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ANALYTIC REVIEW

Translating Guidelines for the Diagnosis and Management of Sports-Related Concussion Into Practice

Abstract: *Sports injuries are a significant clinical and public health concern. There is a growing call to improve the translation of available evidence-based and expert-informed sports injury prevention interventions into sustained use in practice by physicians and others (eg, athletic trainers, coaches, and parents) who care for injured athletes. This article provides a brief overview of the current sport injury prevention implementation literature before focusing specifically on the translation of guidelines (including consensus and position statements) developed to assist physicians and others diagnose and manage athletes with sport-related concussion and the associated return-to-play decisions. The outcomes of more than 20 published studies indicate that physician, athletic trainer, coach, parent, and athlete knowledge, use of, and compliance with sport-related concussion guidelines are limited. More concerted, coordinated, and theory-informed efforts are required to facilitate the widespread dissemination, translation, and implementation of such guidelines. An example is provided of how implementation drivers could be used to inform the development of a comprehensive, multilevel implementation strategy targeting the individual, organizational, and system-level changes necessary to support the translation of available sport-related concussion guidelines in both the clinical and sports settings.*

Keywords: sports injury; concussion guidelines; translation; implementation

The Need for Better Implementation

The evidence-base concerning what works to prevent many common sports-related injuries is large and growing.[13-17] However, the translation of this evidence into widespread use is lagging.[18] Two recent reviews of sports injury prevention interventions have articulated the importance of focusing attention on

> . . . effective implementation strategies are needed to complement existing evidence-based interventions in order to significantly reduce the incidence and severity of sports-related injuries.

While regular participation in sport and physical activity confers health benefits,[1] injuries sustained during this activity can pose significant public health and clinical problems.[2,3] Sports injuries are a common[4,5] and costly[6,7] barrier to ongoing participation in physical activity[8,9] and a concern for parents of young participants.[10] As such, the prevention of sport-related injuries should be a priority for physicians, scientists, and sports administrators alike.[11,12]

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disseminating and implementing efficacious interventions in order to make a significant impact on the public health burden of sports injuries.[13,15] Effectively undertaking such knowledge dissemination and translation activities requires an understanding of the implementation setting (context, culture, and capacity), the translation of what is already known into formats (guidelines, programs, resources, policies, etc) that can be accessed and used by target audiences, and the development and operationalization of effective implementation plans.[19-21]

Despite the importance of implementation activities to maximizing the public health outcomes of sports injury prevention research, historically, little emphasis has been placed on exploring ways to facilitate the implementation of interventions in real-world contexts.[22-24] This began to change in the mid to late 2000s, particularly in terms of research exploring how best to maximize intervention uptake among target audiences.[20,22,25] The outputs of this research can be grouped into 3 broad categories:

1. Editorials, commentaries, and study protocols either calling for more and better implementation research or outlining how such research is being, or could be, conducted.[18,21,26-36] This body of work has been underpinned by frameworks and theories from health promotion,[37-39] behavioral science,[40,41] and more recently, implementation science.[26,42,43]
2. Frameworks to guide efforts to translate knowledge and implement sports injury prevention interventions.[19,20,26,44-47]
3. Descriptions and evaluations of implementation efforts[48-52] and plans.[53,54] This work includes identifying factors that influence implementation activities and outcomes[55-59] as well as assessing whether physicians, athletes, and coaches know about, or adhere to sports injury prevention interventions, recommendations and guidelines across a range of sports and settings.[57,60-86]

Several common themes have emerged from this body of literature. First, there is now general acknowledgment that effective implementation strategies are needed to complement existing evidence-based interventions in order to significantly reduce the incidence and severity of sports-related injuries. Second, encouraging medical personnel (family, emergency and sports physicians, and athletic trainers)[66,67,78-80,87] and sports participants (athletes and coaches)[†] to comply with or use evidence-base injury prevention interventions, guidelines, and regulations can be challenging. Finally, the implementation of sports injury prevention interventions could benefit significantly from what is already known and applied in the fields of health promotion, behavioral science, and implementation science.[‡] This point is particularly pertinent with respect to the need to do more than just educate or disseminate information about evidence-based interventions among physicians, coaches, and athletes.[94]

