PROGRAM EVALUATION AND PERCEPTIONS OF IMPLEMENTATION (PEPI): ATHLETE CONCUSSION EDUCATION INTERVENTIONS TO IMPROVE CARE-SEEKING

by

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(Under the Direction of JULIANNE SCHMIDT)

ABSTRACT

Concussion education programs encourage athletes to seek care after an injury, which protects athletes' short- and long-term health. Athletic trainers (ATs) use programs with a variety of delivery methods and content. Understanding program content and other messengers' perceptions of the programs' implementation potential (acceptability, appropriateness, and feasibility) may inform clinical practice. We developed the Program Evaluation and Perceptions of Implementation (PEPI) process to identify and evaluate educational interventions content and potential for successful implementation. The research aims of this project were to identify 1) the degree to which ATs perceive concussion education interventions as acceptable, appropriate, and feasible; and 2) the extent to which these perceptions are patterned by setting, staff-to-athlete ratio, role in selecting programming, and whether concussion education is delivered. A rapid scoping review identified fifteen programs. We determined which of the expert-recommended recommendations each program addressed, selected the programs that exceeded the average number (N=8, mean=3.5), and invited ATs completing a continuing education activity to participate in research. After providing consent, demographics, and

institutional information (setting, staff-to-athlete ratio, role in selecting education, and whether education is delivered), participants completed surveys on acceptability, appropriateness, and feasibility for each program. Each survey contains four Likert-type items with responses ranging from 1 (“completely disagree”) to 5 (“completely agree”), which were averaged into construct scores. The 281 ATs (62.2% female gender, 33.9±10.0 years-old) practiced in secondary school (N=108, 38.4%) and collegiate (N=173, 61.5%) settings with an average staff ratio of 176.8±169.5 athletes per full-time AT (median=116.7 [IQR:54.8-250.0]). Forty-nine percent (N=138) could modify their programming, and 88% (N=249) performed education. All programs had positive average ratings (means>3.0, range=3.47-4.47) and all but one had >50% positive perceptions (range=49.1-81.9%). Generalized linear models revealed that except for acceptability and appropriateness of the CrashCourse program (p-values=.004-.018, respectfully), individual and institutional factors were largely not significant predictors of perceptions of implementation outcomes (p-values=.050->.999). ATs may have similar perceptions of program implementation regardless of the factors we explored. Future studies should explore other contextual and program characteristics that may impact implementation of concussion programming. The PEPI process should undergo further study with other health education topics and populations.

INDEX WORDS: Health education, Research translation, Athletic training, Implementation, Care-seeking, Scoping review

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DEDICATION

I dedicate this dissertation to my “adoring” husband, Scott. Your encouragement and motivation have been among the strongest driving forces to completing this project. I love you and I like you.

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CHAPTER 1

INTRODUCTION

Background

Competitive athletics provides psychological and physical benefits; however, it also brings the risk of concussions, also known as mild traumatic brain injuries (Andersen et al., 2019; Kramer, 2020). Concussions result from forces transmitted to the brain from a hit to the head or body (Davis et al., 2023). These head injuries result in a variety of signs and symptoms that, in the short-term, affect an individual's ability to perform their activities of daily living, and may result in long-term consequences like cognitive deficits, increased musculoskeletal injury risk, and increased risk of subsequent concussions (Jildeh et al., 2022; Patricios et al., 2023; Redlinger et al., 2022; Schmidt et al., 2018).

Concussion Care Seeking

Timely access to medical treatment may improve post-injury outcomes (Asken et al., 2018; Schmidt et al., 2023). Athletes who report concussions immediately and are removed from play tend to have less severe symptoms that resolve sooner, and better neurocognitive function in the first month of recovery (Charek et al., 2020; Schmidt et al., 2023). Meanwhile, delaying or neglecting to seek care results in poorer injury outcomes such as more severe or numerous symptoms, a longer time until their concussion-related symptoms subside, and persistent decreased performance on

clinical concussion tests (Asken et al., 2018; Barnhart et al., 2021; Lynall et al., 2022; Schmidt et al., 2023).

Concussions may result in symptoms that are invisible to others, such as headache or light sensitivity; therefore we cannot completely rely on a bystander (e.g., an athletic trainer (AT) or coach) to identify all concussions (Patricios et al., 2023). Unfortunately, approximately 50% of concussions go unreported, and half of the athletes who report concussions do not seek care immediately (Schmidt et al., 2023). Athletes need to be empowered to seek care for a concussion, yet they face informational, social, and structural barriers to doing so (Craig et al., 2020; Ernst & Kneavel, 2022; Kerr et al., 2014; Register-Mihalik et al., 2017). Besides not knowing they have a concussion, athletes often report feeling that concussions are not a serious enough injury to warrant reporting and hesitate to seek care because they do not want to be removed from play and/or do not want to let their team down (Conway et al., 2020; Craig et al., 2020). Concussion education has been implemented widely to address these knowledge gaps and encourage care seeking, but the education must have appropriate content and be performed effectively to address these barriers (Craig et al., 2020; Ferdinand Pennock et al., 2023).

Concussion Education

Athletic organizations are encouraged, or sometimes mandated, to establish and follow concussion management policies (National Collegiate Athletic Association Sport Science Institute, 2023a; National Federation of State High School Associations, 2023; The Network for Public Health Law, 2019). These policies can have positive effects across the three levels of injury prevention including processes for reducing the risk of

concussion, resources for early concussion identification and removal from play, and guidelines for proper injury management to improve outcomes and reduce long-term consequences (Parsons & Baugh, 2018; Sullivan et al., 2020). Concussion education is often included as a section of organizational concussion management policies or legislative requirements (National Collegiate Athletic Association Sport Science Institute, 2023a; The Network for Public Health Law, 2019). Education may be presented separately or in combination for different audiences, including coaches, athletes, and other members of the athletics community, and determining if the content addresses the audience's needs is typically left up to the individual delivering the education, rather than being specifically outlined in a policy or legislation (Coxe et al., 2018; National Collegiate Athletic Association Sport Science Institute, 2023a; The Network for Public Health Law, 2019). Each of these audiences have different roles to play in supporting concussion reporting and proper management, and their respective educational interventions can assist the learners in identifying their roles in reducing long- and short-term concussion harms. Concussion education for athletes typically covers the signs and symptoms of concussion, injury risk factors, and expectations for returning to school and physical activity post-injury (Conaghan et al., 2021; Mallory et al., 2022).

Concussion Education Implementation

State and sport-organization mandates about concussion education began increasing in more prevalence after legislative action in 2009. By 2014, all 50 states and the District of Columbia instituted laws requiring concussion education regarding youth sports (Foreman, 2010; The Network for Public Health Law, 2019). Most of these laws

include requirements to provide concussion education to athletes participating in public school-based interscholastic sports (Foreman, 2010; The Network for Public Health Law, 2019). The National Collegiate Athletic Association (NCAA) similarly requires their member institutions to deliver education to their athletes, coaches, sports medicine staff, and administrators (National Collegiate Athletic Association Sport Science Institute, 2023a). As a result, many interscholastic athletes at the high school and college levels are required to receive annual concussion education (Concannon, 2016; National Collegiate Athletic Association Sport Science Institute, 2023a; Parsons & Baugh, 2018). However, many youth athletic organizations unaffiliated with public secondary schools or collegiate organizations that are not NCAA members are not beholden to the aforementioned laws and regulations (The Network for Public Health Law, 2019). Furthermore, even of those who do participate in organizations that have education mandates, not all athletes receive, or remember receiving, concussion education (Carroll-Alfano & Wolf Nelson, 2019).

Athletic trainers, medical professionals who often provide medical care to athletes, commonly provide this education to their athletes and other members of the athletics community through videos, online modules, handouts, and presentations (Kroshus & Baugh, 2016; Weber Rawlins & Valovich McLeod, 2023). ATs are knowledgeable about concussions and aware of the areas for improving concussion prevention at their institution, what resources are available, and what educational content is acceptable and appropriate for their athletes (Commission on Accreditation of Athletic Training Education, 2022). The process of selecting and implementing concussion education interventions is often led, or delegated completely, to the AT

(Carroll-Alfano & Wolf Nelson, 2019; Kroshus & Baugh, 2016). Given the breadth of their knowledge and responsibility to select and provide the education, ATs perceptions of concussion education are uniquely important when assessing concussion education program implementation, including their acceptability, appropriateness, and feasibility.

Target impacts for these educational interventions typically include improving athletes' knowledge about concussions and their attitudes and beliefs towards seeking care for concussions (Conaghan et al., 2021; Mallory et al., 2022). However, concussion education interventions have mixed results on their ability to improve athletes' concussion knowledge and concussion care-seeking behavior (Conaghan et al., 2021; Kroshus et al., 2015). Studies of concussion education interventions frequently neglect measures of long-term knowledge retention and tend to evaluate intent to report, rather than actual changes in reporting behavior (Conaghan et al., 2021). Importantly, the implementation, or the process of selecting and executing an intervention, and subsequent long- or short-term success of any intervention may vary between a research trial and real-world applications, making the study of implementation, or the process of executing a program or intervention, critical to improving care-seeking through education (Kroshus et al., 2015).

Expert Recommendations

Educational intervention content and delivery and institutional policies may play a role in successful changes to behavior, and until recently, no specific guidance existed on what concussion education should include or what organizations should do to support concussion care-seeking. In 2019, 33 experts in concussion education convened to identify best practices for improving athletes' and military service members'

concussion symptom reporting that include policy and educational goals (Kroshus et al., 2020). The experts used a modified Delphi process to identify 17 recommendations for collegiate institutional processes and health education to improve willingness to seek care for a potential concussion in athletes and federal military cadets (Kroshus et al., 2020). The recommendations were grouped into five domains: education content (Domain 1), methods for delivering concussion education (Domain 2), types of education other members of the athletic community should receive (Domain 3), and processes that teams/military units (Domain 4) and organizations (Domain 5) can implement to improve concussion care-seeking (Kroshus et al., 2020).

Table 1.1 NCAA-DoD Mind Matters Challenge recommendations on improving concussion education. Items related to the content

Domain 1: Content of concussion education for athletes and military service members	
1	**The potential dilemma individuals face when deciding to disclose a concussion (e.g., tradeoffs, concerns about what might happen next, knowing how to report, etc.).**
2	**The potential dilemma individuals face when deciding to disclose a concussion (e.g., tradeoffs, concerns about what might happen next, knowing how to report, etc.).**
3	**Short-term benefits of early concussion symptom disclosure (e.g., athletic, academic, occupational).**
4	**What is known about possible long-term manifestations of concussion and head injury.** **Concussion-related misperceptions (e.g., knowledge gaps).**
5	Site-specific information regarding institutional concussion resources and policies (e.g., steps to take if an individual suspects they have a concussion
Domain 2: Dissemination and implementation of concussion education	
6	Actively collaborate with organizational stakeholders (including coaches/commanders, primary healthcare providers, athletes/service members, military chain of command) to select concussion education approaches that are engaging, interactive and that foster discussion.
7	Share messaging about concussion symptom disclosure on a regular basis and in a variety of ways (e.g., formal education, informal conversations, posters).

8	**Integrate messaging about the importance of complete concussion symptom disclosure throughout the recovery process**
Domain 3: Concussion education for other stakeholders	
9	Provide coaches/leaders in the military chain of command with evidence-based concussion education that is aimed at supporting athletes/service members in concussion symptom disclosure.
10	Provide sports medicine/front-line medical staff with strategies about how to engage coaches/leaders in the military chain of command in supporting athletes/service members in concussion symptom disclosure.
11	Provide easily accessible information to parents/guardians about how to support athlete/service member concussion symptom disclosure.
12	Provide easily accessible information to other key site-specific stakeholders (e.g., student-life administrators, faculty athletic representatives, leadership, chain of command) about how to support athlete/service member concussion symptom disclosure.
Domain 4: Team-level and unit-level processes	
13	**Provide athletes/service members with education that addresses the role they can play in encouraging peers to disclose possible concussion symptoms (e.g., share evidence-based bystander education programming).**
14	Provide opportunity for team members and coaches/leaders in the military chain of command to discuss and establish team values that are supportive of concussion symptom disclosure.
Domain 5: Organizational processes	
15	Actively collaborate with organizational stakeholders (including coaches/leaders in the military chain of command, primary healthcare providers, athletes/service members) to identify and address organizational barriers to concussion symptom disclosure.
16	Evaluate the effectiveness of institutionally selected concussion education approaches in changing athlete/service member concussion symptom disclosure behavior.
17	Communicate in a deliberate manner institutional values that emphasize safety and its importance in athletic performance/military readiness.

Note: bolded recommendations refer to information that can be presented to athletes to improve their symptom disclosure. Adapted from Kroshus E, Cameron KL, Coatsworth JD, et al. Improving concussion education: consensus from the NCAA-Department of Defense mind matters research & education grand challenge. *Br J Sports Med*. 2020;54(22):1314-1320. doi:10.1136/bjsports-2020-102185

It is unclear if existing educational interventions include the content suggested in these recommendations for improving care-seeking after a concussion. The recommendations include organizational- or team-based policies, and suggestions for educational interventions for other stakeholders. Therefore, not all of the recommendations directly refer to the content of athlete-focused concussion education. Domain 1 specifically addresses athlete education content, as does Recommendation 8 (being honest about symptoms throughout recovery) and Recommendation 13 (encouraging teammates to report a concussion). Describing intervention content in the context of the expert recommendations will allow ATs to identify which materials and program has the content to best address their athletes' knowledge gaps.

Previous research shows that ATs agree that following the recommendations would meaningfully change athletes' care-seeking behavior, with potential implementation differences between practice settings (Drattell et al., 2024b). Secondary school ATs felt that six of the seven recommendations related to topics that should be included in athlete education would be less feasible to provide than college setting ATs (Drattell et al., 2024b). Athletic trainers in colleges that are not members of the NCAA typically have fewer resources and fewer sports medicine staff members, so they may similarly feel that the seven recommendations would be less feasible to deliver some interventions (Gallucci & Petersen, 2017). These secondary school ATs report significantly greater barriers in their social influence and resources to perform education than their collegiate counterparts (Drattell et al., 2024a). It is important to consider the disparity of resources allocated to athletics across settings when characterizing learning objectives (Gallucci & Petersen, 2017; Rankin, 1992).

Scientific Rationale for the Precursory Objective: A Scoping Review

Relatively little attention is paid to dissemination of research findings to health practitioners, leading to a 17-year lag between innovations and clinical practice (Morris et al., 2011). Review articles, including those on concussion education, help clinicians more easily and quickly synthesize research findings to inform evidence-based practice. Systematic reviews have previously examined the context and effects of concussion interventions, but not the content, which is critical information for clinicians when deciding which is most acceptable and appropriate for their setting (Conaghan et al., 2021; Mallory et al., 2022). Other researchers have asked ATs about the content and delivery of the education they provided to their athletes, but it did not identify the content of individual interventions or discuss the findings in the context of the expert recommendations (Kroshus & Baugh, 2016).

A standard systematic review approach may not be appropriate in the rapidly evolving field of concussion education research. A scoping review, especially one following “rapid review” methodology, can be performed more quickly than traditional systematic reviews (Grant & Booth, 2009; Langlois et al., 2017). The iterative and flexible qualities of a scoping review make it an appropriate mechanism to expedite the synthesis and dissemination of advances in research to improve clinical practice in a timely manner (Grant & Booth, 2009; Langlois et al., 2017).

There are a wide range of publicly available concussion education interventions, and it can be time consuming to thoroughly review the options. This is especially true for ATs given the breadth of their clinical requirements and high prevalence of burnout (Baugh et al., 2020; DeFreese & Mihalik, 2016). Therefore, it is imperative that we

achieve this precursory objective of performing a rapid scoping review to identify existing interventions and determine which expert recommendations each meets. Sharing information about their availability and respective fulfillment of the expert recommendations will help clinicians select educational interventions to improve their athletes' care-seeking for a possible concussion. This information will also inform the research aims of this project, which will investigate the implementation of the programs identified in this precursory scoping review.

Scientific Rationale for the Research Aims

The practice of program evaluation is an essential and underutilized process to assess and improve the quality, effectiveness, and implementation of health interventions (Kidder et al., 2024). The types and purpose of program evaluations differ throughout the stages of development and implementation but can be simply described as formative and summative (Scriven, 1967). Formative program evaluations serve to improve intervention quality through development and implementation by assessing features such as acceptability, appropriateness, and feasibility, which may result in modifications and improvement (Scriven, 1967). Summative evaluations measure the shorter-term impact and long-term outcomes based on the intervention's goals (Scriven, 1967). Critically, the process of program evaluation is cyclical and may be utilized on an ongoing basis for continued improvements (Kidder et al., 2024). This process is rarely reported in concussion education research, but feedback from these formal evaluations could be helpful in improving current concussion education interventions or in developing novel interventions.

Concussion education research often focuses on efficacy (i.e., outcomes in a controlled environment like a research trial), and fails to investigate the effectiveness (i.e., the results from real-life application). Additionally, the outcomes of these trials typically investigate the learners' educational outcomes (e.g., athlete knowledge, attitudes, and beliefs), but not how the interventions are perceived or implemented by its users (e.g., clinically practicing ATs) (Carroll-Alfano & Wolf Nelson, 2019; Provvidenza et al., 2013). It can be challenging to secure resources and standardize research protocols for studies evaluating intervention effectiveness and implementation, but these outcomes are vital to improving interventions (Carroll-Alfano & Wolf Nelson, 2019; Provvidenza et al., 2013).

The lack of formative program evaluation and examination of real-world application highlights the challenges with translating research to practice (Finch et al., 2013). Ensuring that practicing ATs believe interventions are acceptable, appropriate, and feasible to implement outside of a research trial is critical to widespread intervention success (Kidder et al., 2024). Yet, limited research has explored their implementation barriers and facilitators to performing regular and effective concussion education (Carroll-Alfano & Wolf Nelson, 2019; Drattell et al., 2024b; Provvidenza et al., 2013). ATs in secondary schools most often use educational materials from federal or state organizations and feel that more engaging material might be more effective (Weber Rawlins & Valovich McLeod, 2023). There has been no similar investigation in collegiate ATs.

Acceptability, appropriateness, and feasibility, among other constructs, are preconditions and indicators of successful implementation processes and outcomes

(Proctor et al., 2011). The Acceptability of Intervention Measure (AIM), Intervention Appropriateness Measure (IAM), and Feasibility of Intervention Measure (FIM) are a trio of brief and widely-used implementation outcome measures that have high internal validity and test-retest reliability (Weiner et al., 2017). These measures allow for the identification of the extent to which the users feel that the content and delivery method are suitable, relevant, and could be carried out successfully.

Investigating the degree to which ATs believe concussion educational programs are acceptable, appropriate, and feasible to deliver will help clinicians identify impactful and uncomplicated programs, especially if further analyzed within clinical contexts like educational setting. Additionally, some interventions can be shared in a multitude of ways with different levels of feasibility. For instance, educational fact sheets could be distributed electronically via email, as individual hardcopy handouts, or posted in public spaces, and a deeper understanding of these differences may be helpful for ATs considering different programming. Institutional and personal factors may influence a person's perception of program implementation (Damschroder et al., 2022). When considering the implementation of a program, the opinion of ATs in similar settings may be more impactful than those in other settings. Culturally and age-appropriate health education may improve knowledge translation, and thus, setting may play an important factor in whether a program is perceived as acceptable, appropriate, or feasible (Wittink & Oosterhaven, 2018). ATs overseeing a larger number of athletes or who do not feel empowered to make autonomous decisions about delivering education may find it more challenging to change programming or make some programs harder to implement than others (Oglesby et al., 2020). Finally, ATs implementing concussion education for the

first time may face unique challenges to implement programming, and thus, the opinion of people who similarly do not regularly perform concussion education may be more impactful than those who already deliver programming regularly.

Purpose Statement

The overall goal of this study is to evaluate widely available concussion education interventions' potential for successful implementation in different clinical settings.

Precursory objective: To systematically appraise the content of widely available concussion education interventions based on expert recommendations. This will serve to provide ATs and other education providers with information about what types of information is presented to the learner in each identified educational program.

Hypothesis: We expected this appraisal process would yield 5-10 concussion education interventions for further examination under the following specific aims.

Aim 1: To identify the degree to which ATs believe concussion education interventions are acceptable, appropriate, and feasible.

Hypothesis: Since the programs are specifically designed as athlete-focused concussion education interventions, we hypothesize that the ATs will rate all of the programs as acceptable, appropriate, and feasible (mean score > 3.0).

Aim 2: To identify the influence of institutional factors on concussion education interventions' perceived acceptability, appropriateness, and feasibility, including: setting, staff-to-athlete ratio, the AT's role in selecting what concussion education is performed, and whether or concussion education is currently performed.

