And How Does It Work?*, J. PHYSICAL EDUC. RECREATION & DANCE 18, 18-20 (1998).

204. William O. Roberts, Janny Dwyer Brust, Barbara Leonard & Brian J. Hebert, *Fair-Play Rules and Injury Reduction in Ice Hockey*, 150 ARCHIVES PEDIATRICS & ADOLESCENT MED. 140, 141 (1996); Aynsley Smith et al., *Hockey Education Program (HEP): A Statewide Measure of Fair Play, Skill Development, and Coaching Excellence*, *in* FIFTH INTERNATIONAL SYMPOSIUM ON SAFETY IN ICE HOCKEY (2009).

205. Andrew White, *Fair Play in Youth Football: Reducing Injury Rates Through Improved Sportsmanship Behavior* (2018) (unpublished Ph.D. dissertation, University of Minnesota) *available at* https://conservancy.umn.edu/handle/11299/194601.

206. Aynsley M. Smith et al., *Does Fair Play Reduce Concussions? A Prospective, Comparative Analysis of Competitive Youth Hockey Tournaments*, 2 BMJ OPEN SPORT & EXERCISE MED. e000074, e000074 (2016).

207. *Id.* at e000074-75.

208. *Id.*

209. *Id.* at e000075.

210. *Id.*

number of non-concussive head injuries sustained was significantly less for the Fair Play group, indicating that risk actually decreased through the FP program.[211]

In addition to making sports safer for youth athletes, removing risky gameplay like tackling and checking can be economically advantageous. A study published in 2014 estimated the cost-effectiveness of a ban on body checking in youth ice hockey,[212] and found that greater checking led to significantly higher injury rates and healthcare costs.[213] The difference was substantial: healthcare costs were 2.5 times (about $289 Canadian dollars per player) higher for the checking group in just one season.[214] Focusing on prevention of the injury, rather than simply care after the injury, is also likely to reduce the rising costs of concussion-related emergency room visits.[215]

The preliminary success of Fair Play rule changes, as well as the many emerging options for changing rules and adopting new technology to minimize head trauma, offer promising avenues for improving concussion policy. Legislatively-mandated concussion education should be revisited to align with these additional reforms.

2. Changing Incentives

As presently designed, there are few legal penalties for failure to adhere to concussion guidelines,[216] and compliance with concussion education is not well aligned with incentives to win. A promising way to improve concussion education efficacy is to better integrate it into a sport's reward system. We should design a system in which athletes and teams are tangibly rewarded for better concussion care. Importantly, these tangible rewards need to be closely linked to winning.

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211. Additionally, teams that were more likely to forfeit their FPPs due to unsportsmanlike conduct were five times more likely to sustain any form of injury than the teams who retained their FPPs, and 40-50% of total FPPs forfeited were due to the same recurring teams. It is also worth noting that a small recurring number of teams were primarily responsible for "both the high number of FPPs forfeited and the consequential rate of injury." *Id.* at e000080.

212. Sarah Lacny et al., *Reality Check: The Cost–Effectiveness of Removing Body Checking from Youth Ice Hockey*, BRIT. J. SPORTS MED., Jun 6, 2014 at 1, 1.

213. *Id.* at 3-5.

214. *Id.* at 5 (estimating that for the average 1,273 injuries sustained each season, over $213,280 Canadian dollars could be saved by athletes and their families).

215. Walter Hardesty, Bhavna Singichetti, Honggang Yi, Julie Leonard, Alyssa Janezic & Jingzhen Yang, Paediatric *Emergency Department Utilisation and Associated Healthcare Costs Before and After Concussion Laws*, 23 INJ. PREVENTION A17-A18 (2017).

216. Francis X. Shen, *Quasi-Professional Negligence* (Aug. 15, 2018) (unpublished manuscript) (on file with author).

There are many ways in which this integration could be achieved. To align incentives, states could design both carrot and stick incentives. Carrot incentives would be akin to what health insurance companies do to encourage weight loss: if you hit your target health goals, you get a material reward, e.g. a reduction in insurance costs or a cash payment. In the context of sports concussions, teams and leagues that demonstrate high quality concussion prevention and care could be provided with additional resources. In youth sports, this could work because a relatively small amount of money can go a long way for resource-strapped youth sports organizations.

To illustrate, consider the current incentives for a 6th grade soccer team coached by volunteer parents. Under current law, these already over-extended parents and busy middle-school kids are simply expected to self-teach themselves about concussion through one of the available modules. There is little repercussion if they do not pay attention to the concussion information. As we have reviewed in previous parts, concussion education disseminated in this way is unlikely to work.

Now imagine a different incentive structure. Imagine that the state has created a three-tier set of incentives for concussion prevention. In Tier I, if the team submits a concussion protocol that includes primary preventative measures, such as reducing contact drills during practices, their team gets a $500 bonus. In Tier II, if the team can demonstrate that they have taken action to improve or maintain high-level concussion care and prevention policies, that bonus goes up to $1,500. And in Tier III, if the team joins a "fair play" league that disincentivizes risky athlete behaviors by issuing stricter penalties, the bonus reaches $2,500. For a youth sports team, these levels of funding mean new uniforms, new equipment, and the ability to travel to tournaments. Integrated in this way, concussion education is likely to achieve more buy-in.

While we favor the "carrot" approach, states could consider more punitive measures as well. In contrast to provision of additional resources for successful compliance, the state could impose penalties for non-compliance. For instance, much like the state inspects restaurants and puts a restaurant grade on the front door so patrons can see it, a concussion care grading system could be implemented. The burden would be on the youth sports team to submit verification of compliance with relevant care requirements in their concussion protocols, and those teams that do not comply would be identified on a publicly accessible website. Parents could quickly search to see what the youth sport safety rating is for a particular team. The state could also modify its law to allow for increased civil penalties for failure to comply with educational requirements.

Considering concussion statutes holistically, and not just the educational

components independently, there is some emerging evidence that these statutes may be improving concussion reporting.[217] We think revisions to all components of these statutes, and not just the educational components, as part of a more comprehensive public health intervention could bring about significantly more improvement.

3. Changing Culture

Youth sports has become a booming $8 billion industry that increasingly emphasizes preparing athletes for collegiate and professional careers, despite the fact that very few of these athletes will actually play in college or beyond.[218] Athletes, parents, and coaches alike can invest significant amounts of time, money, and physical and emotional commitment to the sport.[219] This creates a culture that values winning more than the experience and, more importantly, the safety of the athlete.[220] Recognizing that this is the landscape of modern youth sports, concussion education interventions must go deeper than simply providing additional information. Culture change will require addressing both athlete attitudes and coaching philosophy.

Thankfully, there are already programs being developed to accomplish these cultural change goals. Some of the programs are peer-to-peer, led by fellow athletes. For instance, the Headway Foundation was formed by former collegiate athletes (each of whom experienced a serious concussion) to engage with athletes on "inspiring a brain-first mindset during competition."[221] The Headway Foundation's centerpiece is a campaign called "New Tough." The Foundation recognizes that "the culture of sports negatively influences concussion reporting and that athletes, coaches and parents do not fully acknowledge the risks of playing while injured," and aims "to change that by introducing a new type of toughness."[222] The New Tough principles are:

- It is the toughness to go against your instinct as an athlete and put your brain-health first.

217. Jingzhen Yang et al., *New and Recurrent Concussions in High-School Athletes Before and After Traumatic Brain Injury Laws, 2005–2016*, 107 AM. J. PUB. HEALTH 1916, 1918-21 (2017); Shen, *supra* note 5, at 14-15.

218. *Probability of Competing Beyond High School*, NCAA, http://www.ncaa.org/about/resources/research/probability-competing-beyond-high-school (last accessed Aug. 15, 2018).

219. Echlin, *Concussion Education, Identification, and Treatment, supra* note 161, at 2.

220. *Id.* at E7-E8.

221. *The Goals*, HEADWAY FOUNDATION, http://headwayfoundation.com/thegoals/ (last accessed visited Aug. 15, 2018).

222. *What is New Tough?*, HEADWAY FOUNDATION, http://headwayfoundation.com/what-is-new-tough-2/ (last visited Aug. 15, 2018).

- It is the strength to report concussion symptoms, and it is the patience to complete recovery before returning to the game you love.
- It is the courage to speak up for brain-injured teammates and offer support while they heal.
- And it is the integrity to play the game within the rules by avoiding illegal hits to the head or neck, no matter how high the stakes or emotions.[223]

Notably, none of the state-mandated concussion education programs approach concussion policy change in this way. Legislative action to date has focused on medical information, e.g. signs and symptoms of concussion, as opposed to this more foundational cultural change. Future policy should look at opportunities to more directly address culture change.

There are also cultural change programs aimed at coaches. For instance, the InsideOut Initiative is a "transformational" football coaching development program pioneered by former collegiate athletes.[224] Supported by the NFL Foundation, the Initiative's purpose is to facilitate "systemic change" by transforming the current ""win-at-all-costs"" sports culture to one that fosters moral and emotional development through gameplay.[225] Another key purpose of the program is to dismantle false measures of masculinity that negatively affect youth, focusing on the tenets of "athletic ability, sexual conquest, and economic success."[226] While there is currently no empirical evidence that this system reduces injury rates, an initial assessment of the program found that over 97% of all respondents reported that an education-based athletic system is a better fit for the athletes, parents, and coaches than the winning-focused system and that over 83% of respondents are changing their athletic policies and practices to reflect the tenets of the Initiative.[227]

These are only two of many programs aimed at changing the culture of youth sports.[228] It is beyond the scope of this article to catalog them, but the point is that there are many viable paths to transform concussion education so that it is more likely to bring about cultural change.

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223. *Id.*

224. INSIDEOUT INITIATIVE, https://insideoutinitiative.org/, (last visited Aug. 15, 2018).

225. *Id.*

226. *Id.*

227. *Id.*

228. *See, e.g.* Stewart A. Vella, Lindsay G. Oades & Trevor P. Crowe, *A Pilot Test of Transformational Leadership Training for Sports Coaches: Impact on the Developmental Experiences of Adolescent Athletes*, 8 INT'L J. SPORTS SCI. & COACHING 513 (2013); THE CHANGING THE GAME PROJECT, https://changingthegameproject.com/coaching (last visited Aug. 14, 2018); *Transformational Coaching Program*, SYMBIONT PERFORMANCE GROUP, INC. (Mar. 2014), http://www.symbiontperformance.com/id83.html.

4. Targeted, Evidence-Based Education Interventions

Across the wide variety of concussion education programs reviewed in this Article, there is much variation in the educational content, some of which may not be consistent with the latest consensus from experts.[229] Going forward, concussion education should aim to utilize evidence-based principles of knowledge transfer.[230]

Equally important, most concussion education programs were not targeted to specific groups or sports.[231] Looking ahead, more sport-specific programming would likely be beneficial. In 2014, the Coaching Association of Canada (CAC) and the Public Health Agency of Canada's *Active and Safe* initiative developed an interactive concussion e-learning module, called *Making Head Way*, that provides sport-specific concussion training for coaches using a standardized program format.[232] The module, designed to "help coaches reduce the incidence of brain injuries in team sports and to improve decision-making about when it is safe to return to play after a head injury," includes a general non-specific module in addition to sport-specific modules for soccer, football, snowboarding, freestyle skiing, and speed skating.[233] The CAC also provides concussion guidelines that are freely available and individually developed for parents, coaches, athletes, and teachers.[234]

Parents can also be better targeted. Although most legislation requires parents to be educated on concussions, there is relatively little research on the effect of concussion education on this population. What research there is suggests that parental education may be effective.

One study evaluated the effectiveness of *Brain 101* (see Section B) on

229. Mrazik et al., *supra* note 58, at 1548-53.

230. Gleadhill et al., *supra* note 58, at 8-22.

231. *See* discussion *supra* Part III.

232. Julie Parkins-Forget, *Making Head Way in Sport eLearning module is Now Available at No Charge*, COACH.CA (Jul. 17, 2014), http://cac-website-drupal.ind.ninja/making-head-way-sport-elearning-module-now-available-no-charge.

233. *Id.* Each module contains information related to concussion prevention, recognition, management, and return-to-play. In some youth sport organizations, this program has become the educational standard: for example, Football Canada coaches are required to complete the Making Head Way football module before the beginning of each season, but a partnership between Football Canada and the CAC has made this module free of charge to coaches. *Making Head Way in Football E-Learning Now Mandatory for the Upcoming Season*, FOOTBALL CANADA, (Jan. 22, 2015), http://footballcanada.com/making-head-way-in-football-e-learning-module-now-mandatory-for-upcoming-season/ (last visited Apr. 3, 2018.

234. *Concussion Awareness*, COACH.CA, https://www.coach.ca/concussion-awareness-s16361, (last visited Jun. 22, 2018).

parents.[235] Parents of high school student-athletes were then randomly assigned to view the *Brain 101* education materials or to view safety material from the CDC.[236] Parents who had taken the *Brain 101* course had greater concussion knowledge, knowledge application, and behavioral intention than parents who had not.[237] Another study came to a similar conclusion, finding that concussion education resulted in greater concussion knowledge.[238]

C. The Future of Concussion Education

We have shown in this Article that, in many different ways, current concussion education efforts are falling short. Concussion education isn't making concussion policy worse, but it also seems unlikely to make it much better. As such, this is a missed opportunity and a waste of resources. We can do better.

The solution is not simply to tinker with existing educational materials, but to package concussion education along with a host of additional reforms aligned to improve primary prevention of concussion and concussion reporting culture. The task is daunting, because cultural norms that disfavor concussion reporting run deep. However, there is reason to be optimistic about the opportunity for meaningful reform.

As we have discussed above, there are new technologies, new educational programs, new cultural change efforts, and a continued sense in both the legal and policy communities that promoting brain health for youth athletes is a top priority. We hope that the future of concussion education builds on this momentum and becomes more dynamic and effective than it currently is.

CONCLUSION

Every state has passed legislation aimed at improving the identification and management of concussion in youth athletes. A key component of this legislation is concussion education. Yet as we have reviewed in this Article, the general consensus from 54 peer-reviewed articles on concussion education interventions is that they can produce only short-term gains in concussion knowledge, not

235. Glang et al., *supra* note 70, at 91-97.

236. *Id.* at 92-93.

237. *Id.* at 94.

238. Mark Hecimovich, Doug King & Ida Marais, Player and Parent Concussion Knowledge and Awareness in Youth Australian Rules Football, SPORT J., Apr. 1, 2016, at 1, 4-9; but see Ian Macdonald & Roxanne Hauber, Educating Parents on Sports-Related Concussions, 48 J. NEUROSCIENCE NURSING 297, 299-300 (2016); Tamerah Hunt, N., Chloe Salway, Steve Patterson & Jody Langdon, Concussion Knowledge and Understanding in Guardians Following Administration of Standardized Education Form, 50 MED. & SCI. SPORTS & EXERCISE 477 (2018).

lasting changes in concussion behavior or reductions in concussion incidence. We argue that this failure of concussion education is primarily due to its misalignment with incentives to win, its lack of attention to primary prevention, and its one-size-fits-all approach to education. We propose a new type of concussion education intervention, better aligned with incentives to win, focusing on primary prevention, and addressing culture change in concussion reporting.

APPENDIX A1. ANNOTATED SUMMARY TABLE OF STATE CONCUSSION STATUTE EDUCATIONAL MANDATES

State	Provision Text	Citation[239]

239.. For state statute citations, *see*: Chris Lau, *Leaders and Laggards: Tackling State Legislative Responses to the Youth Sports Concussion Epidemic*, 85 FORDHAM L. REV. 2879, 2886 (2017).

State	Provision Text	Citation[239]
Alabama	"...(a) Each local school system and governing body of each sport or recreational organization shall develop guidelines and other pertinent information and forms to inform and educate youth athletes and their parents or guardians in their program of the nature and risk of concussion and brain injury, including continuing to play after a suspected concussion or brain injury. On a yearly basis, a concussion and head injury information sheet shall be signed and returned by the youth athlete and the athlete's parent or guardian prior to the youth athlete's initiating practice or competition. Each local school system and sports or recreational organization governing body shall ensure that coaches receive annual training to learn how to recognize the symptoms of a concussion and how to seek proper medical treatment for a person suspected of having a concussion. (b) Each local school system and sports or recreational organization shall establish by rule the requirements of the training which shall be provided by using designated resources to the extent practicable and timelines to ensure that, to the extent practicable, every coach receives the training before the beginning of practice for the school athletic team."	ALA. CODE 1975 § 2211E-2 (2018)
Alaska	"...(a) The governing body of a school district shall consult with the Alaska School Activities Association to develop and publish guidelines and other information to educate coaches, student athletes, and parents of student athletes regarding the nature and risks of concussions. Guidelines developed under this section must	ALASKA STAT. §§ 14.30.142.143 (2016)

State	Provision Text	Citation[239]
	include a description of the risks of return to play and standards for return to play, including the procedures required under (c) and (d) of this section. (b) A school shall annually provide to a student and the parent or guardian of a student who is under 18 years of age written information on the nature and risks of concussions. A student may not participate in school athletic activities unless the student and the parent or guardian of a student who is under 18 years of age have signed a verification of receipt of the information required under this subsection…"	
Arizona	"...(b) Guidelines, information and forms, developed in consultation with a statewide private entity that supervises interscholastic activities, to inform and educate coaches, pupils and parents of the dangers of concussions and head injuries and the risks of continued participation in athletic activity after a concussion. The policies and procedures shall require that, before a pupil participates in an athletic activity, the pupil and the pupil's parent must sign an information form at least once each school year that states that the parent is aware of the nature and risk of concussion…"	ARIZ. REV. STAT. ANN. § 15-341(24)(b) (2016)
Arkansas	"…a)(1) As used in this section, "youth athletic activity" means an organized athletic activity in which the participants, a majority of whom are under nineteen (19) years of age are: (A) Engaged in an athletic game or competition against another team, club, or entity; or	ARK. CODE ANN. §§ 6-18-708, -710 (2017).

State	Provision Text	Citation[239]
	(B) In practice or preparation for an organized athletic game or competition against another team, club, or entity. (2) "Youth athletic activity" does not include a college or university activity or an activity that is incidental to a nonathletic program. (b) The General Assembly finds that: (1)(A) Concussion is one (1) of the most commonly reported injuries in children and adolescents who participate in sports and recreational activities. (B) The Centers for Disease Control and Prevention estimates that as many as three million nine hundred thousand (3,900,000) sports-related and recreation related concussions occur in the United States each year. (C) A concussion is caused by a blow or motion to the head or body that causes the brain to move rapidly inside the skull. (D) The risk of catastrophic injuries or death is significant when a concussion or head injury is not properly evaluated and managed; (2)(A) Concussion is a type of brain injury that can range from mild to severe and can disrupt the way the brain normally works. (B) Concussions can occur in any organized or unorganized sport or recreational activity and can result from a fall or from players colliding with each other, the ground, or with obstacles. (C) Concussions can occur with or without loss	

State	Provision Text	Citation[239]
	of consciousness, but the vast majority occur without loss of consciousness; (3) Continuing to participate in a youth athletic activity after sustaining a concussion or exhibiting symptoms of head injury leaves the youth athlete especially vulnerable to greater injury and even death; (4) Despite the existence of generally recognized return-to-play standards for concussion and head injury, some affected youth athletes are prematurely returned to play, resulting in a risk of further physical injury or death to youth athletes in the State of Arkansas; (5) The Arkansas Activities Association is a recognized national leader in the development and implementation of concussion protocols for student athletes in grades seven through twelve (7-12); and (6) It is necessary to establish concussion protocols substantially similar to those developed and implemented by the Arkansas Activities Association to protect all student athletes in Arkansas. (c) The Department of Health shall develop concussion protocols substantially similar to those developed and implemented by the Arkansas Activities Association to protect all youth athletes engaged in youth athletic activities in Arkansas. (d) Guidelines developed under this section shall include: (1) Pertinent information and forms to	

State	Provision Text	Citation[239]
	inform and educate coaches, youth athletes, and the parents or guardians of youth athletes of the nature and risks of concussions and head injuries, including the risks of continuing to play after a concussion or head injury; (2) A requirement that the person operating a youth athletic activity annually1 shall distribute a concussion and head injury information sheet to each person who intends to participate in the youth athletic activity; (3) A requirement that a person shall not participate in a youth athletic activity unless the person returns the information sheet signed by the person and, if he or she is under eighteen (18) years of age, by his or her parent or guardian..."	
California	"…(a) If a school district, charter school, or private school elects to offer an athletic program, the school district, charter school, or private school shall comply with both of the following: … (2) On a yearly basis, a concussion and head injury information sheet shall be signed and returned by the athlete and the athlete's parent or guardian before the athlete initiates practice or competition."	CAL. EDUC. CODE § 49475 (West 2016)
Colorado	"…(1)(a) Each public and private middle school, junior high school, and high school shall require each coach of a youth athletic activity that involves interscholastic play to complete an annual concussion recognition education course. (b) Each private club or public recreation	COLO. REV. STAT. § 25-43-103 (2017).

State	Provision Text	Citation[239]
	facility and each athletic league that sponsors youth athletic activities shall require each volunteer coach for a youth athletic activity and each coach with whom the club, facility, or league directly contracts, formally engages, or employs who coaches a youth athletic activity to complete an annual concussion recognition education course. (2)(a) The concussion recognition education course required by subsection (1) of this section shall include the following: (I) Information on how to recognize the signs and symptoms of a concussion; (II) The necessity of obtaining proper medical attention for a person suspected of having a concussion; and (III) Information on the nature and risk of concussions, including the danger of continuing to play after sustaining a concussion and the proper method of allowing a youth athlete who has sustained a concussion to return to athletic activity. (b) An organization or association of which a school or school district is a member may designate specific education courses as sufficient to meet the requirements of subsection (1) of this section."	
Connecticut	"…(a) (1) For the school year commencing July 1, 2010, and each school year thereafter, any person who holds or is issued a coaching permit by the State Board of Education and is a coach of intramural or interscholastic athletics shall complete an initial training course	CONN. GEN. STAT. §§ 10149b to -149c (2017)

State	Provision Text	Citation[239]
	regarding concussions, developed or approved pursuant to subdivision (1) of subsection (b) of this section, prior to commencing the coaching assignment for the season of such school athletics. (2) For the school year commencing July 1, 2014, and each school year thereafter, any coach who has completed the initial training course described in subdivision (1) of this subsection shall annually review current and relevant information regarding concussions, prepared or approved pursuant to subdivision (2) of subsection (b) of this section, prior to commencing the coaching assignment for the season of such school athletics. Such annual review shall not be required in any year when such coach is required to complete the refresher course, pursuant to subdivision (3) of this subsection, for reissuance of his or her coaching permit. (3) For the school year commencing July 1, 2015, and each school year thereafter, a coach shall complete a refresher course, developed or approved pursuant to subdivision (3) of subsection (b) of this section, not later than five years after completion of the initial training course, as a condition of the reissuance of a coaching permit to such coach. Such coach shall thereafter retake such refresher course at least once every five years as a condition of the reissuance of a coaching permit to such coach. (b) (1) The State Board of Education, in consultation with (A) the Commissioner of Public Health, (B) the governing authority for intramural and interscholastic athletics, (C) an appropriate organization representing licensed	

State	Provision Text	Citation[239]
	athletic trainers, and (D) an organization representing county medical associations, shall develop or approve a training course regarding concussions. Such training course shall include, but not be limited to, (i) the recognition of the symptoms of a concussion, (ii) the means of obtaining proper medical treatment for a person suspected of having a concussion, and (iii) the nature and risk of concussions, including the danger of continuing to engage in athletic activity after sustaining a concussion and the proper method of allowing a student athlete who has sustained a concussion to return to athletic activity. (2) On or before October 1, 2014, and annually thereafter, the State Board of Education, in consultation with the Commissioner of Public Health and the organizations described in subparagraphs (B) to (D), inclusive, of subdivision (1) of this subsection, shall develop or approve annual review materials regarding current and relevant information about concussions. (3) The State Board of Education, in consultation with the Commissioner of Public Health and the organizations described in subparagraphs (B) to (D), inclusive, of subdivision (1) of this subsection, shall develop or approve a refresher course regarding concussions. Such refresher course shall include, but not be limited to, (A) an overview of key recognition and safety practices, (B) an update on medical developments and current best practices in the field of concussion research, prevention and treatment, (C) an update on new relevant federal, state and local laws and regulations,	

State	Provision Text	Citation[239]
	and (D) for football coaches, current best practices regarding coaching the sport of football, including, but not limited to, frequency of games and full contact practices and scrimmages as identified by the governing authority for intramural and interscholastic athletics. (c) On or before January 1, 2015, the State Board of Education, in consultation with the Commissioner of Public Health and the organizations described in subparagraphs (B) to (D), inclusive, of subdivision (1) of subsection (b) of this section, shall develop or approve a concussion education plan for use by local and regional boards of education. Each local and regional board of education shall implement such plan by utilizing written materials, online training or videos or in-person training that shall address, at a minimum: (1) The recognition of signs or symptoms of concussion, (2) the means of obtaining proper medical treatment for a person suspected of sustaining a concussion, (3) the nature and risks of concussions, including the danger of continuing to engage in athletic activity after sustaining a concussion, (4) the proper procedures for allowing a student athlete who has sustained a concussion to return to athletic activity, and (5) current best practices in the prevention and treatment of a concussion. (d) For the school year commencing July 1, 2015, and each school year thereafter, each local and regional board of education shall prohibit a student athlete from participating in any intramural or interscholastic athletic activity unless the student athlete, and a parent	

State	Provision Text	Citation[239]
	or guardian of such student athlete, (1) reads written materials, (2) views online training or videos, or (3) attends in-person training regarding the concussion education plan developed or approved pursuant to subsection (c) of this section. (e) (1) On or before July 1, 2015, the State Board of Education, in consultation with the Commissioner of Public Health and the organizations described in subparagraphs (B) to (D), inclusive, of subdivision (1) of subsection (b) of this section, shall develop or approve an informed consent form to distribute to the parents and legal guardians of student athletes involved in intramural or interscholastic athletic activities regarding concussions. Such informed consent form shall include, at a minimum, (A) a summary of the concussion education plan developed or approved pursuant to subsection (c) of this section, and (B) a summary of the applicable local or regional board of education's policies regarding concussions. (2) For the school year commencing July 1, 2015, and each school year thereafter, each school shall provide each participating student athlete's parent or legal guardian with a copy of the informed consent form developed or approved pursuant to subdivision (1) of this subsection and obtain such parent's or legal guardian's signature, attesting to the fact that such parent or legal guardian has received a copy of such form and authorizes the student athlete to participate in the athletic activity. (f) The State Board of Education may revoke the coaching permit, in accordance with the	

State	Provision Text	Citation[239]
	provisions of subsection (i) of section 10-145b, of any coach found to be in violation of this section."	
Delaware	"…(d) The Association shall adopt rules and regulations applicable to member schools regarding the appropriate recognition and management of student athletes exhibiting signs or symptoms consistent with a concussion. The rules and regulations shall include, but not be limited to, the following requirements which shall be effective no later than the 2012-2013 school year: (1) Each student athlete and the athlete's parent or guardian shall annually sign and return a concussion information sheet designed by the Association prior to the athlete initiating practice or competition. (2) Each coach shall complete concussion training consistent with a timetable and curriculum established by the Association."	DEL. CODE ANN. tit. 14, § 303 (2017)
Florida	"…j) The FHSAA shall adopt guidelines to educate athletic coaches, officials, administrators, and student athletes and their parents of the nature and risk of concussion and head injury. (k) The FHSAA shall adopt bylaws or policies that require the parent of a student who is participating in interscholastic athletic competition or who is a candidate for an interscholastic athletic team to sign and return an informed consent that explains the nature and risk of concussion and head injury,	FLA. STAT. § 1006.20 (2017)

State	Provision Text	Citation[239]
	including the risk of continuing to play after concussion or head injury, each year before participating in interscholastic athletic competition or engaging in any practice, tryout, workout, or other physical activity associated with the student's candidacy for an interscholastic athletic team."	
Georgia	"…a) As used in this Code section, the term: (1) "Health care provider" means a licensed physician or another licensed individual under the supervision of a licensed physician, such as a nurse practitioner, physician assistant, or certified athletic trainer who has received training in concussion evaluation and management. (2) "Public recreation facility" means a public facility that conducts an organized youth athletic activity in which a participation fee and registration are required. (3) "Youth athlete" means a participant in a youth athletic activity who is seven years of age or older and under 19 years of age. (4) "Youth athletic activity" means an organized athletic activity in which the majority of the participants are youth athletes and are engaging in an organized athletic game or competition against another team, club, or entity or in practice or preparation for an organized game or competition against another team, club, or entity. This term shall not include college or university activities or an activity which is entered into for instructional purposes only, an athletic activity that is incidental to a nonathletic program, youth	GA. CODE ANN. § 20-2324.1 (2017).

State	Provision Text	Citation[239]
	athletic activities offered through a church or synagogue, or a lesson; provided, however, that colleges, universities, churches, and synagogues, and any other entities that conduct youth athletic activities but are not subject to this Code section are strongly encouraged to establish and implement a concussion management and return to play policy. (b) Each local board of education, administration of a nonpublic school, and governing body of a charter school shall adopt and implement a concussion management and return to play policy comprising not less than the following components: (1) Prior to the beginning of each athletic season of a youth athletic activity, provide an information sheet to all youth athletes' parents or legal guardians which informs them of the nature and risk of concussion and head injury... (c) Each public recreation facility shall, at the time of registration for a youth athletic activity, provide an information sheet to all youth athletes' parents or legal guardians which informs them of the nature and risk of concussion and head injury; provided, however, that public recreation facilities are strongly encouraged to establish and implement a concussion management and return to play policy. (d) The Department of Public Health shall endorse one or more concussion recognition education courses to inform Georgia citizens of the nature and risk of concussions in youth athletics, at least one of which shall be available online. Such course or courses may	

State	Provision Text	Citation[239]
	include education and training materials made available, at no charge, by the federal Centers for Disease Control and Prevention or other training materials substantively and substantially similar to such materials."	
Hawaii	"…The department of kinesiology and rehabilitation science of the University of Hawaii, the department of education, and the Hawaii High School Athletic Association shall jointly develop a concussion monitoring and educational program for school athletics and youth athletic activities that shall require: (1) Annual concussion awareness training for coaches, administrators, faculty, staff, and sports officials, including: (A) The signs and symptoms of a concussion; (B) The need to obtain: (i) Proper medical attention for a person suspected of having a concussion; and (ii) Medical clearance from health care professionals trained in concussion management, before a person may engage in any type of physical activity, practice, game, or competition; (C) Information on the nature and risk of concussions, including the danger of continuing to play after sustaining a concussion and the proper method of allowing a person who has sustained a concussion to	2012 Haw. Sess. Laws 197.

State	Provision Text	Citation[239]
	return to activity; and (D) Information on the process of a concussed person's return to school, academic and cognitive issues associated with a concussion, and classroom adjustments that the person may require; (2) Annual concussion awareness education for participants in school athletics or youth athletic activities, including the parents of minor or student participants. The individuals required to receive education pursuant to this paragraph shall sign a concussion information sheet that they have attended, received, and viewed this concussion awareness education…"	
Idaho	"…(1) The state board of education and the Idaho high school activities association shall provide access to appropriate guidelines and information that identify the signs and symptoms of a concussion and head injury and describe the nature and risk of concussion and head injury in accordance with standards of the centers for disease control and prevention through a link on the internet website of the board and the Idaho high school activities association. (2) This section shall apply to any middle school, junior high school and high school in the state participating in or administering an organized athletic league or sport. For the purposes of this section, "youth athlete" or "athlete" means an individual who is eighteen (18) years of age or younger and who is a participant in any middle school, junior high	IDAHO CODE § 33-1625 (2017).