Although there is a clear need to improve the translation of evidence-based injury prevention interventions into sustained practice across all injury issues and sporting contexts, the remainder of this paper will focus specifically on the translation of diagnosis, management, and return-to-play guidelines for sport-related concussion into practice among physicians and those involved in sport. Guidelines can be a useful tool for improving the consistency and efficiency of care and for closing the gap between clinical practice and what the scientific evidence supports.[95-97] As such, consistent use of guidelines has the potential to improve the quality of patient care, reduce the risk of medical negligence, and be cost effective for the healthcare system.[95,96] However, it should be kept in mind that a lack of knowledge or use of available guidelines is not necessarily an indication of poor or inappropriate clinical care.

[†] *References 56, 62, 63, 65, 88, 89.*
[‡] *References 18, 21, 26, 28, 29, 36, 41, 53, 90-93.*

Enhancing the Use of, and Compliance With, Sport-Related Concussion Diagnosis, Management, and Return-to-Play Guidelines

Sport-related concussion is a major public health and clinical concern,[98] with an estimated 1.6 million to 3.8 million sports-related traumatic brain injuries (including those who do, and do not, seek medical attention) each year in the United States.[99] However, these figures may underestimate the true incidence by 6 to 10 times because sport-related concussion is often unrecognized by athletes and is often not reported to doctors.[100]

Family physicians are important carers of concussed athletes[67,80,101] and disseminators of concussion knowledge,[68,102] and multiple clinical guidelines, consensus and position statements (hereafter collectively referred to as guidelines) are available to help them make concussion-related diagnostic, management, and return-to-play decisions. For example, it has been estimated that more than 25 sport-related concussion severity grading scales were available in 2001[103] and that approximately 20 concussion management guidelines were published in the 2 decades prior to 2009.[104] New or updated guidelines continue to emerge to reflect developments in the scientific literature, with the American Medical Society for Sports Medicine,[105] the American Academy of Neurology,[106] and the Concussion in Sport Group (CISG)[107] each publishing new or updated concussion guidelines or position statements in 2013.

Over the past decade, 4 CISG meetings have been held to reach consensus about the understanding and management of concussion in sport.[107-110] At the 2001 meeting in Vienna, concussion was

defined and it was recommended that concussion management strategies be based on an individualized, objective assessment of clinical and cognitive recovery postinjury.[108] From 2001 onward, the CISG stressed that all concussions should be assessed by a medical doctor both at the time of injury and when considering returning-to-play. One of the outcomes of the 2004 Prague CISG meeting was the development of a standardized concussion assessment tool (the SCAT) to help medical personnel diagnose, assess, and manage concussions. A concussion "rehabilitation" protocol was also introduced for a graded return-to-play program.[109] From 2004, it was also recommended that no concussed athlete should return to their sport on the day of injury, although considerations pertaining to the particular circumstances of professional sport were elaborated. At the 2008 meeting, the SCAT2 was further developed to reflect research highlighting the importance of assessing balance and conducting more detailed screening of brain function. In addition, a sideline version of the SCAT2 was developed to help lay people identify concussions on the field of play. These tools were further modified based on published research and testing at the 2013 meeting, and the SCAT3, Child SCAT3, and Concussion Recognition Tool were subsequently produced.[107]

This proliferation of published guidelines has been matched by, and often used to inform, the development of fact sheets, position statements, policies, and guidelines developed by government agencies (eg, US Centers for Disease Control and Prevention http://www.cdc.gov/concussion/sports/index.html), professional associations (eg, College of Family Physicians of Canada http://www.cfpc.ca/uploadedFiles/Health_Policy/_PDFs/Position_Statement_Concussions_Approved%20Feb2012_ENG.pdf), and national and international sports governing bodies. In addition, 49 US states now have legislation governing the management of concussion in sport. These laws generally focus on (*a*) educating coaches, parents, and athletes about concussion and (*b*) medically assessing the concussed athlete.[111,112]

To complement the profusion of concussion guidelines, research has explored whether physicians and others who treat patients with sports-related concussion are aware of these guidelines, have used them in their practice, or whether their practice is in line with guideline recommendations. Early investigations found mixed results across a variety of settings and target groups. For example, only 30% of patients from the Children's Hospital of Alabama received discharge instructions consistent with those recommended in Cantu's 1986 guidelines[113] following a diagnosis of a sports-related closed head injury.[114] More positive findings were reported by Ferrara et al,[115] with around 82% of attendees at a concussion-specific mini-course at the 1999 National Athletic Trainers' Association Annual Meeting and Clinical Symposia reporting using a concussion grading scale. However, only 19% reported using some form of return-to-play guidelines.[115]