Hypothesis: The hypotheses are presented in Chapter 3 due to their dependence on the findings from the precursory objective.

This study will have an immediate impact by allowing ATs to evaluate and compare existing concussion education interventions' content and potential for success based on the opinion of their peers. This will result in short and long-term benefits to athletes by improving their care-seeking and injury outcomes through concussion education. This study will have a continued broad positive impact by providing an iterative framework for measuring educational interventions' potential for successful implementation across a variety of conditions and settings.

Operational Definitions

Acceptability: the degree to which an intervention or process is satisfactory based on the individuals' needs.

Appropriateness: the degree to which an intervention or process is relevant to the setting, user, and/or audience; whether an intervention or process will adequately address the problem.

Athletic trainer: skilled health care professionals who provide injury and illness prevention, including health promotion, and medical care to patients under the direction of a physician.

Concussion: a mild traumatic brain injury that can result from forces transmitted to the head from a hit to the head or body that may result in a variety of signs and symptoms that affect an individual's ability to perform their activities of daily living.

Concussion Management Policy: institutional policies that aim to outline processes and expectations regarding concussion education, prevention, identification, and recovery.

Educational program or intervention: resources designed for individual or small-group delivery that seek to educate the learner about a topic (e.g., sport-related concussion) with a defined implementation and/or dissemination strategy.

Effectiveness: the degree of beneficial effect under less controlled, real-world clinical settings.

Efficacy: the degree to which an intervention produces the expected result in a controlled setting (e.g., in a research lab or trial)

Feasibility: the degree to which an intervention or process is practical or can be easily implemented in a given setting.

Formative evaluation: a form of program evaluation that occurs early in the process of development to aid in adjusting the intervention to improve content and operational processes.

Full-time equivalent: the number of full-time employees plus half the number of part-time employees, representing them as working 50% of the time that a full-time.

Implementation: the process of executing a program or intervention.

Knowledge transfer: the communication and conveying of information.

Program evaluation: a formal method of using data to improve the content, implementation, or outcomes of an intervention.

Robust educational intervention: an educational intervention that contains a variety of educational content and could reasonably serve as stand-alone interventions to improve athlete health, as contrasted with shorter interventions with more limited content, may be more appropriate as supplemental to other interventions.

Summative evaluation: a form of program evaluation that aims to measure the intervention's success in meeting its educational goals.

"Certified Professional" NATA membership: a member who holds a certification and is in good standing with the Board of Certification for the Athletic Trainer (BOC)

Snowballing (forward and backward): the process through which existing articles are used to identify additional sources, either through identifying articles that cite previously identified articles (i.e., forward snowballing) and searching from identified articles' reference lists (i.e., backward snowballing). It is also referred to as "hand searching."

"*Student Certified" NATA membership*: a member who holds a certification and is in good standing with the Board of Certification for the Athletic Trainer (BOC) and is enrolled in full-time graduate studies.

Abbreviations

Athletic trainer (AT)

Acceptability of Intervention Measure (AIM)

Behaviors, Attitude, Norms and Knowledge (BANK)

Board of Certification for the Athletic Trainer (BOC)

Concussion Awareness Training Tool (CATT)

Intervention Appropriateness Measure (IAM)

Feasibility of Intervention Measure (FIM)

Full-time equivalent (FTE)

Korey Stringer Institute Athletic Training Locations and Services Program (ATLAS)

National Athletic Trainers' Association (NATA)

National Collegiate Athletic Association (NCAA)

National Federation of High School Athletic Associations (NFHS)

Peer Concussion Education Program (PCEP)

Program Evaluation and Perceptions of Implementation Process (PEPI)

Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA)

Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for scoping review (PRISMA-ScR)

Template for Intervention Description and Replication (TIDieR)

United States Center for Disease Control and Prevention (CDC)

United States National Institutes for Health (NIH)

CHAPTER 2

PROGRAM EVALUATION AND PERCEPTIONS OF IMPLEMENTATION (PEPI): ATHLETE CONCUSSION EDUCATION INTERVENTIONS TO IMPROVE CARE-SEEKING

LITERATURE REVIEW

Importance

Clinicians who want to provide evidence-based concussion education rely on access to new evidence as it emerges. This is especially true in the context of concussion educational interventions because the science about concussion and the influences on care-seeking behavior is rapidly evolving, and the number of interventions continues to grow. In order for clinicians to provide the most accurate, relevant, and effective information, it is necessary to complete a careful and methodical review of the literature on a regular basis. A scoping review allows for the summary of available research and identification of research gaps (Grant & Booth, 2009). Utilizing a formal "rapid" review strategy allows the evidence to be evaluated systematically and efficiently so clinicians can assess and implement novel interventions in a timely fashion (Langlois et al., 2017).

Educational interventions for injury prevention vary in delivery method and content, among other factors. It is paramount that ATs are able to quickly determine which educational intervention best fits the needs of their institution. However, it is also important that the intervention's content aligns with best practices regarding what strategies will most effectively improve concussion care-seeking (Kroshus et al., 2020).

A group of experts in the field of concussion education developed a list of 17 educational and policy-related recommendations for organizations to improve symptom disclosure for their athletes, presented in Table 1.1 (Kroshus et al., 2020). Seven of the recommendations provide guidance on what content athlete-focused concussion education should include to successfully encourage them to report symptoms of a potential concussion (Kroshus et al., 2020). The Domain 1 recommendations were explicitly “content of concussion education for athletes and service members” (Kroshus et al., 2020). The recommendations within Domain 1 included 1) the dilemma athletes face when deciding to report a concussion, 2) short-term benefits of early concussion reporting, 3) long-term consequences of brain injury, 4) myths and misperceptions about concussion, and 5) site-specific information about reporting and management procedures (Kroshus et al., 2020). Reinforcing the importance of honest symptom disclosure throughout recovery (Recommendation 8) and the athlete’s role in encouraging their teammates to report a potential concussion in others (Recommendation 13) are also important features of comprehensive athlete concussion education (Kroshus et al., 2020).

It may be helpful for ATs or other individuals planning to deliver concussion education to know which of the recommendations, especially the seven topics related to concussion education, are addressed within different concussion education interventions. When considering individual interventions, programs that meet most or all of the seven bolded recommendations in Table 1.1 may have a higher potential impact on concussion care-seeking. Therefore, our precursory objective was to develop a structured and iterative process through with educational programs can be identified

and have their content evaluated based on best practices, and to apply this process in the context of concussion education. We identified widely available concussion education interventions and determined which expert recommended topics each address.

Rapid Scoping Review Methodology

Scoping reviews are a category of systematic review used to identify the range of research performed on a topic and can serve as a foundation for addressing research gaps or more in-depth systematic reviews. This methodology typically includes searching traditional research databases, “snowball” hand searching (e.g., strategic manual searching of reference lists and works citing identified sources) and grey literature (e.g., non-peer reviewed research) searches for relevant work that may not have made it through the publishing process or was disseminated directly to the clinical settings. This procedure offers wider insights into the type of research being performed by investigating non-traditional resources. This review type also may be more clinically relevant because it calls for a narrative summary of the findings that may be more accessible to those unfamiliar with research and allows for more in-depth discussion of the implications of the findings (Garritty et al., 2024; Valerie J. King et al., 2017).

The Cochrane Rapid Reviews Methods Group developed a list of recommendations to inform decisions to expedite in the lengthy process of performing a systematic review, which they call a “rapid review methodology.” (Garritty et al., 2024) Although the process is still time consuming, following a rapid review methodology allows for streamlined and reproducible identification and dissemination of information to those who will benefit from the knowledge it presents, such as the public and

healthcare providers (Garritty et al., 2024). These recommendations include searching fewer databases and having fewer people screen articles, and limiting the amount of data extracted from the included articles. (Garritty et al., 2024) This review approach is ideal for the rapidly developing field of concussion education since the search strategy can be reproduced easily and on an accelerated timeline while minimizing research biases (Garritty et al., 2024; Valerie J. King et al., 2017).

Combining the purpose of a scoping review and the methodology of a rapid review allows for a rigorous and iterative approach to reviewing the landscape of concussion educational interventions. This process can be repeated on a regular basis to help clinicians stay up to date with novel techniques. Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) is in the process of developing a Rapid Review methodology guideline (Stevens et al., 2018). Therefore, we utilized the 2024 Cochrane Rapid Review guidelines to expedite the process of 1) planning the research strategy, 2) identifying and evaluating sources, and 3) collecting and analyzing data (Garritty et al., 2024).

Search Strategy

The search strategy for this project narrowly focused on identifying potential interventions for delivering athlete-focused concussion education and comparing the content to the concussion education expert recommendations (Kroshus et al., 2020). These interventions were operationally defined as resources designed for individual or small-group delivery that seek to educate an athlete about sport-related concussion and for which the creator has made materials publicly available for implementation and/or dissemination (e.g., video, handout, presentation).

To ensure the search was comprehensive and applicable, a multidisciplinary research team designed the strategy with consultation from a university librarian. As suggested by Garritty, et al. (2024), the research team included ATs who were able to serve as “knowledge users” given their experience working in a role that would benefit from the information resulting from this review. We pre-registered the research protocol with the Open Science Framework to establish transparency and allow for reproducibility (Drattell & Schmidt, 2024).

Identifying and Evaluating Sources

Our source identification and evaluation process was expedited by limiting our search to two databases that produced the largest number of results in a pilot search of multiple databases, PubMed and SportDiscus (Garritty et al., 2024). We included grey literature to capture interventions that were not peer-reviewed and novel interventions that have been studied but the results of which had not published. Grey literature sources included theses and dissertations using ProQuest Dissertations and Theses, and online searches of government resources (e.g., United States National Institutes of Health, United States Centers for Disease Control and Prevention (CDC), and clinicaltrials.gov), the National Athletic Trainers Association (NATA) website and its partner organizations for the “Inter-Association Consensus Statement on Best Practices for Sports Medicine Management for Secondary Schools and Colleges” (Courson et al., 2014), and the Concussion in Sport Group and its sponsor organizations (the international governing bodies for the Olympics, equestrian sports, motor sport, football [soccer], hockey, and rugby). We also included forward and backward snowballing of reviews articles captured in the search to identify additional papers that may have been

missed based on the limited number of databases searched (Garritty et al., 2024). Forward searching was performed using PubMed. Backward searching was performed by reviewing the articles' references.

The database search strategy was designed by the authors and a university librarian to include the following search terms: concuss* OR mTBI OR "mild traumatic brain injury" OR "sport related concussion" OR SRC AND athlet* OR "student athlete" AND "health education" OR "injury prevention" OR Program OR "educational program" OR intervention OR education AND attitudes OR beliefs OR behavior OR knowledge OR intention OR disclos* OR report* OR care seek*. Grey literature searches utilized the term "concussion education" on each organization's website to determine if they have developed or shared educational interventions. The search results were reported per the PRISMA reporting guidelines extension for scoping reviews (PRISMA-ScR) in Figure 2.1 (Tricco et al., 2018).

We limited the search of peer-reviewed publications to papers published in the English language because it is the research team's primary language. We time-limited the peer-reviewed literature search to five years because the best practices for concussion identification, management, and education are rapidly evolving. No limitation on time since publication was applied to resources identified through snowball searching or grey literature because publication dates may not be available. We excluded education not designed for an individual athlete or small-group audience (e.g., teams), information for which the creator has not specified an intended dissemination or implementation strategy, educational solely designed for post-injury care, conference abstracts, and Level 1-3 grey literature as defined by the National Information Center on

Health Services Research (e.g., blogs, speeches, newsletters, poster sessions) (National Information Center on Health Services Research and Health Care Technology, 2006). Some search results included concussion management policy frameworks, and we extracted data only from the educational interventions in those policies.

Search results were imported into EndNote (version 20.3, Philadelphia, PA) and duplicates were removed. All remaining articles were imported into Rayyan (Cambridge, MA), where we checked for additional duplicates and screened articles (Ouzzani et al., 2016). Article screening was expedited through a process recommended by Cochrane (Garritty et al., 2024). The screeners (JDD and JDS) discussed and clarified the purpose of the search and inclusion/exclusion criteria prior to initiating the screening process. At both the abstract and full-text screening levels, two members of the research team (JDD and JDS) screened 20% of the articles independently, and if 80% agreement was achieved, one screener (JDD) completed the remaining screening (Garritty et al., 2024).

Data Collection and Analysis

Data charting was performed and evaluated using a tool on Microsoft Excel (Redmond, WA) created by one screener (JDD) and approved by the second screener (JDS). For data charting, the screeners (JDS and JDD) completed data extraction together for two articles that were randomly selected using a random number generator, and the remaining data charting was performed by one individual (JDD) (Garritty et al., 2024). The following data were extracted: primary author/organization name, intervention name(s), date of publication or most recent update, delivery method(s),

ability to provide a certificate of completion, and the inclusion of intervention content related to the 17 expert recommendations (Kroshus et al., 2020). For transparency, a rubric was created by authors 1 and 5 to determine if the program discussed the contents of a recommendation in depth (“Y”), if it was briefly or partially addressed (“P”), or not mentioned (“N”) (Appendix A). The programs were categorized by delivery mechanism.

Results

The peer-reviewed literature search was performed on May 27, 2024. The grey literature search was performed from May 27, 2024 through May 29, 2024. The search results are presented in a PRISMA-ScR flow diagram in Figure 2.1 (Tricco et al., 2018). The searches for peer-reviewed literature on PubMed and SPORTDiscus identified 1,148 and 352 records, respectively. Next, the research team identified records through a grey literature search on ProQuest (*N* = 145), and the government (*N* = 2), and organizational (*N* = 3) websites listed previously. We removed 237 duplicates using EndNote (Version 20.3, Clarivate, Jersey, UK), Rayyan (Cambridge, MA), and manually. Subsequently, 1,408 unique articles and five programs were evaluated in the abstract screening phase.

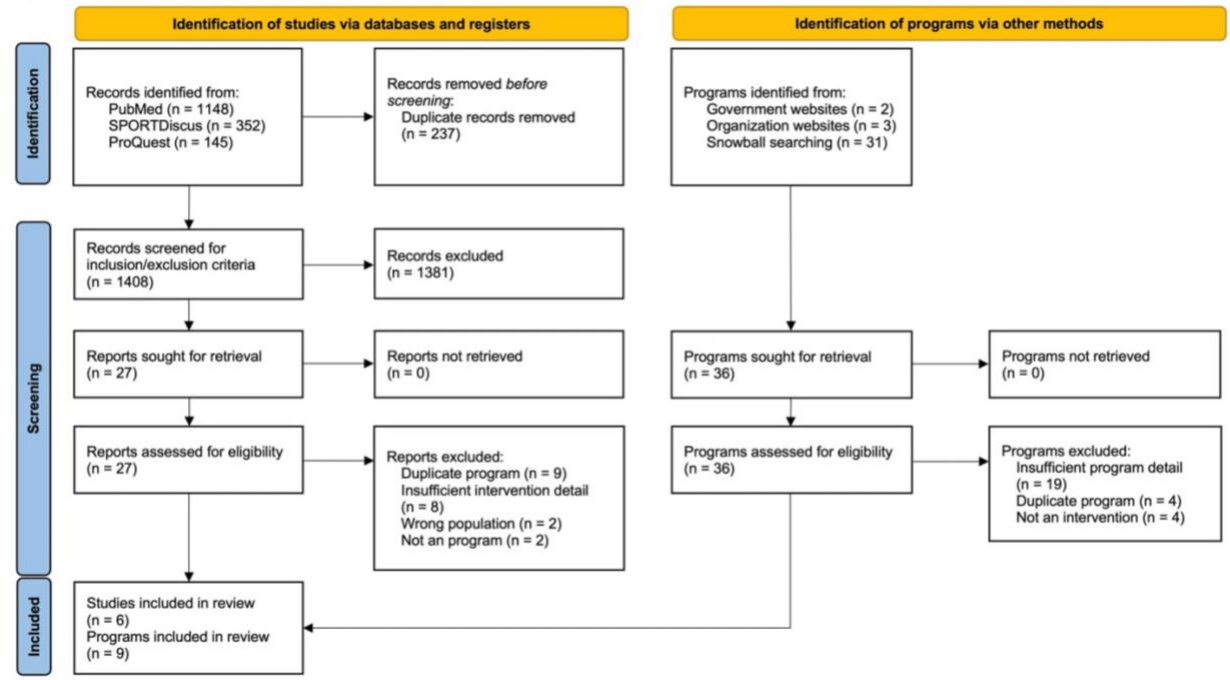

Figure 2.1. Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for scoping review (PRISMA-ScR) Flow Diagram. “Insufficient details” refers to articles and interventions that did not provide materials for intervention implementation (e.g., the video or presentation being studied).

We used Rayyan to select a random 20% sample (*N* = 282), which the two screeners (JDD and JDS) independently reviewed. There was 98.2% (*N* = 277) agreement between screeners, therefore, per the Cochrane guidelines, one screener (JDD) completed the abstract review (Garritty et al., 2024). The five articles with conflicting abstract reviews were included in the full-text screening process.

We identified 27 articles and five programs for full-text screening and were able to access all of the full-text files. We used Rayyan to select another random 20% sample (*N* = 6). The two screeners (JDD and JDS) reviewed the sample articles independently. There was 100% agreement, therefore one screener (author 1) completed the remaining full-text reviews independently (Garritty et al., 2024). Full-text

screening resulted in the exclusion of nine articles representing duplicate programs, eight articles with insufficient resources to implement the program (e.g., lack of detail, missing educational material, inactive hyperlinks), and four for other reasons (i.e., wrong population, not a program), leaving six programs from database searches for inclusion in data charting (Figure 2.1).

We retrieved 189 articles from the grey literature snowball search and eight duplicates were removed. The remaining articles were screened by title and 150 articles were removed by the inclusion and exclusion criteria listed previously. Thirty-nine articles were screened by abstract, and an additional eight results were removed. Full-text files or active hyperlinks were retrieved for the 31 articles identified through the snowball search. Full-text screening resulted in the exclusion of 19 programs due to insufficient resources to implement the program, four that represented duplicate programs, and four that were not programs (e.g., an implementation strategy, review paper). This search resulted in the identification of four additional programs through grey literature, for a total of nine grey literature programs for inclusion in data charting (Figure 2.1).

Program Characteristics

Our search captured 15 programs that were publicly available and described in sufficient detail to allow for data charting. Notably, one-third (*N* = 27, 34%) of the programs that underwent full-text screening did not include sufficient resources for a potential user to implement the program. The programs we successfully identified fell into four delivery categories: videos (*N* = 6) (Children's Hospital of Philadelphia, 2013; Evans, 2014; FIFPro, 2019; Teach Aids, 2024; University of Wisconsin-Madison, 2020;

York Region Government, 2018), online modules (*N* = 4) (BC Children's Hospital, 2024; National Federation of State High School Associations, 2018; University of North Carolina at Chapel Hill, 2018; World Rugby, 2016), in-person programming (*N* = 3) (Chestnut Hill College, 2020; One Team, 2019; Parachute Canada, 2022), and fact sheets (*N* = 2) (Centers for Disease Control and Prevention, 2024; National Collegiate Athletic Association Sport Science Institute, 2024). The programs that provided a publication or most recent update date were published or updated between October 2013 (Children's Hospital of Philadelphia, 2013) and April 14, 2024 (National Collegiate Athletic Association Sport Science Institute, 2024). The number of expert recommendations met ranged from 1-7 (.2 2). All of the online modules, and one of each the video-based, in-person, and fact sheet programs provide a method for a recording completion (BC Children's Hospital, 2024; Centers for Disease Control and Prevention, 2024; National Federation of State High School Associations, 2018; Parachute Canada, 2022; Teach Aids, 2024; World Rugby, 2016). Additional details on the included studies can be found in Table 2.2 and Appendix A.

Table 2.2: Results of Data Charting, including the organization that created the athlete concussion education program, program name, most recent publication date (if available), delivery type, ability to offer a certificate of completion, and notation of the recommendations addressed in the content according to the scoring rubric.