State	Provision Text	Citation[239]
	school or high school athletic league or sport. (3) At the beginning of each sports season before a youth athlete participates in any organized practice or game, the youth athlete and the youth athlete's parent or guardian shall receive the guidelines and information described in subsection (1) of this section from the school for which the athlete plays, and shall review the guidelines and information. Coaches, referees, game officials, game judges and athletic trainers shall review such guidelines and information upon employment and biennially thereafter. (4) Schools shall obtain written consent from the youth athlete's parent or guardian on an annual basis attesting to the fact that the youth athlete's parent or guardian has received a copy of the concussion information and guidelines as outlined in subsection (3) of this section, acknowledges the inherent risk and authorizes the youth athlete to participate in athletic activity. (7) Students who have sustained a concussion and return to school may need informal or formal accommodations, modifications of curriculum, and monitoring by medical or academic staff until the student is fully recovered. A student athlete should be able to resume all normally scheduled academic activities without restrictions or the need for accommodation prior to receiving authorization to return to play by a qualified health care professional as defined in subsection (6) of this section. (8) If an individual reasonably acts in	

State	Provision Text	Citation[239]
	accordance with the protocol developed pursuant to subsection (5) of this section, then acting upon such protocol shall not form the basis of a claim for negligence in a civil action. (9) Any youth sport organization or association in this state may comply with this section. If a youth sport organization or association is in full compliance with this section, then the youth sport organization or association shall be afforded the same protections from liability in a civil action pursuant to subsection (8) of this section."	
Illinois	"…c) This Section applies to any interscholastic athletic activity, including practice and competition, sponsored or sanctioned by a school, the Illinois Elementary School Association, or the Illinois High School Association. This Section applies beginning with the 2016-2017 school year. (d) The governing body of each public or charter school and the appropriate administrative officer of a private school with students enrolled who participate in an interscholastic athletic activity shall appoint or approve a concussion oversight team. Each concussion oversight team shall establish a return-to-play protocol, based on peer-reviewed scientific evidence consistent with Centers for Disease Control and Prevention guidelines, for a student's return to interscholastic athletics practice or competition following a force or impact believed to have caused a concussion. Each concussion oversight team shall also establish a return-to-learn protocol, based on peer-reviewed scientific evidence consistent with Centers for	105 ILL. COMP. STAT. 5/22-80 (2016).

State	Provision Text	Citation[239]
	Disease Control and Prevention guidelines, for a student's return to the classroom after that student is believed to have experienced a concussion, whether or not the concussion took place while the student was participating in an interscholastic athletic activity. (e) A student may not participate in an interscholastic athletic activity for a school year until the student and the student's parent or guardian or another person with legal authority to make medical decisions for the student have signed a form for that school year that acknowledges receiving and reading written information that explains concussion prevention, symptoms, treatment, and oversight and that includes guidelines for safely resuming participation in an athletic activity following a concussion. The form must be approved by the Illinois High School Association... (h)(1) The Illinois High School Association shall approve, for coaches, game officials, and non-licensed healthcare professionals, training courses that provide for not less than 2 hours of training in the subject matter of concussions, including evaluation, prevention, symptoms, risks, and long-term effects. The Association shall maintain an updated list of individuals and organizations authorized by the Association to provide the training. (2) The following persons must take a training course in accordance with paragraph (4) of this subsection (h) from an authorized training provider at least once every 2 years: (A) a coach of an interscholastic athletic	

State	Provision Text	Citation[239]
	activity; (B) a nurse, licensed healthcare professional, or non-licensed healthcare professional who serves as a member of a concussion oversight team either on a volunteer basis or in his or her capacity as an employee, representative, or agent of a school; and (C) a game official of an interscholastic athletic activity. (3) A physician who serves as a member of a concussion oversight team shall, to the greatest extent practicable, periodically take an appropriate continuing medical education course in the subject matter of concussions. (4) For purposes of paragraph (2) of this subsection (h): (A) a coach, game official, or non-licensed healthcare professional, as the case may be, must take a course described in paragraph (1) of this subsection (h); (B) an athletic trainer must take a concussion-related continuing education course from an athletic trainer continuing education sponsor approved by the Department; (C) a nurse must take a concussion-related continuing education course from a nurse continuing education sponsor approved by the Department; (D) a physical therapist must take a concussion-related continuing education	

State	Provision Text	Citation[239]
	course from a physical therapist continuing education sponsor approved by the Department; (E) a psychologist must take a concussion-related continuing education course from a psychologist continuing education sponsor approved by the Department; (F) an occupational therapist must take a concussion-related continuing education course from an occupational therapist continuing education sponsor approved by the Department; and (G) a physician assistant must take a concussion-related continuing education course from a physician assistant continuing education sponsor approved by the Department. (5) Each person described in paragraph (2) of this subsection (h) must submit proof of timely completion of an approved course in compliance with paragraph (4) of this subsection (h) to the district superintendent or the superintendent's designee in the case of a public elementary or secondary school, the chief school administrator or that person's designee in the case of a charter school, or the appropriate administrative officer or that person's designee in the case of a private school. (6) A physician, licensed healthcare professional, or non-licensed healthcare professional who is not in compliance with the training requirements under this subsection (h) may not serve on a concussion oversight team	

State	Provision Text	Citation[239]
	in any capacity. (7) A person required under this subsection (h) to take a training course in the subject of concussions must complete the training prior to serving on a concussion oversight team in any capacity."	
Indiana	"… (a) Before July 1, 2012, the department shall disseminate guidelines, information sheets, and forms to each school corporation for distribution to a school to inform and educate coaches, student athletes, and parents of student athletes of the nature and risk of concussion and head injury to student athletes, including the risks of continuing to play after concussion or head injury. Sec. 3. Each year, before beginning practice for an interscholastic sport or an intramural sport in which a head coach or assistant coach elects to or is required to comply with this chapter, a student athlete and the student athlete's parent: (1) must be given the information sheet and form described in section 2 of this chapter; and (2) shall sign and return the form acknowledging the receipt of the information to the student athlete's coach. The coach shall maintain a file of the completed forms. (b) Prior to coaching football to individuals who are less than twenty (20) years of age and are in grades 1 through 12, each head football coach and assistant football coach shall complete a certified coaching education course	IND. CODE §§ 20-34-7-1 to -6 (2016).

State	Provision Text	Citation[239]
	that: (1) is sport specific; (2) contains player safety content, including content on: (A) concussion awareness… (e) An organizing entity shall maintain a file of certificates of completion awarded under subsection (b)(4) to any of the organizing entity's head coaches and assistant coaches. Sec. 7. (a) This section applies after June 30, 2017. (b) This section applies to a head coach or assistant coach who: (1) coaches any: (A) interscholastic sport; or (B) intramural sport and elects to comply or as part of the head coach's or assistant coach's coaching certification requirements is required to comply with this chapter; and (2) is not subject to section 6 of this chapter. (c) Before coaching a student athlete in any sport, a head coach and every assistant coach described in subsection (b) must complete a certified coaching education course that: (1) contains player safety content on concussion awareness; (2) requires a head coach or an assistant coach to complete a test demonstrating	

State	Provision Text	Citation[239]
	comprehension of the content of the course; and (3) awards a certificate of completion to a head coach or an assistant coach who successfully completes the course. (d) A course described in subsection (c) must be approved by the department, in consultation with a physician licensed under IC 25-22.5 who has expertise in the area of concussions and brain injuries. The department may, in addition to consulting with a physician licensed under IC 25-22.5, consult with other persons who have expertise in the area of concussions and brain injuries. (e) A head coach and every assistant coach described in subsection (b) must complete a course described in subsection (c) at least once each two (2) year period. If a head coach or an assistant coach receives notice from the school that new information has been added to the course before the end of the two (2) year period, the head coach or the assistant coach shall: (1) complete instruction; and (2) successfully complete a test; concerning the new information to satisfy subsection (c). (f) Each school shall maintain all certificates of completion awarded under subsection (c)(3) to each of the school's head coaches and assistant coaches.	

State	Provision Text	Citation[239]
Iowa	3. Training. a. The department of public health, Iowa high school athletic association, and the Iowa girls high school athletic union shall work together to develop training materials and courses regarding concussions and brain injuries, including training regarding evaluation, prevention, symptoms, risks, and long-term effects of concussions and brain injuries. Each coach or contest official shall complete such training at least every two years. b. Individuals required to complete training pursuant to this subsection shall submit proof of such completion to the Iowa high school athletic association or the Iowa girls high school athletic union, as applicable. 4. Guidelines and information sheet. a. The department of public health, Iowa high school athletic association, and the Iowa girls high school athletic union shall work together to distribute the guidelines of the centers for disease control and prevention of the United States department of health and human services and other pertinent information to inform and educate coaches, students, and the parents and guardians of students of the risks, signs, symptoms, and behaviors consistent with a concussion or brain injury, including the danger of continuing to participate in extracurricular interscholastic activities after suffering a concussion or brain injury and their responsibility to report such signs, symptoms, and behaviors if they occur. b. For school years beginning on or after	IOWA CODE § 280.13C(2016)

State	Provision Text	Citation[239]
	July 1, 2018, each school district and nonpublic school shall provide to the parent or guardian of each student in grades seven through twelve a concussion and brain injury information sheet, as provided by the department of public health, the Iowa high school athletic association, and the Iowa girls high school athletic union. The student and the student's parent or guardian shall sign and return a copy of the concussion and brain injury information sheet to the student's school prior to the student's participation in any extracurricular interscholastic activity…"	
Kansas	"…(c) The state board of education, in cooperation with the Kansas state high school activities association, shall compile information on the nature and risk of concussion and head injury including the dangers and risks associated with the continuation of playing or practicing after a person suffers a concussion or head injury. Such information shall be provided to school districts for distribution to coaches, school athletes and the parents or guardians of school athletes. (d) A school athlete may not participate in any sport competition or practice session unless such athlete and the athlete's parent or guardian have signed, and returned to the school, a concussion and head injury information release form. A release form shall be signed and returned each school year that a student athlete participates in sport competitions or practice sessions."	KAN. STAT. ANN. § 72135 (2017)

State	Provision Text	Citation[239]
Kentucky	"…(1) (a) The Kentucky Board of Education or organization or agency designated by the board to manage interscholastic athletics shall require each interscholastic coach to complete a sports safety course consisting of training on how to prevent common injuries. The content of the course shall include but not be limited to emergency planning, heat and cold illnesses, emergency recognition, head injuries including concussions, neck injuries, facial injuries, and principles of first aid. The course shall also be focused on safety education and shall not include coaching principles. (b) The state board or its agency shall: 1. Establish a minimum timeline for a coach to complete the course; 2. Approve providers of a sports safety course; 3. Be responsible for ensuring that an approved course is taught by qualified professionals who shall either be athletic trainers, registered nurses, physicians, or physician's assistants licensed to practice in Kentucky; and 4. Establish the minimum qualifying score for successful course completion. (c) A course shall be reviewed for updates at least once every thirty (30) months and revised if needed. (d) A course shall be able to be completed through hands-on or online teaching methods in ten (10) clock hours or less.	KY. REV. STAT. ANN. § 160.445 (West 2017)

State	Provision Text	Citation[239]
	(e) 1. A course shall include an end-of-course examination with a minimum qualifying score for successful course completion established by the board or its agency. 2. All coaches shall be required to take the end-of-course examination and shall obtain at least the minimum qualifying score. (f) Beginning with the 2009-2010 school year, and each year thereafter, at least one (1) person who has completed the course shall be at every interscholastic athletic practice and competition. (2) (a) Beginning with the 2012-2013 school year, and each year thereafter, the state board or its agency shall require each interscholastic coach to complete training on how to recognize the symptoms of a concussion and how to seek proper medical treatment for a person suspected of having a concussion. The training shall be approved by the state board or its agency and may be included in the sports safety course required under subsection (1)(a) of this section. (b) The board or its agency shall develop guidelines and other pertinent information or adopt materials produced by other agencies to inform and educate student athletes and their parents or legal guardians of the nature and risk of concussion and head injury, including the continuance of play after concussion or head injury. Any required physical examination and parental authorization shall include acknowledgement of the education information required under this paragraph. (c) Upon request, the board or its agency shall	

State	Provision Text	Citation[239]
	make available to the public any training materials developed by the board or agency used to satisfy the requirements of paragraph (a) of this subsection. The board or its agency shall not be held liable for the use of any training materials so disseminated."	
Louisiana	"…A. The governing authority of each public and nonpublic elementary school, middle school, junior high school, and high school shall: (1) Prior to beginning of each athletic season, provide pertinent information to all coaches, officials, volunteers, youth athletes, and their parents or legal guardian which informs of the nature and risk of concussion and head injury, including the risks associated with continuing to play after a concussion or head injury. (2) Require each coach, whether such coach is employed or a volunteer, and every official of a youth athletic activity that involves interscholastic play to complete an annual concussion recognition education course which is in accordance with the provisions of Subsection C of this Section. (3) Require as a condition of participation in any athletic activities that the youth athlete and the youth athlete's parents or legal guardian sign a concussion and head injury information sheet which provides adequate notice of the statutory requirements which must be satisfied in order for an athlete who has or is suspected to have suffered a concussion or head injury to return to play.	LA. STAT. ANN. §§ 40:1089.1-.5 (2016).

State	Provision Text	Citation[239]
	B. Each private club or public recreation facility and each athletic league which sponsors youth athletic activities shall: (1) Prior to beginning of each athletic season, provide pertinent information to all coaches, officials, volunteers, youth athletes, and their parents or legal guardian which informs of the nature and risk of concussion and head injury, including the risks associated with continuing to play after a concussion or head injury. (2) Require each volunteer coach for a youth athletic activity and each coach with whom the club, facility, or league directly contracts with, formally engages, or employs who coaches a youth athletic activity and each official to complete an annual concussion recognition course which is in accordance with the provisions of Subsection C of this Section. (3) Require as a condition of participation in any athletic activities that the youth athlete and the youth athlete's parents or legal guardian sign a concussion and head injury information sheet which includes but is not limited to adequate notice of the statutory requirements which must be satisfied in order for an athlete who has or is suspected to have sustained a concussion or head injury to return to play. C. (1) The concussion recognition education course required by this Section shall include the following information: (a) How to recognize the signs of and symptoms of a concussion.	

State	Provision Text	Citation[239]
	(b) The necessity of obtaining proper medical attention for a person suspected of having sustained a concussion. (c) The nature and risk of concussions, including the danger of continuing to play after sustaining a concussion and the proper method and statutory requirements which must be satisfied in order for a youth athlete to return to play in the athletic activity. (2)(a) An organization or association of which a school or school district is a member may designate specific education courses as sufficient to meet the requirements of Subsection A of this Section. (b) Training material made available by the Centers for Disease Control and Prevention "CDC" entitled, "Heads Up: Concussion in Youth Sports" and any amendments or updates thereto, training material made available by the National Federation of High Schools for the Louisiana High School Athletic Association and any amendments or updates thereto, or other training materials substantively and substantially similar to the CDC materials, along with dissemination of a copy of the statutory requirements which must be satisfied in order for a youth athlete who has or is suspected to have sustained a concussion to return to play in the athletic activity, shall be deemed to satisfy the education requirements provided for in this Section. The office of public health within the Louisiana Department of Health shall promulgate and make available to all public	

State	Provision Text	Citation[239]
	and private middle schools, junior high schools, and high schools, private clubs, public recreation facilities, and each athletic league which sponsors youth athletic activities information which informs of the nature and risk of concussion and head injury, including the risks associated with continuing to play after a concussion or head injury."	
Maine	"… 1. Training. A requirement that athletic directors, coaches and other school personnel involved with school activities and athletics must be trained in the identification and management of concussive and other head injuries; 2. Student and parental acknowledgment. A requirement that prior to each school year each student participating in a school athletic activity and the student's parent or legal guardian must review the school's policy for the management of concussive and other head injuries and sign a statement acknowledging that review…"	MAINE §254, sub-§17 (2017)
Maryland	"…(b)(1) The Department shall develop policies and implement a program to provide awareness to coaches, school personnel, students, and the parents or guardians of students, in collaboration with the Maryland Department of Health, each county board, the Maryland Public Secondary Schools Athletic Association, the Maryland Athletic Trainers' Association, the Brain Injury Association of Maryland, and representatives of licensed health care providers who treat concussions, on: (i) The nature and risk of a concussion or	MD. CODE ANN., EDUC. § 7-433 (West 2017).

State	Provision Text	Citation[239]
	head injury; (ii) The criteria for removal from and return to play; (iii) The risks of not reporting injury and continuing to play; and (iv) Appropriate academic accommodations for students diagnosed as having sustained a concussion or head injury. (2) The program shall include a process to verify that a coach has received information on the program developed under paragraph (1) of this subsection. (3)(i) Before a student enrolled in a public school system in the State may participate in an authorized interscholastic athletic activity, the county board shall provide a concussion and head injury information sheet to the student and a parent or guardian of the student. (ii) The student and the parent or guardian of the student shall sign a statement acknowledging receipt of the information sheet. (iii) The Department shall create the information sheet and acknowledgment statement required under this paragraph. (4) The Department may use materials available from the Centers for Disease Control and Prevention, the Brain Injury Association of Maryland, or any other appropriate entity to carry out the requirements of this subsection. (d)(1) Before an individual participates in an	

State	Provision Text	Citation[239]
	authorized athletic activity on school property, the county board shall provide, or require that a third party provide: (i) Information on concussions and head injuries to the individual and, if applicable, a parent or guardian of the individual; and (ii) Notice that acknowledgment of the receipt of the information by the individual and, if applicable, the parent or guardian of the individual, is required. (2) The information required under paragraph (1) of this subsection shall be in the form of: (i) A separate information sheet; or (ii) A notice on the registration form for a youth sports program stating that information on concussion and head injury is available, including directions on how to receive the information electronically. (3) The individual and, if applicable, the parent or guardian of the individual shall: (i) Acknowledge receipt of the information by: 1. Signature; 2. Checking an acknowledgment box on the registration form; or 3. Another method of written or electronic acknowledgment; and (ii) Return the acknowledgment to the county board or third party."	

State	Provision Text	Citation[239]
Massachusetts	"…(a) The department shall direct the division of violence and injury prevention to develop an interscholastic athletic head injury safety training program in which all public schools and any school subject to the Massachusetts Interscholastic Athletic Association rules shall participate. Participation in the program shall be required annually of coaches, trainers and parent volunteers for any extracurricular athletic activity; physicians and nurses who are employed by a school or school district or who volunteer to assist with an extracurricular athletic activity; school athletic directors; directors responsible for a school marching band; and a parent or legal guardian of a child who participates in an extracurricular athletic activity. In developing the program, the division may use any of the materials readily available from the Centers for Disease Control and Prevention. The program shall include, but not be limited to: (1) current training in recognizing the symptoms of potentially catastrophic head injuries, concussions and injuries related to second impact syndrome; and (2) providing students that participate in any extracurricular athletic activity, including membership in a marching band, the following information annually: a summary of department rules and regulations relative to safety regulations for students participation in extracurricular athletic activities, including the medical protocol for post-concussion participation or participation in an extracurricular athletic activity; written information related to the recognition of symptoms of head injuries, the biology and the short-term and long-term consequences of a	MASS. GEN. LAW SCH. 111, § 222 (2017)

State	Provision Text	Citation[239]
	concussion… (b) The department shall develop forms on which students shall be instructed to provide information relative to any sports head injury history at the start of each sports season. These forms shall require the signature of both the student and the parent or legal guardian thereof. Once complete, the forms shall be forwarded to all coaches prior to allowing any student to participate in an extracurricular athletic activity so as to provide coaches with up-to-date information relative to an athlete's head injury history and to enable coaches to identify students who are at greater risk for repeated head injuries. (d) A coach, trainer or volunteer for an extracurricular athletic activity shall not encourage or permit a student participating in the activity to engage in any unreasonably dangerous athletic technique that unnecessarily endangers the health of a student, including using a helmet or any other sports equipment as a weapon..."	
Michigan	"…(1) Before June 27, 2013, the department shall develop, adopt, or approve educational materials on the nature and risk of concussions. (2) Before June 27, 2013, the department shall develop, adopt, or approve a concussion awareness training program in an electronic format that includes all of the following: (a) The nature and risk of concussions. (b) The criteria for the removal of an	MICH. COMP. LAWS §§ 333.9155-.9156 (2016).

State	Provision Text	Citation[239]
	athlete from physical participation in an athletic activity due to a suspected concussion and his or her return to that athletic activity. (c) The risks to an athlete of not reporting a suspected concussion and continuing to physically participate in the athletic activity. (3) As soon as they are available, the department shall make the educational materials and training program required under this section available to the public on the department's internet website. The department shall make the training program available to all individuals required to participate in the program under section 91561 and to any interested individual including school personnel, coaches, parents, students, and athletes. The department shall periodically review the training program required under this section and, for purposes of section 9156, make recommendations regarding the frequency of the training program based on changes to the training program that are developed, adopted, or approved by the department. (2) Before a youth athlete may participate in an athletic activity sponsored by or operated under the auspices of an organizing entity, the organizing entity shall do all of the following: (a) Comply with all the requirements of this section with regard to its coaches, employees, volunteers, and other adults who are involved with the participation of youth athletes in athletic activity sponsored by or operated under the auspices of that organizing entity and who are required to participate in	

State	Provision Text	Citation[239]
	the concussion awareness training program developed under section 9155.1 (b) Ensure that each coach, employee, volunteer, and other adult who is required to participate in the concussion awareness training program developed under section 9155 completes the training program once every 3 years, unless the department recommends more frequent training. (c) Provide the educational materials developed under section 9155 to each youth athlete who participates in an athletic activity sponsored by or operated under the auspices of the organizing entity and a parent or guardian of the youth athlete. (d) Obtain a statement signed by each youth athlete and a parent or guardian of the youth athlete acknowledging receipt of the educational material developed under section 9155. The organizing entity shall maintain the statement obtained under this subdivision in a permanent file for the duration of that youth athlete's participation in athletic activity sponsored by or operated under the auspices of that organizing entity or until the youth athlete is 18 years of age. Upon request, the organizing entity shall make the statements obtained under this subdivision available to the department."	
Minnesota	"…(a) Consistent with section 121A.38, any municipality, business, or nonprofit organization that organizes a youth athletic activity for which an activity fee is charged shall:	MINN. STAT. §§ 121A.37.38 (2017).

State	Provision Text	Citation[239]
	(1) make information accessible to all participating coaches, officials, and youth athletes and their parents or guardians about the nature and risks of concussions, including the effects and risks of continuing to play after receiving a concussion, and the protocols and content, consistent with current medical knowledge from the Centers for Disease Control and Prevention, related to: (i) the nature and risks of concussions associated with athletic activity; (ii) the signs, symptoms, and behaviors consistent with a concussion; (iii) the need to alert appropriate medical professionals for urgent diagnosis and treatment when a youth athlete is suspected or observed to have received a concussion; and (iv) the need for a youth athlete who sustains a concussion to follow proper medical direction and protocols for treatment and returning to play; and (2) require all participating coaches and officials to receive initial online training and online training at least once every three calendar years thereafter, consistent with clause (1) and the Concussion in Youth Sports online training program available on the Centers for Disease Control and Prevention Web site."	

State	Provision Text	Citation[239]
Mississippi	"…Each local board of education, administration of a nonpublic school, and governing body of a charter school shall adopt and implement a concussion management and return to play policy that includes the following components: (a) Parents or guardians shall receive and sign a copy of the concussion policy before the start of the regular school athletic event season."	MISS. CODE ANN. § 3724-5 (2017).
Missouri	"…1. The provisions of this section shall be known as the "Interscholastic Youth Sports Brain Injury Prevention Act". No later than December 31, 2011, the department of health and senior services shall work with a statewide association of school boards, a statewide activities association that provides oversight for athletic or activity eligibility for students and school districts, and an organization named by the department of health and senior services that specializes in support services, education, and advocacy of those with brain injuries to promulgate rules which develop guidelines, pertinent information, and forms to educate coaches, youth athletes, and parents or guardians of youth athletes of the nature and risk of concussion and brain injury including continuing to play after concussion or brain injury. The primary focus of rules promulgated under this section shall be the safety and protection against long-term injury to the youth athlete. 2. On a yearly basis, each school district shall distribute a concussion and brain injury information sheet to each youth athlete participating in the district's athletic program. The information form shall be signed by the	MO. REV. STA. § 167t.765 (2016).

State	Provision Text	Citation[239]
	youth athlete's parent or guardian and submitted to the school district prior to the youth athlete's participation in any athletic practice or competition."	
Montana	"…(1) Each school district, nonpublic school, or youth athletic organization in this state offering organized youth athletic activities shall adopt policies and procedures to inform coaches, officials, youth athletes, and parents or guardians of the nature and risk of brain injuries, including the effects of continuing to play after a concussion. The policies, content, and protocols must be consistent with current medical knowledge as to: (a) the nature and risk of brain injuries associated with athletic activity; (b) the signs, symptoms, and behaviors consistent with a brain injury; (c) the need to alert a licensed health care professional for urgent recognition and treatment when a youth athlete exhibits signs, symptoms, or behaviors consistent with a concussion; and (d) the need to follow proper medical direction and protocols for treatment and returning to play after a youth athlete sustains a concussion. (2) A form documenting that educational materials referred to in subsection (1) have been provided to and viewed by each youth athlete and the youth athlete's parent or guardian must be signed by each youth athlete and the youth athlete's parent or guardian and	MONT. CODE ANN. §§ 20-7-1301 to - 1304 (2017)

State	Provision Text	Citation[239]
	returned to an official designated by the school district, nonpublic school, or youth athletic organization prior to the youth athlete's participation in organized youth athletic activities. The form must apply for a period not to exceed 1 year. (3) School districts, nonpublic schools, and youth athletic organizers shall ensure access to a training program consistent with subsection (1). Each coach and official participating in organized youth athletic activities shall complete the training program at least once each year. (4) School districts, nonpublic schools, and youth athletic organizations may invite the participation of appropriate advocacy groups and appropriate sports governing bodies to facilitate the requirements of subsections (1) through (3)."	
Nebraska	"…(1) Each approved or accredited public, private, denominational, or parochial school shall: (a) Make available training approved by the chief medical officer on how to recognize the symptoms of a concussion or brain injury and how to seek proper medical treatment for a concussion or brain injury to all coaches of school athletic teams; (b) Require that concussion and brain injury information be provided on an annual basis to students and the students' parents or guardians prior to such students initiating practice or competition. The information provided to students and the students' parents	NEB. REV. STAT. §§ 719101 to 9106 (2016)

State	Provision Text	Citation[239]
	or guardians shall include, but need not be limited to: (i) The signs and symptoms of a concussion; (ii) The risks posed by sustaining a concussion; and (iii) The actions a student should take in response to sustaining a concussion, including the notification of his or her coaches; and (c) Establish a return to learn protocol for students that have sustained a concussion. The return to learn protocol shall recognize that students who have sustained a concussion and returned to school may need informal or formal accommodations, modifications of curriculum, and monitoring by medical or academic staff until the student is fully recovered. (1) Any city, village, business, or nonprofit organization that organizes an athletic activity in which the athletes are nineteen years of age or younger and are required to pay a fee to participate in the athletic activity or whose cost to participate in the athletic activity is sponsored by a business or nonprofit organization shall: (a) Make available training approved by the chief medical officer on how to recognize the symptoms of a concussion or brain injury and how to seek proper medical treatment for a concussion or brain injury to all coaches; and (b) Provide information on concussions and brain injuries to all coaches and athletes	

State	Provision Text	Citation[239]
	and to a parent or guardian of each athlete that shall include, but need not be limited to: (i) The signs and symptoms of a concussion; (ii) The risks posed by sustaining a concussion; and (iii) The actions an athlete should take in response to sustaining a concussion, including the notification of his or her coaches."	
Nevada	"…1. The Nevada Interscholastic Activities Association shall adopt a policy concerning the prevention and treatment of injuries to the head which may occur during a pupil's participation in interscholastic activities and events, including, without limitation, a concussion of the brain. The policy must provide information concerning the nature and risk of injuries to the head which may occur during a pupil's participation in interscholastic activities and events, including, without limitation, the risks associated with continuing to participate in the activity or event after sustaining such an injury... 3. Before a pupil participates in an interscholastic activity or event, and on an annual basis thereafter, the pupil and his or her parent or legal guardian: (a) Must be provided with a copy of the policy adopted pursuant to subsection 1; and (b) Must sign a statement on a form prescribed by the Nevada Interscholastic Activities Association acknowledging that the pupil and his or her parent or guardian have	NEV. REV. STAT. § 385B.080 (2016)

State	Provision Text	Citation[239]
	read and understand the terms and conditions of the policy."	
New Hampshire	"…Education is the key to identification and appropriate management of all concussions. The school board of each school district shall develop guidelines and other pertinent information and forms for student sports to inform and educate coaches, student-athletes, and student-athletes' parents or guardians of the nature and risk of concussion and head injury including continuing to play after concussion or head injury. On an annual basis, a school district or school shall distribute a concussion and head injury information sheet to all student athletes. The Brain Injury Association of New Hampshire is available to educate and assist the public with implementing and/or updating concussion management protocols."	N.H. REV. STAT. ANN. §§ 200:49:52 (2017).
New Jersey	"…a. The Department of Education shall work to develop and implement, by the 2011-2012 school year, an athletic head injury safety training program. The program shall be completed by a school physician, a person who coaches a public school district or nonpublic school interscholastic sport, intramural sport, or cheerleading program, and an athletic trainer involved in a public or nonpublic school interscholastic sports program, intramural sports program, or cheerleading program. The safety training program shall include, but need not be limited to, the following:	N.J. STAT. ANN. §§ 18A:40-41.1 to -41.7 (West 2017)

State	Provision Text	Citation[239]
	(1) the recognition of the symptoms of head and neck injuries, concussions, and injuries related to second-impact syndrome; and (2) the appropriate amount of time to delay the return to competition or practice of a student-athlete or cheerleader who has sustained a concussion or other head injury. b. The department shall update the safety training program as necessary to ensure that it reflects the most current information available on the nature, risk, and treatment of sports-related concussions and other head injuries. c. The department shall develop an educational fact sheet that provides information about sports-related concussions and other head injuries. A school district or a nonpublic school that participates in an interscholastic sports program, intramural sports program, or cheerleading program shall distribute the educational fact sheet annually to the parents or guardians of student-athletes and cheerleaders and shall obtain a signed acknowledgment of the receipt of the fact sheet by the student-athlete or cheerleader and his parent or guardian. d. As used in P.L.2010, c. 94 (C.18A:40-41.1 et seq.), "student-athlete" means any student enrolled in a public or nonpublic school in this State who is a participant in an interscholastic sports program or intramural sports program organized by the school."	

