Going Beyond the State Law: Investigating High School Sport-Related Concussion Protocols

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Going Beyond the State Law:

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Context: State laws provide general guidelines for sport-related concussion (SRC) management, but do not comprehensively address the multiple layers of management for this complex injury. While high schools are encouraged to develop a SRC protocol that includes both state law tenets and additional management practices, the execution of this warrants examination.

Objective: To investigate state law compliance and practice components included in high school SRC protocols, and determine whether the degree of sports medicine coverage influenced protocol quality.

Design: Qualitative document analysis.

Setting: High school athletics.

Participants: In total, 184 Pennsylvania high schools [24.3% of schools statewide; full-time athletic trainer=149, part-time athletic trainer=13, missing=21] voluntarily provided copies of their protocol from the 2018-2019 academic year.

Main Outcome Measures: Four athletic trainers conducted document analyses using a 67-item component analysis guide. Frequencies were computed for included protocol components related to the state law, preparticipation and prevention, recognition and assessment, and management. The difference in the total number of included components (max 60) by sports medicine coverage was assessed using a Mann-Whitney U test.

Results: There was heterogeneity in components included in the submitted protocols. Only 23.4% included all mandatory state law tenets. Immediate removal from play was noted in 67.4% of protocols, while only 1.6% contained prevention strategies. Return-to-play was
addressed more frequently than return-to-learn (74.5% versus 32.6%). The sample had a mean of 15.5±9.7 total components per protocol. Schools with full-time sports medicine coverage had significantly more protocol components than those with part-time athletic trainers (15 [8.5-22.5] versus 6 [3-10.5] median components; $U = 377.5, p < .001$)

**Conclusions:** School-level written SRC protocols were often missing components of the state law and additional best practice recommendations. Full-time sports medicine coverage in high schools is recommended to increase SRC protocol and healthcare quality.

**Key Words:** secondary school athletics; policies and procedures; compliance; document analysis

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**Key Points:**

- The majority of high school SRC protocols were not fully compliant with all mandatory state law tenets.
- While return-to-play was commonly addressed in high school SRC protocols, return-to-learn considerations were notably absent.
- Employing athletic trainers full-time may aid in the establishment of high school SRC protocols that encompass both state law and additional best practice recommendations.
Sport-related concussion (SRC) continues to be a prominent injury in high school athletics, resulting in acute and potential long-term issues.\(^1,2\) The recent advancement in research regarding the prevention, management, recovery, and education on SRCs has led to better injury recognition, which may be one of the factors that has contributed to the increase in SRC diagnoses in the high school setting.\(^3\) Another important factor in improving SRC awareness was the development of SRC state laws, beginning with the Zachary Lystedt Law in Washington in 2009. Since then, the additional 49 states and the District of Columbia have followed suit and passed youth SRC laws of their own. While most laws have three primary tenets (education, removal from play, return to participation), they may also include additional elements, including provisions for returning to academics, educating other stakeholders, and liability concerns.\(^4\) Furthermore, the responsibility for implementation and enforcement of the laws differ across states, with some requiring oversight by the department of education and others by the state interscholastic association.\(^4\) In addition to the SRC state laws, many state interscholastic associations have established SRC policies that further guide the clinical care for high school athletes. These policies may mandate additional items such as following a return-to-play (RTP) progression, use of pre-season baseline testing, or practice contact restrictions.