					Recommendations addressed*																
					Domain 1: Content					2: Dissemination			3: Other stakeholders				4: Team-level		5: Organization-level		
Organization	Intervention name	Most recent publication /update†	Delivery type	Offers certificate	1 Dilemma to report	2 Short-term benefits	3 Long-term consequences	4 Misperceptions	5 Site information (how to report)	6 Collaborate to select education	7 Educate regularly	8 Honesty throughout recovery	9 Educate coaches	10 Educate ATs on collaboration	11 Educate parents	12 Educate site admin	13 Peer education	14 Discuss values	15 Identify organizational barriers	16 Evaluate education effectiveness	17 Institutional values
Teach Aids	CrashCourse	Sept 8, 2018	Video	Y	Y	Y	P	Y	P	N	N	P	N	N	N	N	Y	N	N	N	N
Dr. Mike Evans	Concussion Management and Return to Learn	Aug 27, 2014	Video	N	N	Y	N	Y	N	N	N	Y	N	N	N	N	N	N	N	N	N
FIFPro	FIFPro Concussion Awareness Video with Petr Cech	Oct 30, 2019	Video	N	P	N	Y	Y	P	N	N	N	N	N	N	N	Y	N	N	N	N
York Regional Government	Concussion 2018	Sept 7, 2018	Video	N	N	N	N	Y	P	N	N	N	N	N	N	N	N	N	N	N	N
Children's Hospital of Philadelphia	Frequently Asked Questions About Concussions	Oct 30, 2013	Video	N	Y	Y	P	Y	P	N	N	P	N	N	P	P	N	N	N	N	N
University of Wisconsin - Madison	Social-Marketing Intervention	Dec 19, 2020	Video	N	Y	Y	Y	Y	P	N	N	N	N	N	N	N	Y	N	N	N	N
University of North Carolina – Chapel Hill	Behaviors, Attitude, Norms, and Knowledge (BANK)	Apr 10, 2018	Module	N	P	Y	N	P	P	N	N	Y	N	N	N	N	Y	N	N	N	N
NFHS and CDC	Concussion for Students	Jun 6, 2018	Module	Y	Y	P	Y	Y	P	N	N	Y	Y	N	N	N	Y	N	N	N	N
British Columbia Children's Hospital	Concussion Awareness Training Tool for Athletes	April 26, 2023	Module	Y	Y	Y	Y	Y	P	N	N	Y	N	N	N	N	Y	N	N	N	N
World Rugby	Concussion Management for the General Public	February 2, 2016	Module	Y	P	P	Y	Y	P	N	N	P	Y	N	Y	Y	N	N	N	N	N
Chestnut Hill College	Peer Concussion-Education Program	April 6, 2020	In-person	N	Y	P	Y	Y	N	Y	Y	P	N	N	N	N	Y	P	P	Y	N
One Team	Safety Huddle	July 11, 2019	In-person	N	N	P	N	Y	P	N	Y	N	P	N	P	P	N	P	N	N	N
Parachute Canada	Smart Hockey	Sept 30, 2022	In-person	Y	N	Y	P	Y	P	N	Y	Y	P	N	P	P	Y	P	N	N	N
NCAA	Concussion Safety: What Athletes Need to Know	January 15, 2024	Fact Sheet	N	N	Y	Y	Y	P	N	N	N	N	N	N	N	Y	P	N	N	N
CDC	HEADS UP to High School Sports	April 17, 2024	Fact Sheet	Y	Y	Y	P	Y	P	N	N	Y	N	N	Y	N	Y	N	N	N	N

* Recommendations are from Kroshus, et al. 2020.

† Date of the most recent article publication or press release as of the rapid review search dates.

Note: The scoring rubric and data charting notes can be found in Appendix A. CDC = Centers for Disease Control and Prevention, NFHS = National Federation of State High School Associations, NCAA = National Collegiate Athletic Association, AT = Athletic trainer, Y = Yes, P = Partially met, N = Not met.

Video-based Programs

Nearly half (*N* = 6) of the identified programs consisted of watching a video or series of videos, some with additional written content, like a summary, on a website (Table 2.2) (Children's Hospital of Philadelphia, 2013; Evans, 2014; FIFPro, 2019; Teach Aids, 2024; University of Wisconsin-Madison, 2020; York Region Government, 2018). All six programs addressed potential misperceptions athletes may have about concussions (Children's Hospital of Philadelphia, 2013; Evans, 2014; FIFPro, 2019; Teach Aids, 2024; University of Wisconsin-Madison, 2020; York Region Government, 2018). The second most common recommendation the videos discussed was the short-term benefits of reporting (*N* = 4) (Children's Hospital of Philadelphia, 2013; Evans, 2014; Teach Aids, 2024; University of Wisconsin-Madison, 2020). Three videos addressed the dilemma athletes face when deciding to report a concussion, typically through testimonials or vignettes (Children's Hospital of Philadelphia, 2013; Teach Aids, 2024; University of Wisconsin-Madison, 2020). Three videos encouraged learners to report other players who may have a concussion and framed it as a way to support and protect your teammates (FIFPro, 2019; Teach Aids, 2024; University of Wisconsin-Madison, 2020).

Although many programs addressed being honest about symptom reporting, only one video encouraged learners to be honest about symptom disclosure throughout recovery (Table 2.2) (Evans, 2014). Only two programs, a collection of videos by an author at the University of Wisconsin-Madison (2020), and a video by a professional football (soccer) players' union collaborative, FIFPro, (2019) discussed long-term consequences of concussion. Others briefly mentioned the potential for long term

consequences, such as concussions potentially being “devastating for your long-term future,” (Children’s Hospital of Philadelphia, 2013) or leading to “permanent brain damage,” (Teach Aids, 2024), but did not provide any other information.

As shown in Table 2.2, none of the videos provided site-specific information about policies or resources. All videos captured in our search were targeted toward an athlete audience, and none discussed how often to deliver concussion education or provided education for coaches, parents, or administrators.

Online Module Programs

The search methods captured four interactive, online educational modules. Two were designed by non-academic organizations – Concussion Management for the General Public by World Rugby, and Concussion for Students designed collaboratively by the National Federation of State High School Associations (NFHS) in collaboration with the CDC (Table 2.2) (National Federation of State High School Associations, 2018; World Rugby, 2016). Two programs, Behaviors, Attitude, Norms, and Knowledge (BANK) and Concussion Awareness Training Tool (CATT) were designed by the University of North Carolina at Chapel Hill and British Columbia (BC) Children’s Hospital, respectfully (BC Children’s Hospital, 2024; University of North Carolina at Chapel Hill, 2018). The programs designed by World Rugby, NFHS, and BC Children’s Hospital provide a certificate of completion and have a mechanism through which an organization can electronically track module completion (BC Children’s Hospital, 2024; National Federation of State High School Associations, 2018; World Rugby, 2016). BANK is not able to automatically provide a messenger or learner with a record of who had completed the module (University of North Carolina at Chapel Hill, 2018).

The modules addressed a variety of recommendations within their content (2.2). Four recommendations were included in three of the four module programs: long-term consequences of concussion (BC Children's Hospital, 2024; National Federation of State High School Associations, 2018; World Rugby, 2016), myths and misperceptions of concussion (BC Children's Hospital, 2024; National Federation of State High School Associations, 2018; World Rugby, 2016), being honest about symptoms throughout recovery (BC Children's Hospital, 2024; National Federation of State High School Associations, 2018; University of North Carolina at Chapel Hill, 2018), and discussing their athletes' role in encouraging teammates to report (BC Children's Hospital, 2024; National Federation of State High School Associations, 2018; University of North Carolina at Chapel Hill, 2018). The dilemma athletes face when reporting a concussion was discussed in the programs by the NFHS (National Federation of State High School Associations, 2018) and UNC (2024) programs. UNC (2018) and CATT (2024) programs discussed short-term benefits of reporting a concussion quickly. Content reinforcing the importance of coaches being supportive of concussion symptom disclosure was provided in the NFHS (2018) and World Rugby (2016) modules. World Rugby's (2016) module also provided information relevant to parents and administrators' roles in supporting concussion symptom disclosure.

A few recommendations were excluded from all of the modules (Table 2.2). All four online module programs talked about the reporting and management process, but did not discuss site-specific policies or resources (BC Children's Hospital, 2024; National Federation of State High School Associations, 2018; University of North Carolina at Chapel Hill, 2018; World Rugby, 2016). Similar to traditional videos, none

encouraged collaboration or gave ATs the resources to engage others in identifying organizational barriers, selecting education program(s), and/or evaluating the program(s) effectiveness (Table 2.2). No modules provided a variety of ways to perform the education, allowed for a discussion about team or organizational values, or discussed collaborating to select, deliver, or evaluate education (Table 2.2).

In-person Programs

The three in-person programs captured in this search had different designs and implementation strategies: one brief coach discussion, one coach or administrator presentation, and one peer-led presentation and workshop (Table 2.2) (Chestnut Hill College, 2020; One Team, 2019; Parachute Canada, 2022). Only one provided a written form where the athlete indorsed having received education (Parachute Canada, 2022). All three addressed potential myths and misperceptions about concussion and reinforced the need to provide education regularly, but otherwise varied widely in the number of recommendations addressed in their respective content (Table 2.2) (Chestnut Hill College, 2020; One Team, 2019; Parachute Canada, 2022).

A 1-2-minute Safety Huddle program was designed for a coach to provide a brief statement to their team members prior to any practice or game discussing how a concussion happens, when to tell someone, why to report, and encouraging peers to report teammates' injuries (One Team, 2019). The brief program met two recommendations, misperceptions about concussion and educating the teams regularly, and partially met a number of recommendations including discussing the short-term benefits of reporting, providing site-specific information, and providing an opportunity for coaches to discuss team values (Table 2.2). It also partially met recommendations

related to providing information that may be relevant to coaches, parents, and administrators (One Team, 2019).

The Smart Hockey program was designed for youth hockey organizations throughout Canada and included multiple fact sheets and other programming that could be distributed in conjunction with in-person team discussions (Parachute Canada, 2022). Smart Hockey recommended using regular and unique educational approaches by suggesting that in conjunction with the team meeting, teams could use social media to share messaging about concussion safety, for example, taking a team picture with a banner showing that they will prioritize safety while playing hockey (Parachute Canada, 2022). The team meeting content included discussion about the short-term benefits of reporting, common misperceptions about concussion, that they should be honest about their symptoms at the time of injury and throughout recovery, and reinforced that athletes should report concussions in themselves and others (Parachute Canada, 2022). Some partially met recommendations included discussing team values and site-specific information (Parachute Canada, 2022). The Smart Hockey resources included a “Code of Conduct” where parents, coaches, and athletes pledge to take concussions seriously and follow the recommendations from the educational material (Parachute Canada, 2022).

The other in-person program, Peer Concussion Education Program (PCEP), is designed to be instructed by a pair of teammates and provided detailed educational information (Chestnut Hill College, 2020). The program includes a establishing a collaborative administrative group to selecting and train team opinion leaders to provide formal education to their teammates and ongoing encouragement to teammates to

report possible concussions (Chestnut Hill College, 2020). PCEP also suggests that the interdisciplinary team evaluate educational outcomes annually (Chestnut Hill College, 2020). The publicly provided PCEP resources include two PowerPoint presentations and a worksheet, and instructional videos for messengers to provide additional guidance on implementation (Chestnut Hill College, 2020). The PowerPoint presentations address common concussion misperceptions, potential long-term consequences of concussion, encourage honest symptom disclosure throughout recovery, and encourage reporting a teammates' concussion (Chestnut Hill College, 2020). A second meeting led by peer educators involves completing a worksheet meant to encourage teammates to acknowledge the dilemma they face in deciding to report a concussion using a Cognitive-Behavioral Theory approach (Chestnut Hill College, 2020). The training resources allow modification for, but do not include, including site-specific reporting or injury management processes (Chestnut Hill College, 2020). It also inherently allows for a discussion about team values, but since the educational sessions explicitly exclude the coach, this program does not fully meet that expert recommendation (Chestnut Hill College, 2020).

Fact Sheet Programs

The two fact sheets identified in this search were designed by organizations targeting different athlete populations (Table 2.2) (Centers for Disease Control and Prevention, 2024; National Collegiate Athletic Association Sport Science Institute, 2024). The NCAA resources were designed to help their affiliated institutions comply with the association's regulations (National Collegiate Athletic Association Sport Science Institute, 2019, 2023a, 2024). The CDC resources targeted high school

athletes and included two fact sheets, one for a general audience and another specific to high school athletes, and a link to the aforementioned module hosted on the NFHS website (Centers for Disease Control and Prevention, 2024; National Federation of State High School Associations, 2018).

The fact sheets had different target audiences but some shared information. Both fact sheets discuss common misperceptions, short-term benefits symptom reporting, and the athlete's role in supporting their teammates in reporting concussions (Table 2.2) (Centers for Disease Control and Prevention, 2024; National Collegiate Athletic Association Sport Science Institute, 2024). Neither talked about organizations collaborating to select or evaluate the effectiveness of the education provided, or to meet to identify and address organizational barriers to seeking care for a concussion, nor did they mention a timeline for providing the education (e.g., annually) (Centers for Disease Control and Prevention, 2024; National Collegiate Athletic Association Sport Science Institute, 2024).

The NCAA fact sheet addressed potential long-term consequences of brain injury, and the CDC only partially addressed the topic (Table 2.2) (Centers for Disease Control and Prevention, 2024; National Collegiate Athletic Association Sport Science Institute, 2024). Only the CDC resources discussed the dilemma athletes face when reporting a concussion (Centers for Disease Control and Prevention, 2024). The bottom of one CDC high school athlete fact sheet also included a tear-off portion where the parent and athlete could sign and provide to the institution to document they had received and read the resource, but no automatic completion record is provided (Centers for Disease Control and Prevention, 2024).

Discussion

This scoping review identified 41 unique educational programs for athletes related to sports-related concussions, however, only 15 publicly provided sufficient resources to implement the program. The programs offered a variety of delivery methods, including videos, interactive online modules, in-person programs, and fact sheets, which allows messengers to select from a variety of implementation strategies (BC Children's Hospital, 2024; Centers for Disease Control and Prevention, 2024; Chestnut Hill College, 2020; Children's Hospital of Philadelphia, 2013; Evans, 2014; FIFPro, 2019; National Collegiate Athletic Association Sport Science Institute, 2024; National Federation of State High School Associations, 2018; One Team, 2019; Parachute Canada, 2022; Teach Aids, 2024; University of North Carolina at Chapel Hill, 2018; University of Wisconsin-Madison, 2020; World Rugby, 2016; York Region Government, 2018). None of the programs met all expert recommendations for content (Table 2.2). However, it is important to recognize that not all of the recommendations specifically address athlete concussion education content, nor does an institution have to limit themselves to one program (Kroshus et al., 2020). Organizations may consider the messengers' and audiences' unique needs, resources, and preferences, and recognize that those factors may change over time, reinforcing the need for messengers to be aware of available programs in a timely manner to make informed decisions about which program(s) to utilize (Campbell & Quintiliani, 2006; Drattell et al., 2024a; Drattell et al., 2024b).

Before exploring the data gathered from the programs that met our search criteria, it is important to draw attention to the relatively large number of programs that

did not provide program resources. This exposes a notable gap in the ability for messengers to implement programs that may be effective in improving their athletes' concussion care-seeking behavior. Authors and organizations can consider following the Template for Intervention Description and Replication (TIDieR) checklist, or a similar set of guidelines, for any program dissemination to ensure that the program can be translated into practice (Hoffmann et al., 2014). TIDieR items 3 and 4, that pertain to the resources and procedures, are of particular importance in replication, either in practice or in research (Hoffmann et al., 2014).

The programs that did provide resources were organized into four main categories: video, module, in-person discussion, or fact sheet. The four delivery mechanisms identified are consistent with previous research about concussion-related educational strategies for adolescent, youth, and college athletes (Mallory et al., 2022). It is important to consider the audiences' preferred delivery method and messenger, which may vary by individual and organization (Campbell & Quintiliani, 2006). The expert recommendations suggest that athletes' care-seeking behavior may be improved by using multiple delivery methods over multiple time points throughout the year, and therefore perhaps a variety of programs (Kroshus et al., 2020). This aligns with research showing that athletes find a multi-modal program more engaging (Scott et al., 2021). In the research trial from the University of North Carolina at Chapel Hill, the module was provided to the athletes in conjunction with the NCAA fact sheet, which demonstrates the potential for implementing a variety of programs (National Collegiate Athletic Association Sport Science Institute, 2024; University of North Carolina at Chapel Hill, 2018).

Many organizations are required to deliver concussion education to their athletes, making documentation of implementation imperative to document compliance with laws or regulations (National Collegiate Athletic Association Sport Science Institute, 2023a; Parsons & Baugh, 2018; The Network for Public Health Law, 2019). Most of the online modules allowed for electronic documentation that the messenger could access or that the learner could provide (BC Children's Hospital, 2024; National Federation of State High School Associations, 2018; World Rugby, 2016). One online video, CrashCourse, had the ability to have messengers keep track of who completed education, but is optional, and if the video is delivered in person, it would not maintain the same electronic record (Teach Aids, 2024). The Smart Hockey program had a form that organizations could use to track attendance at an in-person education session, and a similar process could be used with any of the other in-person programs, or video sessions if those are delivered in a live setting (Parachute Canada, 2022). The CDC "General Information" fact sheet is one of the most commonly implemented tool in secondary schools where no specific program is mandated (Weber Rawlins & Valovich McLeod, 2023). It includes a tear-off section that could be retained for documentation purposes, however, it is important to note that if the documentation section of the page is removed, some information from the other side of the page would be missing if the learner wanted to reference the material at a later date (Centers for Disease Control and Prevention, 2024). Messengers can consider distributing the flyer printed single-sided or also sharing a digital version if they intend to collect the signature portion of the fact sheet. Either of the fact sheets could be delivered by email or through other

organizational platforms, which may be sufficient to serve as a record of providing education.

Although we noted the inclusion of content related to all the recommendations in this scoping review, only seven of the expert recommendations are directly related to the content of concussion education for athletes (Kroshus et al., 2020). The first four recommendations were almost uniformly addressed either briefly or in-depth in the programs we evaluated, especially the myths or misperceptions about concussion (Recommendation 4) (Kroshus et al., 2020).

Most programs only discussed the steps for reporting a concussion and did not discuss institutional processes or resources for concussion management (Recommendation 5), which may be a limitation of utilizing universal programs meant for a general athlete audience (Kroshus et al., 2020). Although universal educational programs like public videos would not be able to discuss the specifics of a particular institution, there was limited discussion about what resources might be available or what processes might follow immediately after reporting a concussion. It is important that athletes have the skills to report a concussion, including knowing what actions to take to report a concussion at their institution (Warmath & Winterstein, 2019). Institutions may decide to share site-specific information when implementing concussion education, since the resources themselves may lack this information or be misaligned with the institutional processes. This also highlights the potential benefit of being able to address institution-specific details during in-person concussion education programs.

We described two recommendations from Domains 2 and 5 as potential content for athlete education: encouraging others to report a concussion, and being honest

about symptoms throughout recovery. Two-thirds of the programs explicitly included Recommendation 13, encouraging other athletes to report a potential concussion (Table 2.2). This was often presented through testimonials or fictional vignettes. Meanwhile, the importance of honesty about symptoms throughout recovery, Recommendation 8, was only addressed in half of the programs. Many programs mentioned that symptoms may recur while going through the return to play process but did not instruct the learner that it is important to disclose that information to their medical provider or another adult. This small but important difference is critical to making sure athletes understand that recovery may not be a straightforward process, what changes may be necessary if symptoms return, and that they need to be honest for their own health and safety.

Some expert panel recommendations addressed topics unrelated to the content of what the athlete needs to know after receiving concussion education, and their inclusion in an educational module would be extraneous to the purpose of educating the athlete about seeking care for a concussion. Those recommendations discuss processes for having an institutional interdisciplinary team collaborate on selecting, implementing, and evaluating the outcomes of education (Recommendations 6, 15, and 16), institutional leadership and coaches discussing the value of safety and honestly on a regular basis (Recommendations 7, 14, and 17), or recommending education for coaches, administrators, ATs, and parents/guardians (Recommendations 9-12). As anticipated, these recommendations were, in fact, largely omitted from the athlete concussion education programs (Table 2.2). It is not unreasonable for athlete-focused concussion educational programs to not address institutional values and barriers to concussion care-seeking, collaboration on selecting, implementing, and evaluating the

impact of concussion education, or educating other stakeholders (e.g., parents, coaches, and administrators). The organizations that offer fact sheet programs also offer handouts for coaches, parents, and/or administrators, and two organizations offering interactive module programs offer modules for other roles (e.g., parents, coaches) (BC Children's Hospital, 2024; Centers for Disease Control and Prevention, 2024; National Collegiate Athletic Association Sport Science Institute, 2024; National Federation of State High School Associations, 2018). The PCEP instructed users to implement the program with an interdisciplinary team and provided recommendations on how the group could evaluate the outcomes, which would address Recommendations 6 and 16 (Chestnut Hill College, 2020).