State	Provision Text	Citation[239]
New Mexico	"… C. Each school district shall ensure that each coach participating in school athletic activities and each student athlete in the school district receives training provided pursuant to Paragraph (1) of Subsection D of this section. D. The New Mexico activities association shall consult with the brain injury advisory council and school districts to promulgate rules to establish: (1) protocols and content consistent with current medical knowledge for training each coach participating in school athletic activities and each student athlete to: (a) understand the nature and risk of brain injury associated with athletic activity; (b) recognize signs, symptoms or behaviors consistent with a brain injury when a coach or student athlete suspects or observes that a student athlete has received a brain injury; (c) understand the need to alert appropriate medical professionals for urgent diagnosis or treatment; and (d) understand the need to follow medical direction for proper medical protocols; and (2) the nature and content of brain injury training and information forms and educational materials for, and the means of providing these forms and materials to, coaches, student athletes and student athletes' parents or guardians regarding the nature and risk of brain injury resulting from athletic activity, including the risk of continuing or returning to	N.M. STAT. ANN. § 2213-31 (2017)

State	Provision Text	Citation[239]
	athletic activity after a brain injury. E. At the beginning of each academic year or the first participation in school athletic activities by a student athlete during an academic year, a school district shall provide a brain injury training and information form created pursuant to Subsection D of this section to a student athlete and the student athlete's parent or guardian. The school district shall receive signatures on the brain injury training and information form from the student athlete and the student athlete's parent or guardian confirming that the student athlete has received the brain injury training required by this section and that the student athlete and parent or guardian understand the brain injury information before permitting the student athlete to begin or continue participating in school athletic activities for that academic year. The form required by this subsection may be contained on the student athlete sport physical form... C. Each youth athletic league shall ensure that each coach participating in youth athletic activities and each youth athlete in the league receives training provided pursuant to Paragraph (1) of Subsection D of this section. D. The department of health shall consult with the brain injury advisory council to promulgate rules to establish... (2) the nature and content of brain injury training and information forms and educational materials for, and the means of providing these forms and materials to, coaches, youth athletes and youth athletes'	

State	Provision Text	Citation[239]
	parents or guardians regarding the nature and risk of brain injury resulting from youth athletic activity, including the risk of continuing or returning to youth athletic activity after a brain injury. E. At the beginning of each youth athletic activity season or the first participation in youth athletic activities by a youth athlete during a youth athletic activity season, a youth athletic league shall provide a brain injury training and information form created pursuant to Subsection D of this section to a youth athlete and the youth athlete's parent or guardian. The youth athletic league shall receive signatures on the brain injury training and information form from the youth athlete and the youth athlete's parent or guardian confirming that the youth athlete has received the brain injury training required by this section and that the youth athlete and parent or guardian understand the brain injury information before permitting the youth athlete to begin or continue participating in youth athletic activities for the athletic season or term of participation."	
New York	"…42. a. The commissioner, in conjunction with the commissioner of health, shall promulgate and review as necessary rules and regulations relating to pupils who suffer mild traumatic brain injuries, also referred to as a "concussion," while receiving instruction or engaging in any school sponsored or related activity. In developing such rules and regulations, the commissioner shall consider comments from stakeholders and other interested parties including but not limited to parents, teachers, students, school	N.Y. EDUC. LAW § 305(42) (McKinney 2017).

State	Provision Text	Citation[239]
	administrators, school athletic trainers, sport coaches, medical and health professionals, the public schools athletic league (PSAL), the New York state public high school athletic association (NYSPHSAA), and other athletic associations. Such regulations shall include, but not be limited to: (i) requiring a course of instruction relating to recognizing the symptoms of mild traumatic brain injuries and monitoring and seeking proper medical treatment for pupils who suffer mild traumatic brain injuries. Such course of instruction shall be required to be completed on a biennial basis by all school coaches, physical education teachers, nurses and athletic trainers. The course of instruction required by this subparagraph shall include, but not be limited to, the definition of a "concussion," signs and symptoms of mild traumatic brain injuries, how such injuries may occur, practices regarding prevention, and the guidelines for the return to school and to certain school activities after a pupil has suffered a mild traumatic brain injury regardless of whether such injury occurred outside of school. Such training may be completed by means of courses of instruction, including but not limited to, courses provided online and by teleconference approved by the department; (ii) providing that the department and the department of health shall post on their internet websites information relating to mild traumatic brain injuries, which shall include but not be limited to, the definition of a "concussion," signs and symptoms of mild traumatic brain injuries, how such injuries may occur, and the	

State	Provision Text	Citation[239]
	guidelines for the return to school and to certain school activities after a pupil has suffered a mild traumatic brain injury regardless of whether such injury occurred outside of school. Schools shall be required to include such information in any permission form or parent or person in parental relation consent form or similar document that may be required for a pupil's participation in interscholastic sports and shall also include such information, or reference how to obtain such information from the department and the department of health internet websites, on the school's internet website, if one exists... (iv) authorizing each school or school district, in its discretion, to establish a concussion management team which may be composed of the athletic director (if any), a school nurse, the school physician, a coach of an interscholastic team, an athletic trainer or such other appropriate personnel as designated by the school or school district. The concussion management team shall oversee the implementation of the rules and regulations promulgated pursuant to this subdivision as it pertains to their associated school including the requirement that all school coaches, physical education teachers, nurses and athletic trainers that work with and provide instruction to pupils engaged in school sponsored athletic activities complete training relating to mild traumatic brain injuries. Furthermore, every concussion management team may establish and implement a program which provides information on mild traumatic brain injuries to parents and persons in parental	

State	Provision Text	Citation[239]
	relation throughout each school year."	
North Carolina	"…(a) The Matthew A. Gfeller Sport-Related Traumatic Brain Injury Research Center at UNC-Chapel Hill in consultation with the North Carolina Medical Society, the North Carolina Athletic Trainers Association, the Brain Injury Association of North Carolina, the North Carolina Neuropsychological Society, the North Carolina High School Athletic Association, Inc., and the Department of Public Instruction shall develop an athletic concussion safety training program. The program shall be developed for the use of coaches, school nurses, school athletic directors, volunteers, students who participate in interscholastic athletic activities in the public schools, and the parents of these students. SECTION 2.(b) The program shall include, but not be limited to, the following: (1) Written information detailing the recognition of the signs and symptoms of concussions and other head injuries. (2) A description of the physiology and the potential short-term and long-term effects of concussions and other head injuries. (3) The medical return-to-play protocol for post-concussion participation in interscholastic athletic activities. Concussion safety requirements for	N.C. GEN. STAT. § 115C-12.23 (2016)

State	Provision Text	Citation[239]
	interscholastic athletic competition. SECTION 3. G.S. 115C-12(23) reads as rewritten: "(23) Power to Adopt Eligibility Rules for Interscholastic Athletic Competition. - The State Board of Education shall adopt rules governing interscholastic athletic activities conducted by local boards of education, including eligibility for student participation. With regard to middle schools and high schools, the rules shall provide for the following: a. All coaches, school nurses, athletic directors, first responders, volunteers, students who participate in interscholastic athletic activities, and the parents of those students shall receive, on an annual basis, a concussion and head injury information sheet. School employees, first responders, volunteers, and students must sign the sheet and return it to the coach before they can participate in interscholastic athletic activities, including tryouts, practices, or competition. Parents must sign the sheet and return it to the coach before their children can participate in any such interscholastic athletic activities. The signed sheets shall be maintained in accordance with sub-subdivision d. of this subdivision."	
North Dakota	"…1. Each school district and nonpublic school that sponsors or sanctions any athletic activity in this state and requires a participating student to regularly practice or train, and compete, is subject to the terms of a	N.D. CENT. CODE § 15.1-18.2-04 (2017)

State	Provision Text	Citation[239]
	concussion management program... 7. The student's school district or nonpublic school shall ensure that before a student is allowed to participate in the athletic activity described in subsection 1, the student and the student's parent shall document that they have viewed information regarding concussions incurred by students participating in athletic activities. The required information must be provided by the student's school district or nonpublic school and must be made available in printed form or in a verifiable electronic format."	
Ohio	"… (B) No school district board of education or governing authority of a chartered or nonchartered nonpublic school shall permit a student to practice for or compete in interscholastic athletics until the student has submitted, to a school official designated by the board or governing authority, a form signed by the parent, guardian, or other person having care or charge of the student stating that the student and the parent, guardian, or other person having care or charge of the student have received the concussion and head injury information sheet required by section 3707.52 of the Revised Code. A completed form shall be submitted each school year, as defined in section 3313.62 of the Revised Code, for each sport or other category of interscholastic athletics for or in which the student practices or competes. (C)(1) No school district board of education or governing authority of a chartered or nonchartered nonpublic school shall permit an individual to coach interscholastic athletics	OHIO REV. CODE ANN. § 3313.539 (West 2016).

State	Provision Text	Citation[239]
	unless the individual holds a pupil-activity program permit issued under section 3319.303 of the Revised Code for coaching interscholastic athletics. (2) No school district board of education or governing authority of a chartered or nonchartered nonpublic school shall permit an individual to referee interscholastic athletics unless the individual holds a pupil-activity program permit issued under section 3319.303 of the Revised Code for coaching interscholastic athletics or presents evidence that the individual has successfully completed, within the previous three years, a training program in recognizing the symptoms of concussions and head injuries to which the department of health has provided a link on its internet web site under section 3707.52 of the Revised Code or a training program authorized and required by an organization that regulates interscholastic athletic competition and conducts interscholastic athletic events."	
Oklahoma	"…B. The State Department of Health shall create a concussion management section on its website to provide the guidelines necessary for each school district board of education and youth sports organization to develop their own policies and procedures pertaining to, but not limited to: 1. A concussion and head injury information sheet for game officials, team officials, athletes, parents or guardians and other persons having care or charge of athletes of the signs and symptoms of concussion or	OKLA. STAT. tit. 70, § 24-155 (2017)

State	Provision Text	Citation[239]
	head injury and the risk of continuing to practice or compete in an athletic event or activity after sustaining a concussion or head injury; 2. "Return to Learn" guidelines for teachers and relevant school personnel pertaining to athletes who are returning to the classroom after sustaining a concussion or head injury; 3. "Graduated Stepwise Return to Athletic Participation" guidelines for team officials pertaining to athletes returning to practice or competition after a concussion or head injury; and 4. Links to one or more free online concussion training programs as provided by the Centers for Disease Control and Prevention (CDC), the National Federation of State High School Associations (NFHS) or a comparable program or resource. C. Each school district board of education and youth sports organization or association shall develop policies and procedures pursuant to subsection B of this section to inform and educate their respective coaches, game officials, team officials, athletes and their parents or guardians of the nature and risk of concussion and head injury, including continuing to play after concussion or head injury. On an annual basis, information regarding concussion and head injuries shall be disseminated to the athlete and his or her parent or guardian. Acknowledgment and understanding of the information shall be completed by the athlete and the athlete's	

State	Provision Text	Citation[239]
	parent or guardian and maintained by the school or the youth sports organization or association prior to the athlete's participation in practice or competition. 1. On an annual basis, game officials and team officials shall undergo concussion training provided by the CDC, the NFHS or a comparable program or resource. A record of completion of the training course shall be readily available upon request."	
Oregon	"…(2)(a) Each school district shall ensure that coaches receive annual training to learn how to recognize the symptoms of a concussion and how to seek proper medical treatment for a person who is suspected of having a concussion. (b) The board shall establish by rule: (A) The requirements of the training described in paragraph (a) of this subsection, which shall be provided by using community resources to the extent practicable; and (B) Timelines to ensure that, to the extent practicable, every coach receives the training described in paragraph (a) of this subsection before the beginning of the season for the school athletic team."	OR. REV. STAT. §§ 336.485, 417.875 (2016).
Pennsylvania	"…**(a) Educational materials.**--The Department of Health and the Department of Education shall develop and post on their Internet websites guidelines and other relevant materials to inform and educate students participating in or desiring to participate in an athletic activity, their parents and their coaches	24 PA. CONS. STAT. §§ 5322-5323 (2016)

State	Provision Text	Citation[239]
	about the nature and risk of concussion and traumatic brain injury, including the risks associated with continuing to play or practice after a concussion or traumatic brain injury. In developing the guidelines and materials, the departments shall utilize existing materials developed by the Centers for Disease Control and Prevention. A student participating in or desiring to participate in an athletic activity and the student's parent or guardian shall each school year, prior to participation by the student in an athletic activity, sign and return to the student's school an acknowledgment of receipt and review of a concussion and traumatic brain injury information sheet developed under this subsection. **(e) Training course.**--Once each school year, a coach shall complete the concussion management certification training course offered by the Centers for Disease Control and Prevention, the National Federation of State High School Associations or another provider approved by the Department of Health. A coach shall not coach an athletic activity until the coach completes the training course required under this subsection."	
Rhode Island	"…(a) The department of education and the department of health shall work in concert with the Rhode Island Interscholastic League to develop and promulgate guidelines to inform and educate coaches, teachers, school nurses, youth athletes, and their parents and/or guardians of the nature and risk of concussion and head injury, including continuing to play after concussion or head injury. A concussion and head injury information sheet shall be signed and returned by the youth athlete and	16 R.I. GEN. LAWS §§ 16-91-1 to -4 (2016)

State	Provision Text	Citation[239]
	the athlete's parent and/or guardian prior to the youth athlete's return to practice or competition. (b) School districts are required to use training materials made available by the United States Center for Disease Control and Prevention entitled "Heads Up: Concussion in the High School Sports/Concussion in Youth Sports" and any updates or amendments thereto, or training materials substantively and substantially similar thereto. The department of education shall post training materials made available by the Center for Disease Control and Prevention and the Rhode Island Interscholastic League on its website. All coaches and volunteers involved in a youth sport or activity covered by this chapter must complete a training course and a refresher course annually thereafter in concussions and traumatic brain injuries. All school nurses must complete a training course and an annual refresher course in concussions and traumatic brain injuries. Teachers and teachers' aides are strongly encouraged to complete the training course in concussions and traumatic brain injuries. Training may consist of videos, classes, and any other generally accepted mode and medium of providing information. (c) School districts are encouraged to have all student athletes perform baseline neuropsychological testing, computerized or otherwise. Parents and/or guardians shall be provided with information as to the risk of concussion and/or traumatic brain injuries prior to the start of every sport season and they shall	

State	Provision Text	Citation[239]
	sign an acknowledgement as to their receipt of such information."	
South Carolina	"…(A) The South Carolina Department of Health and Environmental Control, in consultation with the State Department of Education, shall post on its website nationally recognized guidelines and procedures regarding the identification and management of suspected concussions in student athletes. The Department of Health and Environmental Control also shall post on its website model policies that incorporate best practices guidelines for the identification, management, and return to play decisions for concussions reflective of current scientific and medical literature developed by resources from or members of sports medicine community organizations including, but not limited to, the Brain Injury Association of South Carolina, the South Carolina Medical Association, the South Carolina Athletic Trainer's Association, the National Federation of High Schools, the Centers for Disease Control and Prevention, and the American Academy of Pediatrics. Guidelines developed pursuant to this section apply to South Carolina High School League-sanctioned events. (B) A local school district shall develop guidelines and procedures based on the model guidelines and procedures referenced in subsection (A). (C) Each year prior to participation in athletics, each school district shall provide to	S.C. CODE ANN. § 59-63-75 (2016).

State	Provision Text	Citation[239]
	all coaches, volunteers, student athletes, and their parents or legal guardian, an information sheet on concussions which informs of the nature and risk of concussion and brain injury, including the risks associated with continuing to play after a concussion or brain injury. The parent or legal guardian's receipt of the information sheet must be documented in writing or by electronic means before the student athlete is permitted to participate in an athletic competition or practice."	
South Dakota	"…The South Dakota High School Activities Association, in concert with the Department of Education, shall develop guidelines to inform and educate member schools, coaches, athletes, and the parents or guardians of athletes, of the nature and risk of concussion, including continuing to play after sustaining a concussion. A concussion information sheet shall be signed and returned by any athlete who seeks to compete in activities sanctioned by the South Dakota High School Activities Association and the athlete's parent or guardian prior to the athlete's participation in any youth athletic activities sanctioned by the South Dakota High School Activities Association. A signed information sheet is effective for one academic year. The guidelines and information sheet shall include protocols and content consistent with current medical knowledge for informing and educating each member school, coach, and athlete participating in athletic activities sanctioned by the South Dakota High School Activities Association, and the athlete's parent or guardian as to:	S.D. CODIFIED LAWS §§ 1336-4 to -14 (2017)

State	Provision Text	Citation[239]
	(1) The nature and risk of concussions associated with athletic activity; (2) The signs, symptoms, and behaviors consistent with a concussion; (3) The need to alert appropriate medical professionals for urgent diagnosis or treatment if an athlete is suspected to have received a concussion; and (4) The need to follow proper medical direction and protocols for treatment and return to play after an athlete sustains a concussion. The South Dakota High School Activities Association and the South Dakota Department of Education shall develop a training program consistent with § 13-36-9. Each coach participating in athletic activities sanctioned by the South Dakota High School Activities Association shall complete the training program each academic year."	
Tennessee	"…(a) This section applies to school youth athletic activity. (b)(1) The governing authority of each public and nonpublic elementary school, middle school, junior high school and high school, working through guidance approved by the department of health and communicated through the department of education, shall at a minimum: (A) Adopt guidelines and other pertinent information and forms as approved by the	TENN. CODE ANN. §§ 68-55-501 to 503 (2016).

State	Provision Text	Citation[239]
	department of health to inform and educate coaches, school administrators, youth athletes and their parents or guardians of the nature, risk and symptoms of concussion and head injury, including continuing to play after concussion or head injury; (B) Require annual completion by all coaches, whether the coach is employed or a volunteer, and by school athletic directors of a concussion recognition and head injury safety education course program approved by the department. In developing the program, the department may use any of the materials readily available from the centers for disease control and prevention, but shall include the centers' concussion signs and symptoms checklist which must be used by a licensed health care professional, coach or other designated person making a determination as to whether a youth athlete exhibits signs, symptoms or behaviors consistent with a concussion. The department shall make the concussion recognition and head injury safety education course program available on its web site for any school to access free of charge. The program shall include, but not be limited to: (i) Current training in recognizing the signs and symptoms of potentially catastrophic head injuries, concussions and injuries related to second impact syndrome; (ii) The necessity of obtaining proper medical attention for a person suspected of having sustained a concussion; and (iii) The nature and risk of concussions,	

State	Provision Text	Citation[239]
	including the danger of continuing to play after sustaining a concussion and the proper method and statutory requirements that must be satisfied in order for a youth athlete to return to play in the athletic activity; (C) Require that, on a yearly basis, a concussion and head injury information sheet be signed and returned by each coach and athletic director and, if appointed, a licensed health care professional to the lead administrator of a nonpublic school or, for a public school, the local education agency's director of schools prior to initiating practice or competition for the year; (D) Require that, on a yearly basis, a concussion and head injury information sheet be reviewed by all youth athletes and an athlete's parent or guardian. The information sheet shall be signed and returned by the youth athlete, if the youth athlete is eighteen (18) years of age or older, otherwise by the athlete's parent or guardian, prior to the youth athlete's initiating practice or competition to confirm that both the parent or guardian and the youth athlete have reviewed the information and understand its contents. The information sheet shall include, but not be limited to: (i) Written information related to the recognition of symptoms of head injuries; (ii) The biology and the short-term and long-term consequences of a concussion written in layman's terminology; (iii) A summary of state board of education rules and regulations relative to safety regulations for the student's	

State	Provision Text	Citation[239]
	participation in extracurricular athletic activities; and (iv) The medical standard of care for post-concussion participation or participation in an extracurricular athletic activity; (E) Maintain all documentation of the completion of a concussion recognition and head injury safety education course program and signed concussion and head injury information sheets for a period of three (3) years... (a) This section applies to community-based youth athletic activity. (b)(1) Any city, county, business or nonprofit organization that organizes a community-based youth athletic activity for which an activity fee is charged, working through guidance from the department of health, shall at a minimum: (A) Adopt guidelines and other pertinent information and forms as developed by the department of health to inform and educate the director of the youth athletic activity, coaches, youth athletes and their parents or guardians of the nature, risk and symptoms of concussion and head injury, including continuing to play after concussion or head injury; (B) Require annual completion by the director of the youth athletic activity, all coaches, whether a coach is employed or a volunteer, and, if appointed, the licensed health care professional of a concussion recognition and head injury safety education	

State	Provision Text	Citation[239]
	course program developed by the department. In developing the program, the department may use any of the materials readily available from the centers for disease control and prevention, but shall include the centers' concussion signs and symptoms checklist which must be used by a licensed health care professional, coach or other designated person making a determination as to whether a youth athlete exhibits signs, symptoms or behaviors consistent with a concussion. The department shall make the concussion recognition and head injury safety education course program available on its web site for any youth athletic activity operated by a city, county, business or nonprofit organization to access free of charge. The program shall include, but not be limited to: (i) Current training in recognizing the signs and symptoms of potentially catastrophic head injuries, concussions and injuries related to second impact syndrome; (ii) The necessity of obtaining proper medical attention for a person suspected of having sustained a concussion; and (iii) The nature and risk of concussions, including the danger of continuing to play after sustaining a concussion and the proper method and statutory requirements that must be satisfied in order for a youth athlete to return to play in the athletic activity; (C) Require that, on a yearly basis, a concussion and head injury information sheet be signed and returned by each coach to the head of the youth athletic activity prior to	

State	Provision Text	Citation[239]
	initiating practice or competition for the year; (D) Require that, on a yearly basis, a concussion and head injury information sheet be reviewed by all youth athletes and an athlete's parent or guardian. The information sheet shall be signed and returned by the youth athlete, if the youth athlete is eighteen (18) years of age or older, otherwise by the athlete's parent or guardian, prior to the youth athlete's initiating practice or competition to confirm that both the parent or guardian and the youth athlete have reviewed the information and understand its contents. The information sheet shall include, but not be limited to: (i) Written information related to the recognition of symptoms of head injuries; (ii) The biology and the short-term and long-term consequences of a concussion written in layman's terminology; and (iii) The medical standard of care for post-concussion participation or participation in an athletic activity; (E) Maintain all documentation of the completion of a concussion recognition and head injury safety education course program and signed concussion and head injury information sheets for a period of three (3) years..."	
Texas	"…A student may not participate in an interscholastic athletic activity for a school year until both the student and the student's parent or guardian or another person with legal authority to make medical decisions for the	TEX. EDUC. CODE ANN. §§ 38.151.160 (West 2015)

State	Provision Text	Citation[239]
	student have signed a form for that school year that acknowledges receiving and reading written information that explains concussion prevention, symptoms, treatment, and oversight and that includes guidelines for safely resuming participation in an athletic activity following a concussion. The form must be approved by the University Interscholastic League. a) The University Interscholastic League shall approve for coaches of interscholastic athletic activities training courses that provide for not less than two hours of training in the subject matter of concussions, including evaluation, prevention, symptoms, risks, and long-term effects. The league shall maintain an updated list of individuals and organizations authorized by the league to provide the training. (b) The Texas Department of Licensing and Regulation shall approve for athletic trainers training courses in the subject matter of concussions and shall maintain an updated list of individuals and organizations authorized by the board to provide the training. (c) The following persons must take a training course in accordance with Subsection (e) from an authorized training provider at least once every two years: (1) a coach of an interscholastic athletic activity; (2) a licensed health care professional who serves as a member of a concussion oversight team and is an employee, representative, or agent of a school district or open-enrollment	

State	Provision Text	Citation[239]
	charter school; and (3) a licensed health care professional who serves on a volunteer basis as a member of a concussion oversight team for a school district or open-enrollment charter school. (d) A physician who serves as a member of a concussion oversight team shall, to the greatest extent practicable, periodically take an appropriate continuing medical education course in the subject matter of concussions. (e) For purposes of Subsection (c): (1) a coach must take a course described by Subsection (a); (2) an athletic trainer must take: (A) a course described by Subsection (b); or (B) a course concerning the subject matter of concussions that has been approved for continuing education credit by the appropriate licensing authority for the profession; and (3) a licensed health care professional, other than an athletic trainer, must take: (A) a course described by Subsection (a) or (b); or (B) a course concerning the subject matter of concussions that has been approved for continuing education credit by the appropriate licensing authority for the profession.	

State	Provision Text	Citation[239]
	(f) Each person described by Subsection (c) must submit proof of timely completion of an approved course in compliance with Subsection (e) to the school district superintendent or the superintendent's designee or, in the case of a home-rule school district or open-enrollment charter school, a person who serves the function of a superintendent or that person's designee. (g) A licensed health care professional who is not in compliance with the training requirements under this section may not serve on a concussion oversight team in any capacity."	
Utah	"…Each amateur sports organization shall: (1) adopt and enforce a concussion and head injury policy that: (a) is consistent with the requirements of Section 26-53-301; and (b) describes the nature and risk of: (i) a concussion or a traumatic head injury; and (ii) continuing to participate in a sporting event after sustaining a concussion or a traumatic head injury; (2) ensure that each agent of the amateur sports organization is familiar with, and has a copy of, the concussion and head injury policy; and (3) before permitting a child to participate in a sporting event of the amateur sports	UTAH CODE ANN. §§ 26-53-101 to 102, -201, 301, -401 (West 2016).

State	Provision Text	Citation[239]
	organization: (a) provide a written copy of the concussion and head injury policy to a parent or legal guardian of a child; and (b) obtain the signature of a parent or legal guardian of the child, acknowledging that the parent or legal guardian has read, understands, and agrees to abide by, the concussion and head injury policy."	
Vermont	"… b) Guidelines and other information. The Secretary of Education or designee, assisted by members of the Vermont Principals' Association selected by that association, members of the Vermont School Boards Insurance Trust, and others as the Secretary deems appropriate, shall develop statewide guidelines, forms, and other materials, and update them when necessary, that are designed to educate coaches, youth athletes, and the parents and guardians of youth athletes regarding: (1) the nature and risks of concussions and other head injuries; (2) the risks of premature participation in athletic activities after receiving a concussion or other head injury; (3) the importance of obtaining a medical evaluation of a suspected concussion or other head injury and receiving treatment when necessary; (4) effective methods to reduce the risk of concussions occurring during athletic	VT. STAT. ANN. tit. 16, § 1431 (2016)

State	Provision Text	Citation[239]
	activities; and (5) protocols and standards for clearing a youth athlete to return to play following a concussion or other head injury, including treatment plans for such athletes. (c) Notice and training. The principal or headmaster of each public and approved independent school in the State, or a designee, shall ensure that: (1) the information developed pursuant to subsection (b) of this section is provided annually to each youth athlete and the athlete's parents or guardians; (2) each youth athlete and a parent or guardian of the athlete annually sign a form acknowledging receipt of the information provided pursuant to subdivision (1) of this subsection and return it to the school prior to the athlete's participation in training or competition associated with a school athletic team; (3)(A) each coach of a school athletic team receive training no less frequently than every two years on how to recognize the symptoms of a concussion or other head injury, how to reduce the risk of concussions during athletic activities, and how to teach athletes the proper techniques for avoiding concussions; and (B) each coach who is new to coaching at the school receive training prior to beginning his or her first coaching assignment for the school; and (4) each referee of a contest involving a high	

State	Provision Text	Citation[239]
	school athletic team participating in a collision sport receive training not less than every two years on how to recognize concussions when they occur during athletic activities."	
Virginia	"…A. The Board of Education shall develop and distribute to each local school division guidelines on policies to inform and educate coaches, student-athletes, and their parents or guardians of the nature and risk of concussions, criteria for removal from and return to play, risks of not reporting the injury and continuing to play, and the effects of concussions on student-athletes' academic performance. B. Each local school division shall develop policies and procedures regarding the identification and handling of suspected concussions in student-athletes. Such policies shall: 1. Require that in order to participate in any extracurricular physical activity, each student-athlete and the student-athlete's parent or guardian shall review, on an annual basis, information on concussions provided by the local school division. After having reviewed materials describing the short- and long-term health effects of concussions, each student-athlete and the student-athlete's parent or guardian shall sign a statement acknowledging receipt of such information, in a manner approved by the Board of Education…"	VA. CODE ANN. § 22.1271.5 (2017)

State	Provision Text	Citation[239]
Washington	"…(2) Each school district's board of directors shall work in concert with the Washington interscholastic activities association to develop the guidelines and other pertinent information and forms to inform and educate coaches, youth athletes, and their parents and/or guardians of the nature and risk of concussion and head injury including continuing to play after concussion or head injury. On a yearly basis, a concussion and head injury information sheet shall be signed and returned by the youth athlete and the athlete's parent and/or guardian prior to the youth athlete's initiating practice or competition."	WASH. REV. CODE § 28A.600.190 (2016)
Washington D.C.	"… (a) The Mayor shall establish, through rulemaking, a training program on: (1) The nature and risk of a concussion; (2) The criteria for the removal of an athlete from physical participation in an athletic activity and his or her return to it; and (3) The risks to an athlete of not reporting an injury and continuing to physically participate in the athletic activity. (b) The Mayor shall determine, through rulemaking, which individuals shall be required to complete the training program. (c) In addition to those individuals required to complete the training program, the Department of Health may make the program available to any interested individual, including school personnel, parents, students, and athletes."	D.C. CODE §§ 72871.01-.05 (2017)

State	Provision Text	Citation[239]
West Virginia	"… (d) The rules required by this section shall include, but are not limited to, the following: Guidelines and other pertinent information to inform and educate appropriate school administrators, coaches, interscholastic athletes and their parents or guardians of the nature and risk of concussion and head injury including the risks of continuing to play or practice after a concussion or head injury; A concussion and head injury information sheet that shall be signed and returned by the interscholastic athlete and the athlete's parent or guardian on an annual basis before the interscholastic athlete begins practice or competition; A requirement that each head coach of an interscholastic sport at a high school or middle school who is a member of the West Virginia Secondary School Activities Commission complete a commission-approved concussion and head injury recognition and return-to-play protocol course annually…"	W. VA. CODE § 18-2-25a (2016)
Wisconsin	"… (2) In consultation with the Wisconsin Interscholastic Athletic Association, the department shall develop guidelines and other information for the purpose of educating athletic coaches and pupil athletes and their parents or guardians about the nature and risk of concussion and head injury in youth athletic activities. (3)(a) At the beginning of a season for a youth athletic activity, the person operating the youth athletic activity shall distribute a concussion and head injury information sheet to each	WIS. STAT. § 118.293 (2017)

State	Provision Text	Citation[239]
	person who will be coaching that youth athletic activity and to each person who wishes to participate in that youth athletic activity. No person may participate in a youth athletic activity unless the person returns the information sheet signed by the person and, if he or she is under the age of 19, by his or her parent or guardian. (b) 1. Notwithstanding par. (a), a public or private school is not required to distribute an information sheet to a pupil enrolled in the school who wishes to participate in a youth athletic activity operated by the school during a school year, and a pupil enrolled in the school may participate in that youth athletic activity without returning an appropriately signed information sheet for that activity, if the pupil has returned an appropriately signed information sheet for another youth athletic activity operated by the school during the same school year. 2. Notwithstanding par. (a), a private club is not required to distribute an information sheet to a person who wishes to participate in a youth athletic activity operated by the private club, and a person may participate in that youth athletic activity without returning an appropriately signed information sheet for the activity, if the person has returned an appropriately signed information sheet to the club within the previous 365 days."	

State	Provision Text	Citation[239]
Wyoming	"… (xxxiii) To assist local school districts in developing protocols under W.S. 21-3-110(a)(xxxii) and in sufficient time to enable school districts to adopt and implement protocols commencing school year 2011-2012, develop model protocols for addressing risks associated with concussions and other head injuries resulting from athletic injuries. No district shall be required to adopt any part of the model protocols… (xxxii) Commencing school year 2011-2012, adopt protocols to address risks associated with concussions and other head injuries resulting from athletic injuries. Implementation of this paragraph shall be subject to the immunity provisions of the Wyoming Governmental Claims Act. The protocols shall:) Include training of coaches and athletic trainers to facilitate the recognition of symptoms of concussions;) Address restrictions concerning participation in school athletic events after suffering a concussion or head injury;) Include means for providing to students and parents information on head injuries and concussions and related restrictions on participation in athletic activities."	WYO. STAT. ANN. §§ 21-2-202(a)(xxxiii), 21-3110(a)(xxxii) (2017).