Equivalent lines of research have been conducted among athletes. Only half of the players from teams participating in the 2000 New Zealand national schools rugby union competition were aware of the International Rugby Board (IRB) concussion guidelines that applied to them, and only 60% correctly identified the IRB-mandated 3-week stand down period following a concussion.[116] This is despite the fact that this stand down period has been a law of the game since 1968. Furthermore, of the 62% who suspected that they had been concussed, just more than half reported their suspicions to a doctor or sports (first aid) medic, more than half made their own return-to-play decision, and only 22% received medical clearance before returning to play.[116] A similar lack of compliance with return-to-play regulations following concussion was identified more recently among Australian schoolboy and community rugby union players.[62]

A search of the PubMed, Scopus (Elsevier), SPORTDiscus (EBSCO), and Google Scholar databases (using the terms *sport* AND *concussion* AND *guideline*) (1980-2013 inclusive) identified that, since this early research, more than 20 studies examining knowledge of, or compliance with, concussion guidelines have been published in the peer-review scientific literature. This search identified studies that were predominately cross-sectional in nature, investigated guideline knowledge and compliance among a range of stakeholders, including physicians, athletic trainers, coaches, athletes, and parents across a variety of sports. A summary of these studies appears in Table 1.

Although most of the published research investigating physician knowledge and use of concussion guidelines has been conducted in North America, it appears that the lack of knowledge, and use, of readily available sport-related concussion guidelines is not restricted to this region. For example, a 2013 study of club medical officers for English League football (soccer) teams identified that more than 25% had not heard of the 2008 CISG consensus statement and more than 50% did not routinely follow the guidelines in spite of the dissemination of information about these guidelines by the Fédération Internationale de Football Association (FIFA), the international governing body in this sport.[78]

In 2013, the authors of this review conducted an online survey of a small sample (n = 37) of Australian general practitioners (family physicians) and the main findings are also summarized in Table 1. Although 84% of the responding physicians had diagnosed and/or managed patients with a sport-related concussion (51% in the previous 12 months), 46% were not aware of any specific guidelines for the diagnosis and/or management of sport-related concussion. Of those who were aware of such guidelines, 40% reported that they were aware of the Sports Medicine Australia (Australia's peak national umbrella body for sports medicine and sports science) Smartplay guidelines, 25% were aware of one or more of the CISG consensus statements, and 5% each were

Table 1.

Summary of Studies of the Knowledge of, and Compliance With, Concussion Diagnosis, Management and Return-to-Play (RTP) Guidelines Among Physicians, Others Who Provide Medical Services in Sports Settings, and Sports Coaches, Athletes, and Parents.