Limitations

The purpose of this scoping review was to assist those who provide concussion education to athletes select appropriate programming for their audience. Utilizing a rapid scoping review methodology allows for sharing results more quickly but also introduces limitations. The Cochrane rapid review methodology allows for limiting the search to two databases and grey literature. We had to make critical a priori decisions in which databases to search and what grey literature search strategy was sufficient and replicable, therefore the search may not have captured all possible programs. Rapid reviews also limit the number of article screeners and data charting, and including more reviewers may capture more programs and the collection of more extensive data. Only two of the 15 programs were reviewed by multiple individuals to determine the degree that a program addressed a recommendation (e.g., met, partially met, not met). Utilizing a scoping review methodology means we did not assess the validity of the publications

or the program outcomes and therefore cannot use the information gathered here to make clinical recommendations. However, given our intent to develop and share a map of the available programs with practitioners, further examination of efficacy was not relevant to the purpose of this review. Finally, there is a limitation in the literature itself in that nearly half of the potential programs we found did not include sufficient details to allow the general population to implement the program. Corresponding authors of articles without resources may be willing to share those resources upon request, however, we wanted to evaluate programs with the lowest barriers to implementation for the messengers.

Conclusions

The overall goal of this study was to provide a replicable and detailed review of athlete-audience concussion education programs content and implementation. These findings highlight opportunities to improve clinical practice, research, and policy. Although none of the programs included all of the recommendations that are relevant to improving athlete symptom disclosure, it is important to note that programs can be used in combination with each other or other tools, including mandated education from other organizations not captured in this search (e.g., legislation, other athletic association regulations). In program research and development, developers can consider including program educational material or other resources when publishing study results to improve research translation. These findings also identified gaps in the current programming that should be considered when developing and evaluating new programs. Clinicians may utilize these findings to update their current educational strategies. This information may inform future systematic reviews to provide additional

insights. Effectiveness-implementation research may further our understanding about the effects of these programs when delivered individually or in combination.

Application of Findings to Aims 1 and 2

The overall goal of this study is to develop a methodology for replicable and detailed review of health education intervention content and implementation, and specifically in this case, to identify concussion education interventions with high potential for success. The expert recommendations included seven topics that, if presented to an athlete, could improve an athlete's willingness to seek care for a concussion and therefore should be included in an athlete-focused educational intervention. Identifying an intervention that included all seven could allow the AT to cover the most content with a single intervention, however, none of the identified interventions achieved that goal.

Although ATs can use interventions in combination, we wanted to understand the implementation of individual interventions. Therefore, we limited the research aims to interventions that had the most robust content, operationally defined as including an above-average number of the seven target recommendations. The average number of the seven educational recommendations covered was 3.47, so we used four recommendations as a cutoff for inclusion in the research aims. Therefore, eight interventions identified in the rapid scoping review underwent formative evaluation to identify the degree to which ATs believe the selected interventions are acceptable, appropriate, and feasible to implement in their settings.

We did not want to minimize the impact that some of the less robust interventions may have in concussion education. In fact, the authors of the expert recommendations

noted that "all of the content domains do not need to be addressed in a single educational program, session, or set of materials" (Kroshus et al., 2020). Future research should investigate the extent to which all of these programs may serve as either independent or complementary programming. We will also capture the ATs' perceptions of what aspects of care-seeking that each intervention might improve (e.g., knowledge, attitudes towards concussion, intent to report), but those results are outside the scope of this project.

These results will have a positive impact on ATs' ability to provide concussion education by identifying interventions that their peers believe have a high potential for successful implementation. Athletes' short- and long-term health will benefit from these findings when ATs more efficiently and effectively implement education. These results will have a continued impact by developing a process through which injury prevention education interventions can be rapidly evaluated for their potential success in a clinical setting.

CHAPTER 3

METHODOLOGY

Findings from the Precursory Objective

The scoping review identified eight interventions that provided resources necessary for ATs to implement independently and met at least four of the recommendations we believe are relevant to be included in content of an athlete-audience concussion education intervention (Table 3.1). Those interventions were CrashCourse (Teach Aids, 2024), Social-Marketing Intervention (University of Wisconsin-Madison, 2020), Smart Hockey (Parachute Canada, 2022), NCAA Concussion Safety (National Collegiate Athletic Association Sport Science Institute, 2024), CATT (BC Children's Hospital, 2024), CDC's HEADS UP to High School Sports (Centers for Disease Control and Prevention, 2024), the NFHS Concussion for Students (National Federation of State High School Associations, 2018), and the PCEP (Chestnut Hill College, 2020).

Table 3.1: Results of Data Charting: Intervention Content for the Eight Recommendations Related to Athlete-Audience Concussion Education

Organization	Intervention name	Delivery type	Recommendations*							Number of education recommendations met
			1 Dilemma to report	2 Short-term benefits	3 Long-term consequences	4 Misperceptions	5 Site information (how to report)	8 Honesty throughout recovery	13 Peer education	
Teach Aids	CrashCourse	Video	Y	Y	P	Y	P	P	Y	4†
Dr. Mike Evans	Concussion Management and Return to Learn	Video	N	Y	N	Y	N	Y	N	3
FIFPro	FIFPro Concussion Awareness Video with Petr Cech	Video	P	N	Y	Y	P	N	Y	3
York Regional Government	Concussion 2018	Video	N	N	N	Y	P	N	N	1
Children's Hospital of Philadelphia	Frequently Asked Questions About Concussions	Video	Y	Y	P	Y	P	P	N	3
University of Wisconsin-Madison	Social-Marketing Intervention	Video	Y	Y	Y	Y	P	N	Y	5†
University of North Carolina – Chapel Hill	Behaviors, Attitude, Norms, and Knowledge (BANK)	Module	P	Y	N	P	P	Y	Y	3
NFHS and CDC	Concussion for Students	Module	Y	P	Y	Y	P	Y	Y	5†
BC Children's Hospital	Concussion Awareness Training Tool for Athletes	Module	Y	Y	Y	Y	P	Y	Y	6†
World Rugby	Concussion Management for the General Public	Module	P	P	Y	Y	P	P	N	2
Chestnut Hill College	Peer Concussion-Education Program	In-person	Y	P	Y	Y	N	P	Y	4†
One Team	Safety Huddle	In-person	N	P	N	Y	P	N	N	1
Parachute Canada	Smart Hockey	In-person	N	Y	P	Y	P	Y	Y	4†
NCAA	Concussion Safety: What Athletes Need to Know	Fact Sheet	N	Y	Y	Y	P	N	Y	5†
CDC	HEADS UP to High School Sports	Fact Sheet	Y	Y	P	Y	P	Y	Y	5†

* Recommendations are from Kroshus, et al. 2020.

† Program met enough recommendations to be included in Aims 1 and 2

Note: CDC = Centers for Disease Control and Prevention, NFHS = National Federation of State High School Associations, BC = British Columbia, NCAA = National Collegiate Athletic Association, AT = Athletic trainer, Y = Yes, P = Partially met, N = Not met

Hypotheses

The research aims for this project were to 1) identify the degree to which ATs perceive concussion education interventions as acceptable, appropriate, and feasible; and 2) identify the influence of individual and institutional factors on concussion education interventions' perceived acceptability, appropriateness, and feasibility, including: setting, staff-to-athlete ratio, the AT's role in selecting what concussion education is performed, and whether or concussion education is currently performed.

For Research Aim 1, we hypothesized that the ATs would rate all of the programs as acceptable, appropriate, and feasible because the programs are specifically designed to be delivered by people like ATs and to match the learning needs of the audiences to whom the ATs provide such education (athletes). For Research Aim 2, we hypothesized that there would not be a significant difference in program acceptability, regardless of setting, staff ratio, role in selecting education, or if they currently perform concussion education. We hypothesized that setting would significantly predict perceived appropriateness for the NFHS Concussion for Students module, the CDC HEADS UP handout, and the NCAA student handout, such that the NFHS and CDC interventions are more appropriate for high school athletes and the NCAA handout are more appropriate for college athletes. We hypothesized that setting, staff-to-athlete ratio, and whether concussion education is currently performed would predict feasibility, such that those as setting competitiveness rises, more staff are hired

to care for fewer athletes, and for those who currently perform concussion education will perceive programs as more feasible.

Scientific Rationale for Study Population and Recruitment Strategy

ATs typically lead decision making about concussion management, including injury prevention education, at the collegiate level (Kroshus & Baugh, 2016). The NCAA has formal policies regarding these processes (National Collegiate Athletic Association Sport Science Institute, 2019, 2023a, 2023b), which have been mimicked in other collegiate athletic associations' regulations (National Association of Intercollegiate Athletics, 2016). The expert recommendations for improving athletes' care-seeking after a concussion were designed for the NCAA civilian and federal military institutions (Kroshus et al., 2020). The authors noted that the recommendations may not be applicable for other settings (Kroshus et al., 2020), however, previous research has shown minimal differences between secondary school and collegiate ATs' perceptions of the recommendations' feasibility (Drattell et al., 2024b). Therefore, we recruited ATs practicing in colleges/universities affiliated with the NCAA and other athletic associations and in secondary schools to compare the potential for successful implementation across settings.

We did not limit our population based on the length of time they have maintained certification as an AT because previous research demonstrated no effect of years certified on perceptions of a recommendation's utility or feasibility (Drattell et al., 2024b). Additionally, ATs have varying levels of control of what educational intervention is delivered to their athletes throughout their careers, and all opinions are valuable. We captured to what extent the participants control what education their athletes receive in

the survey. ATs working in other settings were also invited to complete the research surveys, however, their data were not included in this project.

We utilized non-traditional research project recruitment efforts in an effort to recruit clinically practicing ATs who may not typically respond to a traditional request for research participation. ATs need to acquire, and usually pay for, a number of Continuing Education Units (CEUs) per 2-year reporting cycle. We created a learning activity for which ATs can earn free CEUs, during which learners were invited to complete additional research activities. This recruitment method may have biased our sample towards those who needed to complete continuing education activities, those who were interested in the learning objectives (i.e., define types of review articles, discuss barriers and facilitators to providing evidence-based care, list commonalities of concussion education), and those who are interested in concussion education.

After enrolling in the learning activity, but prior to engaging with the educational materials, we invited learners to participate in the research project. A project flow sheet is presented in Figure 3.1, which visualizes the separation of the learning activity participation and research participation. If they click a “yes” response to the invitation to participate in research, they were asked to provide informed consent and complete a demographic questionnaire before progressing to the learning material. If the learner clicked the “no” response, they were taken directly to the learning material. Only research participants were asked to complete the Acceptability of Intervention Measure (AIM), Intervention Appropriateness Measure (IAM), and Feasibility of Intervention Measure (FIM) surveys for each educational intervention. All learners were able to leave the educational module and return where they left off within 2 weeks of when they most

recently edited their responses on the Qualtrics page, but they must have passed a participant assessment about the learning objectives (> 70% correct) at the end of their participation to receive a Certificate of Completion to claim the CEU participation hours. Research participants were able to discontinue their participation at any time by no longer responding to survey questions.

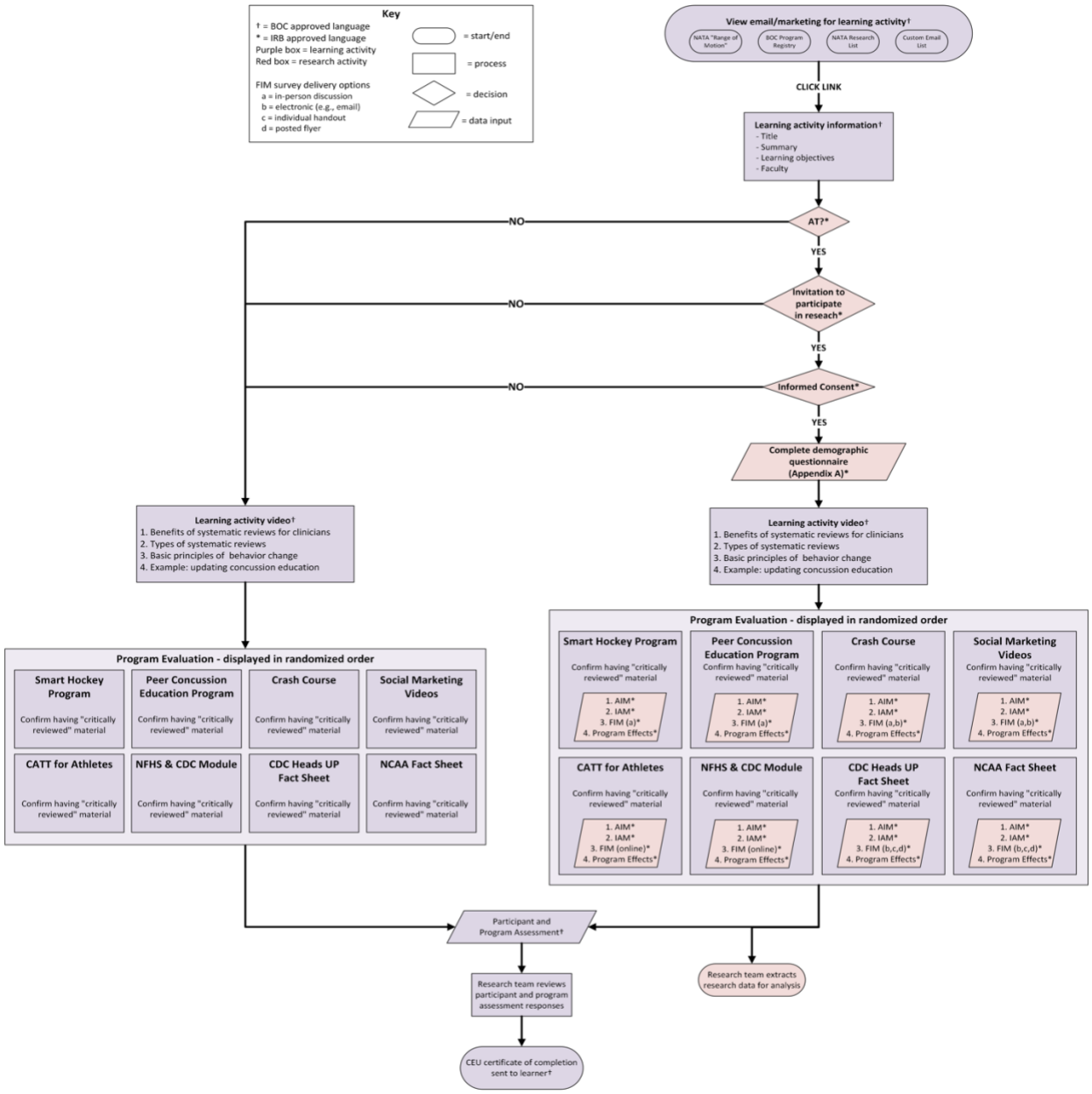

Figure 3.1. A flow sheet of engaging with the learning activity and research activity. The purple boxes designate portions of the learning activity that are for learning activity purposes. The pink boxes designate portions that are for research purposes.
Note: CEU = Continuing Education Units, NATA = National Athletic Trainers' Association, BOC = Board of Certification, AIM = Acceptability of Intervention Measure, AIM = Intervention Appropriateness Measure, FIM = Feasibility of Intervention Measure

Athletic Trainer Sampling Strategy

We used five methods to advertise this learning activity, and performed research recruitment by asking all learners who self-identified as ATs if they were interested in participating in research. The marketing materials for the learning activity did not mention the optional research activities, except for the NATA research survey list, which required mentioning research. In that case, we mentioned “optional research activity during this learning activity.”

Marketing the Learning Activity

We shared information about the learning activity through:

1. Distribution through the NATA research survey list
2. Advertisement in the NATA *Range of Motion* newsletter
3. Posting on a BOC-managed database of learning activities
4. Emailing ATs identified from college and secondary school databases
5. Email and social media posts to our personal and professional networks.

The first three learning activity marketing methods used a third party to make initial contact. The NATA sent emails to a random selection of 1,000 members who had agreed to be contacted for research and surveys in the Communication Preferences in their NATA membership profile. We limited the sample for this marketing strategy to 1,000 participants because there is a per-person fee for sending emails to over 1,000 individuals and we decided to pursue other lower-cost or free marketing methods. To be included in the potential NATA email recipient pool for this project, individuals must have been registered in the “Certified Professional” or “Student Certified” membership categories and reported being employed in the secondary school or collegiate institution

settings. The list of recipients remained anonymous to the research team, except for those who provided contact information by enrolling in the learning activity. Follow-up emails were sent by NATA to the 1,000 individuals every other week for eight weeks. We also placed an advertisement for the learning activity in the NATA bi-weekly newsletter, *Range of Motion*, for one month. Participants may have also found the learning activity by seeing the course information we posted on the BOC-managed learning activities database, as required by the BOC for all learning activities.

Marketing strategies that were initiated by the research team included a pseudo-random list of ATs created by the research team, and social media accounts associated with the individuals and the research lab. We generated a pseudo-random list of contacts using a random number generator to identify two institutions from each region or conference of four collegiate athletic associations (i.e., NCAA, National Junior College Athletic Association, National Association for Intercollegiate Athletics, California Community College Athletic Association). We then collected their ATs' email addresses from the schools' athletics staff directories. We identified secondary school ATs' email addresses through the Korey Stringer Institute Athletic Training Locations and Services (ATLAS) Project directory, where ATs working in the secondary school level can voluntarily provide their contact information. There is a numbered list of schools for each state, and we used a random number generator to pick 12 high schools from each state and Washington DC. We limited the search for contact information to schools with full-time ATs. If a randomly selected school did not employ a full-time AT, the next numbered school with a full-time AT was included. For states with less than 12 full-time ATs listed, we invited up to the total number of full-time ATs listed. This search yielded

1,809 AT contacts from 308 colleges and 597 high school AT contacts. Those randomly identified ATs received an email from the research team inviting them to participate in the learning activity with periodic follow-up emails and encouragement to share the information with other ATs.

This research recruitment strategy was novel, and since we had not previously attempted to recruit for a research survey from within a learning activity it was difficult to anticipate how successful we would be in marketing the learning activity in a randomized way and the percent of learners who would consent to participate in the research activity. Therefore, we supplemented the aforementioned learning activity marketing strategies by sharing information about the learning activity with our professional networks via emails and social media. The educational program was advertised on social media sites including Facebook, Instagram, LinkedIn, X (Twitter), and BlueSky. As with other marketing materials, the posts shared information about the learning activity and encouraged those who saw it to share information about the program with their personal and professional networks, and did not mention the research activities.

Research Recruitment

All participants who enrolled in the learning activity were asked if they were ATs, and those who self-identified as an AT were asked if they were interested in participating in research. Additional information about the study and the consent form were presented to those who were interested. The marketing materials all directed to the same website, so we were unable to determine through which of the five advertising mechanisms people received information about the learning activity and could not

perform data analysis based on marketing strategy. We set a target sample size of 200-500 AT research participants.

Inclusion Criteria: ATs holding an active certificate by the BOC that practice clinically in a secondary school or collegiate institution full-time (>30 hours per week).
Exclusion Criteria: Individuals under the age of 18 years.

Presentation of Educational Interventions

The rapid scoping review identified a selection of publicly available interventions for formative evaluation based on the availability of materials and having addressed at least four of the seven expert recommendations on what athlete education should include. We created a 30-minute presentation describing the scoping review methodology and its findings, after which the learners were able to review the interventions in-depth independently and have the option to participate in the research survey evaluating the interventions.

We made a deliberate effort to focus the video content on the precursory objective's purpose and methodology and not the scoping review findings to avoid biasing the participants' responses toward a specific intervention or delivery method. The video focused on 1) the benefits of systematic reviews for clinicians, 2) the different types of systematic reviews, and 3) the basic principles of implementation research. The video provided a brief overview of our findings as an example of these concepts.

After the video, all learners viewed the eight programs we deemed eligible to include in the research. Each intervention was presented on individual pages as

described by the authors on their website or published article. Videos and flyers were embedded into the Qualtrics page with links to the host websites, and other learning formats were linked to the program's respective page with summary text, if available from the host website. All participants were asked to confirm that they had critically reviewed the intervention information on each page for CEU purposes, and research purposes for those who consented to participate. After confirming they have reviewed the material, research participants completed surveys of implementation performance indicators. The surveys were presented at the bottom of the page to allow for the participant to refer back to the educational material as needed. The participants were not required to review all eight programs. Interventions were presented in a random order to each participant to attempt that each program was reviewed by an equitable number of participants, assuming that some would discontinue their participation without reviewing all eight.

Measurements

Demographics

We collected demographic data in the electronic survey, including age in years, sex (i.e., female, male, intersex, or prefer not to respond), and gender identity (i.e., cisgender female, cisgender male, transgender female, transgender male, non-binary, not listed, not sure, or prefer not to respond). We also collected employment information including their status (e.g., full-time, part-time), setting (secondary school or collegiate), athletic association (i.e., National Collegiate Athletic Association, National Association of Intercollegiate Athletics, National Junior College Athletic Association, or and other, that allowed for a free-text response), NCAA division (if applicable), experience with

concussion education, and their role in deciding what educational intervention is implemented. The full list of questions is provided in Appendix B.