APPENDIX A2. ANNOTATED SUMMARY TABLE OF RESEARCH STUDIES ON CONCUSSION EDUCATION INTERVENTIONS

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
Cook et al. (2003) [240]	In the 2001-a2002 hockey season, 3 of 5 hockey teams were randomly assigned to view the ThinkFirst Canada Smart Hockey video (60 minutes), viewed at mid-season.	2 of 5 hockey teams were randomly assigned to receive no educational intervention.	Youth hockey	75 11-year old male youth hockey players from 5 teams in the Greater Toronto Youth Hockey League (15% response rate).	2 question quiz (short answer) on the signs and causes of concussion given to treatment group immediately before and after video at midseason and 3 months later. The quiz was given to control group at mid-season	Treatment group showed increased knowledge from before the video to immediately after the video, with this improved knowledge maintained 3 months later while control group showed no knowledge gains from mid-season to 3 months later; Although there were no changes in the total number of	Comparisons are made across teams; Treatment video was viewed as a team; Mean number of penalties /1,000 player hours was calculated and used in data analysis; Cross checking and checking from

240. D. J. Cook et al., *Evaluation of the Thinkfirst Canada, Smart Hockey, Brain and Spinal Cord Injury Prevention Video*, 9 INJ. PREVENTION 361 (2003).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
					and 3 months later; Number and type of penalties by each team were recorded throughout the entire season, although methods of obtaining this information were not specified.	penalties committed by both groups after the video, athletes in the treatment group had fewer cross checking and checking from behind penalties after watching the video; There were no changes in the frequency of these penalties from athletes in the control group.	behind penalties put players at a high risk of injury and the consequences of these behaviors were emphasized in the video.

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
Goodman et al. (2006)[241]	Study 1: Some participants (specific number not specified) were randomly assigned by the computer to play the computer game Symptom Shock[3] (6 minutes) that used an audio	Study 1: Some participants (specific number not specified) were randomly assigned by the computer to play a control version of the Symptom Shock computer game.	Youth hockey	Study 1: 130 youth hockey players ages 11-17 from 11 different teams in the Kamloops Minor Hockey Association in British Columbia, Canada; Gender not specified but assumed to be	Study 1: 36 question quiz (true/false) where participants indicated whether or not the item listed is a concussion symptom was given immediately after playing Symptom Shock.	Study 1: Participants in treatment group identified more concussion symptoms correctly than participants in the control group. In addition, the participants in the treatment group completed the quiz faster than participants in the control group.	Symptoms listed on the quiz were the same concussion symptoms seen in the treatment condition of Symptom Shock; The only difference between Study 1 and Study 2 was the participa

241. David Goodman et al., *Video Gaming Promotes Concussion Knowledge Acquisition in Youth Hockey Players*, 29 J. ADOLESCENCE 351 (2006). 3 The Symptom Shock computer game shows concussion and non-concussion symptoms on a screen and players must match identical symptoms and then identify whether or not they are appropriate symptoms for a concussion. Correct responses move your puck forward towards your opponent's net and incorrect responses move you backwards, and the aim is to score a goal in your opponent's net. The control version of the game has players match animals and faces instead of concussion symptoms.

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	overlay to explain game instructions; Years of data collection not specified.			males.			nts and the way that instructions were presented to participants. In Study 1, participants were given instructions via an audio overlay while in Study 2, participants were given instructions via an interactive tutorial. The game itself and the quiz remained the same.
	Study 2: 16 of 33 participants were randomly assigned by the computer to play Symptom Shock using an interactive tutorial to explain game instructions;	Study 2: 17 of 33 participants were randomly assigned by the computer to play a control version of the Symptom Shock computer game.	Youth hockey	Study 2: 33 youth hockey players ages 13-14 from 7 different teams playing in a Richmond Minor Hockey Association Bantam C Tournament in British Columb	Study 2: 36 question quiz (true/false) where participants indicated whether or not the item listed is a concussion symptom was given immediately after playing Symptom Shock.	Study 2: Participants in treatment group identified more concussion symptoms correctly than participants in the control group. In addition, the participants in the treatment group completed the quiz faster than participants in the control group.	

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	Years of data collection not specified.			ia, Canada; Gender not specified but assumed to be males.			
Gianotti and Hume (2007) [242]	From July 2003 to June 2005, 30,000 Sideline Concussion Check cards (SCCs) were mailed to rugby coaches or distributed to rugby coaches at	Concussion/brain injury (CBI) moderate to serious claims (MSCs) made in 2002/2003, before the distribution of SCCs, were compared to CBI MSCs made in 2003/2004 and	Focused on rugby, but included data for skiing and horseback riding (both of which also distributed SCCs), as well as for cycling, motorsports,	People who made claims to New Zealand's Accident Compensation Corporation (ACC); claims can be made from any age group and were not	In January 2006, data from July 1999 to June 2005 were extracted from the Accident Compensation Corporation (ACC) database. This data included: the number of CBI MSCs	There was a 10.7% decrease in rugby CBI MSCs from 2002/2003 (before treatment) to 2004/2005 even though there was in increase in the number of rugby players in this time period.; Comparatively, there was only a 4.2% decrease in CBI MSCs	A medical doctor makes the diagnosis for a CBI claim to the ACC; It is not stated when the other sports received their Sideline Concussion Check cards, although it is

242. Simon Gianotti & Patria Hume, *Concussion Sideline Management Intervention for Rugby Union Leads To Reduced Concussion Claims*, 22 NEUROREHABILITATION 181 (2007).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	RugbySmart workshops (20,000 SCCs were mailed or distributed at workshops in 2003/2004 and 10,000 SCCs were distributed at workshops in 2004/2005).	2004/2005, after the distribution of SCCs; Outcomes measured in rugby were compared to outcomes measured in other sports and nonsports from 1999 to 2005; CBI MSCs in sports in which the SCCs were distributed were compared to sports where the SCCs were not	league, and water-related sports (all of which did not distribute SCCs) when making comparisons	specified in the article.	made to the ACC, where the CBI MSC occurred (sport or non-sport), the type of sport in which the CBI MSC occurred, and the number of days between the CBI occurrence and seeking of medical treatment. The cost effectiveness of the SCCs was also calculated.	in other sports and a 16.9% increase in non-sport CBI MSCs; Sports where SCCs were distributed showed a decrease in CBI MSCs after 2003/2004 while most sports without SCC distribution showed a continual increase in CBI MSCs from 1999/2000 to 2004/2005; There was a decrease in the median number of days between getting a CBI MSC and seeing a medical	assumed that they were also distributed between 2003 and 2005.

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
		distributed from 1999 to 2005.				professional in rugby players from 6 days in 1999 to 2003 to 4 days in 2003 to 2005, but a similar decrease was seen in other sports; It was estimated that SCC distribution saves $690,690 with a return on investment of $12.60 for every $1 invested.	
Mitchko et al. (2007) [243]	Pretesting of CDC video: Focus groups of high school	Not applicable.	High school football, track, soccer, softball, lacrosse, swimmin	Two focus groups, one containing 6 male high	Discussion on thoughts of video and how the video might change	After viewing the video, athletes stated that they would be more likely to see	Pretesting and pilot testing led to the final version of

243. Jane Mitchko et al., *CDC's Approach to Educating Coaches About Sports-Related Concussion*, 38 AM. J. HEALTH EDUC. 105 (2007).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	students and one coach, where the CDC video was viewed; Years of data collection not specified.		g, baseball, wrestling, basketball, volleyball, and field hockey.	school football players and coach from Maryland and one containing 14 male and female high school student athletes from Virginia.	their behavior.	a healthcare professional after a head injury and more likely to consider whether they had symptoms of concussion after being hit in the head.	CDC's Heads Up: Concussion in High School Sports toolkit; The years in which this pretesting and pilot testing took place were not specified, but it was before September 2005.
	Pretesting of CDC toolkit for coaches: Focus groups of high school coaches regarding the toolkit; Years of data	Not applicable.	High school football, basketball, baseball, soccer, softball, wrestling, and volleyball	6 in-person focus groups with 50 high school coaches from Texas, Virginia, and California and 2 conference calls	Discussion on coaches' thoughts of the toolkit and how it might change their behavior.	After reviewing the toolkit, coaches reported that they were more educated about concussions, believed concussions to be more severe than they previously	

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	collection not specified.			with 14 high school coaches from rural Montana, California, Colorado, Virginia, Pennsylvania, and Alabama; Coaches were male and female and coached male and female athletes.		thought, and had the intent to form an effective plan to manage concussions.	
	1,000 coaches were mailed the CDC toolkit	No control group.	High school soccer, softball, football, lacrosse,	500 high school coaches from Texas, Maine,	Phone surveys were used to determine coach opinions	Most coaches found the toolkit useful and easy to use, with many	

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	and then asked to complete a phone survey 2 weeks later; Years of data collection not specified.		wrestling, basketball, volleyball, gymnastics, ice hockey, and field hockey	Michigan, California, and North Carolina (1,000 coaches were selected to participate); Gender not specified.	on the toolkit about 2 weeks after the toolkit was mailed to them.	coaches saying that they would distribute the CDC concussion material to educate others; Many coaches also thought that the toolkit could be useful in developing a concussion management plan in their school.	
Valovich McLeod et al. (2007)[244]	250 coaches were asked to complete a survey via mail, at coaches' meetings, or	Not applicable	Not specified	156 coaches of youth (ages 814) sports (62% response rate)	21 question quiz, with 16 yes/no questions asking about concussion symptoms, 1 question	Coaches who had participated in a coach education program prior to completing the survey were more likely to recognize a greater	

244. Valovich McLeod et al., *Sport-Related Concussion Misunderstandings Among Youth Coaches*, 17 CLINICAL J. SPORTS MED. 140 (2007)

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	after practice; Years of data collection not specified.				presenting a scenario and requiring a yes/no answer about whether a concussion occurred, and 4 true/false questions on managing concussions.	number of concussion symptoms.	
Gianotti et al. (2009)[245]	At the beginning of the rugby season in March 2001, RugbySmart was	Survey data from 1996, 1997, and 1998 (before RugbySmart implementation)	Rugby	Rugby players (all ages) from the New Zealand Rugby Union; 1,125 male	In September 2006, the number of reported MSCs was collected from the	The injury claim rate for head/neck/spine injuries decreased from 122 per 100,000 players in 2001 to 93 per 100,000 players in	The incidence data reported here is not specific to concussions and therefore

245. Simon Gianotti et al., *Evaluation of Rugbysmart: A Rugby Union Community Injury Prevention Programme*, 12 J. SCI. & MED. SPORT 371 (2009).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	implemented.	were compared to survey data from 2005 (after RugbySmart implementation); Moderate to serious injury claims (MSCs) reported to the Accident Compensation Corporation (ACC) were compared from 2001, when RugbySmart was first implemented,		rugby players in a senior amateur club over the age of 19 completed the ACC survey (554 from 1996, 1997, and 1998 combined and 571 from 2005).	ACC database for the years 2001 through 2005. The number of rugby participants each year was collected from the New Zealand Rugby Union. Survey data on self-reported safe behaviors from the ACC was collected in 1996, 1997, 1998 (before RugbySmart), and in	2005. There was an increase in the percentage of players who self-reported safe tackling, safe scrum, and safe ruck from 1996, 1997, and 1998 (before RugbySmart) to 2005 (after RugbySmart).	was not included in the article.

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
		through 2005.			2005 (after RugbyS mart).		
O'Donoghue et al. (2009) [246]	221 high school coaches were asked to complete a survey; Years of data collection not specified.	Not applicable	17 high school sports, including football, lacrosse, soccer, gymnastics, and basketball; the other 12 sports were not specified	126 high school coaches (57% response rate) from 12 high schools (35% response rate) in 4 Virginia cities agreed to participate.	24 question quiz (multiple choice) on concussion knowledge with 8 questions on concussion recognition, 8 questions on concussion management, and 8 questions on concussion preventio	Coaches who had previously attended a concussion workshop had higher scores on concussion management questions than coaches who had not previously attended a concussion workshop; No difference in concussion knowledge between coaches who indicated they had previously reviewed CDC's Heads	Concussion defined as "injury to the brain after a blow to the head resulting in transient alterations in neurological functioning".

246. Erin M. O'Donoghue et al., *Assessment of High School Coaches' Knowledge of Sport-Related Concussions*, 1 ATHLETIC TRAINING SPORTS HEALTH CARE 120 (2009).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
					n.	Up toolkit and those who had not.	
Echlin et al. (2010) [247]	At the beginning of the 2009-2010 hockey season, 16 of 58 hockey players were randomly assigned to view the ThinkFirst concussion DVD (length of video not specifie	22 of 58 players were randomly assigned to receive no educational intervention.	Junior league hockey	58 male junior league hockey players (ages 16-21) from two teams; Location is not specified.	26 question quiz (multiple choice and true/false) on concussion knowledge and concussion management given to treatment groups before and after treatment at the beginning of the season,	There was no change in knowledge of concussions or concussion management over time for participants in the DVD, ICM, or control groups; When the data for the DVD and ICM groups were combined, participants in the treatment group appeared to have greater improvement	Comparison made between players; One team dropped out 21 days after the treatment so there was not a large enough sample size to analyze the effect of the treatment after 30

247. Paul S. Echlin et al., *A Prospective Study of Concussion Education in 2 Junior Ice Hockey Teams: Implications for Sports Concussion Education*, 29 NEUROSURGICAL FOCUS E6 (2010).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	d) and 20 of 58 players were randomly assigned to do the Interactive Computer Module (ICM, length not specified).				after 15 games (50 days), and after 30 games (91 days). The same quiz was given to the control group at the beginning of the season, after 15 games, and after 30 games.	s in quiz score after 15 games than participants in the control group, although this difference only approached significance.	games; This study was part of the Hockey Concussion Education Project.
Glang et al. (2010) [248]	40 of 75 coaches were randomly assigned to view the ACTive:	35 of 75 coaches were randomly assigned to read a CDC article on	Not specified	75 coaches of youth ages 10-14 in community sport; Nationa	50-question quiz containing 45 true/false questions on concussi	Coaches in the treatment group had greater gains in concussion symptom recognition, general	

248. Ann Glang et al., *Online Training in Sports Concussions for Youth Sports Coaches*, 5 INT'L J. SPORTS SCI & COACHING 1 (2010).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	Athletic Concussion Training using Interactive Video Education online video (3 short modules, 1520 minutes in total); Years of data collection not specified.	bicycle and pedestrian safety (15-20 minutes).		1 sample.	on symptoms, general concussion knowledge, and concussion misperceptions; and 10 questions on self-efficacy and behavioral intention rated on a 5-point Likert was given immediately before and after reviewing material.	concussion knowledge, concussion misperception recognition, self-efficacy, and behavioral intention after viewing the material compared to coaches in the control group.	

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
Sarmiento et al. (2010) [249]	1,009 high school coaches who had ordered and received the CDC's Heads Up: Concussion in High School Sports toolkit between September 2005 and July 2006 were asked to complete a survey.	No control group.	High school football, boys/girls basketball, boys/girls soccer, baseball, boys hockey, boys gymnastics, boys lacrosse, boys rugby, boys/girls tennis, fencing, girls volleyball, softball, and track and field	333 high school coaches who had received the Heads Up toolkit (33% response rate); National sample; 6 focus groups were conducted with 23 coaches who completed the survey.	Survey containing multiple choice, Likert scale, and open-ended questions was mailed to participants regarding concussion knowledge, attitudes, and behaviors; Focus groups of about 4 coaches were conducted using open-	Half of coaches viewed concussions more seriously after using the toolkit; One-third of coaches reported learning something new; coaches who implemented the toolkit being more likely to report learning something new and to report an attitude change. The majority of coaches educated other coaches and athletes	

249. Sarmiento et al., *Evaluation of the Centers for Disease Control and Prevention's Concussion Initiative for High School Coaches: 'Heads Up: Concussion in High School Sports'*, 80 J. SCHOOL HEALTH 112 (2010).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
					ended questions.	about concussions following review of the toolkit, and 38% changed the way they prevent and manage concussions.	
Sawyer et al. (2010)[250]	In 2005, 5,121 high school coaches were mailed the CDC Heads Up: Concussion in High School Sports toolkit and were selected to complet	No control group.	High school football, boys/girls basketball, boys/girls softball, boys/girls volleyball, boys/girls soccer, boys/girls wrestling, girls	497 randomly selected high school coaches employed in Maine, Michigan, California, North Carolina, and Texas (10% response rate).	40 question telephone survey (open-ended and closed-ended questions) on demographic information, use of the toolkit, and assessment of the toolkit	About 80% of coaches displayed or planned to display the CDC concussion poster from the toolkit in high traffic areas and about 80% planned to disseminate the Fact Sheets for Athletes and Parents. Almost all coaches rated the toolkit	

250. Richard J. Sawyer et al., *High School Coaches' Assessments, Intentions to Use, and Use of a Concussion Prevention Toolkit: Centers for Disease Control and Prevention's Heads Up: Concussion in High School Sports*, 11 HEALTH PROMOTION PRAC. 34 (2010).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	e a survey.		field hockey, ice hockey, boys/girls lacrosse, and gymnastics		was given about two weeks after mailing the toolkit.	positively and found it useful. About 80% found the toolkit easy to use.	
Chrisman et al. (2011) [251]	In 2009, 500 pediatricians, 500 family physicians, and 500 internists were selected from the American Medical Association	250 physicians from each group were randomly selected to receive the survey, but not the CDC Heads Up physicia	No sport specified.	414 physicians (27.2% response rate)	A four-page survey, consisting of 35 items designed to measure physician concussion knowledge, experience with concussi	There was no significantly difference between the intervention and control group in general concussion knowledge. There was a significant difference between these groups for the return-to-play	

251. Sara P. Chrisman et al., *Physician Concussion Knowledge and the Effect of Mailing the CDC's "Heads Up" Toolkit*, 50 CLINICAL PEDIATRICS 1031 (2011). 14 The toolkit consisted of a cover letter, a 23-page booklet describing the nature, diagnosis, and management of concussions, a concussion check card, a concussion evaluation form, concussion information for patients, and a CD-ROM with more concussion resources.

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	physician master file to receive the CDC Heads Up physician toolkit[14] and a concussion knowledge survey. 250 physicians from each group were randomly selected to receive the materials.	n toolkit.			ons, and concussion management scenarios. The knowledge section contained nine true-false questions, with responses along a 5-item Likert scale, ranging from strongly disagree to strongly agree. The concussion management scenario, which measure	scenario, with physicians who received the intervention less likely to recommend next-day return-to-play than the control group.	

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
					d likelihood of physician to recommend return to play, consisted of one scenario with five different symptom presentations, with each presentation requiring a response on a 4item Likert scale, ranging from 'definitely not safe to return to play' to 'definitely safe to		

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
					return to play'.		
Koh (2011) [252]	In the 2008-2009 snowboarding season, students in a snowboarding class were given a concussion education presentation related to snowboarding developed by the research	No control group.	Snowboarding	208 male and female college students ages 18-32 in a snowboarding class at a South Korea university (93% response rate).	20 question quiz (question type not specified) on concussion knowledge given immediately before and after treatment; survey on concussion history and use of protective equipment given	Concussion knowledge significantly increased following treatment; There was no difference in concussion knowledge between snowboarders who got a concussion during the course and who did not.	Concussion defined as "direct or indirect blow to the head or elsewhere on the body…with an impulsive force transmitted to the head resulting in various physiological signs and symptoms as

252. Jae O. Koh, *Effect of Snowboard-Related Concussion Safety Education for Recognizing Possible Concussions*, 51 J. SPORTS MED. & PHYSICAL FITNESS 625 (2011).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	er on the first day of class (30 minutes).				on the last day of class.		identified from a symptoms checklist;" 1 snowboard exposure is 1 snowboarder on 1 day.
Bagley et al. (2012) [253]	599 students participated in the Sports Legacy Institute Community Educators (SLICE) curriculum (40-60 minute presentation);	No control group.	Not specified	599 male and female students ages 9-18 from 18 elementary, middle, and high schools; Location not specified.	7 question quiz containing 2 free response questions asking students to list concussion symptoms and to identify appropriate concussi	The average quiz score improved after treatment; Additionally, 80% of students passed the quiz (scored 50% or higher) after treatment compared to 34% of students who passed the quiz prior to treatment.	

253. Alexander F. Bagley et al., *Effectiveness of the SLICE Program for Youth Concussion Education*, 22 CLINICAL J. SPORTS MED. 385 (2012).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	Years of data collection not specified.				on responses and 5 true/false and multiple choice questions on concussion knowledge given before and after treatment.		
Bramley et al. (2012) [254]	In the winter of 2009-2010, 183 student athletes were mailed a survey.	Not applicable	High school soccer	60 male and female high school soccer players (9th-12th grade) from Ohio and Pennsylvania	4 question quiz: one yes/no question asking if athletes had received concussion education; one question	Statistically significant association between having concussion education and athlete intention to tell a coach about a potential concussion; No	

254. Harry Bramley et al., *High School Soccer Players with Concussion Education are More Likely to Notify Their Coach of a Suspected Concussion*, 51 CLINICAL PEDIATRICS 332 (2012).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
				(33% response rate).	asking if it is OK for athletes to continue play if they suffer a concussion, rated as never OK, sometimes OK, or always OK; 2 questions with different potential concussion scenarios asking if the athlete would never, sometimes, or always tells their coach.	relationship between prior concussion education and intention to return to a game after receiving a concussion, although almost all players indicated that someone with a concussion should not return to play.	

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
Covassin et al. (2012)[255]	1,000 coaches were selected to complete a survey after utilizing CDC Heads Up: Concussions in Youth Sports materials; Years of data collection not specified.	No control group.	Youth football, soccer, softball, basketball, cheerleading, baseball, teeball, and volleyball	340 randomly selected coaches in the National Alliance for Youth Sports (NAYS)[256] who had received CDC Heads Up materials (34% response rate); National sample.	22 question survey was given to coaches after they had seen the materials on the usefulness of the CDC material, their awareness and perceptions of concussion, the role of coaches in concussi	The majority of coaches learned something from the CDC materials and they self-reported that they can now more easily identify concussion symptoms, believe concussions to be a serious issue, and recognize the role of concussion safety; Most coaches educated others about	

255. Tracey Covassin et al., *Educating Coaches About Concussion in Sports: Evaluation of the CDC's "Heads Up: Concussion in Youth Sports" Initiative*, 82 J. SCHOOL HEALTH 233 (2012).

256. The NAYS is an organization that advocates for safety in youth sports. NAYS offers a coach training program through the National Youth Sports Coaches Association (now called the NAYS Coach Training and Membership Program). Being a member of NAYS gives coaches access to the NYSCA training program, which provides information on building kids' confidence, sportsmanship, safety, and how to teach skills for a specific sport. NAYS also offers a free concussion training course.

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
					on safety, and concussion incidence.	concussion prevention and management after receiving the CDC materials; 66/321 coaches reported a concussion during the previous season.	
Miyashita et al. (2013) [257]	50 participants sat through a PowerPoint lecture regarding concussion symptoms, side effects, and concussi	No control group.	College Division II soccer and basketball	50 NCAA Division II male and female soccer and basketball players at Metropolitan State Univers	10 question quiz, including 4 questions on personal concussion history and 6 multiple choice and true/false questions	Concussion knowledge increased from before treatment to the end of the sports season; At the end of the season, 6 participants self-reported that they got a concussion during that season, with 3 of the 6	

257. Theresa L. Miyashita et al., *The Impact of an Educational Intervention on College Athletes' Knowledge of Concussions*, 23 CLINICAL J. SPORT MED. 349 (2013).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	on management, presented by the researcher at the beginning of the season (20 minutes); Years of data collection not specified.			ity of Denver.	on concussion knowledge, was given before the season (immediately before treatment), and after the season (January for soccer and March for basketball).	stating that the treatment lecture influenced their immediate reporting and management of the concussion.	
Torres et al. (2013) [258]	919 Division I athletes were emailed a link to a	Not applicable	College Division I football, basketball, lacrosse	262 Division I male and female athletes at the Univers	35 question quiz on concussion reporting intentions rated	Athletes who indicated that they had previously experienced a concussion were more likely to be	

258. Daniel M. Torres et al., *Sports-Related Concussion: Anonymous Survey of a Collegiate Cohort*, 3 NEUROLOGY: CLINICAL PRAC. 279 (2013).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	survey; Year of data collection not specified.		, soccer, wrestling, and others.	ity of Pennsylvania (29% response rate).	on a 5-point Likert scale, knowledge of concussion symptoms, whether they had discussed concussions with their athletic trainer or doctor, concussion history, and whether they had received formal concussion education.	formally educated about concussions; No analyses were done comparing the knowledge and behavioral intentions of athletes who had received formal concussion education and those who had not.	
Courn oyer and Tripp (2014)	In first half of the 2012 football	Not applicable	High school football	314 male high school football	75 question quiz (true/false)	No relationship found between prior	

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
[259]	season, 334 student athletes were asked to complete a survey.			players (94% response rate) from 11 high schools in North Central Florida (85% response rate).	containing 50 questions asking participants to identify concussion symptoms, 24 questions asking participants to identify possible long-term consequences of mismanaged concussions, and 1 question asking whether participants had been	concussion education given by a parent, formal source, or both and knowledge of concussion symptoms or long-term consequences of concussions.	

259. Janie Cournoyer & Brady L. Tripp, *Concussion Knowledge in High School Football Players*, 49 J. ATHLETIC TRAINING, 654 (2014).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
					previously educated about concussions.		
Cusimano et al. (2014) [260]	8 of 17 teams were randomly assigned to view the Smart Hockey: More Safety, More Fun video; Length of video not specified; Years of data collection not specifie	9 of 17 teams were randomly assigned to have a discussion with the researcher about injuries in hockey instead of viewing the video. There was time for questions from	Youth hockey	135 youth hockey players ages 10 (n=89) and 14 (n=46) from 17 teams in the Greater Toronto Area; 267 players from 31 teams began the study but did not complete the 2	22 question quiz containing 11 multiple choice questions on general concussion knowledge, signs of concussion, and return to play; 4 questions rated on a 4-point Likert scale regardin	There was an increase in concussion knowledge for participants in the treatment group immediately following the video, but this knowledge decreased to where it was before the video after two months; There was no difference in concussion knowledge between the treatment	Video is shown as a team.

260. Michael D. Cusimano et al., *Effectiveness of an Education Video on Concussion Knowledge in Minor League Hockey Players: A Cluster Randomised Controlled Trial*, 48 BRIT. J. SPORTS MED. 141 (2014).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	d.	players and the discussion included information on the symptoms and management of concussions.		month follow up, thus they were not included in the analysis; Gender not specified.	g attitudes of concussion; and 7 questions rated on a 4-point frequency scale from never to frequently on behaviors related to concussion given to treatment and control group immediately before the video or discussion; The 11 concussion knowledge	and control group both before the video or discussion and two months later; When splitting participants by age, the 10 year-olds in both the treatment and control groups did not show changes in concussion knowledge from before the video or discussion to 2 months later; However, the 14 year-olds in the treatment group showed increased concussion knowledge both immediately	

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
					questions were given to the treatment group again immediately after the video. The entire quiz retaken by both groups 2 months later.	after the video and 2 months later when compared to their knowledge before the video while the 14 year-olds in the control group did not show changes in concussion knowledge 2 months later; There was no change in concussion attitudes or concussion-related behaviors from before the video or discussion to 2 months later for both the treatment and control groups.	

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
Echlin et al. (2014) [261]	In the winter term of the 2012-2013 school year, 146 of 299 students were randomly assigned to view a concussion education emodule (40 minutes).	153 of 299 students were randomly assigned to receive no education training.	Not applicable	299 male and female ninth grade students ages 13-14 from 4 public high schools in Ontario, Canada	25 question quiz (multiple choice and true/false) on basic concussion knowledge given to treatment and control groups one week before treatment. Given to treatment group immediately after treatment and given to	Students in both the treatment and control groups showed gains in concussion knowledge from the first quiz to the second quiz, but these gains were significantly greater for students in the treatment group.	This study was part of the Sport Concussion Education Project

261. Paul S. Echlin et al., *The Sport Concussion Education Project. A Brief Report on an Educational Initiative: From Concept to Curriculum*, 121 J. NEUROSURGERY 1331 (2014).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
					control group one week after first quiz.		
Higginson et al. (2014) [262]	160 NCAA Division I student athletes were surveyed about their concussion history, reporting history, and perceived effectiveness of NCAA concussion education in a cross-	No control group.	No sport specified.	160 NCAA Division I student athletes from a Midwestern university.	Participants were provided a written knowledge test and asked questions regarding their history of concussion, their history of reporting past concussions or concussion symptoms, and their personal assessment of the	54 student athletes reported that they had sustained at least one concussion through participating in NCAA sports. Of these student athletes, 62.9% didn't report their concussion symptoms. Athletes who reported their symptoms and athletes who didn't report their symptoms did not have	

262. Liam Higginson et al., *The Evaluation of the Effectiveness of NCAA Concussion Education Legislation*: *640 Board# 55 May 28, 2*, MED. & SCI. SPORTS & EXERCISE 162 (2014).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	sectional research study.				effectiveness of NCAA concussion education.	significantly different perceptions of the effectiveness of NCAA concussion education.	
Kroshus et al. (2014)[263]	In fall 2012, all athletes from 6 college hockey teams received concussion education from their institution, as required by the NCAA; Delivery of concussion educatio	No control group.	College Division I ice hockey	146 male college hockey players from 6 teams in the same NCAA Division I hockey conference	42 question quiz containing 25 true/false questions on concussion knowledge with 10 questions regarding attitudes towards concussions, 5 questions regarding subjective norms towards	There were no significant changes in concussion knowledge, attitudes, or subjective norms after receiving concussion education; Following concussion education, there was a small change in behavioral intention, such that players indicated they would be less likely to continue	Players receive concussion education as a team; one of the 6 teams received concussion education materials over the summer so this team only took one quiz,

263. Emily Kroshus et al., *NCAA Concussion Education in Ice Hockey: An Ineffective Mandate*, 48 BRIT. J. SPORTS MED. 135 (2014).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	n varied by team, but players from all teams received a concussion handout either in person (4/6) or via email (2/6); Players from 4 teams were also given a lecture on concussions, and players from 1 team were given both a lecture				concussions, and 1 question on intention to play with concussion symptoms rated on a 5-point Likert scale from strongly disagree to strongly agree, as well as an open ended question asking participants to describe their concussion education; The quiz was	playing if they thought they got a concussion; Not all athletes remembered receiving concussion education, but those who did remember receiving a lecture had a greater change in behavioral intention than players who did not remember or did not receive a lecture; Players on the team that had both a lecture and video had significantly greater improvements in concussion knowledge	which was included with quizzes that other teams took after concussion education

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	and a video (length of lectures and video not specified).				given the day before participants received concussion education (before the hockey season) and the day after participants received concussion education.	compared to other teams; Although no changes were significant, players on the team that had both a lecture and video had significantly better attitudes and behavioral intentions following education than players on other teams.	
Kurowski et al. (2014) [264]	496 student athletes were asked to complete a quiz during preseaso	Not applicable	High school football, boys/girls soccer, boys/girls basketb	496 male and female high school athletes ages 13-18	38 question quiz containing 27 true/false questions on concussi	Previous concussion education was associated with greater concussion knowledge but not better	

264. Brad Kurowski et al., *Factors that Influence Concussion Knowledge and Self-Reported Attitudes in High School Athletes*, 77 J. TRAUMA & ACUTE CARE SURGERY, S12 (2014).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	n training.		all, and boys/girls wresting.	from 2 suburban high schools near Cincinnati, Ohio.	on symptoms and general concussion knowledge and 11 questions rated as never, sometimes, or always regarding concussion attitudes and behaviors; quiz was given during preseason training.	attitudes and behavioral intentions.	
Manasse, Cohick and Shapley	160 football players received a concussi	No control group.	High school football	160 football players from 2 Southern	41 question quiz containing 9 true/false	Players showed a statistically significant improvement in concussion	

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
(2014) [265]	on education presentation conducted by the researcher, which included a video modified from the CDC's Heads Up: Concussion in High School Sports—Information for Coaches (5 minutes) and a PowerPoint presenta			California high schools; Gender not specified.	questions on concussion symptoms, 14 true/false questions on concussion knowledge, 3 true/false questions based on scenarios that makes up the concussion knowledge index, and 15 questions regarding concussion attitudes rated on a 5-point Likert	knowledge following treatment but did not show significant changes in concussion attitudes following treatment.	