Physicians and Others Who Provide Medical Services				
Authors and Year	**Study Design**	**Sample/Target**	**Guidelines**	**Finding**
Genuardi and King (1995)[114]	Patient record examination	Patients discharged with a diagnosis of a closed head injury or concussion (n = 33), US	Cantu 1986 CMSG 1991	30% of patients received appropriate discharge instructions
Bazarian et al (2001)[81]	Cross-sectional survey	Emergency physicians, emergency nurse practitioners, pediatricians, pediatric nurse practitioners, family practitioners, and family practice nurse practitioners (n = 1442), US	CMSG 1991	8% responded correctly for grade I concussion scenario, 56% for grade 2 scenario and 28% for grade 3 scenario
Ferrara et al (2001)[115]	Cross-sectional survey	Attendees at the 1999 National Athletic Trainers' Association (NATA) Annual Meeting and Clinical Symposia (n = 339), US	AAN DNS Cantu DNS CMSG DNS	Evaluated an average of seven concussions per year Athletic trainers (34%) and team physicians (40%) primarily responsible for RTP clinical decision making 28% used the CMSG, 19% Cantu, and 13% AAN >18% did not use a concussion grading scale or RTP guideline
Notebaert and Guskiewicz (2005)[87]	Cross-sectional survey	Certified athletic trainers and members of the NATA (n = 2750), US	NATA 2004 AAN 1997 Cantu 2001 CMSG 1994	Diagnosed an average of 8 concussions per year 3% cover all three areas recommended by NATA, 24% used at least two methods, and 80% used at least 1 method 30% used AAN, 21% CMSG, 20% Cantu, 13% some combination of or a site-specific RTP guidelines 9% did not using any RTP guidelines
Pleacher and Dexter (2006)[80]	Cross-sectional survey	Pediatricians, family doctors, family nurse practitioners, and doctor's assistants (n = 367), US	AAN 1997 CMSG 1991 Cantu 1986	58% treated 1-4 patients with concussion in the preceding year 68% used published guidelines (of these AAN 55%, 24% CMSG, and 13% Cantu) 32% did not use published guidelines
Covassin et al (2009)[117]	Cross-sectional survey	Program directors and certified athletic trainers (n = 513) holding educational positions in accredited athletic training programs, US	NATA 2004 AAN 1997 Cantu 2001 CMSG 1994	80% taught NATA guidelines, Cantu 61%, CMSG 52%, AAN 42%, and CISG 15% 61% used NATA guidelines Cantu 28%, CMSG 26%, AAN 24%, and 2001 CISG 12% to assess and manage concussion

(continued)

Table 1. (continued)

Physicians and Others Who Provide Medical Services				
Authors and Year	**Study Design**	**Sample/Target**	**Guidelines**	**Finding**
			CISG 2001	47% used NATA, AAN 15%, Cantu 12%, CMSG 11% and CISG 11% for RTP decisions 66% had not heard of CISG guidelines
Giebel et al (2011)[79]	Cross-sectional survey	Emergency physicians and emergency medicine residents (n = 73), US	AAN (DNS) Cantu (DNS) CMSG (DNS)	43% evaluated 6-15 patients with sports-related concussions annually; 28% evaluated >15 23% used nationally recognized guideline to evaluate sports-related concussions (10% used AAN, 8% Cantu)
Boggild and Tator (2012)[118]	Cross-sectional survey	Graduating university medical students (n = 222) and neurology / neurosurgery residents (n = 80), Canada	Some survey items based on CISG 2008	48% and 57% did not recognize chronic traumatic encephalopathy and second impact syndrome, respectively as possible consequences of repetitive concussions 24% did not think that "every concussed individual should see a physician"
Burke et al (2012)[119]	Cross-sectional survey	Medical schools (n = 14), Canada	None specified	29% provided concussion-specific education 43% offered head injury education that incorporated a concussion component 29% did not offer any concussion education
Price et al (2012)[78]	Cross-sectional survey	Club Medical Officers of all (n = 92) English Football Association league clubs, UK	CISG 2008	28% had not heard of guidelines 56% did not follow guidelines 21% recorded an approved preseason cognitive score 42% completed a recommended postconcussion assessment 44% regularly enforced a rest period that did not meet guidelines
Chinn and Porter (2013)[66]	Cross-sectional survey	Community College head athletic trainers (n = 64), US	NATA 2004	71% did not conduct baseline testing 81% and 85%, respectively, used self-report symptoms checklist for sideline concussion assessment and RTP 32% used objective cognitive assessments at sideline and to determine RTP 10% used computerized cognitive assessment as part of RTP process
Lebrun et al (2013)[67]	Cross-sectional survey	Family physicians, Canada (CAN) (n = 80) and US (n = 109)	CISG 2008	96% CAN, 95% US diagnosed and treated concussions Sport was main etiology of concussions (53% CAN, 77% US)

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Table 1. (continued)