Measures of Implementation Success

We quantified perceived implementation success using a trio of program performance indicator surveys: the Acceptability of Intervention Measure (AIM), Intervention Appropriateness Measure (IAM), and Feasibility of Intervention Measure (FIM) (Weiner et al., 2017). These measures' validity were assessed by the University of Washington through a multi-phase process including consultation with implementation scientists and mental health professionals, followed by validity, reliability, and sensitivity assessments through vignettes provided to clinical practitioners (Weiner et al., 2017). Each survey consists of four questions per construct (12 items total) measured on a 5-point ordinal scale ranging from 1 ("completely disagree") to 5 ("completely agree") and item responses were averaged to create a single score related to each construct, with higher scores indicating greater agreement. In prior studies, each survey has strong evidence of reliability and validity (Weiner et al., 2017). The survey questions took approximately 1-2 minutes to complete and were completed separately for each intervention (Appendix C).

For fact sheet and video interventions that can be delivered in multiple ways, we asked participants to complete the FIM up to three times considering the feasibility under different scenarios: digital distribution (e.g., email), hard-copy individual handouts, hard-copy posters, or during an in-person presentation, as appropriate (See Figure 3.1).

Data Processing

At the conclusion of the study, survey responses were exported from Qualtrics (Provo, UT). Duplicate participants were identified by matching first and last names with email and/or IP address. When participants completed multiple survey attempts, the response with the most programs reviewed was retained for data analysis and the other(s) were removed. Participant responses were removed if they spent less than 30.0 seconds on the Qualtrics page where the educational material was presented or if they failed to confirm having reviewed the material. Participants who reported practicing full-time in a secondary school or college setting and completed one survey (AIM, IAM, or FIM) for at least one educational strategy were included in the analysis. Personal identifiers (e.g., name, email, IP address, geo-location) were removed prior to importing the data to SPSS. We calculated the institution athlete-to-staff ratio ("staff ratio") by dividing the total number of all athletes who receive medical care from the ATs by the number of full-time equivalent (FTE) ATs reported to be on staff. FTE were calculated as the number of full-time ATs plus half the number of part-time ATs, representing them as working 50% of the time that a full-time AT would be present.

$$Staff\ Ratio = \frac{Total\ number\ of\ athletes}{(\#FullTime\ ATs) + (0.5)(\#\ PartTime\ ATs)}$$

Statistical Analysis

Sample Size Justification

We proposed to target a sample size based on the exploratory nature of the first research aim. The primary purpose of this project was to develop a system through which health interventions can be identified and subsequently rated by their users; the

data comparing ratings is secondary to this purpose. Since the first research aim is descriptive, we aimed to capture the largest representative sample possible.

There are no data comparing AIM, IAM, or FIM scores in ATs on evidence-based practices or health education interventions, nor are there data comparing AIM, IAM or FIM scores in any population about concussion education. Using research on a different population and different type of intervention is inappropriate for power analyses. Additionally, given the exploratory nature of our first aim, we proposed utilizing the *practical-effect-size approach* suggested for research that aims to be replicated and extended (Giner-Sorolla et al., 2024). Giner-Sorolla et al. (2024) suggest the typical effect size analysis should be "practically meaningful," and in this case, it is important to consider that each team, rather than each setting category (college or secondary school, or athletic association affiliation), have different educational needs when providing concussion education and the results comparing settings may not be practically meaningful to the clinicians. Further, they suggest that research with "low power" size may discourage researchers from studying hard-to-reach populations, such as ATs, which is a relatively small field compared to physicians, nurses, and other people who provide patient education for injury prevention (Giner-Sorolla et al., 2024).

We used three similar studies to set a target sample size for this project, based on the structure of this project in: 1) evaluating perceptions of education practices, 2) evaluation in the context of the expert recommendations, and 3) being implemented after a learning activity for ATs that offers CEUs. One study on ATs' perceptions of concussion education in secondary school ATs had a sample size of 203 (Weber Rawlins & Valovich McLeod, 2023). Our previous work comparing college and

secondary school ATs' perceptions of the expert recommendations had a sample size of 515 (Drattell et al., 2024b). Finally, another survey of ATs' concussion management practices was distributed after a live, in-person learning activity and had 339 respondents (Ferrara et al., 2001). Based on these studies and the descriptive nature of the study, we proposed a target sample size of 200-500 AT respondents.

We will interpret the effect size of our results using Pearson r effect size benchmarks, interpreted as large, medium, and small at 0.5, 0.3, and 0.1, respectively (Cohen, 1992). We present the minimum sample sizes required to meet a-priori α=.05 and β=.8 for a general linear regression with four predictors in Table 3.2 as calculated in G*Power Version 3.1.9.6 (Heinrich Heine University Düsseldorf, Düsseldorf, Germany).

Table 3.2: Total sample size needed to achieve β=.8 with a-priori α=0.05 at three effect sizes based on the statistical analysis plan for Aim 2, performing a linear multiple regression with four predictor variables.

Effect size	**Sample size**
Large (.5)	30
Medium (.3)	45
Small (.1)	125

Data Analysis

Statistical analyses were performed using SPSS 29.0.1 (IBM Corporation, Armonk, NY). Demographic and employment data were analyzed using descriptive analysis based on data type (means and standard deviations, medians and interquartile range, or frequencies). The AIM, IAM, and FIM scores are Likert scales and were analyzed as continuous variables. We calculated means and standard deviations for

each program's acceptability, appropriateness, and feasibility for each implementation strategy and used those data for statistical analyses. We checked the scores for normality using Shapiro-Wilk tests, and due to their non-parametric distribution, we also calculated and presented the median and interquartile ranges. We evaluated the internal consistency of the AIM, IAM, and FIM surveys in this sample using Cronbach's alpha.

For Aim 2, we ran separate regression analyses for the acceptability, appropriateness, and feasibility (AIM, IAM, and FIM, respectively) of each program, resulting in 24 regression analyses. We did not plan post hoc analysis or multiple analyses of the same data, and therefore did not utilize a Bonferroni correction when establishing an a-priori significance level. However, given the similar data being analyzed in these models, we have an increased risk for Type 1 error, or erroneously rejecting the null hypothesis. Our data analysis and sample size were planned to use a linear regression; however, our data did not fit this model, and we utilized a generalized linear model. Utilizing a non-parametric regression model also decreases power and may require a larger sample size. Ultimately, we captured over twice the number of required participants based on our power analysis and feel that we have an adequate sample despite using multiple non-parametric analyses.

We used Wilcoxon Signed Rank tests to compare FIMs for the two video delivery methods, and Friedman tests to compare FIM scores for fact sheets that had three delivery methods with post-hoc Wilcoxon Signed Rank tests if indicated by a Friedman test $p<.05$. If no differences existed, we averaged the program's FIM scores to identify a single FIM score, otherwise we used the delivery method with the highest feasibility.

Professional settings were classified as ordinal variables and served as a proxy for the amount of financial resources typically allocated at each level in the order of least- to highest-funded: secondary school, non-NCAA college, NCAA Division I, NCAA Division II, and NCAA Division I (Gallucci & Petersen, 2017; Rankin, 1992). Participants reported their role in selecting education for their athletes (sole decision-maker, could modify programming, or not a decision-maker), and whether or not concussion education was performed at their institution at least annually. We evaluated the discriminant validity of the AIM, IAM, and FIM surveys used in Aim 2 by performing Spearman's correlations.

The survey AIM, IAM, and FIM responses for all of the eight programs were non-normally distributed, and we were unable to establish a normal distribution with log, square root, or Box-Cox transformations. Therefore, we performed 24 individual generalized linear regressions with a gamma distribution and log link to determine if the setting, staff ratio, role in selecting concussion education practices, or concussion education practices predicted the AIM, IAM, and FIM scores with an a-priori $\alpha = .05$. The data analysis plan is summarized in Table 3.3.

Table 3.3: Data analysis plan

Aims	**Independent Variables**	**Dependent Variables**	**Data Analysis**
Aim 1: Identify the degree to which ATs believe interventions are acceptable, appropriate, and feasible.	Concussion education intervention	Repeated for each of 8 programs: • Acceptability • Appropriateness • Feasibility (1-3 scores, based on delivery methods) (total: 30)	Descriptive analysis. (means and standard deviations). Cronbach alpha of all dependent variable surveys. If non-normally distributed, medians

			and interquartile ranges were reported.
Aim 2: To identify the influence of institutional factors on concussion education interventions' perceived acceptability, appropriateness, and feasibility, including setting, the staff-to-athlete ratio, the AT's role in selecting concussion education, and whether or concussion education is currently performed.	Setting (SS, non-NCAA, NCAA Division III, II, and I) AT-to-athlete ratio (FTE ATs/sum of all athletes) Role as a decision-maker in selecting concussion education (a decision maker, can modify programming, not a decision maker) Perform concussion education at least annually (yes, no)	Repeated for each of 8 programs: • Acceptability • Appropriateness • Feasibility (mean score if separate FIM are not different; highest score if significantly different) (total: 24)	Descriptive analysis and spearman's rank correlations of dependent variable surveys. Regression based on data type. Linear regression if data do not violate assumptions. Generalized linear model if the data violate the assumptions for linear regression with a distribution to appropriately represent the data.

CHAPTER 4

PROGRAM EVALUATION AND PERCEPTIONS OF IMPLEMENTATION (PEPI): ATHLETE CONCUSSION EDUCATION INTERVENTIONS TO IMPROVE CARE-SEEKING [1]

[1] Drattell JD, Gay J, Kroshus E, Lynall RC, Schmidt JD. To be submitted to *Sports Medicine*.

Abstract

Program evaluation is an essential and underutilized process to improve the quality, effectiveness, and implementation of health interventions. People delivering health promotion education often have multiple programming options, and may benefit from a resource to guide decision-making when selecting programming. The purpose of this study was to develop and demonstrate the two-phase Program Evaluation and Perceptions of Implementation (PEPI) Process, a structured and iterative process to first identify and evaluate educational programs based on best practices, then gather prospective users' feedback using three surveys on the programs' acceptability, appropriateness, and feasibility. Each survey uses the mean score of five 5-point Likert type items where a higher score reflects more positive feelings. Here, we illustrated the second phase using concussion education for athletes. We recruited ATs practicing in the secondary school or college setting during a professional education course, 281 of whom evaluated at least one of the eight included programs (63.3% female sex, 62.2% female-identifying, 33.9.±10.0 years old). Descriptive analysis revealed ratings ranging from 3.67±0.91 to 4.44±0.62 in acceptability, 3.66±0.88 to 4.40±0.64 in appropriateness, and 3.47±0.91 to 4.48±0.60 in feasibility. A 12-minute video program was rated highest for all three measures, and a collaborative peer education program had the lowest mean rating for all three measures. At least 50% of participants rated all programs favorably (>3.0). The PEPI process provides information to quantitatively evaluate health promotion programs that may be useful for guiding the process of selecting programming. This application of the PEPI process for concussion education provides

information about program content and perceptions of implementation success for individuals who are seeking new educational programs.

KEYWORDS

Concussion, health education, health promotion, athletes

Introduction

It can be challenging for those who are implementing health education ("messengers") to stay aware of new programming options and critically appraise them to determine which may be most appropriate, acceptable, and feasible for them to deliver (Rubio-Valera et al., 2014). The messengers also may not be aware of best practices for learning objectives (Drattell et al., 2024b), nor have the time to determine the degree to which the programs available to them align with those best practices. The messengers' perceptions of health education interventions are often ignored in program evaluation, which more often focus on efficacy (i.e., outcomes in a controlled environment like a research trial) and learner outcomes (Carroll-Alfano & Wolf Nelson, 2019; Glasgow et al., 2003; Provvidenza et al., 2013).

Participation in competitive athletics often carries the risk of concussions, also known as mild traumatic brain injuries, that result from forces transmitted to the brain from a hit to the head or body (Andersen et al., 2019; Davis et al., 2023; Kramer, 2020). Since 2014, all 50 states and the District of Columbia have instituted laws requiring concussion education for youth sports, as has the National Collegiate Athletic Association (NCAA) for their member organizations (National Collegiate Athletic

Association Sport Science Institute, 2023a; National Federation of State High School Associations, 2023; Parsons & Baugh, 2018; The Network for Public Health Law, 2019). Despite this mandate, the field of sports medicine has limited research on the process of implementing these health interventions (Finch, 2011). Athletic trainers, medical professionals who often provide medical care to athletes, are knowledgeable about concussions and often lead the process of selecting and delivering concussion education (Carroll-Alfano & Wolf Nelson, 2019; Commission on Accreditation of Athletic Training Education, 2022; Kroshus & Baugh, 2016). Given their professional role, ATs are appropriate messengers who may provide important feedback on concussion education program implementation (Kidder et al., 2024).

To address challenges with selecting health education programming, we developed a two-phase Program Evaluation and Perceptions of Implementation (PEPI) process to identify and assess health education programs so that messengers have the information they need to identify programs that meet their learning objectives and that they have the resources to deliver. The PEPI process begins with evaluating the program design, delivery method, and content by performing a scoping review that appraises programs' content compared to topic-specific learning objective best practices. The second phase involves evaluating the potential for program implementation by asking potential messengers to report the the degree to which they feel that the programs are acceptable, appropriate, and feasible. This information is foundational to selecting programming with the potential for sucessful implementation (Weiner et al., 2017). In this article, we present an application of the second phase of the PEPI process that evaluated concussion education programs, which are commonly

required in secondary school and collegiate athletics in the United States (National Collegiate Athletic Association Sport Science Institute, 2023a; National Federation of State High School Associations, 2023; Parsons & Baugh, 2018; The Network for Public Health Law, 2019).

The purpose of this study was to develop and demonstrate the Program Evaluation and Perceptions of Implementation (PEPI) Process, which is a structured and iterative process through which educational programs can be identified and have their criterion validity measured (have their content evaluated based on best practices), then have messengers who could use the program assess the degree to which the programs might be successfully implemented. This process serves to disseminate information to messengers about what health programs are available, provide a critical appraisal of their content, and the opinions about other potential users' beliefs about the programs' potential for successful implementation. In this paper, we provide an illustrative example of the PEPI process. Building upon prior work that identified and appraised widely available concussion education (Drattell et al., In Prep), here, we aimed to identify the degree to which ATs believe concussion education interventions are acceptable, appropriate, and feasible using the AIM, IAM, and FIM. Since the programs were specifically designed to be delivered by people like ATs and to meet common learning objectives for athlete-focused concussion education programs, we hypothesized that the programs would receive favorable acceptability, appropriateness, and feasibility scores.

Methods

Participants

We recruited participants who took a professional continuing education course on identifying and implementing evidence-based practices. We created the learning activity and shared it with ATs as required by the BOC, and through professional networks and social media. The learning activity included a 30-minute video followed by the presentation of the education programs investigated in this research project. We included ATs actively certified by the BOC that practice clinically full-time (>30 hours per week) in a secondary school or collegiate institution and excluded those who were under the age of 18. Prior to engaging in the learning activity, learners were invited to participate in the research survey. Those who clicked “yes” were asked to provide informed consent and complete a demographic questionnaire before progressing to the learning material. We collected demographic data in the electronic survey, including age, sex, and gender identity. We also collected employment information including their status (e.g., full-time, part-time) and setting (e.g., secondary school, college/university). If the learner clicked “no” to the consent, they were taken directly to the learning material and the research survey questions were not displayed. Participants were able to discontinue their participation at any time by 1) not answering the survey questions, or 2) discontinuing the learning activity.

Identifying Programs

The first stage of the PEPI process is to identify programs on topic of interest. We previously completed the first phase of the PEPI process, a scoping review, and identified 15 free, publicly available concussion education programs for athletes and

appraised the programs' content based on whether or not they included expert-recommended topics (Drattell et al., In Prep; Kroshus et al., 2020). Although messengers can use multiple programs, we made an a-priori decision to evaluate programs individually to simplify this illustration of the PEPI process. Therefore, we elected to evaluate the top 50% of programs from the scoping review based on the number of expert recommendations the content included. We chose this subset of programs because they are most likely to deliver the greatest amount of content and/or serve as the primary programming at an organization (Drattell et al., In Prep). The programs included:

- Two video programs: CrashCourse and Social Marketing Intervention (Teach Aids, 2024; University of Wisconsin-Madison, 2020)
- Two programs meant to facilitate in-person discussions: Peer Concussion Education Program (PCEP) and Smart Hockey (Chestnut Hill College, 2020; Parachute Canada, 2022)
- Two online interactive modules: Concussion Awareness Training Tool for athletes (CATT) and Concussion for Students by the NFHS (BC Children's Hospital, 2024; National Federation of State High School Associations, 2018)
- Two fact sheets: A pair of files in the CDC HEADS UP materials and the NCAA's Concussion Safety (Centers for Disease Control and Prevention, 2024; National Collegiate Athletic Association Sport Science Institute, 2024).

Presentation of Programs

The research survey was hosted on Qualtrics (Provo, UT). The eight programs were presented in a random order to minimize chronology bias and attempt to capture

an equal number of reviews per program, in anticipation of participant drop-out (Figure 4.1). Each intervention was presented on individual pages as described by the authors on their website or published article. Videos and fact sheets were embedded into the Qualtrics page, and other learning formats were linked to the program's respective page with summary text, if available from the host website. For video programs and videos of interactive learning modules, the arrow to progress the page was hidden for half of the video duration. This was meant to encourage attention while allowing participants to watch the video at a slightly increased speed based on their preference. Participants were asked to confirm that they had critically reviewed the intervention information on each page.

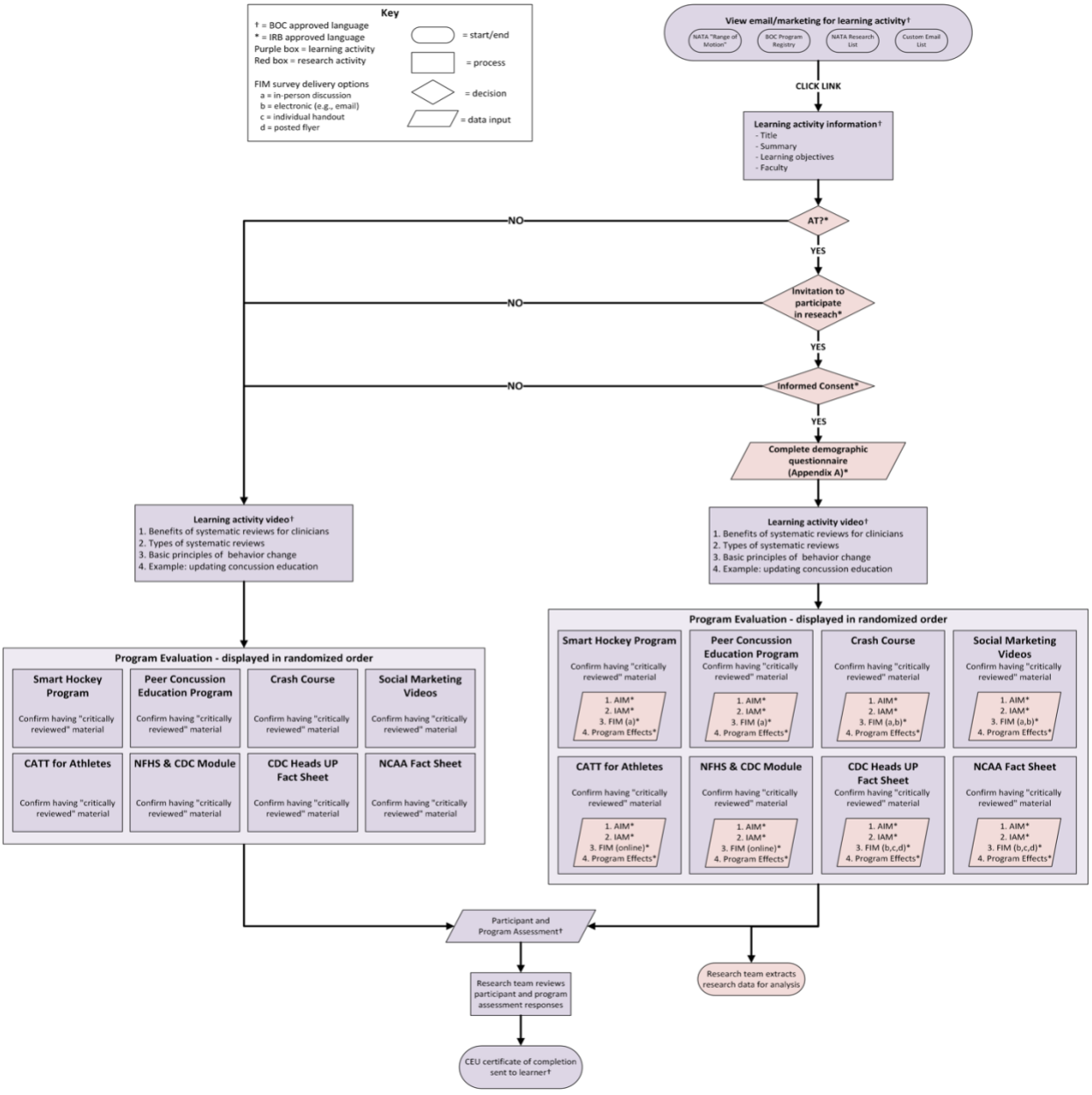

Figure 4.1. A flow sheet of engaging with the learning activity and research activity. The purple boxes designate portions of the learning activity that are for learning activity purposes. The pink boxes designate portions that are for research purposes.
Note: NATA = National Athletic Trainers' Association, BOC = Board of Certification CEU = Continuing Education Units, AT = athletic trainer, AIM = Acceptability of Intervention Measure, AIM = Intervention Appropriateness Measure, FIM = Feasibility of Intervention Measure

Perceptions of Implementation

We quantified perceived implementation success using a trio of widely used program performance indicator surveys, the AIM, IAM, and FIM (Weiner et al., 2017). The measures were delivered in tandem, and each consists of four questions (12 total items) measured on a 5-point ordinal scale ranging from 1 (“completely disagree”) to 5 (“completely agree”) with 3 representing “neither agree nor disagree.” Each survey has high psychometric properties in the paper describing their development (Weiner et al., 2017). The responses were averaged to create a single score related to each construct. There is no standardized “acceptable” cut-off score for the AIM, IAM, or FIM. We established that a mean rating greater than 3 (“neither agree nor disagree”) would reflect a respondent having favorable feelings toward a program’s acceptability, appropriateness, or feasibility. The AIM, IAM, and FIM surveys were presented at the bottom of the page where the program materials were displayed or linked to allow for the participant to refer back to the educational material as needed. Some programs could be delivered in multiple methods, and in those cases, separate FIM surveys were displayed and examined. We determined that fact sheets could be utilized electronically (“digital”), or on paper distributed individually (“handouts”), or posted publicly (“flyers”). Videos could be presented in person or shared electronically (“digital”).