265. Nancy J. Manasse-Cohick & Kathy L. Shapley, *Concussion Education for High School Football Players: A Pilot Study*, 35 COMMUNICATIONS DISORDERS Q. 182 (2014).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	tion (20 minutes) with time for a question /answer session afterwards; Years of data collection not specified.				scale that make up the concussion attitude index; quiz given 2 weeks before treatment and immediately after treatment.		
Rivara et al. (2014) [266]	In the 2012 fall sports season, 778 student athletes participated in a study examining concussion	Not applicable	High school football and girls' soccer	20 Washington high schools; 68 high schools were contacted 778 football and girls' soccer	Coaches given survey on awareness of return to play recommendations and concussion education as well as 6	122 out of 778 athletes reported 147 concussions in the 2012 fall sports season. 100 out of the 147 reported were concussions new for that season. Cumulative incidence=10	Defined concussion as: 2 or more symptoms that were given a score greater than a 1 on the 6point scale from the

266. Frederick P. Rivara et al., *The Effect of Coach Education on Reporting of Concussions Among High School Athletes After Passage of a Concussion Law*, 42 AM. J. SPORTS MED. 1197 (2014).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	incidence			players in grades 9-12 and their parents	question quiz on concussion knowledge before season. Athletes are given a baseline survey about prior concussions; athletes call in weekly throughout the fall sports season to report the number of games and practices they participated in and whether they experienced concussio	.7%. Overall incidence=3.6/1,000 athlete exposures (greater incidence rate in games than practice in both football and soccer). Coach concussion education did have an effect on whether the coach was aware or unaware of the athlete concussions that occurred in the 2012 fall sports season. When coach education was provided by quiz or video, coaches were less likely to be aware of concussions.	SCAT-2 OR 1 symptom with a score of 5 of 6 that persisted for more than a few hours. Cumulative incidence: the number of new cases of concussions divided by the number of athletes in the study Overall incidence rate: number of new cases of concussions

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
					n symptoms; parents call in weekly to report the number of games and practices their child participated in and whether their child experienced concussive symptoms; if concussive symptoms were reported by parent or athlete, the athlete was called by a		divided by the number of reported athlete exposures.

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
					research assistant to get more information about symptoms and severity.		
Glang et al. (2015) [267]	In August-November 2011, 13 of 25 high schools (including 445 of 1,004 parents and 2,264 of 4,804 athletes) were randomly assigned to receive access to Brain	12 of 25 schools (including 559 of 1,004 parents and 2,180 of 4,804 athletes) were randomly assigned to review safety material from the CDC; Parents read material	High school fall sports, including football, soccer, cheerleading, volleyball, water polo, wrestling, basketball, and color guard	4, 804 male and female fall student athletes and 1,004 parents from 25 Oregon high schools.	36 question quiz containing 26 true/false questions on concussion knowledge, 6 questions rated on a 5-point Likert scale regarding knowledge application, and 4 questions	Parents and athletes in the treatment group had greater gains in concussion knowledge, knowledge application, and behavioral intention than those in the control condition; More schools in the treatment program created a concussion management	Comparison made between schools

267. Ann E. Glang et al., *The Effectiveness of a Web-Based Resource in Improving Post-Concussion Management in High Schools*, 56 J. ADOLESCENT HEALTH 91 (2015).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	101: The Concussion Playbook website and online training (about 45 minutes); Athletic directors and principles of these schools were asked to implement Brain 101 policies, such as starting a concussion management team.	on safe teen drivers while student athletes read material on teen safety while working.			rated on a 5-point Likert scale measuring intention to report a concussion given to student athletes immediately before and after reviewing materials; 38 question quiz containing 18 true/false questions on symptom identification, 10 questions rated on a 5-point Likert	team than schools in the control program; There were 201 documented concussions in the treatment group for an incidence rate of 51.5 concussions/ 1,000 Fall athletes and 153 documented concussions in the control group for an incidence rate of 43.2 concussions/ 1,000 Fall athletes; There was no statistically significant difference in concussion incidence rates between schools; Out	

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
					scale regarding knowledge application and 10 questions providing a concussion scenario with the intention to respond to the concussion rated on a 5-point Likert scale given to parents immediately before and after reviewing materials; Interview with	of the athletes who received a concussion, there were no statistically significant differences between schools in the average time for the athlete to return to play, whether the athlete saw a healthcare professional, the average days of school missed, and whether the athlete received special accommodations at school.	

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
					school administration asked about the development of concussion management team; Athletic trainers kept concussion logs to keep track of incidence		
Hotz et al. (2015) [268]	20 high school football teams (10 in fall 2013 and 10 in fall 2014) with a total of 563	In fall 2014, 9 high school football teams with a total of 483 athletes were assigned to	High school football	1,046 high school football players ages 13-18 from 29 high schools in Miami-Dade County;	17 question multiple choice quiz on concussion knowledge given to treatment group before	Participants in the treatment group demonstrated no significant changes in concussion knowledge from before treatment to immediately	

268. Gillian Hotz et al., *The Challenges of Providing Concussion Education to High School Football Players*, 2 CURRENT RES.: CONCUSSION 103 (2015).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	athletes were assigned to receive Sports Legacy Institute Community Educators (SLICE) training (30 minutes) before the first game of the football season.	receive no training.		Gender not specified.	treatment, immediately after treatment, and 6 months after treatment. Quiz given to control group at the beginning of the football season and 6 months later.	after treatment and from before treatment to 6 months later; However, participants in the control group had increased concussion knowledge 6 months later compared to the beginning of the season, and this knowledge was significantly greater than the knowledge of participants in the treatment group.	

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
Hunt (2015) [269]	34 of 68 student athletes were randomly assigned to watch a concussion video created by the researchers (9 minutes); Years of data collection not specified.	34 of 68 athletes were randomly assigned to watch a nutrition video from McGraw Hill's Fitness Video Series (10 minutes).	High school volleyball and football	68 male and female high school varsity and junior varsity athletes ages 13-18 from 3 Division I high schools in South Carolina (81% response rate).	17 question quiz (true/false) on concussion symptom identification given to participants immediately before and after viewing the appropriate video.	Significant difference for time and group-by-time interaction but not for group, meaning that overall (including both groups) there was a significant increase in number of concussion symptoms identified from before the video to after the video and that when separated out by group, the improvement in symptom identification in the treatment group was	Participants viewed video with those in the appropriate treatment/control group at their school; each school had participants in both treatment and control groups.

269. Tamerah N Hunt, *Video Educational Intervention Improves Reporting of Concussion and Symptom Recognition*, 10 ATHLETIC TRAINING EDUC. J. 65 (2015).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
						significantly greater than the improvement in the control group.	
Kerr et al. (2015) [270]	In 2014 season, data was collected from 741 of 2,108 players from 27 teams in 2 leagues that had completed USA Football's Heads Up Football program [271] and were	704 of 2,108 players from 29 teams in 3 leagues who had not completed USA Football's Heads Up Football program and were not affiliated with Pop Warner Football.	Youth football	2,108 youth football players ages 515 from 100 teams in 10 leagues in Arizona, Indiana, Massachusetts, and South Carolina;	Athletic trainers attended practices and games for each team, recording concussions and exposure time.	45 concussions were reported in the 2014 season; concussion rates in practice: Heads Up Football+Pop Warner=0.19/1,000 AEs, Heads Up Football Only=0.65/1,000 AEs, No Heads Up Football=0.59/1,000AEs; Significant difference in	Athlete-exposure (AE): 1 athlete in 1 game or practice; Injury rate: total # of concussions/ total # of AE

270. Zachary Y. Kerr et al., *Comprehensive Coach Education and Practice Contact Restriction Guidelines Result in Lower Injury Rates in Youth American Football*, 3 ORTHOPAEDIC J. SPORTS MED. 1 (2015).

271. USA Football's Heads Up Football program educates coaches on a variety of topics, including concussion education, correct use of equipment, and proper tackling techniques

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	affiliated with Pop Warner Football;[272] and from 663 of 2,108 players from 44 teams in 4 leagues that had completed USA Football's Heads Up Football program but were not affiliated with Pop Warner Football.			Gender not specified.		concussion rates in practice between Heads Up Football + Pop Warner and Heads Up Football Only but no difference between Heads Up Football + Pop Warner or Heads Up Football Only and No Heads Up Football; Concussion rates in games: Heads Up Football + Pop Warner=0.68 /1,000 AEs, Heads Up Football Only=1.5/1,0	

272. Pop Warner Football sets specific guidelines, such that affiliates cannot do full-speed head-on tackling/blocking drills in practice and cannot have more than 1/3 of practice dedicated to contact drills

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
						00 AEs, No Heads Up Football=1.46/1,000AEs; no significant difference in concussion rates in games between all three groups; appears that differences in concussion rates is due to the presence of Pop Warner Football and not Heads Up Football	
Kerr et al. (2015) [273]	In the 2014 football season, data were collected from 38 players from 7	32 players from 8 teams from 2 leagues in South Carolina and 1 league in Arizona	Youth football	70 male youth football players ages 815 from 5 leagues in Arizona and	xPatch accelerometers were placed inside athlete helmets to determine the	7,478 head impacts of 10g or greater were recorded (2,841 in the Heads Up Football group and 4,637 in the non-Heads	This is a subsample of the data collected in the Kerr et al (2015) study above; One of

273. Zachary Y. Kerr et al., *Comprehensive Coach Education Reduces Head Impact Exposure in American Youth Football*, 3 ORTHOPAEDIC J. SPORTS MED 1 (2015).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	teams from 1 league from South Carolina and 1 league from Arizona who had completed USA Football's Heads Up Football program.	that did not participate in USA Football's Heads Up Football program.		South Carolina.	frequency of head impacts in games and practices.	Up Football group); 6 concussions were reported, all in the non-Heads Up Football group; Participants in the non-Heads Up Football group experienced significantly more 10g and 20g head impacts in practice than participants in the Heads Up Football group but this difference was not seen in games	the 7 teams in the Heads Up Football group is also affiliated with Pop Warner Football.

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
Kroshus et al. (2015)[274]	At the midpoint of the 2012-2013 hockey season, 22 athletes from 4 of 12 teams were randomly assigned to view the Concussions in Ice Hockey video (12 minutes). 56 athletes from 4 of 12 teams	26 athletes from 4 of 12 teams only received CDC's Heads Up Concussion in High School Sport: A Fact Sheet for Athletes.	Junior league hockey	103 male hockey players ages 18 or older from 12 teams in the same Tier III junior hockey league; teams were based in the northeast United States.	57 question quiz containing 48 questions regarding concussion knowledge, concussion attitudes, subjective reporting norms, concussion knowledge, reporting intention, and self-efficacy of reporting a concussion that	Under-reporting of concussions was significantly greater one month after treatment for participants who watched Head Games compared to before treatment, but there were no changes in reporting behavior for participants in the two other groups; Participants in all groups showed significant changes in subjective norms of reporting from baseline	Comparisons are made across teams; videos were viewed as a team

274. Emily Kroshus et al., *Pilot Randomized Evaluation of Publicly Available Concussion Education Materials: Evidence of a Possible Negative Effect*, 42 HEALTH EDUC. & BEHAV. 153 (2015).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	were randomly assigned to view the documentary Head Games (90 minutes); All teams also received the CDC's Heads Up Concussion in High School Sport: A Fact Sheet for Athletes.				were rated on a 7point Likert scale and 9 true/false questions on the experience of concussion symptoms during the season and whether a coach was informed was given before treatment, one day after treatment, and one month after treatment.	to both one day and one month later, such that participants were more likely to indicate that their teammates would support playing through concussive symptoms one month after treatment compared to before treatment; Participants who viewed the Concussions in Ice Hockey video showed greater changes in subjective norms one day after treatment compared to	

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
						the control group; There were no differences between groups in concussion knowledge, attitudes about concussions, reporting intentions, or self-efficacy and no changes in these outcomes across all three time points.	
Kurowski et al. (2015) [275]	In the fall 2012 season and the winter 2012-2013 season, 234	262 student athletes from a different high school were assigned to	High school football, boys/girls soccer, boys/girls basketball, and	496 male and female student athletes ages 13 to 18 from two	36 question quiz with 25 true/false question s on concussion	Participants in the treatment group showed gains in concussion knowledge, concussion attitudes, and	Comparisons were made between schools; lectures were given in groups

275. Kurowski et al., *Impact of Preseason Concussion Education on Knowledge, Attitudes, and Behaviors of High School Athletes*, 79 J. TRAUMA & ACUTE CARE SURGERY S22 (2015).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	student athletes in one high school were assigned to receive a concussion education lecture from the research coordinator (20 minutes) before the season began.	receive no educational training.	boys/girls wrestling	high schools in Cincinnati, Ohio.	knowledge and symptoms and 11 questions on behavioral intention and attitudes that students rated as never, sometimes, or always was given to the treatment group before treatment, immediately after treatment, and at the end of the season. The quiz was	behavioral intention immediately after treatment but these gains declined to baseline at the end of the season. There were no changes in these outcomes measures for participants in the control group, and at the end of the season there were no differences in these measures between the treatment and control groups; 43/167 students in the treatment group and 77/222 students in the control	of 20-30 people.

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
					given to the control group before the season began and at the end of the season; At the end of the	group reported concussion symptoms; 11/167 students in the treatment group and 13-122 students in the control	
					season athletes received a survey asking if they had experienced concussion during the season to measure incidence.	group received a concussion diagnosis from a healthcare professional; Of the students who self-reported concussion symptoms, 13/43 in the treatment group and 68/77 in the control group continued to play with	

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
						their concussion symptoms, which was found to be a significant difference; 3/11 students diagnosed with a concussion in the treatment group and 3/13 students diagnosed with a concussion in the control group returned to play while still experiencing concussion symptoms, which was not a significant difference	

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
Parker et al. (2015) [276]	From November 2012 to July 2013, pretest and post test data was obtained for all users of the National Federation of	No control group.	62% of participants were coaches, with sports including baseball, boys/girls basketball, bowling, boys/girls cross	133,764 participants completed the online training for the first time between November 2012 and July 2013; National sample	5 question quiz (multiple choice) on concussion knowledge taken immediately before and after treatment.	Overall, knowledge improved from before treatment to after treatment, but statistical analyses were not performed.	
	State High School Associations (NFHS)/ CDC online course Concussions in Sports:		country, field hockey, flag football, football, boys/girls golf, boys/girls gymnastics, ice				

276. Erin M. Parker et al., *Reach and Knowledge Change Among Coaches and Other Participants of the Online Course: "Concussion in Sports: What You Need to Know"*, 30 J. HEAD TRAUMA REHABILITATION 198 (2015).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	What You Need to Know (20 minutes).		hockey, boys/girls lacrosse, rugby, boys/girls soccer, softball, spirit, swimming, boys/girls tennis, boys/girls track, volleyball, boys/girls water polo, wrestling, and other				
Anderson et al. (2016) [277]	On the first day of football camp in summer 2012,	Not applicable.	High school football	120 male high school football players from	Quiz containing multiple choice and true/false	Prior concussion education was not associated with greater concussion	Two different quizzes both asking about concussi

277. Brit L. Anderson et al., *High School Football Players' Knowledge And Attitudes About Concussions*, CLINICAL J. SPORT MED. 206 (2016).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	120 high school football players completed a survey.			three high schools near Cincinnati, Ohio.	questions on concussion knowledge, questions rated on a Likert scale to measure concussion attitudes, and a question asking whether the athlete had been previously educated about concussions was given.	knowledge or concussion attitudes.	on knowledge and attitudes were used, although each participant only took one of the quiz versions.

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
Chinn and Porter (2016) [278]	Before the Fall 2014 sports season, 986 student athletes were given a survey.	Not applicable.	Community college football, volleyball, men's/women's soccer, and men's/women's water polo	986 male and female student athletes from seven community colleges; Specific age of participants not specified.	59 question quiz with true/false questions asking about concussion knowledge, questions rated on a 7-point Likert scale to determine concussion attitudes, and a question on prior concussion education.	There was an association between the number of times an athlete received concussion education and concussion knowledge, such that the more education received, the greater the concussion knowledge; No statistical tests were performed to determine whether a relationship between concussion attitudes and prior education exists.	

278. Nancy R. Chinn & Paul Porter, *Concussion Reporting Behaviours Of Community College Student-Athletes and Limits of Transferring Concussion Knowledge During the Stress of Competition*, BMJ OPEN SPORT & EXERCISE MED., Aug. 31, 2016 at 1 (2016).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
Eagles et al. (2016) [279]	At the beginning of the 2014-2015 youth hockey season, 43 players were given a Concussion-U presentation by a college hockey player who had retired due to concussions (30 minutes).	No control group.	Youth hockey	43 male youth hockey players ages 13-17 from 4 teams in the metropolitan area of St. John's.	41 question quiz containing 10 true/false questions on concussion symptoms, 13 true/false questions on concussion knowledge, 3 true/false questions based on scenarios that made up the concussion knowledge index, and 15 questions	There was a significant increase in concussion knowledge from before treatment to immediately after treatment and from before treatment to 4-6 months after treatment; Concussion attitude improved from before treatment to immediately after treatment but this increase was not sustained 4-6 months later.	

279. Matthew E. Eagles et al., *The Impact of a Concussion-U Educational Program on Knowledge of and Attitudes About Concussion*, 43 CAN. J. NEUROLOGICAL SCI. 659 (2016).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
					regarding concussion attitudes rated on a 5-point Likert scale that made up the attitude index given immediately before and after treatment, and 4-6 months after treatment.		
Elliott et al. (2016) [280]	From April 2014 to March 2015, 858 students received	No control group.	66% of students indicated they participate in sports, includin	858 youth ages 11-16 in grades 6-8 from 5	10 question quiz with multiple choice, true/false, and open-	Participants showed statistically significant improvements in concussion knowledge	

280. Ross-Jordan S. Elliott et al., *Pediatric Sport-Related Concussion Education: Effectiveness and Long-Term Retention of the Head Safety in Youth Sports (HSYS) Program for Youth Athletes Aged 11-16*, 3 COGENT EDUC. 1 (2016).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	the Head Safety in Youth Sports concussion education program, which is a PowerPoint presentation with videos presented by medical students (3545 minutes).		g: basketball, soccer, football, track, baseball, gymnastics, cycling, skating, wrestling, hockey rugby, volleyball, tennis, and swimming	middle schools in Texas.	ended questions on concussion knowledge given immediately before treatment and immediately after treatment.	following treatment.	
Hecimovich et al. (2016)[281]	From March 2015 to July 2015, parents of youth		Youth Australian Rules Football	1,441 male and female parents of youth ages 19	24 question quiz with 16 true/false questions on	Parents with prior concussion education had greater concussion knowledge	

281. Mark Hecimovich et al., *Player and Parent Concussion Knowledge and Awareness in Youth Australian Rules Football*, SPORT J., Apr. 1, 2016, at 1.

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	football players were asked to complete a survey.			or younger in Australian Rules Football.	concussion symptoms, 5 true/false questions on concussion knowledge, 2 scenarios with the intended behavior rated on a 3-point Likert scale, and 1 question regarding previous concussion education.	than parents without prior concussion education;	
Kroshus et al. (2016)[282]	In September 2013, 28,183 coaches	Not applicable.	Sports not specified; 55.1%	1,818 coaches of NCAA Divisio	18 question quiz containing 9	Coaches who indicated that they had previously received	

282. Emily Kroshus et al., *Content, Delivery, and Effectiveness of Concussion Education For US College Coaches*, 26 CLINICAL J. SPORTS MED. 391 (2016).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	were emailed a survey.		of coaches coached a contact/ collision sport, as determined by the NCAA Sports Medicine Handbook	n I, II, or II sports teams from 755 institutions (6% response rate); National sample.	questions on general concussion knowledge rated on a 5-point Likert scale, 4 scenarios of possible concussions rated on a 5-point scale from likely not a concussion to definitely a concussion, and 5 true/false questions regarding concussion management and return to	concussion training had greater general concussion knowledge, better ability to identify symptoms, and were less likely to allow a player to return to play with sustained concussion symptoms than coaches without previous concussion training.	

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
					play.		
Macdonald and Hauber (2016)[283]	In August 2014, 47 parents were given a presentation about concussions that included three parts: the CDC Heads Up Concussion Online Training, the CDC Heads	No control group.	High school contact sports, including football	29 parents of athletes in contact sports at an urban high school in the Southeastern United States (47 parents sat through the presentation but not all completed the quiz).	20 question quiz with 18 questions rated on a 5-point Likert scale asking about how each part of the presentation affected their concussion knowledge, concussion attitudes, and concussi	Participants indicated that the CDC Online Training was most helpful in changing their concussion knowledge, concussion attitudes, and concussion awareness. The CDC handout was rated as the second-most helpful tool in improving these outcomes with the YouTube video rated third;	

283. Ian Macdonald & Roxanne Hauber, *Educating Parents on Sports-Related Concussions*, 48 J. NEUROSCIENCE NURSING 297 (2016).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	Up to School: Know Your Concussion ABCs handout, and the YouTube video "Know Your Impact: Concussion Awareness" (30-40 minutes total).				on awareness, one question asking whether or not the parent would seek out more concussion information, and one question asking parents to rank the three parts of the presentation in terms of motivating them to seek out more information on concussions.	however, the CDC handout was rated as the most likely tool to motivate them to seek out more concussion information, followed by the YouTube video and then the CDC Online Training; a majority of participants had no desire to seek more information on concussions following the presentation.	

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
McDonald et al. (2016)[284]	During the 2011, 2012, and 2013 school years, 77 female high school athletes completed a survey.	Not applicable.	High school female soccer, softball, basketball, volleyball, track, cross country, dance, cheerleading, equestrian, swimming, gymnastics, tennis, bowling, and motocross	77 female high school athletes from three large high schools in metropolitan areas.	Quiz containing questions on the prior experience of concussion symptoms, number of concussion diagnoses, actions taken following a suspected concussion, and whether or not the participant had previously had concussion	Participants who had previously had concussion education did not have more concussion diagnoses than participants without prior concussion education; participants with prior concussion education were not removed from play after reporting symptoms more often and did not seek medical help after a suspected concussion more often	

284. Tracy McDonald et al., *Underreporting of Concussions and Concussion-Like Symptoms in Female High School Athletes*, 23 J. TRAUMA NURSING 243 (2016).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
					education was given.	than participants without prior concussion education.	
Bosshardt et al. (2017) [285]	120 male rugby players were given an educational presentation developed by the researchers, which consisted of a concussion knowledge assessment and a questionnaire of	No control group.	Rugby	120 male rugby players ages 16-18 from three rugby union schools in England	A knowledge assessment of concussion symptoms, diagnosis, and management, and a questionnaire of behavioral responses to concussion scenarios were administered before the	Athletes significantly improved the number of correct behavioral responses to the concussion scenarios, increasing from 46.1% pre-intervention to 53.9% post-intervention. Athletes also increased the number of correct responses in the knowledge assessment, from 37.85% preinterventi	

285. Chris Bosshardt et al., *Does Concussion Education Have an Impact in Behaviours Amongst School-Age Rugby Players?*, 51 BRIT. J SPORTS MED. A15 (2017).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	behavioral responses to concussion scenarios. Years of data collection were not specified.				intervention and between 2-3 months after the intervention.	on to 44.07% post-intervention, but this difference remained insignificant. Athletes significantly increased their awareness of union and school concussion guidelines, from 19.4% pre-intervention to 73.2% post-intervention.	
Caron et al. (2017) [286]	35 participants were given a concussion education	No control group.	High school basketball and hockey.	35 male high school athletes ages 15-17 from a private school	55 question quiz containing 37 true/false questions on symptom	Concussion knowledge increased from before treatment to after the fourth presentation and from	The first three presentations were given to all 35 participants at

286. Jeffrey G. Caron et al., *Development, Implementation and Assessment of a Concussion Education Programme for High School Student-Athletes*, 36 J. SPORTS SCI. 48 (2017).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	program developed by the researchers that contained four different interactive oral presentations, given about one week apart (30 minutes each session); the content of the presentations was different each week and included signs			in a large Canadian city; Two focus groups with a total of 11 participants were held.	s and general concussion knowledge (which, taken together, comprise the concussion knowledge index), and 18 questions regarding concussion attitudes rated on a 5-point Likert scale that make up the attitude index taken immediately before the first presentation, immediat	before treatment to two months after the fourth presentation; there was no difference in scores from after the fourth presentation to two months after the fourth presentation; there were no significant changes in concussion attitudes throughout the study; data from the focus groups supported these findings since athletes reported learning more about concussions from the presentation	once and the last presentation was given separately to the basketball and ice hockey teams.

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	of concussion, return to play guidelines, long term consequences of concussion, and how to prevent concussion; Years of data collection not specified.				ely after the fourth presentation, and two months after the fourth presentation; focus groups were held two weeks after the fourth presentation to get feedback on the treatment.	but not necessarily being more likely to report concussions as a result of the presentations; however, some athletes indicated that they may try to change their behavior to protect themselves from getting a concussion.	
Carroll-Alfano (2017) [287]	From March 2012 to April 2014, data was collected from 89 of 249	In spring 2012, data was collected from 160 of 249 who graduated high school	College football, softball, men's/women's basketball, men's/women's	249 male and female athletes in the National Association of	4 question quiz with one true/false question asking if the participant had	Participants who had received concussion training were not more likely to seek treatment after a	In summer 2011, Illinois and Indiana passed a law requiring high

287. Miriam Carroll-Alfano, *Mandated High-School Concussion Education and Collegiate Athletes' Understanding of Concussion*, 52 J. ATHLETIC TRAINING 689 (2017).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	participants who should have received mandatory concussion education in high school.	before the mandatory concussion education legislation was passed.	cross-country, men's/ women's track, men's/ women's soccer, men's/ women's volleyball, and others.	Intercollegiate Athletics at St. Xavier University who had attended high school in Indiana or Illinois.	attended concussion training, 2 true/false questions asking if the participant had received a concussion, and if so, if they sought treatment afterwards, and one open-ended question asking participants to list concussion symptoms.	concussion or able to list more concussion symptoms than participants who had not received training. Those who were in high school when concussion education was required did not appear to be more likely to seek treatment after receiving a concussion, although this statistical test was not performed; nor able to name more concussion symptoms than participants who were not in high	schools to provide concussion education materials to athletes; therefore, freshman entering college starting fall 2012 should have received the required concussion education; nonetheless, groups were split into those who reported receiving concussi

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
						school for this mandate	on training and those who did not for comparison in statistical analyses.
Conley and Savenye (2017)[288]	In spring 2012, data was collected from 11 of 23 students who had completed the Brainbook elearning course (50 minutes	12 of 23 students who had not taken the Brainbook training were used as a control group.	78% of students participated in sports, including volleyball, boys basketball, soccer (boys and girls), baseball, football, girls	23 male and female students in grades 9, 10, and 12 from a charter school in Arizona; archival data consisted of surveys from	20 question quiz on concussion knowledge was given 6 months after Brainbook training occurred; face to face interviews with students with 7 open-	The majority of students who had taken the Brainbook training did not change the way they played sports after the training, but some said they are more aware of concussions as a result of the training; students who had Brainbook	Statistical tests were not performed on this data.

288. Quincy Conley & Willi Savenye, *Brainbook: An Impact Study of a Statewide Concussion Awareness Training for High School Athletes*, 56 PERFORMANCE IMPROVEMENT, 28 (2017).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	) in October 2011; archival data of surveys completed by students after Brainbook training was also used.		tennis, wrestling, and softball	150,000 students from Arizona high schools who had previously completed the Brainbook course.	ended questions on concussion knowledge and attitude graded by the researchers on a 3-point rubric were given immediately before or after the quiz.	training had greater concussion knowledge compared to students without the training; students with Brainbook training stated they were less likely to take action in response to a concussion in a teammate or themselves than students without training; students in surveys from the archival data indicated they were made more aware of the risks of concussions from the training.	

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
Kobitowich et al. (2017) [289]	162 undergraduate students from a university participated in a prospective randomized controlled trial. Students were separated into one of three intervention groups: a control group, which was not provided with educational	The control group was not provided with any educational materials.	No sport specified	162 undergraduate students from a university.	Participants completed an 18item knowledge questionnaire before and after the intervention.	All groups demonstrated significantly higher postintervention scores compared to the preintervention scores. The presentation group demonstrated significantly higher postintervention scores than the control and internet group. There was no significant difference in post-intervention scores between the control group and the internet	

289. Tara Kobitowich & Martin Mrazik, *Concussion Education: A Randomised Trial with Undergraduate Students*, 51 BRIT. J. SPORTS MED. A62 (2017).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	materials; an internet group, which was provided with three educational websites and 30 minutes to review the website content; and the presentation group.					group.	
Payne et al. (2017)[290]	41 student athletes participated in an educational session	No control group.	High school boys and girls basketball and girls soccer.	41 male and female student athletes from a Pennsylvania	13 question quiz (true/false) on general concussion	There was no significant improvement in concussion knowledge following treatment.	

290. Ellen K. Payne et al., *Investigation of the Concussion Goggletm Education Program with Secondary School Athletic Team: A Pilot Study*, 2 J. SPORTS MED. & ALLIED HEALTH SCI.: OFFICIAL J. OHIO ATHLETIC TRAINERS ASS'N 1 (2017).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	developed by Innocorp, Ltd, the manufacturers of Concussion Goggles™, which gave students hands on experience with the Concussion Goggles™ (60 minutes); Years of data collection not specified.			high school.	knowledge given immediately before and after treatment.		

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
Caron et al. (2018) [291]	35 high school athletes were exposed to four oral concussion education presentations	No control group.	High school boys basketball and hockey.	35 male high school athletes, ages 15 to 17, from a private school in Canada.	Athlete knowledge and attitudes regarding concussions were evaluated at three time points (preintervention, post-intervention, and 2 months post-intervention) using the Rosenbaum Concussion Knowledge and Attitudes Survey, Student Version.	While athlete concussion knowledge significantly differed over time, with significant improvement noted between pre- and post-intervention, there was no significant difference in concussion attitudes over time. There was no significant difference between post-intervention and the 2-month follow-up.	

291. Jeffrey G. Caron et al., *Development, implementation and assessment of a concussion education programme for high school student-athletes*, J. SPORTS SCI. (2018).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
Daugherty et al. (2018) [292]	A usability and effectiveness assessment of a mobile application game (Heads Up Rocket Blades), developed by the CDC, was conducted by with 12 adults and 13 children at two time points: January 2015, and May/Ju	No control group.	No sport listed.	12 adults and 13 of their children.	The usability assessment consisted of parent and child questions regarding how easy the interface was to use, whether the game was enjoyable to play, and overall impressions of the game. The effectiveness assessment	During the second round of game testing, all children reported that the game was fun and enjoyable. All children correctly identified at least one core objective, and most were able to identify all three core objectives. All parents reported that the game was a good learning tool for teaching concussions, and most reported that they would download	

292. Jill Daugherty et al., *A Description and Evaluation of the Concussion Education Application HEADS UP Rocket Blades*, HEALTH PROMOTION PRAC. (2018).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	ne 2016.				determined whether or not children who played the game could understand at least one of the three core learning objectives predetermined by the CDC. These learning objectives were formulated using research on youth concussion and how youth retain concussi	the game for their children to play at home. Strengths of the game included how easy the game was to understand, how it taught children about important health issues, and its convenience.	