Physicians and Others Who Provide Medical Services				
Authors and Year	**Study Design**	**Sample/Target**	**Guidelines**	**Finding**
				9% US physicians used CISG guidelines >50% had recent sport-related concussions CME and 84% to 94% wanted more concussions education
White et al (2013)[a]	Cross-sectional online survey	General practitioners (n = 37), Australia	CISG 2008 CISG 2013	90% used clinical assessment for initial concussion assessment and RTP decision 25% to 30% used SCAT1 or SCAT2, and balance testing for initial concussion assessment and RTP decision 11% used outdated concussion grading system 10% used neurocognitive testing for RTP decision 22% used RTP guidelines 25% were aware of CISG consensus statements 30% would allow an athlete to RTP in the same game 70% believed that an athlete should retire after 3 concussions in 1 year 50% believed that an athlete who has 2-4 concussions should retire from sport
Knowledge of, and compliance with, concussion management guidelines among players, coaches, and parents				
Sye et al (2006)[116]	Cross-sectional survey	High school rugby players (n = 477), New Zealand	International Rugby Board (IRB), accessed on line 2006	50% were aware of concussion guidelines and 60% identified the governing body mandated stand down period 50% sourced concussion knowledge from teachers/coaches, 42% doctors and sports (first aid) medics, 24% other players, 19% television and the 17% Accident Compensation Corporation/New Zealand Rugby Union Of the 62% who suspected that they had been concussed, 60% reported this to a coach, 53% a doctor or sports (first aid) medic, 46% a parent/caregiver or 31% to teammates; 20% unreported 52% made their own RTP decision, 22% returned after medical clearance
Guilmette et al (2007)[102]	Cross-sectional survey	High school head football coaches (n = 109) New England, US	Some survey items based on • NATA 2004 • CDC 2005 • National Federation for State High School Association, accessed on line 2006	80% received concussion information from coaching associations 70% to 95% would consult a health care professional before allowing players to RTP

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Table 1. (continued)

Physicians and Others Who Provide Medical Services				
Authors and Year	**Study Design**	**Sample/Target**	**Guidelines**	**Finding**
McLeod et al (2007)[120]	Cross-sectional survey	Active youth sports coaches (n = 156), country not specified	None specified	60% identified common concussion symptoms 42% thought concussion required loss of consciousness 32% did not think grade 1 concussion required removal from competition 26% would let symptomatic athlete RTP
Cusimano et al (2009)[121]	Cross-sectional survey	Youth ice hockey players (n = 267), coaches, trainers, and parents (total adults n = 142), Canada	None specified	Significant number held misconceptions about concussion in hockey, which could lead to serious health consequences
O'Donoghue et al (2009)[122]	Cross-sectional survey	Coaches of 17 different high school sports (n = 126), US	Survey based on NATA 2004 CDC 2005	Coaches demonstrated moderate knowledge of sport-related concussion (84%) Area of greatest knowledge was recognition (92%); least was management (79%)
Sullivan et al (2009)[123]	Cross-sectional survey	Parents (n = 200) of male high school rugby union players attending matches, New Zealand	Accident Compensation Corporation, accessed on line 2006	83% believed they could recognize concussion 96% aware of risks of continuing to play while concussed 51% aware of RTP guidelines 81% would insist on teenager seeing doctor before RTP
Yard and Comstock (2009)[69]	Prospective cohort study	Injury reports submitted by athletic trainers at 100 nationally representative high schools, US	AAN 1997 CISG 2004	At least 41% and 15% of concussed athletes RTP prematurely under AAN and CISG RTP guidelines, respectively
Broglio et al (2010)[124]	Cross-sectional survey	Athletes, coaches, and medical staff in club level soccer (n = 342), Italy	None specified	10% of athletes sustained a concussion in past year (62% not reported) Coaches consistently identified non-concussion related symptoms (99%), but not concussion symptoms (39%) Most understood loss of consciousness is not sole indicator of injury (83%) Medical staff relied on clinical exam (92%) and athlete symptom reports (92%) to make concussion diagnosis and RTP decision Little use of neurocognitive (17%) or balance (0%) testing
Boffano et al (2011)[125]	Cross-sectional survey	Amateur rugby union players (n = 65), Italy	None specified	39% reported not being informed about concussion symptoms 28% of "uninformed" players thought they could RTP in same match 8% of 'informed' players though they could RTP immediately

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Table 1. (continued)