Statistical Analysis

Survey responses were exported from Qualtrics (Provo, UT), stored on a secured University drive, and analyzed using SPSS 29.0.1 (IBM Corporation, Armonk, NY). Participant responses were removed if they failed to confirm having reviewed the material or spent less than 30.0 seconds on the page where the educational material

was presented. Participants who completed at least one survey (AIM, IAM, or FIM) for at least one educational strategy were included in the analysis. Some participants did not complete all surveys, therefore sample sizes varied between programs. Demographic and employment data were analyzed using descriptive analysis based on data type (means and standard deviations, medians and interquartile range, or frequencies). We calculated means and standard deviations for each program's AIM (acceptability), IAM (appropriateness), and FIM (feasibility) for each implementation strategy and used those data for descriptive statistical analyses. We also evaluated the internal consistency of the AIM, IAM, and FIM surveys in this sample using Cronbach's alpha. The aim of this study was to provide information for potential users to understand their peers' perceptions of the programs' potential for successful implementation, therefore we did not statistically compare the programs.

Results

Participants

Of the 759 participants who enrolled in the course, 554 (73.0%) consented to participate in research. Two hundred and eighty-one of the consented individuals met inclusion criteria for this study by practicing full-time in the secondary school (N=108, 38.4%) or college (N=173, 61.6%) settings and evaluating at least one program. Two-hundred and seventeen individuals (39.2%) consented to participate in research but completed no research activities. The majority of participants reported having a female sex (N=178, 63.3%) and female gender (N=173, 62.2%) and the average age was 33.9 ± 10.0 years old. Of those who consented to participate, 217 (39.2%) completed no other activities, 28 (5.1%) watched the 30-minute video but completed no research

activities; these individuals were excluded from analysis. Additional demographics are presented in Table 4.1.

Table 4.1. Participant demographics.

	Setting		
Demographics	Secondary School	College	Total
N	108	173	281
Sex (% within setting)			
Female	71 (65.7%)	107 (61.8%)	178 (63.3%)
Male	37 (34.3%)	66 (38.2%)	103 (36.7%)
PNTR	0	0	0
Gender (% within setting)			
Female	66 (62.3%)	107 (62.2%)	173 (62.2%)
Male	34 (32.1%)	62 (36.0%)	96 (34.5%)
Non-Binary	0	0	0
PNTR	6 (5.7%)	3 (1.7%)	9 (3.2%)
Age			
Mean ± SD	35.6 ± 11.2	32.8 ± 9.1	33.9 ± 10.0
Median [IQR]	32.0 [27 - 41.8]	30.0 [26.0 - 36.8]	30.0 [27.0 - 38.0]
Staff Ratio			
Mean ± SD	314.0 ± 190.3	90.6 ± 69.5	176.8 ± 169.5
Median [IQR]	300.0 [190.4 - 401.8]	80.2 [41.8 - 120.4]	116.7 [54.8 - 250.0]

*=p<.05

Note: Sex and Gender may not equal 100 because other answers were available (i.e., "not listed") or the respondent did not answer the questions. PNTR=Prefer Not To Respond, IQR= Interquartile Range.

Perceptions of Implementation

We presented each program's mean acceptability, appropriateness, and feasibility scores for each implementation strategy with standard deviations in Table 4.2. The median and interquartile ranges are reported in Appendix D. The AIM, IAM, and FIM surveys had high internal consistency (Cronbach's alpha range = .926-.966, .929-9.57, and .923-.969, respectively; Appendix E), as defined by Carmines & Zeller (1979). Average program acceptability (AIM) scores ranged from 3.67 ± 0.91 (Peer Concussion Education Program) to 4.44 ± 0.62 (CrashCourse). Average program appropriateness (IAM) scores ranged from 3.66 ± 0.88 (Peer Concussion Education Program) to 4.40 ± 0.64 (CrashCourse). Program feasibility ranged from 3.47 ± 0.91 (Peer Concussion Education Program) to 4.48 ± 0.60 (CrashCourse with in-person delivery).

The percent of participants who agreed that the programs were acceptable (AIM), appropriate (IAM), and feasible (FIM) (mean rating > 3.0) for each program and survey are presented in Table 4.2. More than half of participants' ratings were positive (< 3.0) for nearly all of the program surveys (range=49-82%). CrashCourse had the highest overall percentage of respondent ratings >3.0 (e.g., approving) for AIM (82%), IAM (81%), and FIM scores (82% for in person and digital delivery). The Peer Concussion Education Program had the lowest overall AIM, IAM, and FIM percent approval (53%, 53%, and 49%, respectively). For all implementation surveys, the approval range for each survey was 72-82% for videos, 70-80% for fact sheets, 60-69% for modules, and 49-75% in-person discussion frameworks.

Table 4.2. Mean and standard deviation of athletic trainers' rating on the Acceptability of Intervention Measure (AIM), Intervention Appropriateness Measure (IAM), and Feasibility of Intervention Measure (FIM) for eight concussion education programs, with the percent and number of athletic trainers who had positive perceptions the program (mean rating > 3.0).

Program	Acceptability (AIM)*	Appropriateness (IAM)*	Feasibility (FIM)*				
			In-person	Module	Email	Handout	Poster
Video							
Social-Marketing Intervention (N=231)	3.96 ± 0.75 71.5% (201)	4.03 ± 0.67 73.7% (207)	4.17 ± 0.65 76.2% (214)	-	4.21 ± 0.60 77.2% (217)	-	-
CrashCourse (N=238)	4.44 ± 0.62 81.9% (230)	4.40 ± 0.64 81.1% (228)	4.48 ± 0.60 81.9% (230)	-	4.44 ± 0.60 81.9% (230)	-	-
In-person discussion							
Peer Concussion Education Program (N=212)	3.67 ± 0.91 53.4% (150)	3.66 ± 0.88 53.0% (149)	3.47 ± 0.91 49.1% (138)	-	-	-	-
Smart Hockey (N=225)	4.08 ± 0.77 70.5% (198)	4.12 ± 0.71 73.0% (205)	4.21 ± 0.65 75.1% (211)	-	-	-	-
Module							
Concussion Awareness Training Tool (CATT) for athletes (N=227)	3.90 ± 0.84 65.5% (184)	3.95 ± 0.79 65.5% (184)	-	3.90 ± 0.77 65.8% (185)	-	-	-
NFHS Concussion for students (N=227)	3.73 ± 0.90 60.1% (169)	3.82 ± 0.79 62.3% (175)	-	3.99 ± 0.72 69.0% (194)	-	-	-
Fact sheet							
NCAA Concussion Safety (N=214)	4.08 ± 0.70 69.8% (196)	4.15 ± 0.68 69.8% (196)	-	-	4.40 ± 0.53 74.7% (210)	4.31 ± 0.66 71.9% (202)	4.35 ± 0.62 71.5% (201)
CDC HEADS UP (N=232)	4.08 ± 0.68 75.8% (213)	4.17 ± 0.67 76.5% (215)	-	-	4.37 ± 0.62 79.4% (223)	4.27 ± 0.70 75.8% (213)	4.31 ± 0.67 77.2% (217)

* Mean and standard deviation; - Not applicable. % and number of favorable ratings (> 3.0) are presented for each program and survey.

Note: NFHS=National Federation of State High School Associations, CDC=United States Center for Disease Control and Prevention, NCAA=National Collegiate Athletic Association, AIM = Acceptability of Intervention Measure, IAM = Intervention Appropriateness Measure, FIM = Feasibility of Intervention Measure.

Discussion

This manuscript describes the Program Evaluation and Perceptions of Implementation (PEPI) process and illustrates its application through the evaluation of concussion education programs. The PEPI process is a systematic and iterative process that allows for the identification of potential programming, assessment of their content, and feedback from potential users about their likelihood for successful implementation. This application built upon our previous work, a scoping review that identified and assessed the content of free concussion education programs for athletes, by having potential messengers rate programs' acceptability, appropriateness, and feasibility (Drattell et al., In Prep). Most participants rated all programs above our cut-point for acceptability, appropriateness, and feasibility, with some notable patterns. Our results will help messengers identify potential programs that will meet their needs to ultimately accelerate the translation of research to practice. Further, by targeting learning objectives to improve athlete care-seeking as identified in the first phase, and selecting programs that they can reasonably implement in the second phase, the program(s) delivered may have improved outcomes in promoting athlete care-seeking, and lead to improved short- and long-term health outcomes after a concussion.

Messengers may have a wide number of programs to consider for meeting their instructional goals, however, they may not have the time to find and appraise each program. Additionally, programs may not be disseminated in a way that reaches potential messengers, such as peer-reviewed articles behind a paywall (Tennant et al., 2016). The messengers also may not be aware of what learning objective best practices exist to guide program selection (Drattell et al., 2024b). The first phase of the PEPI

process addresses these gaps by utilizing a scoping review to identify programs and appraise the programs' content compared to best practices for learning objectives. The narrative structure of a scoping review and the application of rapid review methodology allows those implementing the PEPI process to gather and assess the programs in a timely manner, which may narrow the 17-year lag between research innovations and changes to practice (Grant & Booth, 2009; Morris et al., 2011). This structured approach also allows for the rigor, objectivity, and transparency expected in program evaluation (Kidder et al., 2024).

Although the information from the scoping review alone may be helpful for messengers seeking to deliver concussion education or change their existing programming, it lacks one of the "core tenets" of program evaluation – the perspectives of stakeholders, like the messengers (Kidder et al., 2024). Phase two of the PEPI process seeks the input of the messengers who may put the programs into action on the degree to which the programs may actually be successful if implemented. The surveys can be incorporated into an activity that provides a benefit to the messengers, which may encourage participation from those who may not normally participate in a research activity. In this illustration, we recruited participants by offering free professional continuing education units, since our targeted messenger group was ATs who need, and often have to pay for, continuing education opportunities.

Important input from these messengers includes acceptability, appropriateness, and feasibility, which, among other constructs, are preconditions and indicators of successful implementation processes and outcomes (Proctor et al., 2011). There is a slow but growing movement toward effectiveness-implementation studies in research to

identify contexts in which programs work most effectively (Curran et al., 2012). In lieu of coordinated projects identifying real-world application, using the PEPI process to identify the degree to which messengers believe the programs are acceptable, appropriate, and feasible may help others identify impactful and uncomplicated interventions (Kidder et al., 2024). Our results demonstrated that the AIM, IAM, and FIM have high internal consistency in this sample, meaning that the questions within the surveys are likely to represent similar constructs, in this case, acceptability, appropriateness, and feasibility. Publication of these findings may help further disseminate programs to potential messengers and address some of the challenges with translating research to practice (Finch et al., 2013).

Illustrative Application: Concussion Education

Some patterns emerged in the application of the PEPI process second phase for concussion education. We were accurate in hypothesizing that the participants would have positive feelings of acceptability, appropriateness, and feasibility toward all programs, as demonstrated through mean ratings greater than 3.0 for all surveys across all programs. Descriptively, ATs generally had the lowest ratings for programs being acceptable, rather than appropriate and feasible. This finding is notable for those who are developing new programs or adapting existing ones. As outlined in the CDC Program Evaluation Framework, it is important to consider the opinions of “interest holders” in the development phase of programs (Kidder et al., 2024). It is unclear the degree to which the groups who created these eight programs engaged potential messengers in the development stages, however, this highlights the importance of considering user feedback to ensure that they find the program appealing.

The CrashCourse video and Peer Concussion Education Program (PCEP) consistently had the highest and lowest AIM, IAM, and FIM scores, respectively. The CrashCourse video was the shortest video option (12 minutes) (Teach Aids, 2024), which may be easier to play a single video as educational programming or to add the video to existing programming. The cornerstone of the PCEP is creating an interprofessional team to support implementing the program (Chestnut Hill College, 2020). Previous studies have demonstrated that ATs struggle with the feasibility of collaborating with other members of the athletics department staff (Drattell et al., 2024b), which may have decreased perceptions of acceptability, appropriateness, and feasibility.

Some trends among delivery types also became apparent in the descriptive analysis. Nearly three quarters of participants believed the CDC and NCAA fact sheets were acceptable, appropriate, and feasible. This may be unsurprising given the widespread use of written materials in secondary schools and inclusion of the fact sheet in the NCAA medical guidance (National Collegiate Athletic Association Sport Science Institute, 2024; Weber Rawlins & Valovich McLeod, 2023). Meanwhile, approximately two-thirds of participants rated the CATT and NFHS modules favorably. These programs inherently are completed individually, and it may be more challenging to encourage all athletes to complete the module compared to holding a team meeting or providing a fact sheet. A team meeting or fact sheet also allows the messenger to customize the material to the organization or engage in an expanded conversation, which is recommended by experts as a learning objective for concussion education, and

is not possible if they only use an online module as a sole method (Kroshus et al., 2020).

Limitations and Future Directions

The results of PEPI process evaluation could have a broad positive impact by providing an iterative framework for measuring an educational interventions' potential for successful implementation across a variety of conditions and settings, however, there are limitations to consider. This study did not account for program efficacy or effectiveness. It is important to understand how well a program works, which would also influence ATs' perceptions of the programs. For instance, a program with high efficacy may have lower feasibility, but better outcomes than a program that is easier to use. Future applications of the PEPI process could include existing information about effectiveness of the programs to provide that context for the participants, or use existing methods for rating the evidence supporting different intervention options (Barry et al., 2023). Additionally, the PEPI process could be modified to explore other voices in this second phase. The learners' (e.g., athletes') perceptions of acceptability and other characterizations of their enjoyment would be beneficial when selecting a program. Hearing from other community members who deliver concussion education, like coaches' or administrators without access to an AT, would provide valuable information about these programs' implementation.

Critically, many constructs inform implementation success, not just acceptability, appropriateness, and feasibility (Wisdom et al., 2014). It is important, but challenging, to consider the internal and external context in which the education is provided, and personal preferences of the messengers (Wisdom et al., 2014). There is also no

consensus on a meaningful difference when interpreting the AIM, IAM, and FIM survey responses. Given this limitation, we did not perform comparative analysis and leave the interpretation of meaningfulness in the program selection process up to the messengers. Despite lacking quantifiable meaningfulness, these results may be useful for individuals planning effectiveness-implementation studies of health education to help identify programs with a high potential for success. Future work could compare the results of such studies to the results of the PEPI process.

Concussion experts endorse using more than one education program, and this application of the PEPI process asked participants about individual programs. In future applications of the PEPI process for concussion education or other health interventions, programs could be evaluated in combination (Kroshus et al., 2020; Weiner et al., 2017). There are multiple potential participant biases to consider, including recruitment bias such that individuals who like concussion education participated in the study and social desirability to provide acceptable answers. Those who were interested in the learning activity, where individuals were invited to participate in research, may be more inclined to apply evidence-based practices and concussion education, which could affect their responses. Limiting our participants to full-time ATs may have influenced the feasibility for in-person concussion education programs and distribution of fact sheets as individual handouts because ATs who spend less time at their institution have limited time to perform these actions compared to ATs who are on site full-time. We also acknowledge that some participants may not have critically reviewed all materials. We attempted to control for inattention by requiring confirmation of having reviewed the material, setting a time limit for watching the videos, and establishing an a-priori cutoff

for individuals who spent little time on the page where the learning material was presented. There are also concerns about habituation after completing the AIM, IAM, and FIM for eight programs. Future applications of the PEPI process could randomize the survey order, however the programs were presented in a random order which may have reduced habituation effects. Finally, we did not take the programs that participants currently used into consideration; however, the goal was to determine the degree to which they perceived the program regardless of which program(s) they currently use.

Conclusions

It is important that those who are implementing health education programming know what is available, how well those programs align with best practices, and which programs might be more easily implemented. Results from utilizing this program evaluation process will allow those who use health education programs to gather information to support decision-making when selecting which program(s) to implement. The results from this study may allow ATs and others who deliver concussion education to evaluate and compare existing concussion education interventions' content and potential for success based on the opinion of their peers. The majority of ATs agreed that the programs we evaluated were acceptable (AIM), believed the content was appropriate (IAM), and that they would be feasible to deliver (FIM). Utilizing this information may benefit messengers in the short and long-term when selecting appropriate programming. This may ultimately lead to protecting athletes' health by improving their care-seeking and short- and long-term injury outcomes through concussion education.

Authors' Contributions

JD, JG, EK, RL, and JS conceptualized the project and developed the methodology. JD performed software development, data curation, investigation, visualization, writing – original draft and editing. JD and JS performed data analysis. JG, EK, RL, and JS provided supervision and performed writing – review & editing. Every co-author agreed that the work may be included in this thesis or dissertation.

CHAPTER 5

THE IMPACT OF INDIVIDUAL AND INSTITUTIONAL FACTORS ON ATHLETIC TRAINERS' PERCEPTIONS OF ATHLETE CONCUSSION EDUCATION PROGRAM IMPLEMENTATION [2]

[2] Drattell JD, Kroshus E, Gay J, Lynall RC, Schmidt JD. To be submitted to *Journal of Sport and Health Science*.

Abstract

Athletes are often required to receive annual concussion injury prevention education, which is typically delivered by an athletic trainer (AT). Many programs exist, and they may be perceived as more acceptable, appropriate, and/or feasible under different circumstances. We aimed to determine if setting, staff ratio, role in selecting education, or current education practices predict perceived acceptability, appropriateness, and feasibility. Participants enrolled in the study during an online continuing education learning activity. They provided demographic information including their setting, number of athletes at the institution, number of full-time AT staff, their role in selecting education, and whether education was currently delivered. They viewed eight concussion education programs and completed three implementation outcome measure surveys. Each consist of four Likert-type items with responses ranging from 1 ("completely disagree") to 5 ("completely agree"). The average of the four items is used as a single construct score. Two-hundred and eighty-one participants (62.2% female gender, 33.9±10.0 years-old) completed the survey, and 88.5% (N=249) reviewed all eight programs. The ATs' oversaw an average of 176.8±169.5 athletes per full-time AT (median=116.7 [IQR: 54.8-250.0]), 49% (N=138) could modify their programming, and 88% (249) performed education at least annually. Staff ratio predicted the acceptability and appropriateness scores for CrashCourse. There were no other significant predictors for any program's acceptability, appropriateness, or feasibility. Overall, the factors that we analyzed did not influence perceptions of successful implementation. ATs may not need to limit themselves to programs that are designed for a particular setting and may have similar perceptions of implementing the program regardless of their current

educational practices. The ATs' role in selecting education did not impact their perceptions of the programs. Future studies should explore other contextual and program characteristics that predict perceived acceptability, appropriateness, and feasibility.