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
					on-related information.		
Hotz et al. (2018) [293]	During 201520 16, 152 high school football players were provided a 15minute concussion education video created by UConcussion.	No control group.	Football	152 high school athletes from three high school football teams.	Athlete knowledge was surveyed through ten multiple choice questions at three time points (preintervention, immediately postintervention, and three months postintervention). Attitudes, and behavioral questions	Athlete knowledge significantly differed across all time points measured. Athlete knowledge was significantly higher postintervention, and no significant differences were observed between post-intervention and the 3-month follow-up. The attitudes and behavioral questions	The authors only surveyed athlete behaviors and attitudes at the 3month follow-up time point. Therefore, this study did not reveal how athlete behaviors and attitudes changed as a result of the

293. Gillian Hotz, *Concussion: Video Education Program for High School Football Players*, 20 SPORT J. (2018).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
					were surveyed at the 3month postintervention	revealed significant differences across schools.	intervention.
Hunt et al. (2018) [294]	102 parents whose children are involved in athletics within the Georgia High School Association (GHSA) completed a survey that measured concussion knowled	No control group.	No sport listed.	102 GHSA parents. Survey participants were divided into two groups: those that reported receiving the GHSA concussion information sheet *only* (n = 54),	The 34-item on-paper survey contained questions about demographic information, concussion knowledge, and concussion scenarios designed to apply concussion knowledge.	Overall, parents displayed moderate knowledge of concussion. There was no significant difference in knowledge between parents that only received the GHSA information sheet and those that completed additional concussion training. There was	

294. Tamerah Hunt, N., Chloe Salway, Steve Patterson & Jody Langdon, *Concussion Knowledge and Understanding in Guardians Following Administration of Standardized Education Form*, 50 MED. & SCI. SPORTS & EXERCISE 477 (2018).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	ge.			and those that completed additional concussion education (n = 48).		no significant difference between performance on the concussion knowledge questions and the concussion scenario questions.	
Sullivan et al. (2018) [295]	From 2016-2017, 229 (59 participated) of 428 secondary school athletes from the Gaelic Athletic Association of Ireland participa	199 (153 participated) of the 428 athletes were assigned to a control group that did not receive the education	Football and/or hurling/ camogie	428 (212 participated) secondary school athletes from 35 (5 participated) teams in the Gaelic Athletic Associa tion of	Athletes completed a questionnaire at three time points (pre-intervention, immediately after the intervention and 3 months after the	Post-intervention, athletes who completed the intervention exhibited increased behavioral control over concussion symptom recognition, immediate disclosure of symptoms, and reporting intentions	

295. L. Sullivan, L. Pursell & M. Molcho, *Evaluation of a theory-based concussion education program for secondary school student-athletes in Ireland*, HEALTH EDUC. RES. (2018).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
	ted in a concussion education program based on the theory of planned behavior.			Ireland. Of the 428 participants, only	intervention) on their knowledge, attitudes toward concussion reporting, subjective reporting norms, perceived behavioral control, and reporting intention regarding concussion.	compared to their baseline attitudes. There were no significant differences between intervention athletes preintervention and postintervention regarding attitudes of perceived outcomes of concussion reporting and subjective reporting norms. Athletes who completed the intervention had significantly higher knowledge post-intervention and compared to controls. Athletes who	

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
						completed the intervention has significantly higher reporting intentions at the 3-month follow-up compared to controls, but there were no significant differences in perceived behavioral control, subjective reporting norms, and attitudes towards perceived consequences of concussion reporting.	

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
Wallace et al. (2018) [296]	In fall 2016, 102 high school athletes participated in a Concussion Bingo activity.	No control group.	High school football, volleyball, and women's basketball.	102 male and female high school athletes from two Title I urban high schools in northeast Ohio.	Concussion knowledge, including signs/symptoms (true/false), loss of consciousness, injured anatomical structures, risk of multiple concussions, and premature return to play, was assessed pre- and post-intervention using a 10-minute,	Post-intervention, athletes exhibited higher knowledge of "lesser" common signs and symptoms of concussion (i.e. fogginess, changes in mood, and nausea) and information regarding a concussive injury. Athletes exhibited moderately greater general concussion knowledge postintervention compared to pre-	Participants "marked" concussion terms on a bingo card as they appeared in a concussion education presentation.

296. Jessica Wallace, Tracey Covassin & Erica Beidler, *Concussion Bingo: Taking an active learning approach to concussion education with vulnerable populations*, HEALTH EDUC. J. (2018).

Study	Treatment / Intervention	Control conditions	Sport	Subject Population, with N	Outcome measures	Results	Notes on methods
					45-question survey.	intervention (78.3% correct to 86.1% correct).	

Habit Forming: Evidence of Physician Habit in Medical Negligence Litigation

Marc D. Ginsberg*

Abstract:

"Habit" is a time-honored component of the law of evidence. Habit evidence is generally understood as specific conduct which occurs repetitively, over a period of time, in response to a known stimulus. Habitual conduct is also thought to be non-volitional, suggesting that it encompasses conduct without thought.

This paper focuses on whether the practice of medicine is, in any respect, "habitual." Are medical negligence litigants, plaintiffs and physicians, entitled to introduce evidence of physician habit to demonstrate deviation from or compliance with the applicable standard of care? Is the practice of medicine entirely volitional and judgmental, such that classic habit evidence is inapplicable to medical negligence litigation? This Article addresses these topics in an effort to identify the various positions adopted by courts in the United States and recommends that courts receive physician habit evidence in medical negligence trials.

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TABLE OF CONTENTS

> A habit, from the standpoint of psychology, is a more or less fixed way of thinking, willing, or feeling acquired through previous repetition of a mental experience.[1]

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> The physician acquires a volitional habit of taking the pulse and asking patients certain questions. The habit is the familiar way in which his consciousness runs its course during a diagnosis.[2]

INTRODUCTION

Habit is a venerable topic of the law of evidence, pre-dating its appearance in the Federal Rules of Evidence by many years.[3] Of course, habit is currently memorialized by Federal Rule of Evidence 406, which provides:

Rule 406. Habit; Routine Practice

> Evidence of a person's habit or an organization's routine practice may be admitted to prove that on a particular occasion the person or organization acted in accordance with the habit or routine practice. The court may admit this evidence regardless of whether it is corroborated or whether there was an eyewitness.[4]

Rule 406 is an important rule of relevance[5] and admissibility,[6] yet it neither defines "habit" nor specifies who or what may be the source of habit evidence.

By not defining "habit," Rule 406 does not address the nature of habit evidence. On this point, commentators urge that habit "represents semi-automatic or unreflective behavior,"[7] also referred to as "nonvolitional activity that occurs with invariable regularity."[8] One commentator has emphasized that "[i]t is

1. B.R. Andrews, *Habit*, 14 AM. J. PSYCHOL. 121, 121 (1903).

2. *Id.*

3. *See generally* SIMON GREENLEAF, A TREATISE ON THE LAW OF EVIDENCE 53, § 14j. (1899); JOHN HENRY WIGMORE, TREATISE ON THE ANGLO-AMERICAN SYSTEM OF EVIDENCE IN TRIALS AT COMMON LAW, § 270, Rule 40 (1935).

4. FED. R. EVID. 406.

5. *See id.* at 401 (providing the basic definition of "relevance").

6. *See* GLEN WEISSENBERGER, & JAMES J. DUANE, FEDERAL RULES OF EVIDENCE: RULES, LEGISLATIVE HISTORY, COMMENTARY AND AUTHORITY 181 (7th ed. 2011).

7. CHRISTOPHER MUELLER ET AL., EVIDENCE 234-35 (6th ed. 2018); *see also* CHARLES TILFORD MCCORMICK, MCCORMICK'S HANDBOOK OF THE LAW OF EVIDENCE 463 (Edward W. Cleary ed., 2d ed. 1972); ROGER C. PARK ET AL., EVIDENCE LAW, A STUDENT'S GUIDE TO THE LAW OF EVIDENCE AS APPLIED IN AMERICAN TRIALS 296 (4th ed. 2018).

8. Weil v. Seltzer, 873 F.2d 1453, 1460 (D.C. Cir. 1989) (discussing physician habit in the

critical that a specific stimulus and a corresponding response can be discretely identified."[9] Examples of conduct indicative of habit include walking down stairs in a particular fashion, and signaling while driving an automobile[10]—essentially conduct undertaken without thought.

This discussion invites attention to the intersection of habit evidence and the practice of medicine. Do physicians engage in "nonvolitional [professional] activity that occurs with invariable regularity"[11] such that they may avail themselves of habit evidence in defense of medical negligence claims? Conversely, should medical negligence plaintiffs be able to use physician habit evidence to establish that defendant-physicians violated applicable standards of care? Or is medical treatment so necessarily patient specific, by virtue of involving the exercise of patient-specific thought and judgment, that the concept of "physician habit" is a misnomer?

This Article focuses on multiple physician habit evidence topics, including: medical judgment, the "requirement" of nonvolitional conduct, the sources of physician habit evidence and jurisprudence developed in the state and federal courts. Additionally, this paper concentrates on physician habit in non-informed consent litigation. The plan, therefore, is to explore the topic to determine whether physician habit evidence is a realistic evidentiary topic.

I. PHYSICIAN HUMANISM—CHARACTER VS. HABIT

Authors from the University of Pennsylvania have noted that "[h]umanism in medicine combines scientific knowledge and skills with respectful, compassionate care that is sensitive to the values, autonomy, and cultural backgrounds of patients and their families."[12] They identified the following "habits" which support the humanistic practice of medicine: self-reflection, seeking connection with patients, teaching/role modeling humanism, striving to achieve balance, mindfulness and spiritual practice.[13]

The identification of these "habits" requires a discussion of the distinction between character traits and habits. This distinction is necessary to an understanding of the inadmissibility of character evidence and the admissibility

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context of medical negligence). It should be noted that not all courts require non-volitional conduct as a condition of admissibility. The volitional nature of the conduct in question may "go to weight . . . not admissibility." Rosebrock v. E. Shore Emergency Physicians, LLC, 221 Md. App. 1, 20-22 (Md. Ct. Spec. App. 2015).

9. WEISSENBERGER & DUANE, *supra* note 6, at 182.

10. MUELLER ET AL., *supra* note 7, at 234-35; MCCORMICK *supra* note 7, at 462.

11. *Weil*, 873 F.2d at 1460.

12. Carol M. Chou et al., *Attitudes and Habits of Highly Humanistic Physicians*, 89 ACAD. MED. 1252, 1252 (2014).

13. *Id.* at 1254.

of habit evidence. Federal Rule of Evidence 404(a)(1) provides:

> *Rule 404—Character Evidence; Crimes or Other Acts*
>
> (a) Character Evidence.
>
> (1) *Prohibited Uses.* Evidence of a person's character or character trait is not admissible to prove that on a particular occasion the person acted in accordance with the character or trait.[14]

"[I]t is understood that character, for evidentiary purposes, means 'that the person has an ingrained propensity to act in a certain way.'"[15] Many commentators have explained the reasons for the underlying the inadmissibility of character evidence. I have previously provided the following example and explanation:

> [T]wo automobiles, driven by A and B, collide in a traffic-controlled intersection. Driver A has been involved in previous traffic accidents and has received traffic citations for poor driving—failure to conform to the traffic laws. Driver A tends to drive carelessly. Driver A's propensity, in this regard, is inadmissible to prove negligence in the intersection collision litigation. Driver A's prior carelessness does not prove the Driver A caused the intersection collision. In fact, Driver B may have caused the collision.[16]

• • • • •

What is the harm of allowing Driver B to "prove" Driver A's careless character trait? It has been explained that there are two justifications for this exclusionary rule: (1) the evidence may be too influential on the jury, and (2) "the prevention of nullification prejudice,"—the idea that the jury will use character evidence to reach a verdict despite evidence suggesting a different result.* Another equally cogent explanation is that: "character evidence carries a very high *intuitive* value . . . [t]his raises the distinct possibility that the jury will

14. FED. R. EVID. 404.

15. Marc D. Ginsberg, *An Evidentiary Oddity: "Careful Habit" – Does the Law of Evidence Embrace This Archaic/Modern Concept?*, 43 OHIO N.U.L. REV. 293, 297 (2017) (*citing* Glen Weissberger, *Character Evidence Under the Federal Rules: A Puzzle with Missing Pieces*, 48 CIN. L. REV. 1, 2 (1979)).

16. *Id.* at 297.

greatly overvalue character evidence as a predictor of conduct, and make an inaccurate assessment of the facts."[17]

It is quite clear that the concern with inadmissible character evidence in medical negligence litigation has been recognized for well more than one hundred years.[18]

I mention these fundamentals of character evidence in an admittedly circuitous attempt to urge that the six previously mentioned "habits" supporting a humanistic practice of medicine[19] are not habits as contemplated by Rule 406.[20] Instead, they are inadmissible character traits governed by Rule 404.[21]

Insofar as Rule 406[22] requires semi-automatic or non-volitional conduct,[23] it is fair to question whether physicians demonstrate professional habitual conduct at all. Patients are not fungible, and often require individualized treatment. Sir William Osler, a preeminent physician, notes: "Variability is the law of life, and as no two faces are the same, so no two bodies are alike, and no two individuals react alike and behave alike under the abnormal conditions which we know as disease."[24] Osler, therefore, suggests the need for thought and judgment in the treatment of patients. If so, is medical treatment consistent with semi-automatic or non-volitional conduct?

II. ONCE IS NOT ENOUGH—HABIT REQUIRES REPETITION

It seems intuitively obvious that habit evidence requires proof of repetition. At least one appellate court, in a medical negligence context, has made this point. In *Gerke v. Norwalk Clinic*,[25] a patient commenced a medical negligence claim

17. *Id.* at 298 (citing Barrett J. Anderson, *Recognizing Character: A New Perspective on Character Evidence*, 121 YALE L.J. 1914, 1928-29 (2012) (quoting Roger C. Park, *Character at the Crossroads*, 49 HASTINGS L.J. 717, 745 (1998)); Miguel A. Mendez, *The Law of Evidence and the Search for a Stable Personality*, 45 EMORY L.J. 221, 223-24 (1996); David P. Leonard, *The Federal Rules of Evidence and the Political Process*, 22 FORDHAM L. REV. 305, 311 (1995)).

18. *See* Holtzman v. Hoy, 118 Ill. 534 (1886) (discussing the impropriety of asking a defense medical witness about the defendant-physician's "reputation . . . in the community, and amongst the profession, as being an ordinarily skillful and learned physician").

19. Chou et al., *supra* note 12.

20. FED. R. EVID. 406.

21. *Id.* at 404.

22. *Id.* at 406.

23. *But see*, *Rosebrock*, 221 Md. App. 1; Aikman v. Kanda, 975 A.2d 152 (D.C. 2009) (parenthetical would be helpful here, please!).

24. SIR WILLIAM OSLER, *On the Educational Value of the Medical Society, in* AEQUANIMITAS: WITH OTHER ADDRESSES TO MEDICAL STUDENTS, NURSES AND PRACTITIONERS OF MEDICINE, p. 3 (1914); *see also* Mary V. Seeman & Robert E. Becker, *Osler and the Way We Were Taught*, 27 MED. SCI. EDUC. 555, 556 (2017). As to Osler's prominence as a physician, *see* Richard L. Golden, M.D., *William Osler at 150: An Overview of a Life*, 282 J. AM. MED. ASS'N 2252 (1999).

25. Gerke v. Norwalk Clinic, Inc., 2006-Ohio-5621, ¶ 1 (Ohio Ct. App. 2006).

against a physician and clinic for improper treatment of an ovarian cyst.[26] At trial, the jury returned a verdict for the defendants.

During trial, plaintiff unsuccessfully sought to introduce evidence of the defendant-physician's treatment of plaintiff's cyst eleven years earlier to demonstrate how the physician treated plaintiff in 1999. The Court of Appeals easily disposed of plaintiff's position, stating that:

> In order for evidence of habit to be admissible, it must establish a regular or routine practice. Evidence as to one or two isolated occurrences does not establish a sufficient regular practice of admission pursuant to Evid.R.406. [citations omitted].
>
> Here, appellant attempts to use a single act . . . to show that [defendant-physician] acted similarly in 1999 . . . The 1988 treatment is a single occurrence and does not establish a regular practice as required by Evid.R.406.[27]

There was nothing surprising or improper about the trial court's exclusion of the proposed "habit" evidence and the Court of Appeals' approval of the ruling. For habit to exist, evidence of repetition is required.

III. PHYSICIAN JUDGMENT AND VOLITION

Physician judgment is no stranger to the medical literature.[28] It is central to the practice of medicine. "Judgment has been defined as the ability to make correct decisions with uncertain, incomplete, or inconsistent information."[29] The primacy of medical clinical judgment has been explained as follows:

> A basis of this profession is *clinical judgment*. It lies at the heart of the doctor's connoisseurship, expertise and skills, being

26. "An ovarian cyst is a sac or pouch filled with fluid or other tissue that forms in or on an ovary." *What is an Ovarian Cyst?*, AM. C. OBSTETRICIANS & GYNECOLOGISTS, https://www.acog.org/Patients/FAQs/Ovarian-Cysts?IsMobileSet=false (last visited Aug. 14, 2019).

27. *Gerke*, 2006 WL 3041095, at *12.

28. *See* Michael Accad & Darrel Francis, *Does Evidence Based Medicine Adversely Affect Clinical Judgment?*, 362 BRITISH MED. J. 1 (2018); Gunver S. Kienle & Helmut Kiene, *Clinical Judgment and the Medical Profession*, 17 J. EVALUATION CLINICAL PRAC. 621 (2011); Christopher A. Feddock, *The Lost Art of Clinical Skills*, 120 AM. J. MED. 374 (2007); Mark R. Tonelli, *The Philosophical Limits of Evidence-based Medicine*, 73 ACAD. MED. 1234 (1998); Harold Laufman, *Some Thoughts on Surgical Judgment*, 38 SURGICAL CLINICS N. AM. 1171 (1958); Robert M. Bartlett, *The Teaching of Surgical Judgment*, 121 AM. J. SURGERY 220 (1971); John R. Clarke, *Decision Making in Surgical Practice*, 13 WORLD J. SURGERY 245 (1989).

29. Clarke, *supra* note 28, at 245.

> 'almost as important as the technical ability to carry out the procedure itself.' Clinical judgment is developed through practice, experience, knowledge and continuous critical analysis. It extends into all medical areas: diagnosis, therapy, communication and decision making.[30]

Surgical judgment has been the focus of comment for many years. It has been referred to as "the most vital single factor in the practice of surgery—the judgment on which treatment is based."[31] It is "a special form of clinical judgment consisting of the decisions whether or not to operate and what operation to perform."[32]

The concepts of clinical and surgical judgment fit well with Osler's teachings of patient individuality. Consider the following commentary, more than sixty years ago, on the obligations of a surgeon, emphasizing the need:

> [T]o know that there is no such thing as an "average" patient. Even the most 'ordinary' patient with the "simplest" lesion has certain sensitivities, stresses, patterns peculiarly his own, requiring the surgeon's individual attention to his particular problem.
>
> A surgeon who works in the climate of this basic attitude will be swiftly and sensitively respondent to unexpected reactions and events for which surgeons who think in stereotypes may be unprepared.[33]
>
> • • • • •
>
> Even as a patient must not be regarded as 'average,' so the tendency to regard procedures as 'routine' must be avoided. . . . It suggests an unthinking, undifferentiating stereotypy in the surgeon's attitude which will, if adopted, obviate any real potential for what is called surgical judgment.[34]

If volition "refers to the capacity of humans . . . to initiate actions based on internal decision and motivation, rather than external stimulation,"[35] it may be

30. Kienle & Kiene, *supra* note 28, at 621 (internal citations omitted).
31. Fred R. Fairchild, *Surgical Judgment*, 24 CAL. & W. MED. 471, 471 (1926).
32. Clarke, *supra* note 28, at 245.
33. Laufman, *supra* note 28, at 1173.
34. *Id.* at 1174.
35. Patrick Haggard & Hakwan Lau, *What is Volition?*, 229 EXPERIMENTAL BRAIN RES. 285, 285 (2013).

fair to suggest that the exercise of judgment is inextricably bound to volitional actions. If this analysis is viable, physicians do not treat patients through non-volitional conduct seemingly required to establish habit evidence pursuant to Rule 406.[36]

IV. IS NON-VOLITIONAL PHYSICIAN CONDUCT REQUIRED TO ESTABLISH EVIDENCE OF PHYSICIAN HABIT?

There is case law to support the proposition that a physician's volitional conduct does not defeat an effort to utilize that conduct to establish evidence of habit.[37] In *Aikman v. Kanda*, the defendant cardiac surgeon repaired plaintiff's mitral valve[38] through an open-heart procedure. Post-operatively, plaintiff developed multiple complications and sued the defendant, "contending that her injuries resulted from air that accumulated in her heart while it was open during the surgery and that traveled to her brain[.]"[39] Specifically, plaintiff alleged that the defendant surgeon "either failed to employ procedures to remove air from her heart (so-called 'air drill' procedures) before completing the surgery, or performed the air drill inadequately."[40] The jury returned a verdict in favor of the surgeon.[41]

On appeal, plaintiff claimed error in that the surgeon was permitted to testify to his habit (or routine practice) of performing an intraoperative procedure to remove air from plaintiff's heart. The basis of the alleged evidentiary error was "that there was no contemporaneous notation in [plaintiff's] medical records indicating that [the surgeon] had performed an air drill before completing the surgery."[42] Furthermore, "by the time the lawsuit was filed, no one on the surgical team could specifically recall the details of [plaintiff's] surgery."[43]

The surgeon's trial testimony insofar as it related to habit was explained as follows:

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36. FED. R. EVID. 406.

37. *Rosebrock*, 221 Md. App. 1; *Aikman*, 975 A.2d. 152.

38. *Aikman*, 975 A.2d at 155.

39. Heart "valves prevent the backward flow of blood." *Anatomy and Function of the Heart Valves*, JOHNS HOPKINS MEDICINE, https://www.hopkinsmedicine.org/health/conditions-and-diseases (last visited Feb. 5, 2019). The mitral "valve is located between the left atrium and the left ventricle." *Id.*

40. *Aikman*, 975 A.2d at 155. The court's description suggests that plaintiff alleged central nervous damage resulting from air embolization during heart surgery. *See* Jens Tingleff et al., *Intraoperative Echocardiographic Study of Air Embolism During Cardiac Operations*, 60 ANNALS THORACIC SURGERY 673 (1995); Jean-Paul Dalmas et al., *Intracardiac Air Cleaning in Valvular Surgery Guided by Transesophageal Echocardiography*, 5 J. HEART VALVE DISEASE 553, 555 (1996).

41. *Aikman*, 975 A.2d at 155.

42. *Id.*

43. *Id.* at 157.

> [He] explained during . . . trial that he performed the air drill "100 percent of the time" as an "integral part" of mitral valve surgery, but he attributed his inability to recall his actions during [plaintiff's] surgery to his having performed over 500 mitral valve operations over the course of his career (with an average of forty or fifty such procedures each year).[44]

The Court of Appeals referred to the often-pronounced nature of habit evidence as a "regular response to a repeated situation to the point where the doing of the habitual act may become *semi-automatic*,"[45] and noted the defendant-surgeon's testimony as follows:

> [He] established that he had performed more than 500 mitral valve operations . . . and he testified that the air drill "is an integral part of the procedure. So, I do it every time." In addition, [he] described his air drill routine step by step, and in great detail, and described his specific responses to various triggers and developments that occur over the course of the procedure . . . [I]n light of the high . . . "ratio of reactions to situations" that [he] described and the specificity of his account of his routine, we cannot conclude that [the court] erred in determining that, for [him] the air drill was semi-automatic in nature.[46]

It is not clear from the Court's recitation of the surgeon's testimony that each "trigger and development" occurs with every patient. If this is so, it is fair to suggest that the air drill procedure involves volition and judgment. On the other hand, if an air drill procedure is always performed during mitral valve surgery, the performance is automatic, even if the details of performance may vary among patients.

In any event, the Court of Appeals agreed with the trial court "that the volitional nature of habitual conduct is relevant to its probative force, not its admissibility."[47] This approach relaxes the evidentiary burden on physicians seeking to introduce habit evidence.

Aikman v. Kanda was recently cited, with approval, in *Rosebrock v. E. Shore Emergency Physicians, LLC*.[48] In *Rosebrock*, a nurses' aide "slipped and fell on a wet floor in a patient's room" in a nursing home.[49] The evidentiary issue was

44. *Id.*
45. *Id.*
46. *Id.* at 163.
47. *Id.* at 163.
48. *Rosebrock*, 221 Md. App. 1.
49. *Id.* at 5.

whether a physician could testify regarding his routine examination for a patient on a backboard.[50] After testifying that he treated multiple "patients per shift who were presented by ambulance on a backboard,"[51] that annually he saw thousands of patients, "and conduct[ed] a spine examination on every patient on a backboard before removal,"[52] he further testified that:

> I do the same process every time I have a patient on the backboard. The nurses don't take patients off the backboard. The paramedics don't take them off the backboard. It's only the physician that can, what we call, clear the spine and I do it the same way, every single time, every day that I work.[53]

On appeal, the appellant urged that the physician's trial testimony did not meet the requirements of habit because the physician's examination of patients positioned on backboards was "variable activity which requires thought and decision making,"[54] essentially arguing that the patient examination involved volitional conduct.[55] The Court rejected appellant's position, citing *Aikman v. Kanda*,[56] specifically referring to that court's holding that the volitional nature of medical treatment relates to weight, not admissibility of habit evidence.[57]

Volitional conduct/semi-automatic conduct by physicians is not always viewed so charitably by courts with respect to habit evidence. Very recently, the Court of Appeals of Ohio considered unique patient presentations and individual patient assessments as mitigating against acceptable semi-automatic conduct or "responsive behavior to a repeated stimulus" necessary to establish admissible physician habit.[58]

Similarly, the Superior Court of Pennsylvania recently commented on the nature of emergency medicine treatment[59] as non-habitual conduct:

> [T]he manner in which [the defendant-physician] treated patients with Decedent's symptoms was not reflexive, instinctive, semi-automatic or mundane in nature. Medical patients are not

50. For a paper on the use of backboards for spinal immobilization, *see* Derek Cooney et al., *Backboard Time for Patients Receiving Spinal Immobilization by Emergency Medical Services*, 6 INT'L J. EMERGENCY MED. 17 (2013).

51. *Rosebrock*, 221 Md. App. at 21.

52. *Id.*

53. *Id.*

54. *Id.*

55. *Id.*

56. *Aikman*, 975 A.2d at 163-63.

57. *Rosebrock*, 221 Md. App. at 22.

58. Robinson v. Mercy St. Vincent Med. Ctr., 113 N.E. 3d 1100, 1116 (Ohio Ct. App. 2018).

59. Sutch v. Roxborough Mem'l Hosp., 151 A.3d 241, 253 (Pa. Super. Ct. 2016).

> manufactured on assembly lines; they each have unique attributes and idiosyncrasies that call for individualized care. The notion that [the defendant-physician] treats each patient with Decedent's symptoms as reflexively as, for example, the manner in which he climbs stairs is preposterous. His proposed testimony fell well outside the boundaries of Pa.R.E. 406.[60]

In *Figueroa v. Highline Medical Center*,[61] the Court of Appeals of Washington reviewed a trial court's exclusion of proposed habit evidence from the defendant-emergency medicine physician. On appeal from an adverse verdict, the defendant-physician urged "that the trial court improperly precluded him from testifying as to his habit and routine practice of orally instructing patients with compartment syndrome."[62]

The Court of Appeals referred to Washington state precedent and noted that "not all behavior claimed as regular and consistent in similar circumstances is admissible as habit evidence[.]"[63] The Court of Appeals characterized the defendant-physician's conduct as "not consistent and automatic."[64] The physician had not encountered this medical condition "either before or since [the patient]."[65] Accordingly, the defendant-physician's proposed testimony did not rise to the level of habit evidence.

In *Glusaskas v. Hutchinson*,[66] the New York Appellate Division reviewed and reversed a jury verdict in favor of the defendant-cardiovascular surgeon. Curiously, the trial court admitted in evidence "a videotape prepared exclusively for trial by defendant physician of a surgery performed by him on another patient."[67] Apparently, the trial court "permitted the use of the tape . . . , ruling that it was sufficiently relevant to show the jury how the procedure was done[.]"[68] The appellate opinion clearly reveals that the videotaped surgical procedure involved a patient of a different sex, a different age, and with a different physical condition than the patient at issue.[69] Although the defendant-physician believed the videotape would assist in educating the jury, the Appellate

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60. *Id.* at 252-53.

61. Figueroa v. Highline Med. Ctr., No. 68272-5-1, 2013 WL 5636674, at *2 (Wash. Ct. App. Oct. 14, 2013).

62. *Id.* at *4. For an excellent discussion of compartment syndrome, see Kirsten G.B. Elliott & Alan J. Johnstone, *Diagnosing Acute Compartment Syndrome*, 85 J. BONE & JOINT SURGERY 625 (2003).

63. *Figueroa*, 2013 WL 5636674, at *2.

64. *Id.*

65. *Id.*

66. Glusaskas v. Hutchinson, 148 A.D.2d 203, 209 (N.Y. App. Div. 1989).

67. *Id.* at 204.

68. *Id.* at 205.

69. *Id.*

Division concluded that "it is evident that the actual effect of exhibiting the film, if not the defendant's unexpressed intention, was to endeavor to persuade the jury that because he had carefully and successfully operated on another heart patient, he had applied the same degree of care"[70] during the surgery he performed for the patient at issue.

The Appellate Division was not impressed by the defendant-physician's rationale. It commented that "proof of regular usage or habit might be warranted where deliberate and repetitive practice is involved"[71] but physicians performing surgery treat patients with unique medical conditions and that "the actions of the operating doctor"[72] are unique, as well.

The point here is that habit evidence is in the eye of the beholder. Physician conduct is different than one's habit of stopping the car at a red light, always locking the door upon leaving home, or descending stairs one step at a time. Understanding that there is no bright line test for the admissibility of physician habit evidence, this paper will now focus on the sources of physician habit evidence and the various contexts in which physician habit evidence has been admitted in evidence.

V. SOURCES OF PHYSICIAN HABIT EVIDENCE

As mentioned earlier, Rule 406 does not specify sources of habit evidence. It is fair to expect that physician habit evidence would derive from the physician's own testimony about the physician's practice habit. The physician is the obvious choice as the witness to testify about their own practice habits. In various jurisdictions, courts have considered whether patients, nurses, physician staff, and records can be the source of physician habit evidence. These less obvious but potentially controversial sources of habit evidence are worthy of attention here.

A. Patients

Whether a physician's patient or patients can be the source of physician habit evidence raises serious evidentiary concerns. A patient, even a series of patients, only are aware of their respective experiences. If patient testimony is a theoretical source of physician habit evidence, how many patients must testify to establish evidence of habit? The text of Rule 406 does not speak to this question. Additionally, patients, as lay persons, do not have the knowledge, skill or expertise to testify about medical treatment or conditions. As non-expert

70. *Id.* at 205-06.
71. *Id.* at 206.
72. *Id.*

witnesses,[73] patients are very likely unqualified to testify to the detail necessary to establish physician habit. Furthermore, the testimony of a physician's other patients' experiences runs the risk of implicating impermissible character evidence, inadmissible pursuant to Federal Rule of Evidence 404.[74]

This having been said, some courts have embraced patient testimony as the source of physician habit evidence. That jurisprudence is now addressed.

1. Patients Permitted to Provide Physician Habit Evidence

In *Crawford v. Fayez*, the Court of Appeals of North Carolina approved the trial court's decision pursuant to which "five of defendant's former patients were permitted to testify . . . that defendant had informed them of Medrol's[75] possible side effects, including bone damage."[76] Predictably, plaintiff contended "that 'habit' may not be proven by the testimony of a succession of witnesses who observed the behavior in question on a single occasion"[77] and requires proof "by the testimony of a witness who has regularly observed the habitual behavior."[78]

The Court of Appeals referred to the state's evidentiary rule 406[79] and noted (as with Federal Rule of Evidence 406) its silence "as to the methods by which the existence of habit may be proven[.]"[80] It then precisely raised the issue on appeal, as follows: "It is unclear, however, whether habit may be shown by a succession of witnesses who observed the relevant conduct on separate, single occasions."[81]

To address this issue, the Court of Appeals purported to review and consider federal authority regarding Rule 406 and concluded that the trial testimony of defendant's former patients was permissible to establish habit.[82] Specifically, the Court of Appeals referred to *Wetherill v. University of Chicago*,[83] a case

73. *See* FED. R. EVID. 702; Daubert v. Merrell Dow Pharm., 43 F.3d 1311 (9th Cir. 1995).