Physicians and Others Who Provide Medical Services				
Authors and Year	**Study Design**	**Sample/Target**	**Guidelines**	**Finding**
Mrazik et al (2011)[68]	Cross-sectional survey	Minor hockey associations coaches (n = 178), Canada	None specified	>90% rated concussions knowledge highly important in their role 36% received concussions information from family physicians, 57% of whom viewed the source as very/quite helpful >90% would not allow player to RTP if suspected concussion and presented with common symptoms 99% would recommend athlete see family physician after head injury
Bramley et al (2012)[83]	Cross-sectional survey	Youth ice hockey coaches (n = 314), US	CISG, 2008 referred to but not explicitly applied	2% would never allow player to RTP in an undefined game 81% to 83% would never allow a player to RTP in championship game or high school final
Hollis et al (2012)[62]	Prospective cohort study	Community rugby union players (n = 1958), Australia	IRB, accessed on line 2011	10% sustained ≥1 concussion during follow-up Median number of days before RTP (or training) postconcussion was 3 (range 1-84) 78% did not receive RTP advice postconcussion 100% who received correct advice did not comply with stand-down regulation 87% of concussed players RTP (or training) within 1 week, 91% by 2nd week and 95% by 3rd week
Murphy et al (2012)[126]	Cross-sectional survey	High school varsity football coaches, athletic trainer and athletic directors (n = 59), US	None specified	83% saw between 0 and 10 concussions each season, 12% 11-20, 5% 20+ 46% used SCAT2 31% used neurocognitive testing 100% completed concussion training
White et al (2013)[85]	Cross-sectional survey	Australian football and rugby league coaches and sports trainers (n = 916), Australia	Australian Football League and Australian National Rugby League sport-specific guidelines, both based on CISG, 2008	>90% correctly identified 5 of 8 key concussion signs or symptoms <50% recognized increased risk of second concussion following initial concussion Nearly 75% incorrectly believed or were uncertain that scans typically show damage to brain after concussion <25% recognized, and >40% were uncertain that younger players typically take longer to recover from concussion than adults

Abbreviations: CMSG = Colorado Medical Society Guidelines; AAN = American Academy of Neurology; NATA = National Athletic Trainers Association; CISG = Concussion in Sport Group; CDC = Centers for Disease Control and Prevention; IRB = International Rugby Board; DNS = date not specified; RTP = return-to-play; CME = continuing medical education.
[a]These data have not been published previously and so are included in full here.

aware of the American Medical Society for Sports Medicine position statement on concussion in sport and the Australian Football League concussion guidelines.

Athletes, parents, and coaches have also been shown to have deficiencies in their concussion knowledge and return-to-play behaviors.[§] What is particularly concerning from a physician's perspective is that these findings highlight that providing coaches and parents with information about sport-related concussion is not enough to change athletes' return-to-play behavior. This is demonstrated by the discrepancy between coaches' and parents' knowledge about what they should do if confronted with a return-to-play decision for a concussed athlete or child,[68,102,123] and what athletes and injury surveillance reports indicate actually happens.[62,69,116]

Despite repeated calls for greater investment in translating the available guidelines into improvements in the diagnosis and management of sports-related concussion,[‖] considerable work remains to be done. This situation is not unique to sport-related concussion guidelines. A 2011 systematic review of physicians' use of a broad range of clinical guidelines identified that, although awareness of guidelines was high (90%), the median proportion of respondents who reported adhering to guideline recommendations was 36% (interquartile range 35% to 56%), with similar proportions of "leakage" (around 15%) between each of the 4 stages from guideline awareness to agreement, adoption, and adherence.[96] In addition, a 2010 systematic review of the effectiveness and efficiency of a wide range of clinical guideline dissemination and implementation strategies indicated that most guideline implementation research is not informed by cognitive, behavioral, or organizational theory[127] and the majority of interventions were associated with modest to moderate improvements in care at best.[128]

Although some evaluations of sport-related concussion education initiatives with sports coaches have been published recently,[52,129,130] to date there have been no coordinated, well-planned or theory-informed efforts to disseminate or implement sport-related concussion guidelines with physicians.[33] There have, however, been recent discussions about the potential application of knowledge transfer[34,35] and social marketing principles[33] and the use of social media platforms such as Facebook and Twitter[33,131] to enhance the translation of concussion guidelines into changes in practice among physicians and others involved in sport. Interestingly, nearly all the discussion around increasing the uptake and use of concussion guidelines has focused exclusively on improving or increasing education of physicians, sports coaches, and athletes[34,105,107] or embracing new and popular electronic communication channels to better disseminate available guidelines.[33,101] Although efforts in these areas are undoubtedly needed, the widespread dissemination of guidelines has been shown to have limited effect on changing physician behaviour.[95,132,133] There is also considerable evidence in the broader field of implementation science that having access to information, guidelines, policies, education, and training alone are generally ineffective implementation methods, and that longer term multilevel implementation strategies targeting individual, organizational, and system-level changes are usually more effective.[94]