KEYWORDS:

Acceptability, Appropriateness, Feasibility, Consolidated Framework for Implementation Research, Health Education

Introduction

Concussions are a common injury in sports that result from forces transmitted to the brain from a hit to the head or body and result in a variety of signs and symptoms (Davis et al., 2023; Pierpoint & Collins, 2021). These head injuries affect an individual's ability to perform their activities of daily living and may result in long-term consequences like cognitive deficits, increased musculoskeletal injury risk, and increased risk of subsequent concussions (Jildeh et al., 2022; Patricios et al., 2023; Redlinger et al., 2022; Schmidt et al., 2018). Timely initiation of appropriate medical treatment may improve post-injury outcomes (Asken et al., 2018; Schmidt et al., 2023). To encourage care-seeking and concussion identification, athletic organizations are encouraged, or sometimes mandated, to establish and follow concussion management policies and provide concussion education (National Collegiate Athletic Association Sport Science Institute, 2023a; National Federation of State High School Associations, 2023; The Network for Public Health Law, 2019). Many educational programs exist for a variety of

audiences (Drattell et al., In Prep; Mallory et al., 2022). Athletic trainers, medical professionals who often provide medical care to athletes, commonly select and deliver this education to their athletes and other members of the athletics community using videos, online modules, handouts, and presentations (Carroll-Alfano & Wolf Nelson, 2019; Kroshus & Baugh, 2016; Mallory et al., 2022; Weber Rawlins & Valovich McLeod, 2023).

However, ATs face time barriers to delivering concussion education, even if they think doing so would be useful in increasing athlete symptom disclosure (Drattell et al., 2024a; Drattell et al., 2024b). Given this time constraint, ATs may find it more efficient to consider their peers' opinions about concussion education programs when evaluating which programming to implement. We took the Consolidated Framework for Implementation Research into consideration when selecting individual and organizational factors to capture and include in the analysis (Damschroder et al., 2022). Setting and staff ratio might reflect characteristics of the outer setting (policies, pressure) or inner setting (structural, priorities) (Damschroder et al., 2022). An AT's role in selecting education could reflect their status as an opinion leader in the organization, and current education practices may reflect their existing behavioral characteristics (Damschroder et al., 2022). We selected outcomes of acceptability (e.g., appeal), appropriateness (e.g., suitability), and feasibility (e.g., ease of use), as indicators of implementation processes, and thus, helpful information for ATs to reference (Proctor et al., 2011). The Acceptability of Intervention Measure (AIM), Intervention Appropriateness Measure (IAM), and Feasibility of Intervention Measure (FIM) are a trio of brief and widely-used implementation outcome measures that have high internal

validity and test-retest reliability and can be used to measure these constructs (Weiner et al., 2017).

Therefore, the purpose of this study was to determine the influence of individual and institutional factors on concussion education programs' perceived acceptability, appropriateness, and feasibility, including ATs' practice setting, staff-to-athlete ratio, the AT's role in selecting what concussion education is performed, and whether or not concussion education is currently performed. The AIM, IAM, and FIM explore different outcomes that play a role in program implementation (Weiner et al., 2017). Acceptability and appropriateness are personal and social concepts; however, feasibility relies on practicality and resources (Weiner et al., 2017), therefore we had different hypotheses based on the three outcomes. We hypothesized none of those factors would have a significant effect on acceptability. We hypothesized that professional setting would predict appropriateness for the programs that were developed for secondary school or collegiate athlete audiences. Regarding feasibility, we hypothesized that setting, staff-to-athlete ratio, autonomy in selecting programing, and current concussion education practices would significantly predict feasibility, such that as setting increased in competitiveness, AT staff care for fewer athletes per person, and those who currently perform concussion education will perceive programs as more feasible.

Methods

Participants

Learners participating in an athletic training professional continuing education course on discovering and applying evidence-based practices were invited to complete this research survey. The research activity was approved by the Institutional Review

Board. Those who were interested in participating in the research activity completed an IRB-approved consent form and provided demographic information, including employment details (e.g., professional setting, if concussion education was delivered, the number of full- and part-time athletic training staff members and athletes at their institution) and to what degree they were involved in selecting concussion education (i.e., sole decision maker, allowed to make modifications, not a decision maker). We included ATs who reported being over the age of 18 and practicing full-time in secondary schools or collegiate athletics in this study. Participants could withdraw from the study by discontinuing the learning activity or not responding to the survey questions.

Presentation of Programs

The module included the presentation of eight free and publicly available concussion education programs for athlete audiences on individual web pages. There were four types of delivery methods, with two programs presented per type. The delivery methods were:

- Videos (Social Marketing Intervention and CrashCourse) (Teach Aids, 2024; University of Wisconsin-Madison, 2020)
- In-person discussion templates (Smart Hockey and the Peer Concussion Education Program (PCEP)) (Ernst & Kneavel, 2020; Parachute Canada, 2022)
- Online modules (Concussion Awareness Training Tool (CATT) and Concussion for Students) (BC Children's Hospital, 2024; National Federation of State High School Associations, 2018)

- Fact sheets from two organizations (the NCAA and the Centers for Disease Control and Prevention (CDC) (Centers for Disease Control and Prevention, 2024; National Collegiate Athletic Association Sport Science Institute, 2024).

Programs were displayed in a random order with descriptive text from the host website or article, if available, and links to the original website or article. Videos were embedded into the website for video-based programs and online modules. Images of the flyers were embedded on the websites with links to full-page PDFs. Only learners who consented to participate were shown the AIM, IAM, and FIM surveys at the bottom of each page (Weiner et al., 2017). Participants were asked to confirm that they had critically reviewed the program before completing the AIM, IAM, and FIM surveys.

Perceptions of Implementation

We utilized a set of three widely used implementation science surveys with high psychometric properties meant to quantify program performance: the Acceptability of Intervention Measure (AIM), Intervention Appropriateness Measure (IAM), and Feasibility of Intervention Measure (FIM) (Weiner et al., 2017). These surveys each consist of four Likert-type items presented simultaneously that ask the participant to respond to each statement on a 5-point scale ranging from 1 (“completely disagree”) to 5 (“completely agree”), with 3 labeled as “neither agree nor disagree” (Weiner et al., 2017). The average of the four responses is used as a single construct score (Weiner et al., 2017). For programs that could be delivered in multiple ways (e.g., videos shown in person or shared electronically and fact sheets that can be shared electronically, as individual handouts, or posted as flyers), multiple FIM surveys were displayed to the participants.

Statistical Analysis

Responses were captured in Qualtrics (Provo, UT) and analyzed using SPSS 29.0.1 (IBM Corporation, Armonk, NY). To be included in analyses, participants must have acknowledged reviewing the materials, had the program website displayed for a minimum of 30.0 seconds, and completed at least one AIM, IAM, or FIM survey. We explored demographic data using descriptive analysis (means and standard deviations, medians and interquartile range, or frequency) based on data type.

Professional settings were classified as ordinal variables and served as a proxy for the amount of financial resources and competitiveness typical to level in the order of least- to highest-funded: secondary school, non-NCAA college, NCAA Division III, NCAA Division II, and NCAA Division I (Gallucci & Petersen, 2017; Rankin, 1992). Institution athlete-to-staff ratio ("staff ratio") was calculated by dividing the total number of athletes who receive medical care from the organization's AT staff by the number of full-time equivalent (FTE) ATs the participants reported to be on staff. FTE were calculated as the number of full-time ATs plus half the number of part-time ATs, representing them as working 50% of the time that a full-time AT would be present. Participants reported their role in selecting education for their athletes (sole decision-maker, could modify programming, or not a decision-maker), and whether concussion education was performed at their institution at least annually (yes or no).

The AIM, IAM, and FIM scores were analyzed as continuous variables. As suggested by the survey development procedures, we identified single AIM, IAM, and FIM survey responses by averaging the survey responses to the five items (Weiner et al., 2017). We used Wilcoxon Signed Rank tests or Friedman tests with post-hoc

Wilcoxon Signed Rank tests to compare FIM scores for programs with multiple delivery methods to determine a single FIM score. We made an a priori decision to average the FIM scores if no differences existed, and otherwise used the delivery method with the highest feasibility. Further evaluation of the programs with multiple delivery methods, and therefore multiple feasibility scores (i.e., fact sheets and videos) showed no differences (p-value range=.159-.493), with the one exception for the CDC fact sheet (χ^2=6.115, p=.047). Digital flyer distribution had significantly higher feasibility ratings than handout (z=-2.722, p=.006), but not the poster (z=-1.512, p=.131). Handout and flyer distribution were not significantly different (z=-0.82, p=.412). Therefore, we utilized the digital distribution FIM score for analysis. We evaluated the discriminant validity of the AIM, IAM, and FIM scores by performing Spearman's correlations.

The survey AIM, IAM, and FIM responses for all of the eight programs were non-normally distributed, and we were unable to establish a normal distribution with log, square root, or Box-Cox transformations. Therefore, we performed 24 generalized linear regressions with a gamma distribution and log link to determine if the setting, staff ratio, role in selecting concussion education practices, or concussion education practices predicted the AIM, IAM, and FIM scores.

Results

Participants

Seven hundred and fifty-nine participants enrolled the course, and nearly three quarters of participants (N=554, 73.0%) consented to participate in research. Of the consented individuals, 50.7% (N=281) met the inclusion criteria. Nearly three-quarters (N=207, 73.7%) of included participants reviewed all eight programs. The majority of

participants were female sex (N=173, 62.2%) and identified with the female gender (N=178, 62.2%), and were 33.9 ± 10.0 years old. One hundred and eight (38.4%) practiced full-time in the secondary school setting and 173 (61.6%) practiced in the collegiate setting. The ATs reported that the organization's staff ratio was 176.8 ± 169.5 athletes per FTE AT staff member (median=116.67 [IQR: 54.8-250.0]). Most ATs (N=249, 88.6%) report providing concussion education at least annually. Additional demographic details are presented in Table 5.1.

Table 5.1. Participant demographics by practice setting.

Demographics	Secondary School	Non-NCAA college	NCAA D3	NCAA D2	NCAA D1	Total
N (%)	108 (38.4%)	16 (5.7%)	83 (18.1%)	23 (8.2%)	51 (29.5%)	281 (100.0%)
Sex (% within setting) (N=281)						
Female	71 (65.7%)	12 (75.0%)	30 (58.8%)	18 (78.3%)	47 (56.6%)	178 (63.3%)
Male	37 (34.3%)	4 (25.0%)	21 (41.2%)	5 (21.7%)	36 (43.4%)	103 (36.7%)
PNTR	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Gender (% within setting) (N=278)						
Female	66 (62.3%)	11 (73.3%)	30 (58.8%)	18 (78.3%)	48 (57.8%)	173 (62.2%)
Male	34 (32.1%)	4 (26.17%)	19 (37.3%)	5 (21.7%)	34 (41.0%)	96 (34.5%)
Non-Binary	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
PNTR	6 (5.7%)	0 (0%)	2 (3.9%)	0 (0%)	1 (1.2%)	9 (3.2%)
Age mean ± SD (N= 281)	35.6 ± 11.2	31.6 ± 8.4	32.4 ± 9.8	30.6 ± 9.0	31.9 ± 8.7	33.9 ± 10.0
Staff Ratio mean ± SD (N= 280)	314.0 ± 190.3	137.3 ± 69.0	142.9 ± 80.9	102.1 ± 35.9	47.0 ± 30.0	176.8 ± 169.5
Role in Selecting Education (N= 281)						
Sole Decision maker	49 (45.4%)	7 (43.8%)	8 (15.7%)	6 (26.1%)	17 (20.%)	87 (31.8%)
Can modify programming	46 (42.6%)	6 (37.5%)	34 (66.7%)	9 (39.1%)	43 (51.8%)	138 (49.1%)
Not a decision maker	13 (12.0%)	3 (18.8%)	9 (17.6%)	8 (34.8%)	23 (27.7%)	56 (19.9%)
Provide Education (N= 281)						
Yes	90 (83.3%)	11 (68.8%)	49 (96.1%)	20 (87.0%)	79 (95.2%)	249 (88.6%)
No	18 (16.7%)	5 (31.3%)	2 (3.9%)	3 (13.0%)	4 (4.8%)	32 (11.4%)

NCAA=National Collegiate Athletic Association, IQR= Interquartile Range, PNTR=Prefer Not To Respond, SD=standard deviation.

Perceptions of Implementation

We ran 24 separate generalized linear model regressions for the results of the three surveys for the eight programs. The relationship of setting, staff ratio, role in selecting education, and education practices with acceptability, appropriateness, and feasibility scores for each program are presented in Table 5.2. The regression results including the chi square values are presented in Appendix F. The AIM, IAM, and FIM surveys showed low discriminant validity (Dancey & Reidy, 2007). The AIM and IAM scores had strong to very strong correlations (range=.745-.874, Appendix G). The AIM and IAM scores had slightly lower correlations with FIM scores (range=.540-.730 and .612-.798, respectively; Appendix G). Staff ratio had a positive relationship with CrashCourse acceptability (β=0.0002, $\chi^2_{(1)}$=7.001, p=.008) and appropriateness (β=0.0002, $\chi^2_{(1)}$=6.949, p=.008). The beta weight was exponentiated for interpretation, which resulted in a value of 0.0002. Therefore, for each additional athlete in the staff-to-athlete ratio, the average AIM and IAM scores rose 0.02 points.

Table 5.2. Significance values for separate generalized linear model regressions of setting, staff ratio, role in selecting education, and education practices on perceptions of intervention implementation of athletic trainers' perceptions of acceptability, appropriateness, and feasibility of eight concussion education programs.

		Predictor p-value			
Program	**Omnibus Test p-value**	**Setting**	**Staff Ratio**	**Role in Selecting Education**	**Provide Education**
Social Marketing Intervention					
AIM	.750	.939	.551	.252	.841
IAM	.104	.067	.892	.536	.849
FIM	.079	.039*	.367	.443	.636
CrashCourse					
AIM	.004*	.113	.008*	.516	.344
IAM	.018*	.275	.008*	.508	.276
FIM	.050	.051	.274	.683	.533
Smart Hockey					
AIM	.882	.989	.612	.704	.217
IAM	.784	.780	.232	.886	.162
FIM	.409	.372	.066	.462	.281
Peer Concussion Education Program					
AIM	>.999	.994	.600	.971	.700
IAM	.947	.909	.231	.709	.755
FIM	.895	.969	.218	.927	.265
Concussion Awareness Training Tool					
AIM	.976	.838	.736	.676	.826
IAM	.989	.843	.907	.872	.886
FIM	.918	.810	.700	.761	.302
NFHS Concussion for Students					
AIM	.739	.541	.622	.471	.976
IAM	.649	.511	.918	.831	.862
FIM	.975	.754	.673	.978	.718
NCAA Concussion Safety					
AIM	.491	.677	.969	.200	.530
IAM	.799	.883	.705	.332	.632
FIM	.954	.733	.901	.823	.799
CDC HEADS UP					
AIM	.121	.690	.957	.090	.277
IAM	.108	.370	.693	.189	.140
FIM	.806	.860	.420	.382	.509

* p<.050

Note: AIM=Acceptability of Intervention Measure, IAM=Intervention Appropriateness Measure, FIM=Feasibility of Intervention Measure, NFHS=National Federation of State High School Associations, CDC=United States Center for Disease Control and Prevention, NCAA=National Collegiate Athletic Association.

Discussion

Overall, program acceptability, appropriateness, and feasibility ratings were not influenced by the factors we explored: AT setting, staff ratio, role in selecting concussion education, or whether concussion education is currently performed at the institution. Perceptions of CrashCourse acceptability and appropriateness were better among ATs working in settings where there are fewer ATs per athlete.

Overall, the acceptability, appropriateness, and feasibility of the eight programs that we evaluated did not differ across ATs with varying personal and professional circumstances. The general lack of significant findings reflect that ATs find the programs appealing, the content appropriate, and they are realistic to deliver regardless of the personal and professional circumstances we explored. In light of these findings, ATs may select and implement any of these programs and not feel self-limited based on these factors.

Regarding the personal and social concepts of acceptability and appropriateness, we hypothesized that setting, staff ratio, role in selecting education, and education practices would not predict the ATs' perceptions of program acceptability, and that only setting would predict appropriateness (Weiner et al., 2017). These findings may be beneficial for clinicians when considering which programs to implement. The ATs liked the programs (e.g., acceptable) and felt that any of the programs are applicable to promoting athlete health and safety regardless of setting, their role in selecting education, and whether they had performed concussion education before. These findings suggest that the program authors used language that would be appropriate for learners at the secondary school and collegiate levels, which is crucial

for comprehension in health education materials (Wittink & Oosterhaven, 2018). We believed that setting may influence appropriateness because some programs include branding and text that refer to either high school or collegiate sports. Organizations where each FTE AT oversaw more athletes saw the CrashCourse program as more acceptable and appropriate. However, the rate of improved score was 0.0002 of a survey point per additional athlete. We attempted to conceptualize the clinical meaningfulness of this change using our participants' mean staff ratio of 176.8 athletes per FTE AT. If an institution's staff ratio increased by 50% by adding an additional 88 athletes, and no AT staff, CrashCourse acceptability and appropriateness ratings would increase by 0.02, which may not be clinically meaningful. Additionally, nonparametric analyses may have a lower power and require a larger sample size, which may have resulted in Type 1 error.

Regarding the practical concept of feasibility, we believed that the individual and institutional factors we explored would play a role in the ATs' perceptions based on our previous studies that found ATs believed expert recommendations for concussion education and policy had lower feasibility than utility, and that ATs felt their greatest barrier to delivering concussion education was the opportunity do so (Drattell et al., 2024a; Drattell et al., 2024b; Kroshus et al., 2020; Weiner et al., 2017). There is a longstanding disparity in resources allocated to athletics across settings, so it is encouraging that the ATs did not feel limited in the feasibility of delivering any of the programs based on their setting (Gallucci & Petersen, 2017; Rankin, 1992). The in-person discussion programs may require more effort to coordinate, so it was encouraging to see that the feasibility of delivering this program was unaffected by the

number of athletes overseen by each FTE AT. It can also be challenging to start a new behavior (e.g., delivering concussion education) so it was encouraging to see that those factors did not influence perceived feasibility for any of the programs (Prochaska & Prochaska, 2011).

Limitations and Future Directions

Interpretation of this study's results should take into consideration its limitations. The participants who opted in to participate in the learning activity and the research may be more inclined to apply evidence-based practices and concussion education, which could affect their responses. There is also a risk related to social desirability or a lack of attention to detail. The participants were recruited through a continuing education activity that was estimated to take 2.5 hours to complete in full, and participants may have tired at the end or tried to move quickly throughout. We attempted to control for these behaviors by randomizing the order, having a minimum amount of time to view the materials, and allowing participants to exit the program at any time. The participants may have become habituated to the responses if they were giving the programs similar ratings for each survey. In the future, this could be moderated by randomizing the survey order.

Additionally, the institutional and personal factors we explored are only part of what influences health promotion activity implementation (Damschroder et al., 2022; Rubio-Valera et al., 2014). Limiting our participants to full-time ATs may have influenced the feasibility for in-person concussion education programs and distribution of fact sheets as individual handouts because ATs who spend less time at their institution have limited time to perform these actions compared to ATs who are on site full-time.

Additionally, we did not include participants who work in non-traditional settings, such as the military or industrial settings. Including other settings will be an important future direction for the PEPI process to explore perceptions of implementation in settings that are less often explored. Our approach did not directly evaluate the complex effect of various levels of the socioecological framework on implementing health education programs (Rubio-Valera et al., 2014). We also did not ask participants to evaluate the degree to which they could sustain performing the concussion education programs over time, or their ability to deliver it as the developer intended (Proctor et al., 2011). Future research could evaluate other constructs from implementation science research to identify characteristics of the environment, programming, setting, and processes that influence the perceptions about the implementation of concussion education in different contexts. Including information about program effectiveness may provide additional context that may influence perceptions of acceptability, appropriateness, and feasibility, and should be considered for inclusion in future use of the PEPI process (Damschroder et al., 2022).

Conclusions

Understanding predictors for successful implementation of concussion education interventions, including their whether ATs, as program end-users, like the program, think the content is appropriate, and that the program could reasonably be delivered as intended by the program developer, will help clinicians identify interventions that may be successfully implemented. We intended to identify the different clinical settings and circumstances where these programs would be most acceptable, appropriate, and feasible for ATs. Our results demonstrate that the programs may be perceived as

equally acceptable, appropriate, and feasible regardless of setting, staff ratio, role in selecting education, and education practices.

Authors' Contributions

JD, JG, EK, RL, and JS conceptualized the project and developed the methodology. JD performed software development, data curation, investigation, visualization, writing – original draft and editing. JD and JS performed data analysis. JG, EK, RL, and JS provided supervision and performed writing – review & editing. Every co-author agreed that the work may be included in this thesis or dissertation.