74. FED. R. EVID. 404; *see also* Marc D. Ginsberg, *Good Medicine/Bad Medicine and the Law of Evidence: Is There A Role For Proof of Character, Propensity, or Prior Bad Conduct in Medical Negligence Litigation?*, 63 S.C.L. REV. 367 (2011).

75. *See* Akbar K. Waljee et al., *Short Term Use of Oral Corticosteroids and Related Harms Among Adults in the United States: Population Based Cohort Study*, 357 BRITISH MED. J. j1415 (2017). It is unclear how, precisely, this supports your statement. Are you offering examples of side effects? If so, consider adding this at the end of the sentence and elaborating more in a parenthetical.

76. Crawford v. Fayez, 112 N.C. App. 328, 331 (1993).

77. *Id.*

78. *Id.*

79. N.C. Gen. Stat. § 8C-1, Rule 406 (2018).

80. *Crawford*, 112 N.C. App. at 332.

81. *Id.*

82. *Id.* at 336.

83. Wetherill v. Univ. of Chi., 570 F. Supp. 1124 (N.D. Ill. 1983).

involving a claim of "injury by exposure in utero to diethylstilbestrol ("DES")[84] administered to . . . mothers as part of a study . . . conducted in the early 1950s at the University of Chicago . . . hospitals."[85] It is true that in *Wetherill* patients were permitted to testify regarding a "routine practice of securing [patient] consent;"[86] however, physicians testified as well. The *Crawford* court omitted this reference to physician testimony when holding that the testimony at trial of five of defendant's former patients was sufficient to establish physician habit.[87]

Patient testimony to establish physician habit was also approved in *Hall v. Arthur*.[88] Here, the Eighth Circuit Court of Appeals considered an informed consent claim in the context of a neurosurgical procedure, "an anterior cervical discectomy and fusion[.]"[89] At trial, the court permitted "testimony from patients other than [plaintiff] concerning what [defendant] told them about [disk replacement material] prior to surgery."[90] Without citation to authority other than Rule 406, the Eighth Circuit held that this testimony "was properly admitted under Fed. R. Evid. 406, as evidence of the routine practice of an organization."[91] Frankly, unless the Eighth Circuit was implicating an informed consent process utilized by the medical center at which the defendant practiced medicine, it seems that the Eighth Circuit should have approved the patients' testimony as evidence of habit of a physician, not as evidence of the routine practice of an organization.

2. Patients Not Permitted to Provide Physician Habit Evidence

Not all courts are receptive to permitting patient testimony as evidence of physician habit. Of course, a danger of patient testimony is the admission of character evidence, prohibited by Rule 404 and state counterparts. An additional evidentiary concern is "relevance." A physician's treatment of any single patient is not logically related to the treatment of another patient.

84. *See* Linda Titus et al., *Birth Defects in the Sons and Daughters of Women Who Were Exposed in Utero to Diethylstilbestrol (DES)*, 33 INT'L J. ANDROLOGY 377 (2010).

85. *Wetherill*, 570 F. Supp. at 1125.

86. *Id.* at 1127.

87. *Crawford*, 112 N.C. App. at 331.

88. Hall v. Arthur, 141 F.3d 844 (8th Cir. 1998).

89. *Id.* at 847. For literature regarding the use of anterior cervical discectomy and fusion to treat cervical spine disorders, *see* Rahul Yadav et al., *Post-Operative Complications in Patients Undergoing Anterior Cervical Discectomy and Fusion: A Retrospective Review*, 4 J. NEUROANAESTHESIOLOGY & CRITICAL CARE 170 (2017).

90. *Hall*, 141 F.3d at 849.

91. *Id.*

a. United States Court of Appeals, District of Columbia

In *Weil v. Seltzer*,[92] the Court of Appeals for the D.C. Circuit framed the appellate issue as follows: "whether the district court erred in permitting the testimony of five of the defendant's former patients in order to establish the defendant's habit and routine practice of prescribing steroids to his patients."[93] This issue arose from medical negligence litigation involving a physician who allegedly "prescribed steroids to [the patient] on his first visit in 1963 and continued to prescribe steroids over a period of more than twenty years."[94] The Court of Appeals opinion reveals an astounding amount of steroid tablets purchased by the treating physician. Apparently, he routinely advised patients that the prescribed tablets were antihistamines and decongestants, not steroids.[95]

The medical negligence claim against the defendant-physician was tried twice, the second trial yielding a verdict for plaintiff. It was during this trial that five former patients of the defendant-physician were permitted to testify to establish "that [defendant-physician] had prescribed steroids to other allergy patients while representing the drugs to be antihistamines or decongestants."[96]

The Court of Appeals undertook an extensive analysis of habit evidence pursuant to Rule 406. In so doing, the Court of Appeals acknowledged the non-volitional nature of habit: "activity that occurs with invariable regularity,"[97] a "consistent method or manner of responding to a particular stimulus,"[98] with a "reflexive, almost instinctive quality."[99] The Court of Appeals questioned whether the defendant-physician's treatment of other patients *as explained by the patients*, would satisfy the need for proof of a physician's conduct with sufficient regularity.[100]

The Court of Appeals focused on the patients' inability to know how the defendant-physician treated other patients. It noted that "[f]or the former patient testimony to be at all probative [of physician habit] it must show that [the defendant-physician] responded the same way with each patient as he did with the testifying patient."[101] As the testimony of the former patients did not establish physician habit, the testimony constituted character evidence, which was

92. *Weil*, 873 F.2d 1453.
93. *Id.* at 1455.
94. *Id.* at 1456.
95. *Id.*
96. *Id.* at 1460.
97. *Id.*
98. *Id.*
99. *Id.*
100. *Id.*
101. *Id.* at 1461.

inadmissible under Federal Rule of Evidence 404.[102] Accordingly, the Court of Appeals vacated the district court's judgment on the jury verdict in favor of the plaintiff.[103]

b. California

A California Court of Appeal considered the issue of patient supplied, physician habit evidence in *Jackson v. Hajj*,[104] a case involving a medical negligence claim against a surgeon who performed disk compression surgery for a patient with a herniated lumbar disk.[105] Regrettably, post-operatively, the patient suffered serious complications and died.[106] The apparent cause of death was a lacerated abdominal aorta which occurred during surgery.[107]

At trial, "the court had excluded evidence . . . of an allegedly similar misadventure with another patient, which took place some time after the decedent's surgery."[108] Plaintiff offered this evidence to establish the custom and habit of the surgeon.[109]

The Court of Appeal held that plaintiff's proposed evidence "was manifestly insufficient . . . to establish any 'habit' or 'custom' of [the defendant]"[110] but used somewhat equivocal language in so holding. In finding a lack of evidentiary foundation for habit evidence, the Court of Appeal stated that plaintiff "never sought to elicit any evidence from [the defendant-physician]—or from any other competent source—to establish [defendant-physician's] actual habits or customs."[111] The Court of Appeal never suggested the identity of another competent source for evidence of habit. The Court of Appeal also noted that plaintiff's expert witness would "not have had any actual knowledge of [defendant's] habits and customs."[112] Additionally, it commented on the impossibility of attempting to compare the other patient to the decedent and that the other "patient's surgery involved a different portion of the spine, and resulted

102. *Id.*

103. *Id.*

104. Jackson v. Hajj, No. E030178, 2003 WL 21329772 (Cal. Ct. App. June 10, 2003).

105. *Id.* at *3. For a paper discussing this surgery, *see* Mahsa Sedighi & Ali Haghnegahdar, *Lumbar Disk Herniation Surgery: Outcome and Predictors*, 4 GLOBAL SPINE J. 233 (2014); *see also* N.K. Anjarwalla et al., *The Outcome of Spinal Decompression Surgery 5 Years On*, 16 EUR. SPINE J. 1842 (2007).

106. *Jackson*, 2003 WL 21329772, at *3.

107. *Id.* This intra operative injury has been reported in the medical literature. *See* W. Roy Smythe & Jeffrey P. Carpenter, *Upper Abdominal Aortic Injury During Spinal Surgery*, 25 J. VASCULAR SURGERY 774 (1997).

108. *Jackson*, 2003 WL 21329772, at *7.

109. *Id.* at *3-4.

110. *Id.* at *4.

111. *Id.*

112. *Id.*

in injury to a different vessel[.]"[113]

The Court of Appeal reached the correct decision in *Jackson v. Hajj*. Clearly, the defendant-surgeon would have been the appropriate source of evidence to establish his habit (if he had offered such evidence). The reference to an unidentified potential other source of habit evidence was curious.

c. Louisiana

In *Joseph v. Williams*,[114] the Court of Appeal of Louisiana reviewed a podiatry malpractice claim in which the trial court granted the defendant's "motion in limine to exclude the testimony of his former patient, . . . in [plaintiff's] case-in-chief."[115] Plaintiff's strategy in proposing this testimony, along with her own, was to "establis[h] that [the podiatrist] had a habit of persuading patients to submit to surgery based on his failure to disclose the risks of surgery."[116] The podiatrist was permitted "to testify as to his habit . . . in obtaining informed consent[.]"[117] The Court of Appeals noted the propriety of the podiatrist's own habit testimony at trial[118] and that "the former patient's testimony was inadmissible other similar acts (character) evidence."[119]

d. Ohio

In *Cardinal v. Family Foot Care Centers., Inc.*,[120] the Court of Appeals of Ohio considered a defense verdict in a podiatry malpractice case. An evidentiary issue was whether plaintiff should have been permitted "to introduce the testimony of several former patients who would have testified that they were cajoled into unnecessary surgery by the [sic] [defendants]."[121] Without any particular analysis, the Court of Appeals referred to Ohio Evidence Rule 406 and held that "[t]he testimony in the instant case did not rise to the level of habit."[122]

e. Texas

In *Pisharodi v. Saldana*,[123] the Court of Appeals of Texas affirmed a

113. *Id.*
114. Joseph v. Williams, 105 So.3d 207 (La. Ct. App. 2012).
115. *Id.* at 218.
116. *Id.*
117. *Id.*
118. *Id.* at 219.
119. *Id.*
120. 40 Ohio App. 3d 181 (1987).
121. *Id.* at 182.
122. *Id.*
123. Pisharodi v. Saldana, No. 13-13-00721-CV, 2015 WL 7352301 (Tex. Civ. App. Nov. 19,

plaintiff's verdict in a medical negligence claim against a neurosurgeon relating to the patient's death following a lumbar epidural steroid injection.[124] At trial, the court permitted another patient in the defendant's office at the same time as the deceased to testify "about what he observed and experienced that day as a patient, including what he heard and saw after [decedent's] collapse, and the extent of care that Dr. Pisharodi provided to [the other patient]."[125] This testimony was permitted despite a habit evidence[126] objection. The defendant urged "that testimony from [a] lay witness . . . was improper habit evidence because it would have been impossible for [him] to know what was done as a matter of routine with all of Dr. Pisharodi's patient[s] from his one and only encounter as a patient.'"[127]

The Court of Appeals essentially held that the other patient's testimony was not impermissible habit evidence and that this patient testified to his observations. One wonders why this patient was allowed to testify about "the extent of care that Dr. Pisharodi provided to [him]."[128] The care rendered to one patient does not tend to prove any relevant fact relating to the care rendered to another patient.

The above jurisdictional survey supports the position that patients should not constitute a permissible source of physician habit evidence. Patients are simply not qualified to testify regarding the details of medical care and treatment. They are able to testify from their personal knowledge about their experiences with a physician, but it is unlikely that they can testify to medical terminology, and their personal treatment experiences are not relevant to the experiences of other patients. Even a large number of patients treated by the same physician cannot overcome these obstacles. Each can only testify, as lay witnesses, to their personal physician encounters. Patients are not a valid source for physician habit evidence.

B. Nurses

Physicians and nurses work together in various clinical settings.[129] Certainly, there are nurses who frequently work with particular physicians and have

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2015).

124. Lumber epidural steroid injections are commonly used to treat low back pain. *See* James Fredrich & Mark A. Harrast, *Lumbar Epidural Steroid Injections: Indications, Contraindications, Risks, and Benefits*, 9 CURRENT SPORTS MED. REP. 44 (2010).

125. *Pisharodi*, 2015 WL 7352301, at *16.

126. FED. R. EVID. 406.

127. *Pisharodi*, 2015 WL 7352301, at *16.

128. *Id.*

129. *See generally* Robert Boissoneau, et al., *A National Study: The Use of Specialty Surgical Teams*, 17 HEALTH MKT. Q. 49 (1999) (explaining the reasons for the development of specialty surgical teams, including the need or specialized nursing).

observed their practices over a period of time. Courts have correctly concluded that nurses are appropriate sources of physician habit evidence.

1. Massachusetts

In *Elias v. Suran*, the Appeals Court of Massachusetts reviewed a jury verdict in favor of a defendant-neuroradiologist.[130] It framed the only appellate issue as follows: "whether the trial judge erred by admitting in evidence . . . the testimony of a nurse at the Massachusetts General Hospital (MGH) about the routine practice in 1981 at MGH for administering morphine sulfate to patients undergoing angiograms."[131]

At the trial, a nurse was permitted to testify for the defendant-physician regarding the MGH practice of "premedicat[ing] nonemergency angiogram patients with five milligrams of morphine intramuscularly before they came to the department and to premedicate emergency angiogram patients in the neuroradiology department with three milligrams of morphine sulfate intravenously."[132] The testifying nurse had about nine years of experience in the neuroradiology department before the events at issue.[133]

The Appellate Court noted that the nurse's testimony "was relevant to corroborate the defendant's testimony"[134] regarding the administration of the medication. Interestingly, the Massachusetts law of evidence did not permit the admission of habit evidence to prove conduct consistent with the habit, but it did permit "evidence of a business custom . . . to show that an act was performed in conformity with the custom."[135] The Appeals Court approved the nurse's testimony as she did not refer to a specific physician's habit but referred to a hospital practice.[136] This seems to be a distinction without a difference, as the physician who ordered the medication was the defendant. It is clear that his prescribing practice would be encompassed by the hospital's practice.

2. Illinois

In *Vuletich v. Bolgla*, the Appellate Court of Illinois reversed a jury verdict in favor of a defendant anesthesiologist based on the trial testimony of a surgical scrub nurse that the anesthesiologist "had a particular practice and method of monitoring a patient's respiration during surgery when the anesthetic in question

130. Elias v. Suran, 616 N.E.2d 134, 134 (Mass. App. Ct. 1993).
131. *Id.* at 135.
132. *Id.* at 135-36.
133. *Id.* at 135.
134. *Id.* at 136.
135. *Id.*
136. *Id.* at 135.

was being used and that he usually followed that practice."[137] It should be noted that the Appellate Court's opinion pre-dated the Illinois Rules of Evidence by many years.[138] The opinion noted that Illinois courts frowned on habit evidence except in wrongful death cases in which there were no eyewitnesses.[139] In that exceptional circumstance, Illinois courts developed the unfortunate concept of the careful habit. This confuses inadmissible character trait evidence (carefulness) with habit evidence. Regrettably, the careful habit remains a part of Illinois' common law of evidence.[140] The *Vuletich* Court noted that physician eyewitnesses did testify at trial, "so as to preclude the introduction of the evidence of Dr. Bolgla's habits."[141]

Additionally, the Appellate Court held that even in the absence of eyewitness testimony, the nurse's testimony as to the defendant-anesthesiologist's habits would be inadmissible.[142] Apparently, this is so because the nurse testified to a procedure different than that utilized by the defendant-anesthesiologist.[143] Therefore, it is unclear if the Appellate Court would have approved the habit testimony if the nurse and defendant-physician had described identical procedures.

3. Florida

In *Fincke v. Peeples*, the District Court of Appeals of Florida held that a nurse could not testify regarding a physician's habit of prematurely extubating patients.[144] The defendants were an orthopedic surgeon and an anesthesiologist.[145] The patient underwent knee surgery.[146] Post-operatively, the patient died and a medical negligence lawsuit was filed, focusing on whether the patient had been prematurely extubated.[147]

Three nurses testified at trial, two of whom specifically referred to the defendants' practice of prematurely extubating patients.[148] Without any detailed

137. Vuletich v. Bolgla, 407 N.E.2d 566, 569 (Ill. App. 3d 1980).

138. The Illinois Rules of Evidence (IRE) became effective on January 1, 2011. IRE 406 does govern the admissibility of habit evidence. ILL. R. EVID. 406.

139. *Vuletich*, 407 N.E.2d at 570.

140. *See* Marc D. Ginsberg, *An Evidentiary Oddity: "Careful Habit" – Does The Law Of Evidence Embrace This Archaic/Modern Concept*?, 43 OHIO N. L. REV. 293, 302 (2017).

141. *Vuletich*, 407 N.E.2d at 571.

142. *Id.*

143. *Id.*

144. Fincke v. Peeples, 476 So.2d 1319 (Fla. Dist. Ct. App. 1985).

145. *Id.* at 1320.

146. *Id.*

147. *Id.* at 1320-21; *see* Scott K. Epstein, *Extubation Failure: An Outcome To Be Avoided*, 8 CRITICAL CARE 310 (2004).

148. *Fincke*, 476 So.2d at 1321.

analysis, the Court of Appeals held that the trial "testimony consisted of nurses' opinions on that question, not facts," therefore, that testimony was not "admissible to show that [the defendant] had a habit of prematurely extubating patients."[149] The Court of Appeals did not discuss whether a nurse or nurses could be the source of physician habit evidence.

4. California

In *Dincau v. Tamayose*, the California Court of Appeal allowed the admission of testimony by a defendant-physician's nurse to establish the habit of the physician and his office in communicating by telephone with parents of ill children.[150] The Court of Appeal noted that the admission of habit evidence in this context was necessary to enable a physician to establish a defense, years after an event which prompted the litigation.[151]

Nurses may work with physicians in formal practice teams or may otherwise work closely with physicians so that they are able to repetitively observe physician practices over a substantial period of time.[152] Under these circumstances, nurses should be permitted to testify and establish physician habit.

C. Former Medical Assistants

In *Lambert v. Wilkinson*, the Court of Appeals of Ohio considered whether a trial court correctly precluded two of the defendant-physician's medical assistants from testifying that he had a habit of altering medical records. [153] These witnesses had been employees of the defendant-physician in the 1990s and "[o]f particular concern at trial was whether [the defendant] altered or fabricated the medical chart of [the patient] for his December 18, 2003 office visit."[154]

The Court of Appeals did not provide an analytical discussion of physician habit evidence and did not specifically disqualify medical assistants as sources of habit evidence.[155] The Court of Appeals dismissed the proposed testimony as "too remote in time," noting that "the practice of [the defendant-physician] in the 1990s does not necessarily establish the existence of the habit and that the habitual response occurred on or after December 2003."[156] Although the

149. *Id.*

150. Dincau v. Tamayose, 131 Cal. App. 3d 780, 794 (1982).

151. *Id.* at 795.

152. *See* Kevin Grumbach & Thomas Bodenheimer, *Can Health Care Teams Improve Primary Care Practice?*, 291 JAMA NETWORK 1246 (2004).

153. Lambert v. Wilkinson, 2008-Ohio-2915, at ¶ 56 (Ohio Ct. App. 2008).

154. *Id.* at ¶ 69.

155. *See id.*

156. *Id.*

proposed testimony "would have revealed that [the defendant-physician] did, on occasion, alter medical records, this does not constitute proof of a regular response to a repeated, factually-specific situation."[157] Accordingly, the medical assistants' proposed testimony would have amounted to inadmissible character evidence.[158]

It was not at all clear from the Court of Appeals' opinion precisely the detail to which the medical assistants were prepared to testify. Apparently, the medical assistants would have testified that the defendant-physician requested that one of the medical assistants "alter piles of patient medical records so that he would avoid criminal penalty."[159] How frequently the alleged medical records alterations occurred is unknown. Also unclear is how the medical assistants would have known that a physician actually altered medical records. As a result, the Court of Appeals correctly held that the proposed testimony was inadmissible.

D. Administrative Records

A New Jersey Appellate Court confronted the interesting issue of whether administrative records of the Board of Medical Examiners could be the source of physician habit evidence.[160] In *Delgaudio v. Rodriguera*, the plaintiff's claim of medical negligence against the defendant-cardiologist was based on a complication, hemolytic anemia,[161] which he allegedly suffered due to a medication prescribed by the defendant.[162] At trial, "the accuracy and truthfulness of defendant's office record and his say so, was a crucial credibility issue for the jury to resolve."[163]

Apparently, the Board of Medical Examiners records contained information about "the Board's 1993 suspension and 1991 revocation decisions and the findings and conclusions in connection therewith"[164] and the defendant-physician's "record-keeping infractions."[165] At trial, plaintiff unsuccessfully sought to use these records to establish the defendant-physician's habit of record-keeping infractions.[166] The appellate court simply stated that "the record is not sufficient to show 'a regular practice of responding to a particular kind of

157. *Id.* at ¶ 70.
158. *Id.*
159. *Id.* at ¶ 56.
160. *See* Delgaudio v. Rodriguera, 654 A.2d 1007 (N.J. Super. Ct. App. Div. 1995).
161. *See* Gurpreet Dhaliwal, Patricia Cornett & Lawrence Tierney, *Hemolytic Anemia*, 69 AM. FAM. PHYSICIAN 2599 (2004) (explaining the disease and drugs which may cause it).
162. *Delgaudio*, 654 A.2d at 1009-10.
163. *Id.* at 1010.
164. *Id.*
165. *Id.*
166. *Id.*

situation with a specific type of conduct [i.e. habitually failing to record patient complaints].'"[167] This is a correct result, as, in the absence of detailed, identical record-keeping errors occurring in identical circumstances, unrelated record-keeping errors likely establish an inadmissible character trait of carelessness.[168]

E. Physicians

The defendant-physician is the obvious choice as the most likely source of habit evidence. This paper now focuses on the various contexts (other than informed consent litigation) in which physician habit evidence has been embraced by courts.

1. Performance of Surgery and Habit

Medical literature reveals that surgeons are at a higher risk of facing medical negligence claims.[169] Therefore, it is predictable that surgeons would desire to testify about their typical, habitual conduct in the performance of surgical procedures. Additionally, non-surgeon physicians who participate in surgical procedures, are likely candidates to provide habit testimony.

In *McCormack v. Lindberg*, the Minnesota Court of Appeals reviewed a jury verdict in favor of a thoracic surgeon.[170] The medical negligence claim arose from a complication of a rib resection surgery performed to address thoracic outlet syndrome.[171] At trial, "the defendant . . . testified that he had no present recollection of the specific circumstances of [plaintiff's] operation, but testified to his ordinary practices in performing first rib resections in order to establish what he probably did during [plaintiff's] operation."[172]

On appeal, the defendant-physician urged that the aforementioned testimony

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167. *Id.*

168. *Id.*; *See also*, Herbstreith v. de Bakker, 249 Kan. 67, 815 P.2d 102, 109 (1991) (noting that "any evidence offered to prove a trait of character with respect to care or skill is inadmissible . . . as tending to prove the quality of conduct on a specified occasion.").

169. *See* Anupam B. Jena, Seth Seabury, Darius Lakdawalla & Amithabh Chandra, *Malpractice Risk According to Physician Specialty*, 365 N. ENG. J. MED. 629, 632 (2011); *See also* José R. Guardado, *Medical Liability Claim Frequency Among U.S. Physicians*, POL'Y RES. PERSP. AM. MED. ASS'N. (2017).

170. McCormick v. Lingberg, 352 N.W.2d 30, 32 (Minn. Ct. App. 1984).

171. *Id.* at 32. "Thoracic outlet syndrome . . . refers to compression of the subclavian vessels and brachial plexus at the superior aperture of the chest." Harold C. Urschel Jr., *Transaxillary First Rib Resection for Thoracic Outlet Syndrome*, OPERATIVE TECH. IN THORACIC & CARDIOVASCULAR SURGERY 313, 313 (2005). "The majority of patients . . . have pain of the neck, upper chest wall, and upper extremity." Dean Donahue, *Supraclavicular First Rib Resection*, OPERATIVE TECH. IN THORACIC & CARDIOVASCULAR SURGERY 252, 252 (2012).

172. *McCormick*, 352 N.W.2d at 32.

was admissible habit evidence.[173] The Court of Appeals embarked on an interesting, if not curious, analysis of habit evidence.[174] Since the defendant-physician testified "that the operation varies depending upon many factors, including the size and age of the patient," the Court of Appeals wondered if the operative procedure satisfied the "automatic" nature of habitual conduct.[175] The Minnesota Court of Appeals then stated that it would not address this issue as the defendant-physician, also an expert witness, "was not testifying to his usual and customary procedure in order to prove that he acted in conformity with it, but merely to inform the jury of what such an operation entails."[176] Frankly, it is difficult to recognize the distinction urged by the Court of Appeals. Undoubtedly, the defendant-physician desired to explain the operative procedure. However, the defendant-physician, at least implicitly, desired to establish that he followed the appropriate procedures in performing the surgery.[177] Since he did not recall plaintiff's operative procedure, he certainly provided habit evidence.

In *Steinberg v. Arcilla*, the Wisconsin Court of Appeals considered an appeal of a jury verdict in favor of a defendant-anesthesiologist.[178] The plaintiff "had emergency surgery for a ruptured tubal pregnancy."[179] The defendant-anesthesiologist positioned the plaintiff during surgery.[180] Post-operatively, the plaintiff "suffered from pain and numbness in her arms" and claimed "permanent injury to her ulnar nerve, a nerve that runs through her forearm."[181] Plaintiff's theory of liability was that the defendant-anesthesiologist improperly positioned her arms during the surgical procedure.[182]

At trial, the defendant-anesthesiologist "testified that he did not remember anything about [plaintiff's] surgery, including how he positioned her arms."[183] However, the trial court permitted him to testify regarding his "normal practice" of doing so.[184] On appeal, plaintiff claimed that the trial court erred in admitting this evidence.[185]

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173. *Id.* at 35.

174. *Id.*

175. *Id.*

176. *Id.*

177. *See id.* at 30.

178. Steinberg v. Arcilla, 194 Wis. 2d 759, 763 (Wis. Ct. App. 1995).

179. *Id.* "Ectopic pregnancy is any pregnancy that occurs outside the uterine cavity." Anne-Marie Lozeau & Beth Potter, *Diagnosis and Management of Ectopic Pregnancy*, 72 AM. FAM. PHYSICIAN 1707, 1707 (2005). A ruptured ectopic pregnancy requires surgical management. *Id.*

180. *Steinberg*, 194 Wis. 2d at 763.

181. *Id.*

182. *Id.*; *see* Richard C. Prielipp et al., *Ulnar Nerve Pressure*, 91 ANESTHESIOLOGY 345 (1999) ("Ulnar neuropathy is the most common perioperative nerve injury . . . .").

183. *Steinberg*, 194 Wis. 2d at 764.

184. *Id.*

185. *Id.* at 765.

The Wisconsin Court of Appeals, not surprisingly, distinguished habit evidence from character evidence.[186] It then noted that the "regular response to a repeated situation," denoting habit, "need not be 'semi-automatic' or 'virtually unconscious'" under Wisconsin law.[187] Furthermore, the Wisconsin Court of Appeals noted that Wisconsin law did not require a specific number of repetitive instances to qualify as habitual conduct.[188] The defendant-anesthesiologist testified as to his usual positioning of a patient's arms during surgery as well as to the frequency of his participation in surgical procedures.[189] This testimony was appropriate to evidence the defendant-anesthesiologist's habitual conduct.[190]

In *Aikman v. Kanda*, the District of Columbia Court of Appeals considered the appeal from a jury verdict in favor of a cardiac surgeon who performed surgery to repair the plaintiff's mitral valve.[191] Post-operatively, plaintiff suffered an embolic stroke, presumably cardiac in origin, and resultant disabilities.[192] At trial, the issue was whether the cardiac surgeon undertook a procedure to remove air from plaintiff's heart.[193] Plaintiff's medical records did not contain any reference to the air removal procedure and "no one on the surgical team could specifically recall the details of [plaintiff's] surgery."[194]

At trial, the defendant-surgeon was permitted to testify that he performs the air removal procedure in every mitral valve surgery he performs and that he has performed in excess of 500 mitral valve operations, averaging 40-50 of these procedures each year.[195] The D.C. Court of Appeals agreed that the defendant-surgeon's testimony was appropriate to establish his semi-automatic habit.[196] On the issue of whether the performance of a cardiac surgical procedure is a non-volitional event, the D.C. Court of Appeals stated that "the volitional nature of habitual conduct is relevant to its probative force, not its admissibility."[197]

In *Maynard v. Sena*, the Connecticut Appellate Court considered an appeal

186. *Id.* at 765-68.

187. *Id.* at 767 (quoting McCormick on Evidence § 195) (quoting Daniel D. Blinka, *Evidence of Character, Habit, and "Similar Acts" in Wisconsin Civil Litigation*, 73 MARQ. L. REV. 283, 312 (1989)).

188. *Id.* at 768.

189. *Id.* at 770.

190. *Id.*

191. *Aikman*, 975 A.2d at 155. The mitral valve "[guards] the inlet to the left ventricle" and "prevents backflow to the left atrium during ventricular systole." S. Y. Ho, *Anatomy of the Mitral Valve*, 88 Heart iv5, iv5 (2002).

192. *Aikman*, 975 A.2d at 155; *see* George Ntaios & Robert G. Hart, *Embolic Stroke*, 136 CIRCULATION 2403 (2017).

193. *Aikman*, 975 A.2d at 155.

194. *Id.* at 157.

195. *Id.*

196. *Id.* at 163.

197. *Id.* at 164.

from a jury verdict in favor of a defendant-plastic surgeon.[198] The basis of the claim was the allegation that the defendant-plastic surgeon performed an in-office procedure "without wearing surgical gloves."[199] The trial court permitted the surgeon "to testify as to his habit of wearing gloves when performing surgical procedures in his office."[200] The defendant-surgeon had a thirty year career "and . . . he employed the same 'sterile technique' when performing every one of those procedures, regardless of the nature of the procedure."[201] He further testified "that he could not conceive of having performed the procedure on the plaintiff without gloves, because doing so would put him [sic] at risk for contracting an infection."[202]

The Connecticut Appellate Court referred to the Connecticut Code of Evidence governing habit evidence and its commentary.[203] The commentary noted that "[h]abit . . . refer[s] to a course of conduct that is fixed, invariable, and unthinking, and generally pertain[s] to a very specific set of repetitive circumstances[.]"[204]

Unlike other surgical procedures which, due to patient differences, are not likely fixed, invariable, and unthinking, the Connecticut Appellate Court must have viewed a surgeon's use of surgical gloves as classic, habitual conduct as contemplated by the Connecticut Code of Evidence.[205] A surgeon's practice of wearing surgical gloves addresses surgical preparation and routine more so than the actual surgical procedure. The Connecticut Appellate Court was correct in approving the trial court's decision to permit the surgeon's testimony.