Using Implementation Science to Drive Sport-Related Concussion Guideline Use and Compliance

Implementation science is "the study of methods to promote the systematic uptake of research findings and other evidence-based practices into routine practice."[134] It is a growing field that draws on evidence from a wide range of disciplines[94,135] and has implications for everyone interested in bridging the gap between research and practice,[136] including in the field of sports injury prevention.[26] Several models and frameworks outlining productive implementation strategies have emerged,[137-139] but concern has been expressed that such models are often too complex, academic, or time-consuming for physicians and practitioners to use.[140]

One conceptual framework that has emerged from the implementation science literature, and which may be potentially useful for informing future implementation efforts in the context of sport injury prevention, is the notion of implementation drivers developed at the National Implementation Research Network.[26,43] These drivers are based on the common elements of successful implementation programs (including in the field of clinical guidelines)[94] and can be used to leverage improved practitioner competence, and to create more supportive organizational systems and environments for the implementation of new programs, practices, policies, and guidelines. Implementation drivers are independent of the quality of the intervention being implemented[141] and can be broadly classified into 3 categories. *Competency drivers* reflect the capacity of staff or practitioners (eg, physicians, coaches, athletic trainers) to effectively implement the intervention, while *organizational drivers* focus on the organizational processes necessary to facilitate intervention implementation. Finally, *leadership drivers* promote implementation at the start of the process and provide ongoing technical expertise to manage and embed the continued implementation of new initiatives. These drivers work together and can compensate for each other to encourage and support the widespread, high-fidelity implementation of new interventions across settings. These implementation drivers provide a useful starting point for guiding efforts to enhance physician and sports-sector knowledge of, and compliance with, readily available sport-related concussion guidelines.

Table 2 provides a detailed description of how these implementation drivers

[§] *References 62, 69, 85, 116, 120, 121, 123.*
[‖] *Reference 33-35, 101, 107, 110.*

Table 2.

Example of how the Implementation Drivers Could Be Applied to Enhance the Use of Sport-Related Concussion Guidelines in Clinical and Sports Settings.

Implementation Driver	Purpose of Driver	How driver could be used to improve use of and compliance with, recognized sport-related concussion diagnosis, management and return-to-play guidelines in clinical and sports settings	
		Clinical Setting (eg, Family and Emergency Physicians)	Sports Setting (eg, Schools, Community Clubs, Colleges and Universities)
Competency			
Selection	Select practitioners with the capacity (eg, knowledge, skills, qualifications, personal qualities) to implement the intervention	Include willingness and potential capacity to use guidelines as prerequisite for clinical employment	Establish guideline use specific selection criteria (including referral pathway knowledge) for recruitment of coaches and those who provide clinical services in sports settings
Training	Ensure practitioners know when, where, how and with whom to use the intervention	Incorporate guideline use into initial medical training and job orientation processes for physicians	Integrate guideline use training into mandatory accreditation processes for coaches and those who provide clinical services in sports settings
Coaching	Ensure practitioners can actually use the intervention appropriately in the real world	Appoint a guideline "champion" to conduct on-the-job mentoring of other physicians in how and when to use the guidelines	Include guideline follow up and on-the-job coaching into mandatory reaccreditation processes for coaches and those who provide clinical services in sports settings
Perfomance assessment	Measure actual intervention delivery performance of practitioners	Have guideline "champion" conduct regular guideline use audit and feedback for other physicians	Establish practical and efficient guideline use performance measurement and reporting processes for coaches and those who provide clinical services in sports settings
Organizational			
Systems interventions	Align external systems (funding, political agendas, community expectations, media etc) to support intervention implementation	Hospital, clinic and political leaders advocate for review and update of external systems and processes to support guideline use	School, club, college, university, and community leaders identify and advocate for changes to external systems and processes that impede guideline use by coaches and those who provide clinical services in sports settings
Facilitative administration	Remove organizational barriers to intervention implementation (eg, culture, structures, processes, procedures, and resource allocation)	Develop and revise hospital and clinic policies and procedures to support guideline use	Review and regularly update internal school, club and community organization systems and processes to support guideline use