CHAPTER 6

CONCLUSION

Summary

The overall goal of this study was to develop an iterative and rapid process to identify health education programs, evaluate their content, and identify their potential for successful implementation under different circumstances. Our findings allow those who deliver health education to know what free, public concussion education programs for athletes are available, how well those programs align with best practices, and that programs are likely to be easily implemented regardless of their intended setting, staff ratio, role in selecting education, and current education activities.

We performed a rapid scoping review and identified fifteen publicly available athlete concussion education interventions, then critically assessed which of the expert-recommended topics each program addressed (Drattell et al., In Prep; Grant & Booth, 2009). The scoping review search process revealed that many of the research studies on concussion education programs did not include materials that would allow readers to implement the program, which hinders messengers' abilities to use a potentially beneficial educational program. The programs captured in the scoping review provided a variety of educational content and met a wide range of the expert recommendations (Kroshus et al., 2020). These findings will help messengers find programs that meet their needs. Identifying programs that meet the user and learner needs may, in the short-term, improve concussion education delivery and increase athlete care-seeking

after a concussion, leading to short- and long-term benefits to athlete health (Asken et al., 2018; Redlinger et al., 2022; Rubio-Valera et al., 2014; Schmidt et al., 2023).

In the research aims, we identified the programs that exceeded the average number of recommendations, and therefore programs perhaps more likely to be used as standalone programs, and asked ATs to evaluate their potential successful implementation. All programs were rated as acceptable, appropriate, and feasible, which is reassuring given that they were developed for the topic that we investigated. All programs had an average rating that was favorable (> 3.0) in acceptability, appropriateness, and feasibility, and the majority of ATs agreed that the programs we evaluated had a positive potential for implementation success. The individual and institutional factors we explored, setting, staff-to-athlete ratio, autonomy in selecting programing, and current concussion education practices, largely did not predict perceptions of successful implementation, which suggest that ATs may not need to account for institutional and individual factors when selecting and delivering concussion education.

In the future, ATs and others who deliver concussion education may reference these results to evaluate concussion education program options by comparing content and their peers' potential for success. The structured and replicable PEPI process will have a continued impact on health education messengers by measuring educational interventions' potential for concussion education and other health education topics. The results of this study and other PEPI process applications may be useful for researchers selecting programming for effectiveness-implementation studies to measure the real-world application of these programs. We also evaluated these programs in insolation,

but concussion experts endorse using more than one education program (Kroshus et al., 2020), so future applications of the PEPI process could ask participants to evaluate programs in combination, including as an add-on to any education they already perform.

Future studies should explore other program characteristics, such as effectiveness, and other contextual factors, including other settings and other individuals, that predict perceived acceptability, appropriateness, and feasibility. Future applications of the PEPI process could include information about effectiveness to provide that context for the participants, either as reported in research or using the US Preventive Services Task Force methods for assessing preventive interventions (Barry et al., 2023). Additionally, the PEPI process could be modified to explore other voices in this second phase. The learners' (e.g., athletes') perceptions of acceptability and other characterizations of their enjoyment would be beneficial when selecting a program. Hearing from other community members who deliver concussion education, like coaches' or administrators without access to an AT, would provide valuable information about these programs' implementation.

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APPENDICES

A: Data Charting Rubric and Notes

B: Demographic and Employment Questionnaire

Start of Block: Demographics

Q2.1 Please complete this brief list of questions before progressing to the educational video.

Age

What is your age in years?

- Years _____

Skip To: End of Block If Condition: Years Is Less Than 18. Skip To: End of Block.

Sex

What is your sex assigned at birth?

- Female
- Male
- Intersex
- Prefer not to respond

Gender

To which gender do you most identify?

- ○ Cisgender female
- ○ Cisgender male
- ○ Transgender female
- ○ Transgender male
- ○ Non-binary
- ○ Not listed _____
- ○ Not sure
- ○ Prefer not to respond

Setting

What is your primary work setting? If you work in more than one setting, select the setting with which you spend the majority of your time.

- ○ Secondary school athletics
- ○ College/University athletics
- ○ School Administration/Teaching
- ○ Professional Sports
- ○ Student
- ○ Emerging setting/other

Display this question:

If What is your primary work setting? If you work in more than one setting, select the setting with... = Emerging setting/other

EmergingSetting

In which emerging setting do you work?

- ○ Performing arts
- ○ Armed forces
- ○ Industrial/Occupational health
- ○ Public Safety
- ○ Physician practice
- ○ Health care administration/rehabilitation
- ○ Other _____

Display this question:

If What is your primary work setting? If you work in more than one setting, select the setting with... = Secondary school athletics

X→

SSType

In which type of secondary school do you work?

- ○ Public school
- ○ Private school

Display this question:

If What is your primary work setting? If you work in more than one setting, select the setting with... = College/University athletics

AthleticAssn

To which athletic association does your school belong?

- ○ National Collegiate Athletic Association (NCAA)
- ○ National Association of Intercollegiate Athletics (NAIA)
- ○ National Junior College Athletic Association (NJCAA)
- ○ Other _____

Display this question:

If To which athletic association does your school belong? = National Collegiate Athletic Association (NCAA)

NCAADivision

What is the primary NCAA division for your school?

- ○ Division I
- ○ Division II
- ○ Division III

Display this question:

If What is your primary work setting? If you work in more than one setting, select the setting with... = College/University athletics

CollAthletes

Please select the approximate number of athletes who receive medical care from the athletic trainers at your institution.

Intermurals refers to teams/groups where your school's team plays students at other schools.

Intramurals refers to teams/groups where your school's teams only play other teams within your school.

	Not Applicable 0 100 200 300 400 500 600 700 800 900 1000
Varsity	
Intermurals/Club	
Intramurals	

Display this question:

If What is your primary work setting? If you work in more than one setting, select the setting with... = Professional Sports

Or What is your primary work setting? If you work in more than one setting, select the setting with... = Emerging setting/other

Or What is your primary work setting? If you work in more than one setting, select the setting with... = Secondary school athletics

NumberAthletes

Please select the approximate number of athletes who receive medical care from the athletic trainers at your institution.

	Not Applicable	0	100	200	300	400	500	600	700	800	900	1000
Athletes/Professionals												

Display this question:

If What is your primary work setting? If you work in more than one setting, select the setting with... = Secondary school athletics

Or What is your primary work setting? If you work in more than one setting, select the setting with... = College/University athletics

Or What is your primary work setting? If you work in more than one setting, select the setting with... = Professional Sports

Or What is your primary work setting? If you work in more than one setting, select the setting with... = Emerging setting/other

ATstaff

How many certified athletic trainers work with your institution's athletes? (include yourself)

- ○ Full Time (30+ hours per week) _____
- ○ Part Time (< 30 hours per week) _____

EmploymentStatus

What is your position in the medical team?

- ○ Head AT
- ○ Full-time staff AT
- ○ Part-time staff AT
- ○ Certified Graduate Assistant or Intern
- ○ Other _____

YearsCertified

How many years have you been certified as an athletic trainer?

▼ < 1 (1) ... 25+ (26)

ConcussionsManaged

How many concussions do you manage in an average year?

_____

State In which state do you currently practice? If you practice in multiple states, please select where you work the most time.

- Alabama (1)
- Alaska (2)
- Arizona (3)
- Arkansas (4)
- California (5)
- Colorado (6)
- Connecticut (7)
- Delaware (8)
- District of Columbia (9)
- Florida (10)
- Georgia (11)
- Hawaii (12)
- Idaho (13)
- Illinois (14)
- Indiana (15)
- Iowa (16)
- Kansas (17)

- Kentucky (18)
- Louisiana (19)
- Maine (20)
- Maryland (21)
- Massachusetts (22)
- Michigan (23)
- Minnesota (24)
- Mississippi (25)
- Missouri (26)
- Montana (27)
- Nebraska (28)
- Nevada (29)
- New Hampshire (30)
- New Jersey (31)
- New Mexico (32)
- New York (33)
- North Carolina (34)
- North Dakota (35)
- Ohio (36)

- Oklahoma (37)
- Oregon (38)
- Pennsylvania (39)
- Puerto Rico (40)
- Rhode Island (41)
- South Carolina (42)
- South Dakota (43)
- Tennessee (44)
- Texas (45)
- Utah (46)
- Vermont (47)
- Virginia (48)
- Washington (49)
- West Virginia (50)
- Wisconsin (51)
- Wyoming (52)
- Other United States territory (53)
- I do not practice in the United States (54)

End of Block: Demographics

Start of Block: Concussion Education Practices

Role_Education

How involved are you in deciding what concussion education is delivered to your team(s)?

- Sole decision maker
- Can modify programming
- Not a decision maker

Ed_Provided

Is annual concussion education provided at your institution?

- Yes
- No

Display this question:

If Is concussion education provided at your institution? = No

EdNotProvided

Why is concussion education not conducted at your institution?

- [ ] Not mandated
- [ ] Lack of time
- [ ] Lack of personnel
- [ ] Lack of funding
- [ ] Lack of knowledge regarding available resources
- [ ] Other _____

Display this question:

If Is concussion education provided at your institution? = Yes

WhoDelivers

Who delivers concussion education at your institution? (select all that apply)

- [ ] You
- [ ] An athletic trainer other than yourself
- [ ] Coach
- [ ] Athletes complete it by themselves
- [ ] Athletic administrator
- [ ] Physician on sports medicine staff
- [ ] Outside physician/specialist
- [ ] Other _____

Display this question:

If Is concussion education provided at your institution? = Yes

WhoReceives

Who receives concussion education? (select all that apply)

- ☐ All athletes
- ☐ Only contact-sport athletes
- ☐ Only first-year athletes
- ☐ Athletic trainers
- ☐ Coaches
- ☐ Athletic administrators/Staff
- ☐ Other _____

Display this question:

If Is concussion education provided at your institution? = Yes

EdFrequency

How often is concussion education delivered to the athletes?

- ○ Annually
- ○ Every season (multiple times per year)
- ○ I don't know
- ○ Other _____

Display this question:

If Is concussion education provided at your institution? = Yes

EdMethod

What methods do you use to provide concussion education at your institution? (select all that apply)

- [ ] Fact sheet (flyer, handout)
- [ ] Poster
- [ ] Email
- [ ] Online video/module
- [ ] Group (team) in-person presentation/discussion
- [ ] Individual in-person presentation/discussion
- [ ] Other _____

Display this question:

If Is concussion education provided at your institution? = Yes

ProgramUsed

What program(s) were used in the last year? (select all that apply)

- [ ] CDC Heads UP flyers/posters
- [ ] CDC Heads UP online module or NFHS Concussion for Students
- [ ] State athletic association handout
- [ ] State athletic association video/online program
- [ ] Flyer created a sport governing body (examples: USA Swimming, USA Hockey)
- [ ] NCAA handout
- [ ] Self-created in-person presentation
- [ ] Self-created flyer/poster
- [ ] Self-created video/online program
- [ ] Other handout _____
- [ ] Other online module/video _____
- [ ] Other intervention (please describe) _____

Display this question:

If Is concussion education provided at your institution? = Yes

LikeAboutEd

What do you like about the concussion education you provide? (select all that apply)

- ☐ Engaging
- ☐ Short duration
- ☐ Easy to administer
- ☐ There is nothing I like about concussion education at my institution
- ☐ Other _____

Display this question:

If Is concussion education provided at your institution? = Yes

DislikeAboutEd

What do you dislike about the concussion education you provide? (select all that apply)

- [ ] Not engaging
- [ ] Long duration
- [ ] Given once
- [ ] Content
- [ ] There is nothing I dislike about concussion education at my institution
- [ ] Other _____

End of Block: Concussion Education Practices

C: Implementation Survey Measures

Response Scale:

1 = Completely disagree

2 = Disagree

3 = Neither agree nor disagree

4 = Agree

5 = Completely agree

Note: Scales can be created for each measure by averaging responses.

Acceptability of Intervention Measure (AIM)

1) [*Intervention Name*] meets my approval.
2) [*Intervention Name*] is appealing to me.
3) I like [*Intervention Name*].
4) I welcome [*Intervention Name*].

Intervention Appropriateness Measure (IAM)

1) [*Intervention Name*] seems fitting.
2) [*Intervention Name*] seems suitable.
3) [*Intervention Name*] seems applicable.
4) [*Intervention Name*] seems like a good match.

Feasibility of Intervention Measure (FIM)

1) [*Intervention Name*] seems implementable.
2) [*Intervention Name*] seems possible.
3) [*Intervention Name*] seems doable.
4) [*Intervention Name*] seems easy to use.

D: Median and Interquartile Ranges for Research Question One Survey Ratings

Program	Acceptability (AIM)	Appropriateness (IAM)	Feasibility (FIM)				
			In-person	Module	Email	Handout	Poster
Video							
Social-Marketing Intervention	4.00 [3.50 - 4.50]	4.00 [3.75 - 4.50]	4.00 [4.00 - 5.00]		4.00 [4.00 - 5.00]		
CrashCourse	4.63 [4.00 - 5.00]	4.50 [4.00 - 5.00]	5.00 [4.00 - 5.00]		4.50 [4.00 - 5.00]		
In-person discussion							
Peer Concussion Education Program	4.00 [3.00 - 4.00]	4.00 [3.00 - 4.00]	3.75 [3.00 - 4.00]				
Smart Hockey	4.00 [4.00 - 5.00]	4.00 [4.00 - 5.00]	4.00 [4.00 - 5.00]				
Module							
Concussion Awareness Training Tool	4.00 [3.25 - 4.50]	4.00 [3.50 - 4.50]		4.00 [3.50 - 4.25]			
NFHS Concussion for students	4.00 [3.00 - 4.00]	4.00 [3.25 - 4.00]		4.00 [3.75 - 4.25]			
Fact sheet							
NCAA Concussion Safety	4.00 [3.75 - 4.81]	4.00 [4.00 - 5.00]			4.13 [4.00 - 5.00]	4.00 [4.00 - 5.00]	4.00 [4.00 - 5.00]
CDC HEADS UP	4.00 [3.75 - 4.69]	4.00 [4.00 - 5.00]			4.00 [4.00 - 5.00]	4.00 [4.00 - 5.00]	4.00 [4.00 - 5.00]

Note: AIM=Acceptability of Intervention Measure, IAM=Intervention Appropriateness Measure, FIM=Feasibility of Intervention Measure, NFHS=National Federation of State High School Associations, CDC=United States Center for Disease Control and Prevention, NCAA=National Collegiate Athletic Association.

E: Cronbach's Alpha for Research Question One Survey Measures

Program	Acceptability (AIM)	Appropriateness (IAM)	Feasibility (FIM)				
			In-person	Module	Email	Handout	Poster
Video							
Social-Marketing Intervention	0.934	0.933	0.953		0.947		
CrashCourse	0.966	0.957	0.964		0.965		
In-person discussion							
Peer Concussion Education Program	0.943	0.942	0.932				
Smart Hockey	0.951	0.930	0.930				
Module							
Concussion Awareness Training Tool	0.949	0.947		0.924			
NFHS Concussion for students	0.957	0.929		0.943			
Fact sheet							
NCAA Concussion Safety	0.926	0.933			0.923	0.945	0.961
CDC HEADS UP	0.943	0.938			0.969	0.961	0.970

Note: AIM=Acceptability of Intervention Measure, IAM=Intervention Appropriateness Measure, FIM=Feasibility of Intervention Measure, NFHS=National Federation of State High School Associations, CDC=United States Center for Disease Control and Prevention, NCAA=National Collegiate Athletic Association.

F: Significance and Chi Square Values for Research Question Two Predictor and Criterion Variables

Program	Omnibus Test p-value (LR χ^2)	Predictor p-value (Wald χ^2) Setting	Staff Ratio	Role in Selecting Education	Provide Education
Social Marketing Intervention					
AIM	.750 (5.072)	.939 (0.798)	.551 (0.355)	.252 (2.760)	.841 (0.040)
IAM	.104 (13.222)	.067 (8.792)	.892 (0.018)	.536 (1.246)	.849 (0.036)
FIM	.079 (14.090)	.039* (10.116)	.367 (0.815)	.443 (1.629)	.636 (0.224)
CrashCourse					
AIM	.004* (22.579)	.113 (7.473)	.008* (7.001)	.516 (1.322)	.344 (0.894)
IAM	.018* (18.462)	.275 (5.120)	.008* (6.949)	.508 (1.354)	.276 (1.186)
FIM	.050 (15.509)	.051 (9.428)	.274 (1.198)	.683 (0.764)	.533 (0.389)
Smart Hockey					
AIM	.882 (3.713)	.989 (0.316)	.612 (0.258)	.704 (0.703)	.217 (1.526)
IAM	.784 (4.752)	.780 (1.759)	.232 (1.431)	.886 (0.242)	.162 (1.952)
FIM	.409 (8.258)	.372 (4.259)	.066 (3.390)	.462 (1.544)	.281 (1.163)
Peer Concussion Education Program					
AIM	>.999 (0.676)	.994 (0.220)	.600 (0.275)	.971 (0.059)	.700 (0.148)
IAM	.947 (2.788)	.909 (1.002)	.231 (1.433)	.709 (0.687)	.755 (0.098)
FIM	.895 (3.548)	.969 (0.541)	.218 (1.517)	.927 (0.152)	.265 (1.244)
Concussion Awareness Training Tool					
AIM	.976 (2.142)	.838 (1.433)	.736 (0.114)	.676 (0.782)	.826 (0.048)
IAM	.989 (1.680)	.843 (1.404)	.907 (0.014)	.872 (0.273)	.886 (0.021)
FIM	.918 (3.241)	.810 (1.592)	.700 (0.149)	.761 (0.547)	.302 (1.067)
NFHS Concussion for Students					
AIM	.739 (5.172)	.541 (3.101)	.622 (0.243)	.471 (1.507)	.976 (0.001)
IAM	.649 (5.982)	.511 (3.289)	.918 (0.011)	.831 (0.369)	.862 (0.030)
FIM	.975 (2.179)	.754 (1.900)	.673 (0.178)	.978 (0.045)	.718 (0.130)
NCAA Concussion Safety					
AIM	.491 (7.428)	.677 (2.320)	.969 (0.001)	.200 (3.214)	.530 (0.395)
IAM	.799 (4.602)	.883 (1.168)	.705 (0.143)	.332 (2.205)	.632 (0.229)
FIM	.954 (2.651)	.733 (2.014)	.901 (0.015)	.823 (0.390)	.799 (0.065)
CDC HEADS UP					
AIM	.121 (12.756)	.690 (2.247)	.957 (0.003)	.090 (4.821)	.277 (1.184)
IAM	.108 (13.117)	.370 (4.274)	.693 (0.156)	.189 (3.328)	.140 (2.175)
FIM	.806 (4.532)	.860 (1.308)	.420 (0.651)	.382 (1.922)	.509 (0.436)

* p<.050

Note: LR = Likelihood Ratio, AIM=Acceptability of Intervention Measure, IAM=Intervention Appropriateness Measure, FIM=Feasibility of Intervention Measure, NFHS=National Federation of State High School Associations, CDC=United States Center for Disease Control and Prevention, NCAA=National Collegiate Athletic Association.

G: Spearman's Correlation Results for Research Question Two Survey Measures

Program	AIM v IAM	AIM v FIM	IAM v FIM
Video			
Social-Marketing Intervention (N=231)	.810*	.602*	.658*
CrashCourse (N=238)	.843*	.730*	.754*
In-person discussion			
Peer Concussion Education Program (N=212)	.868*	.665*	.739*
Smart Hockey (N=225)	.745*	.618*	.755*
Module			
Concussion Awareness Training Tool (N=227)	.874*	.711*	.798*
NFHS Concussion for students (N=227)	.862*	.640*	.656*
Fact sheet			
NCAA Concussion Safety (N=214)	.857*	.545*	.616*
CDC HEADS UP (N=232)	.854*	.540*	.612*

* p<.001

Note: AIM=Acceptability of Intervention Measure, IAM=Intervention Appropriateness Measure, FIM=Feasibility of Intervention Measure, NFHS=National Federation of State High School Associations, CDC=United States Center for Disease Control and Prevention, NCAA=National Collegiate Athletic Association.

H: Supplemental Analysis

We will perform supplementary data analysis to explore differences based on other individual and institutional characteristics. We captured the number of years participants have maintained certification and other demographic characteristics (e.g., age, sex, gender). ATs employed in non-academic settings (e.g., performing arts, armed forces) were also invited to participate in the research, but their data were not included in the results of this study.

Additional information about the interventions were collected, but those results were outside the scope of this project. The survey included questions about the degree to which each intervention might be effective in improving an athlete's knowledge or concussion care-seeking behaviors. Additionally, there are a number of interventions with multiple implementation strategies, which could be compared to determine which are most feasible. The data could also be analyzed based on delivery method rather than individual programs or based on the number of recommendations addressed in each of the interventions. These results were not reported in this project.