2. Non-Surgical Medical Treatment and Habit

Non-surgeon physicians are also able to avail themselves of habit testimony in medical negligence litigation. In *Thomas v. Hardwick*, the Nevada Supreme Court considered an appeal from a jury verdict in favor of an emergency medicine physician and a medical center.[206] The key issue on appeal was the advice given to the patient by the emergency medicine physician; "[d]id [the decedent] leave the hospital . . . against medical advice, as [the defendants] maintain[,] or was [the decedent] told he was 'fit as a fiddle' and could safely

198. Maynard v. Sena, 158 Conn. App. 509, 511 (2015).
199. *Id.*
200. *Id.* at 514-15.
201. *Id.* at 515.
202. *Id.* at 517.
203. *Id.* at 518.; CONN. CODE EVID. Art. 4-6.
204. *Maynard*, 158 Conn. App. at 518 (citing to CONN. CODE EVID. Art. 4-6, commentary).
205. *See id.*
206. Thomas v. Hardwick, 231 P.3d 1111, 1112 (Nev. 2010).

leave, as appellant . . . maintains?"[207] This issue, of course, relates to whether the defendant-physician complied with or deviated from the applicable standard of care: "that care which a reasonably well qualified physician would provide to a patient under the same or similar circumstances."[208] The Nevada Supreme Court commented on evidence of the applicable standard of care, noting that it "required [the defendant] to counsel [the patient] to agree to be admitted to the hospital for observation and testing, especially since [the patient's] history disclosed he had no regular primary care physician."[209] The patient "left the emergency room . . . against medical advice" and was not admitted to the hospital.[210]

At trial, the defendant-physician was permitted to testify to his "customary practice in treating chest pain patients[,]" and, therefore, "that he urged [the patient] to be admitted for observation and testing but he refused."[211] On appeal, the Nevada Supreme Court referred to the applicable Nevada evidentiary rule governing habit and routine practice evidence and held that the defendant's trial testimony regarding his habit of counseling patients, such as the patient about which the medical negligence claim was filed, was, indeed, relevant.[212]

Thomas v. Hardwick, although not an informed-consent-based medical negligence case, is arguably similar insofar as it involves a physician's instruction or recommendation to a patient.[213] The defendant-physician's workload made it virtually impossible for him to recall the patient.[214] Giving instructions to and counseling a patient "with chest pain complaints and inconclusive test results[,]" to be admitted to the hospital is fairly considered to be automatic or semi-automatic physician conduct.[215]

The Maryland Court of Special Appeals, in *Rosebrock v. Eastern Shore Emergency Physicians*, held that a defendant-emergency medicine physician could testify regarding her habit of examining and treating patients immobilized on backboards.[216] Here, a nurse's aide slipped and fell at a nursing home, was

207. *Id.* at 1113.

208. Marc D. Ginsberg, *Beyond Canterbury: Can Medicine and Law Agree About Informed Consent? And Does it Matter?*, 45 J. L., MED. & ETHICS 106, 106 (2017).

209. *Thomas*, 231 P.3d at 1113.

210. *Id.*

211. *Id.*

212. *Id.* at 1117.

213. *See id.*

214. *Id.* at 1116.

215. *Id.*

216. Rosebrock v. Eastern Shore Emergency Physicians, 108 A.3d 424, 435 (Md. Ct. Spec. App. 2015); *See* Derek R. Cooney, Harry Wallus, Michael Asaly & Susan Wojcik, *Backboard Time For Patients Receiving Spinal Immobilization By Emergency Medical Services*, 6 INT'L J. EMERGENCY MED. 17 (2013) (explaining the use of long spine boards and the need to minimize time of immobilization).

immobilized on a backboard by emergency medical technicians, and was taken to a hospital emergency room.[217] Absent from the emergency room record was the defendant's documentation of a back examination and any mention of the patient's back pain.[218] The patient was ultimately discharged from the hospital with a diagnosis of "knee and hip contusions."[219]

The patient's condition worsened and the patient ultimately received an orthopedic consultation and x-rays, revealing "an acute compression fracture of the L3 vertebrae, 'with possible retropulsed fragment[s] causing nerve root compression.'"[220] The patient underwent a spinal fusion procedure, went to a rehabilitation center, sustained an unexpected "ventricular fibrillation arrest" causing "anoxic brain injury" and lapsed "into a persistent vegetative state . . . until her death."[221] The medical negligence lawsuit followed, culminating in a verdict in favor of the emergency medicine physician.[222]

On appeal, the issue regarding the physician's trial testimony essentially relates to the problem addressed earlier in this paper; is physician treatment "nonvolitional activity that [is] performed with invariable regularity?"[223] If not, should a physician be precluded from testifying to habit when the relevant medical records do not describe the physician's treatment?[224] Significantly, the Maryland Court of Special Appeals cited, with approval, the opinion of the District of Columbia Court of Appeals in *Aikman v. Kanda*.[225] There, the D.C. Court of Appeals held that the volitional nature of the physician's treatment was relevant to the weight to be given to the habit testimony, not to its admissibility.[226] With the volitional/non-volitional issue removed from the habit evidence equation in *Rosebrock*, the key barrier to admissibility fell.

Finally, in *Dawkins v. Siwicki*, the Supreme Court of Rhode Island considered an appeal from a jury verdict in favor of the defendant-emergency medicine physician in connection with a claim that he negligently diagnosed and treated a wrist injury.[227] Allegedly, the defendant-physician diagnosed a wrist sprain for which the patient was splinted and bandaged.[228] This diagnosis surprised the patient, as she believed her wrist was broken.[229]

217. *Rosebrock*, 108 A.3d at 426.
218. *Id.*
219. *Id.*
220. *Id.*
221. *Id.* at 426-27.
222. *Id.* at 427.
223. *Id.* at 432.
224. *Id.*
225. *Id.* at 434-35 (citing to 975 A.2d 152).
226. 108 A.3d at 435 (citing to 975 A.2d at 164).
227. Dawkins v. Siwicki, 22 A.3d 1142, 1145-46 (R.I. 2011).
228. *Id.* at 1146.
229. *Id.*

At trial, the defendant-physician provided habit or routine practice testimony by stating that "when treating patients with similar symptoms and also, with patients who disagreed with a diagnosis, he would have advised plaintiff of the possibility that there was a fracture that was not apparent on the X-ray and that she should follow-up with her own doctor."[230] The medical record contained his note that a follow up visit with the patient's primary care physician was advised.[231]

On appeal, the habit evidence issue focused on the regularity of the physician's conduct.[232] Essentially, plaintiff's position was that in the absence of the physician's testimony specifying how frequently he treated patients with similar injuries, the physician did not establish the foundational basis for habit evidence.[233] The Supreme Court of Rhode Island disposed of this issue without difficulty, stating that "[t]here is no bright-line rule about the number of times the witness must have engaged in a particular practice before evidence of habit and routine may be admitted."[234] The defendant-physician's testimony regarding the many patients he has treated over many years, suffering from "certain types of symptoms or injuries" was sufficient to establish a "specific routine" and the foundation for his habit testimony.[235]

3. Advising Patients of Mammography Failure Rate and Habit

In *Hoffart v. Hodge*, the Nebraska Court of Appeals considered an appeal from a jury verdict in favor of a defendant-obstetrician-gynecologist, who allegedly failed to diagnose breast cancer.[236] The patient had a palpable breast mass and a mammogram, which was interpreted as "'[n]egative bilateral' and the '[p]alpable mass must still be evaluated on a clinical basis.'"[237] The defendant-physician testified "that he would have told her to make an appointment in 2 months to be checked again."[238] The patient's deposition testimony told a different, less concerning story.[239] She "continued to check her breast" but did not return to see the defendant for quite a few months. [240] At that time, she was referred by the defendant-physician "to a surgeon for a biopsy, who removed a

230. *Id.*
231. *Id.*
232. *Id.* at 1155.
233. *Id.*
234. *Id.*
235. *Id.* at 1155-56.
236. Hoffart v. Hodge, 609 N.W.2d 397, 401 (Neb. Ct. App. 2000).
237. *Id.*
238. *Id.*
239. *Id.*
240. *Id.*

1.5 centimeter mass which was found to be malignant."[241] Thereafter, the patient had extensive surgery, therapy and treatment, and succumbed to her disease.[242]

The Nebraska Court of Appeals addressed the propriety of the defendant-physician's trial testimony regarding "his habit or routine of advising his patients about mammogram failure rates."[243] Significantly, as to the repetitive component of habit evidence, the Nebraska Court of Appeals stated that "[t]he precise contours of how frequently and consistently a behavior must occur to rise to the level of habit cannot be easily defined or formulated."[244] The Nebraska Court of Appeals recognized that habit evidence "may be the only vehicle available for a doctor to prove that he or she acted in a particular way on a particular occasion" insofar as it is simply not possible for a doctor to recall every patient encounter.[245] The absence of detailed testimony "concerning regularity (which involves frequency and consistency), specificity, and involuntary response, which are the hallmarks of proof of habit by specific instances rather than by opinion, does not render the opinion evidence inadmissible."[246] The testimonial deficiencies relate to weight, not admissibility of the evidence.[247]

The opinion in *Hoffart* suggests two important points: (1) physician habit may be necessary for a physician's defense and (2) the testimonial foundation necessary to the admission of habit evidence is not rigid or formulaic.[248] The trial court is required to evaluate the factual circumstances and exercise sound discretion in admitting this evidence.[249]

4. Physician Communication with Other Physicians and Habit

Very recently, the Ohio Court of Appeals, in *Dazley v. Mercy St. Vincent Medical Center*, approved of a defendant-physician's habit testimony regarding communicating with consulting physicians, despite reversing summary judgment entered in favor of him.[250] In *Dazley*, a seriously ill patient was seen in a hospital emergency department by an attending physician and then defendant, a resident physician.[251] Following a cardiac work-up, the defendant-resident was directed "to contact . . . the cardiologist on call" and was instructed by the attending

241. *Id.*
242. *Id.*
243. *Id.* at 403.
244. *Id.*
245. *Id.*
246. *Id.* at 405.
247. *Id.*
248. *See id.*
249. *Id.* at 403-04.
250. *See* Dazley v. Mercy St. Vincent Med. Ctr., 2018-Ohio-2433.
251. *Id.* At ¶ 2-3

physician to advise the cardiologist of specific information.[252] The resident-physician did "not remember the substance of [the] conversation" with the cardiology consultant, did not note the conversation in the chart, "and [the cardiology consultant] [did] not recall even having a conversation."[253]

The trial court approved the defendant-resident's deposition testimony "as to what his habit would have been in communicating with a specialist" pursuant to the Ohio Rules of Evidence.[254] The Ohio Court of Appeals addressed the elements of habit evidence, stating, "[t]o be admissible as evidence of habit, the occurrence of the stimulus and the responsive behavior must occur frequently enough to constitute a pattern. [citation omitted]. A sufficient foundation must be provided for the admission of habit evidence. [citation omitted]."[255] The foundation was established by testimony of the frequency of conversations with consultants and of the contents of the conversations.[256] Significantly, the Ohio Court of Appeals did not discuss the volitional vs. non-volitional nature of this conduct.[257]

In *Burris v. Lerner*, the Ohio Court of Appeals reviewed a summary judgment in favor of a physician and considered the propriety of that physician's deposition testimony relating to his habit of contacting a referring physician about test results.[258] Here, a defendant-resident scheduled a patient for a cardiac work-up via a thallium stress test.[259] The test result was read and interpreted by the co-defendant-cardiologist.[260] The result was abnormal, "suggestive of either cardiomyopathy or potentially ischemia in the absence of inducible symptoms of ischemia or diagnostic EKG changes."[261]

The co-defendant-cardiologist testified, by deposition, "that, in light of the abnormalities in [the] test results, it would have been his custom and practice to have called the referring physician . . . at the time he was reviewing the scans."[262] He would have "call[ed] the referring physician the very evening that he was interpreting the test results '[i]f there was a test that's abnormal or . . . of moderate probability for a problem and requires further evaluation.'"[263]

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252. *Id.* at ¶ 6.
253. *Id.* at ¶ 7.
254. *Id.* at ¶ 28.
255. *Id.* at ¶ 41.
256. *Id.* at ¶ 42.
257. *See id.*
258. Burris v. Lerner, 139 Ohio App. 3d 664, 666 (2000).
259. *Id.* For information on this testing, *see* K. Lance Gould, *How Accurate Is Thallium Exercise Testing for the Diagnosis of Coronary Artery Disease*, 14 J. AM. C. CARDIOLOGY 1487 (1989).
260. *Burris*, 139 Ohio App. 3d at 666.
261. *Id.* at 667.
262. *Id.*
263. *Id.*

Furthermore, if the co-defendant-cardiologist was unable to contact the referring physician "that evening, he would have left a message with her answering service asking her to call him."[264] The co-defendant-cardiologist referring physician had no recollection of receiving a call from the cardiologist.[265] Her position was that she was never "advised of the abnormality discovered on the thallium scans."[266] Regrettably, the patient "died of a myocardial infarction."[267]

The aforementioned testimony led the Ohio Court of Appeals to pose this question, and resolution: "whether [the co-defendant-cardiologist's] testimony as to his custom and practice may suffice to controvert [the referring physician's] testimony that she received no such call. Under the law of Ohio, we find that it may."[268] The Ohio Court of Appeals reviewed Ohio jurisprudence relating to habit or routine practice evidence in medical-hospital negligence litigation and concluded that the co-defendant-cardiologist's customary practice testimony was "admissible to contradict [the referring physician's] testimony that she never received such a call."[269] Summary judgment in favor of the defendant-referring physician was reversed due to this significant evidentiary conflict.[270]

VI. THE NEED FOR PHYSICIAN HABIT TESTIMONY IN NON-INFORMED CONSENT MEDICAL NEGLIGENCE LITIGATION

The Nebraska Court of Appeals, in *Hoffart v. Hodge*, correctly identified the need for physician habit as follows:

> [W]e must recognize the reality that a doctor cannot be expected to specifically recall the advice or explanation he or she gives to each and every patient he or she sees and treats . . . [E]vidence of habit may be the only vehicle available for a doctor to prove that he or she acted in a particular way on a particular occasion, and, therefore, proof of habit may be highly relevant.[271]

It seems apparent that physicians cannot and do not record every detail of patient encounters and procedures. I have never subscribed to the theory that "if it wasn't documented, it didn't happen" and, frankly, based on my experience

264. *Id.* at 668.
265. *Id.*
266. *Id.*
267. *Id.*; *See* Kristian Thygesen et al., *Fourth Universal Definition of Myocardial Infarction* (2018), 40 EUR. HEART J. 237 (2019).
268. *Burris*, 139 Ohio App. 3d at 671.
269. *Id.* at 673.
270. *See id.*
271. *Hoffart*, 609 N.W.2d at 168.

representing physicians, I do not believe that juries subscribe to this theory.[272] The nature of the practice of medicine makes physician habit evidence necessary and its admissibility will not compromise the fairness of a jury trial.

CONCLUSION

Physician habit evidence has been embraced by courts (albeit not unanimously) in non-informed consent medical negligence litigation. The admissibility of this evidence is not without controversy, particularly with respect to its source and its reliance on volitional conduct. Rule 406 and analogous state evidentiary rules neither specify the source of habit evidence testimony nor the automatic, semi-automatic, or non-volitional nature of habitual conduct which has historically occupied a role in the analysis of habit evidence.[273] Of course, the most likely source of habit evidence in medical negligence litigation is the defendant-physician. An enlightened view of the non-volitional, semi-automatic or automatic nature of habitual conduct suggests that volitional, non-reflexive, judgment based physician conduct can still form the basis of habitual conduct and habit evidence, and these factors would relate to evidentiary weight, not admissibility.

Physician habit evidence in non-informed consent medical negligence litigation should be welcomed by courts as the courts have welcomed habit evidence in informed consent cases.[274] This evidence assists physicians in providing a fair and reasonable defense in medical negligence litigation.

272. *See* P. Ethicist, *If It Wasn't Documented, It Didn't Happen . . . or Did It*?, 11 J. EMPIRICAL RES. ON HUM. RES. ETHICS 199 (2016).

273. FED. R. EVID. 406.

274. *See* Justin L. Ward, *Physician Habit Evidence In Informed Consent Cases*, 23 J. LEGAL MED. 269 (2002); Kornberg v. United States, 693 Fed. App'x 542, 544 (9th Cir. 2017) (showing the doctor's habit of providing patient's with informed consent).

Battling Over Patents: The Impact of *Oil States* on the Generic Drug Industry

Jonathan J. Darrow, Ameet Sarpatwari, Gregory Curfman*

Abstract:

In the 2018 case of *Oil States Energy Services v. Greene's Energy Group*, the U.S. Supreme Court upheld the constitutionality of *inter partes* review, a non-judicial proceeding for challenging patents that was created by Congress as part of the 2011 Leahy-Smith America Invents Act. By establishing *inter partes* review, Congress hoped to rebalance patent policy to make it faster and less costly to invalidate erroneously granted patents in all fields of technology. In the pharmaceutical industry, generic drug companies have embraced *inter partes* review, filing hundreds of challenges in the first five years after its creation, with moderate success. Biologics, which make up a growing class of pharmaceutical products, are sometimes covered by dozens or scores of patents. As more of these complex therapeutics are developed and approved, *inter partes* review is expected to play an increasingly important role.

In 2018, the Supreme Court upheld the constitutionality of a new non-judicial proceeding for challenging patents, called *inter partes* review, in *Oil States Energy Services v. Greene's Energy Group*.[1] Oil States, the owner of a

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1.. Oil States Energy Servs., LLC v. Greene's Energy Grp., LLC, 138 S. Ct. 1365 (2018).

patent on hydraulic fracturing ("fracking") technology that was invalidated in a challenge before the U.S. Patent and Trademark Office (USPTO), an administrative agency, argued that *inter partes* review unconstitutionally deprived patent owners of their right to be heard in a court, as guaranteed by Article III of the U.S. Constitution, and of their right to a trial by jury, as guaranteed by the Seventh Amendment. In Oil States' view, the private property rights embodied in its patent should not have been subject to abrogation by a non-judicial body whose members answered to a political appointee.

Although *Oil States* addressed a patent directed to technology in the energy industry, the failed challenge to the *inter partes* review procedure has implications for any field of technology in which patents play an important role, including pharmaceuticals. More than 1,100 drug products are protected by at least one patent, with an average of more than three patents for each patent-protected drug.[2] The battle over patents in the pharmaceutical industry has a long history, the modern portion of which began in 1984 with the enactment of the Drug Price Competition and Patent Term Restoration Act ("Hatch-Waxman Act"). Under the Hatch-Waxman Act, litigation over patents can trigger a 30-month stay of approval of a generic drug application in order to provide time for the litigation to resolve, potentially allowing even weak patents to have an important exclusive effect in the market. The Act also provides brand-name manufacturers with the ability to extend the expiration date of one patent per drug product for up to five years, to make up for time lost during clinical testing and U.S. Food and Drug Administration (FDA) review.

To incentivize challenges to weak patents that were delaying generic competition, the Act provided the first generic drug manufacturer that brought a patent challenge with the possibility of obtaining a 180-day period during which no other generic drug company could enter the market.[3] But bringing suit in federal court was (and remains) expensive and time-consuming for patent challengers, in all fields of technology. Where more than $25 million is at stake—as is the case for virtually all litigated pharmaceutical patents—the costs of asserting or defending a Hatch-Waxman patent dispute average approximately $1.1 million or more per litigant.[4]

In the mid-2000s, Congress began to consider whether a rebalancing of

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2.. Reed F. Beall & Aaron S. Kesselheim, *Tertiary Patenting on Drug-Device Combination Products in the United States*, 36 NATURE BIOTECHNOLOGY 142, 143 tbl.1 (2018).

3. Drug Price Competition and Patent Term Restoration Act ("Hatch-Waxman Act"), Pub. L. No. 98-417, 98 Stat. 1585, 1589 (1984).

4. Donika P. Pentcheva & Frank L. Gerratana, AIPLA 2017 REPORT OF THE ECONOMIC SURVEY 42 (2017). The $1.1 million median figure represents a dramatic decline from 2013 and 2015, when medians of $6 million and $5 million, respectively, were reported. *Id.* It is not clear whether the decline represents a trend, or whether it is related to *inter partes* review.

patent policy was necessary to ensure a favorable market environment.[5] After six years of hearings and deliberation, it concluded that "flaws in the [patent] system . . . have become unbearable," and that change was needed to appropriately respond to the "growing sense that questionable patents are too easily obtained and . . . too difficult to challenge."[6] The culmination of Congress's deliberations was the 2011 Leahy-Smith America Invents Act,[7] which made a number of changes to the patent laws, including the establishment of a new type of administrative proceeding called *inter partes* review. The new proceeding allowed the USPTO to reconsider its previous decision to grant a patent and was intended to be faster and less expensive than court litigation.[8]

Congress also reconstituted the USPTO's Board of Patent Appeals and Interferences, an administrative tribunal that addressed matters such as appeals from patent rejections by examiners, into a new Patent Trial and Appeal Board. Like its predecessor, the PTAB comprised administrative patent judges who sat in 3-judge panels to make determinations about patent validity without involving juries. But *inter partes* review allowed patent challengers to participate in patent challenge proceedings to a greater extent than had previously been possible, as part of an adversarial process that resembled litigation.[9]

From the perspective of the patent challenger, *inter partes* review had a number of advantages over litigation. Estimated costs of the new proceeding were approximately ten percent as much as litigation, and the PTAB was generally required to make a judgment within one year of its decision to begin review.[10] A patent's obviousness could be established by a mere preponderance of the evidence, rather than by clear-and-convincing evidence, as would be required in court,[11] and patent claims would be interpreted according to their broadest reasonable interpretation rather than according to their ordinary meaning, increasing the probability that a claim would be invalidated as obvious over the prior art. In contrast with federal lawsuits, in which generic drug manufacturers generally seek to demonstrate patent invalidity only after brand-name manufacturers have sued for patent infringement, *inter partes* review proceedings may be brought by any party at virtually any time. This allows pro-

5. *See* H.R. REP. NO. 112-98, pt. 1, at 57 (2011), *reprinted in* 2011 U.S.C.C.A.N. 67, 88 (listing relevant Congressional hearings on patent reform beginning in 2005).

6. *Id.* at 39.

7. Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011).

8. *See generally* Evan J. Wallach & Jonathan J. Darrow, *Federal Circuit Review of USPTO Inter Partes Review Decisions, by the Numbers*, 98 J. PAT. & TRADEMARK OFF. SOC'Y 105 (2016) (summarizing the background that motivated the America Invents Act).

9. *Id.* at 109.

10. 35 U.S.C. § 316(a)(11) (2018).

11. Jonathan J. Darrow, Reed F. Beall & Aaron S. Kesselheim, *Will* Inter Partes *Review Speed US Generic Drug Entry?*, 35 NATURE BIOTECHNOLOGY 1139, 1139 (2017).

active challenges by generic drug firms and expands the list of prospective challengers to include public interest groups, other competing generic manufacturers, or even hedge funds seeking to profit from patent invalidation by betting against a company's stock.[12]

By the time the Supreme Court rendered its decision in *Oil States*, more than 7,500 petitions for *inter partes* review had been filed, resulting in the partial or complete invalidation of more than 1,600 patents across a broad range of technologies.[13] In the pharmaceutical sector, at least 198 patents covering 134 small-molecule drug products had already been challenged in *inter partes* review, with approximately half of completed challenges resulting in at least partial victory for the patent challenger.[14] In 2018 alone, almost 100 patents in the biopharmaceutical space were challenged,[15] and the number of drug patents challenged each quarter has been approximately four times as high as the number of new drugs approved each quarter.[16]

Although the patent in *Oil States* did not directly concern the pharmaceutical industry, the Pharmaceutical Research and Manufacturers of America (PhRMA), an industry trade group, filed an amicus brief in support of Oil States. PhRMA warned the Court that pharmaceutical companies invest "hundreds of billions of dollars" in drug development, and that these investments, on which future innovations rely, "make sense only because the resulting intellectual property is respected as property."[17] In essence, PhRMA's position as to *inter partes* review echoed the age-old battle over the patent system more generally, which has persisted at least since the patent abolition movement of the 1800s.[18] The basic arguments are relatively straightforward: Those favoring stronger, broader, or longer patent protection suggest that patents are needed to adequately incentivize the initial creation of new inventions, while those favoring more limited patent protection or opposing it altogether emphasize the restrictions on use that accrue

12. *Id.* at 1139–40.

13. U.S. PATENT & TRADEMARK OFFICE, TRIAL STATISTICS IPR, PGR, CBM: PATENT TRIAL AND APPEAL BOARD, Feb. 2018, at 3, 11 (2018), https://www.uspto.gov/sites/default/files/documents/trial_statistics_20180228.pdf.

14. Jonathan J. Darrow et al., *The Generic Drug Industry Embraces a Faster, Cheaper Pathway for Challenging Patents*, 17 APPLIED HEALTH ECON. & HEALTH POL'Y 47, 51 (2019).

15. U.S. PATENT & TRADEMARK OFFICE, TRIAL STATISTICS IPR, PGR, CBM: PATENT TRIAL AND APPEAL BOARD, June 2019, at 4 (2019), https://www.uspto.gov/sites/default/files/documents/Trial_Statistics_2019-06-30.pdf.

16. Darrow et al., *supra* note 14, at 53.

17. Brief for Pharmaceutical Research and Manufacturers of America as Amicus Curiae Supporting Petitioner at 6, Oil States Energy Servs., LLC v. Greene's Energy Grp., LLC, 138 S. Ct. 1365 (2018) (No. 16-712).

18. *See generally* Fritz Machlup & Edith Penrose, *The Patent Controversy in the Nineteenth Century*, 10 J. ECON. HIST. 1 (1950); Mark D. Janis, *Patent Abolitionism*, 17 BERKELEY TECH. L.J. 899 (2002) (describing the patent controversy in the nineteenth century).

once inventions have been created.

Notwithstanding PhRMA's argument, this larger policy question was not at issue in *Oil States*, which instead required the Court to resolve whether Congress could constitutionally delegate the *inter partes* review function to a non-judicial body.[19] The Court upheld Congress's action, rejecting Oil States' challenge in a 7-to-2 decision. The Court explained that although Article III generally prohibits Congress from conferring judicial power on entities outside of the traditional court system, Congress has greater latitude when public rather than private rights are involved. According to the Court, *inter partes* review "falls squarely within the public rights doctrine," which covers matters that arise between the government and those subject to its authority.[20] Specifically, the grant of a patent is a matter between the government, which grants a public franchise in the form of a patent, and the patentee, which discloses its invention in return. Because *inter partes* review is simply a reconsideration of the original patent grant, the Court ruled that Congress permissibly assigned authority to the PTAB. The Court emphasized that its ruling was limited and did not speak to whether a proceeding similar to *inter partes* review would be constitutional if used to settle patent infringement (as opposed to invalidity) cases, which might be more likely to involve private rights, or if it were not subject to review by an Article III court. The Court found that the Seventh Amendment's right to a trial by jury also had not been offended by the creation of *inter partes* review. Under Supreme Court precedent, once Congress properly assigned responsibility for adjudication to a non-Article III body such as the PTAB, the Seventh Amendment posed no independent bar.

Regarding PhRMA's concern that post-grant administrative invalidation could upset the legitimate, investment-backed expectations of businesses, the Court observed that patents confer only those rights that the statute prescribes, and that at the time of grant these rights are subject to the qualification that the U.S. Patent and Trademark Office may reexamine and even cancel a patent's claims at a later time if it determines statutory criteria were in fact not met. Even before the creation of administrative patent review, a patent did not guarantee a particular duration of exclusivity, since it could be challenged and invalidated by the judiciary.

Justice Gorsuch and Chief Justice Roberts dissented, echoing the concern of Oil States that political appointees may be more likely than independent judges to issue decisions that follow political interests, potentially undermining "much hard work and no little investment"[21]—a concern magnified in 2019 when the

19. *See* Petition for a Writ of Certiorari Question 1, at i, Oil States Energy Servs., LLC v. Greene's Energy Grp., LLC, 138 S. Ct. 1365 (2018) (No. 16-712).

20. *Oil States*, 138 S. Ct. at 1368.

21. *Id.* at 1380 (Gorsuch, J., dissenting).

Federal Circuit held that members of the PTAB could be removed without cause.[22] The dissent cautioned that important constitutional protections are often inefficient, such as the need to obtain a warrant before a search or conduct a jury trial before a criminal conviction, and that the expediency of PTAB review is not a justification for dispensing with constitutional safeguards. Despite these concerns, a majority of the Court found *inter partes* review constitutionally permissible, and the new proceeding survived its day in court.

The *Oil States* decision has important implications across all industries but may be particularly significant with respect to timely access to affordable generic drugs. Most drug patents that have been challenged in *inter partes* review are directed to aspects of the drug product other than its active ingredient.[23] Because these "secondary" patents may have expiration dates that extend well beyond the end of primary patents' expiration dates, challenging those that should not have issued because they were obvious could significantly advance the date of generic entry. The filing of a petition for *inter partes* review also does not trigger the 30-month stay available under the Hatch-Waxman Act, potentially shortening the time to generic drug entry for those products protected only by weak patents that would be found invalid if challenged.

Although some commentators have asserted that *inter partes* review makes little difference on the timing of generic drug entry,[24] circumstantial evidence suggests otherwise. Hedge funds have challenged drug patents in *inter partes* review in combination with shorting a company's stock, a stratagem that would result in profits only to the extent the market believes the challenge will impact generic entry. Generic drug firms quickly embraced the proceeding, filing 274 challenges in the pharmaceutical space between September 16, 2012 and April 24, 2017.[25] And the branded drug industry has vigorously opposed *inter partes* review, not only as reflected in PhRMA's amicus brief in *Oil States*, but by proposals that drug patents be exempted from eligibility for *inter partes* review altogether.[26]

The Court's vindication of Congress's choice to streamline patent challenges

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22. Arthrex, Inc. v. Smith & Nephew, Inc., 941 F.3d 1320, 1338 (Fed. Cir. 2019).

23. Jonathan J. Darrow et al., *The Generic Drug Industry Embraces a Faster, Cheaper Pathway for Challenging Patents*, 17 APPLIED HEALTH ECON. & HEALTH POL'Y 47, 51 (2019).

24. Sarah Karlin-Smith, *Patent Review: Not Super Effective in Speeding Early Generic Entry*, POLITICO (August 1, 2016, 12:00 PM), https://www.politico.com/tipsheets/prescription-pulse/2016/08/part-d-premiums-remain-stableptos-patent-review-isnt-speeding-many-genericsportman-calls-for-more-opioid-funding-215637.

25. Darrow et al., *supra* note 23, at 51.

26. Letter from James C. Greenwood, President and CEO, BIO, and John J. Castellani, President and CEO, PhRMA, to Chuck Grassley, Chairman, Senate Judiciary Committee, et al. (July 15, 2015), http://phrma-docs.phrma.org/sites/default/files/pdf/joint-phrma-bio-letter-on-ipr-071515.pdf.

before an administrative body may be especially important for the rapidly growing class of biologic drugs. These drugs are not subject to the regulatory scheme of the Hatch-Waxman Act, including its 180-day generic drug exclusivity incentive, so an inexpensive means of challenging patents may be particularly critical. Although a one-year exclusivity provision is available for "interchangeable" biosimilars, this higher standard has not yet been met for any product, and follow-on biologics have so far been approved only as ordinary biosimilars that do not benefit from the one-year non-patent exclusivity provision. Some biologics, such as the blockbuster tumor necrosis factor-alpha monoclonal antibody adalimumab (Humira), have been protected by veritable intellectual property "fortresses" made up of 100 or more patents.[27] In these cases, the impact of *inter partes* review is more complex. Although the cost of the administrative proceeding is generally lower if only one patent is at issue, this benefit may erode for drugs protected by larger numbers of patents. Only a single patent can be challenged in each *inter partes* review proceeding, in contrast to court litigation where multiple patents can be addressed at once.

Overall, however, the Supreme Court's preservation of an efficient administrative procedure for challenging weak patents can only benefit generic drug and biosimilar manufacturers that seek to enter the market sooner. When these challenges successfully lead to earlier entry by competitors, they can be expected to bring down prices, including those on some of the most expensive drugs and biologics in the world. Following the Court's decision in *Oil States*, *inter partes* review will help to ensure that invalid patents are not preventing patient access to important new medicines.

27. Complaint at 1, AbbVie Inc. v. Amgen Inc., No. 16-cv-00666 (D. Del. Aug. 5, 2016), ECF No. 1, *dismissed.*