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Table 2. (continued)

Implementation Driver	Purpose of Driver	How driver could be used to improve use of and compliance with, recognized sport-related concussion diagnosis, management and return-to-play guidelines in clinical and sports settings	
		Clinical Setting (eg, Family and Emergency Physicians)	Sports Setting (eg, Schools, Community Clubs, Colleges and Universities)
Decision support data systems	Facilitate continuous quality improvement by gathering and using intervention implementation process and impact data	Link guidelines to electronic health records at the point of care including quality reporting capacity	Establish a practical system to measure, report and provide feedback on guideline use within schools, clubs, colleges, universities and community organizations
Leadership			
Technical	Provide operational leadership necessary to implement the intervention once parameters are defined (eg, lead by example, planning, organization, procedures)	Hospital and clinic leaders and documents provide technical advice on guideline use to physicians where required	School, club, college, university, and community leaders actively engage with coaches, athletic trainers and others who provide clinical services in sports settings, to overcome barriers to guideline adoption and use
Adaptive	Provide strategic or managerial leadership for intervention implementation (eg, culture, vision, policies, and resource allocation)	Hospital and clinic leaders align overall mission, values, and philosophy of the hospitals and clinics with guideline use	National sporting, education and political leaders endorse and effectively communicate their support for guideline use to coaches, athletic trainers and others who provide clinical services in sports settings

could be applied to enhance the use of sport-related concussion guidelines in clinical and sports settings. Developing and operationalizing strategies that target each of these implementation drivers should, in principle, help to maximize the likelihood that those in clinical and sports settings responsible for diagnosing, managing, and making return-to-play decisions about concussed athletes are knowledgeable about, and skilled in the use of, recommended sport-related concussion guidelines. These strategies are also likely to create environments (eg, supportive systems, policies, procedures, and leaders) that encourage and assist physicians and sports personnel in their guideline implementation efforts.

In addition to informing the development of strategies to facilitate the use of available concussion guidelines among physicians and those involved in the sports sector, physicians themselves could also use these implementation drivers to guide their efforts to encourage and support individual patients to comply with concussion-related advice. For example, physicians could step outside their clinics and begin to work in partnership with their local communities (sporting clubs, schools, or community groups) to address the issue of the appropriate diagnosis, management and return-to-play of concussed athletes. This could include providing information, education, training, and mentoring to local sports coaches and athletic trainers about the available concussion guidelines, including when and how to use them. Physicians could also work with local club and school/college sports administrators to develop effective policies, systems, and procedures that encourage and support athletic trainers, coaches, athletes, and parents to follow the diagnosis, management, and return-to-play advice contained in the concussion guidelines. Finally, physicians could provide

leadership, perhaps at a regional administrative rather than individual club or school level, to drive the cultural change that may be required to initiate and sustain the use of, and compliance with, available guidelines within their communities.

Conclusion

Sports injuries are a significant public health and clinical concern. A range of evidence-based interventions and guidelines are available to assist physicians and others who care for injured athletes, and research attention has begun to focus more on the translation of these interventions into routine practice. For example, guidelines to aid in the diagnosis and management of sport-related concussion and related return-to-sport decisions have been publicly available in various forms since at least 1986.[113] Yet, as the research summarized in Table 1 of this review strongly indicates, physicians (including family and emergency physicians) and others who care for athletes with sport-related concussion (athletic trainers, coaches and parents) do not routinely know about, use, or comply with such guidelines. Although there has been some recent discussion about the use of knowledge translation theory and social media platforms, there have been no well-planned or coordinated efforts to enhance the knowledge or use of sport-related concussion guidelines among physicians.

Implementation science is a growing field of research that offers the potential to inform the development of targeted and effective strategies to enhance the use of, and compliance with, readily available guidelines among those responsible for diagnosing and managing sport-related concussion. In particular, a multilevel focus on improving competency in the use of such guidelines among all those who care for concussed athletes, developing organizational systems and procedures that encourage and support guideline use, and providing technical and cultural leadership offer significant opportunities to enhance the translation of evidence into practice in this important area of sports medicine.

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