Previous studies have identified variations in the content\(^5,6\) and implementation\(^7,8\) of high school policies or state laws. In one national study of high schools participating in a nationwide sports injury surveillance program, all policies included at least 2 of the 3 key SRC law tenets, with the distribution of education information sheets only being included in 59.2% of the policies.\(^5\) Similarly, a review of policy in New York State identified that no district had 100% compliance with policy elements.\(^8\) Although state laws provide general guidelines for SRC management, they typically do not include specific information to help high schools navigate the
multiple layers of this complex issue. The development of site-specific SRC protocols would take state laws a step further by acting as an emergency action plan for concussive injuries. While they are not yet widely required in high schools, the National Collegiate Athletic Association (NCAA) has begun to mandate that Division-I universities have SRC protocols. These protocols must be specific to the school and include the following key components: preseason education, pre-participation assessments, recognition and diagnosis guidelines, acute post-injury management, follow-up evaluation and care, return-to-learn (RTL) plan, stepwise RTP progression, and a plan for reducing head trauma exposure for contact sports. While the collegiate sport setting offers concise resources for SRC protocol development, guidance for the high school setting is less clear. In the high school setting, the development, implementation, and compliance with SRC protocols may ultimately fall to a singular athletic trainer. Previous literature has identified appropriate sports medicine staffing as a potential key factor for SRC management. One study concluded that the presence of a high school athletic trainer is associated with an overall increase in concussion injury rates in football, while another investigation found a 4.5-8 times higher rate of concussion diagnosis among schools with access to an athletic trainer compared to those without, suggesting improved identification of concussion. In regards to SRC protocol compliance, studies at the collegiate level have identified inconsistent findings regarding sports medicine staffing. For example, one study found that athletic training staff size was not a predictor of SRC protocol compliance among Power 5 schools, however, another large survey study noted that more than a third of respondents (coaches, administrators, clinicians) felt that increasing sports medicine staff size would improve SRC protocol implementation at their institution. Furthermore, in one state, a higher percentage of high schools with access to
 athletic trainers had greater compliance with polices regarding venue specific emergency action plans, heat illness protocols, and access to important emergency equipment, such as automated external defibrillators and cold water immersion tubs.\textsuperscript{14} Interestingly, that same study did not find the presence of an athletic trainer to be a contributing factor to the whether or not school-specific concussion guidelines were available.\textsuperscript{14} Collectively, these findings suggest that athletic trainers are an important factor for elements related to health and safety outcomes, therefore, understanding the influence of sports medicine coverage on high school SRC protocol quality is warranted.

The development and implementation of a multi-faceted SRC protocol provides an opportunity to ensure that high schools are compliant with all tenets of the SRC state law. It also allows athletic trainers and school districts to intentionally develop SRC management plans that incorporate the most current, evidence-based care approaches to improve patient outcomes following an injury. Since little is known regarding the makeup of high school SRC protocols, the purpose of this study was to first investigate state law compliance and additional practice components included in these guiding documents. Our secondary aim was to assess the influence of the level of sports medicine coverage on overall SRC protocol quality. We hypothesized that high school SRC protocols would not include all mandatory elements of the state law and lack best practice recommendations, but protocol quality would be higher for those schools with a full-time athletic trainer.

\textbf{Methods}

\textit{Study Participants and Data Collection}

We utilized a qualitative document analysis study design to investigate the components of SRC protocols from high schools in Pennsylvania during the 2018-2019 academic year. This
investigation was categorized as ‘not human subject research’ by Duquesne University, and therefore, institutional review was not warranted. The Pennsylvania Interscholastic Athletic Association (PIAA) provided us with a current list of all high schools participating in sports under their jurisdiction. We invited all PIAA high schools (n = 757) to participate in this study through an informative e-mail sent to the superintendent, high school principal, and athletic director. One round of follow-up e-mails were sent to high schools who did not respond to our initial communication approximately three-weeks later. Participation was voluntary and indicated when an electronic copy of their high school’s SRC protocol was provided to the research team. We also asked the responding representative from each high school if their athletics program had an athletic trainer (yes/no), and if yes, to indicate the level of sports medicine coverage they provided (full-time, part-time). From July 2018 to January 2019, we had a response rate of 53.4% (n = 404/757). Of those, 17.6% (n = 71) declined participation, 6.4% (n = 26) replied that they did not have a SRC protocol, 12.1% (n = 49) responded but did not include any usable information, 18.3% (n = 74) indicated that they had a SRC protocol but did not provide a copy of it to the research team, and 45.5% (n = 184) sent an electronic copy of their SRC protocol. The 184 SRC protocols assessed in this study accounted for 24.3% of all Pennsylvania high schools.

Protocol Assessment Instrument

A component analysis guide was developed to complete the artifact analyses of the included SRC protocols. The component analysis guide was informed by the Pennsylvania Safety in Youth Sport Act, the 2017 Concussion in Sport Group (CISG) international consensus statement on concussion in sport, the National Athletic Trainers’ Association position statement on the management of sport concussion, the NCAA Diagnosis and Management Best
Practices interassociation consensus document, and the NCAA Concussion Safety Protocol Checklist. The items included in the component analysis guide were also consistent with content found in additional SRC management sources, such as the National Federation of State High School Associations’ suggested guidelines for management of concussion in sport and the American Medical Society for Sports Medicine position statement on concussion in sport. The initial component analysis guide was composed by the principal investigator and reviewed and revised by two additional members of the research team (i.e., one concussion expert, one qualitative research expert). The updated version was then circulated to four external individuals to assess for face validity and comprehension. The team of external reviewers included one concussion researcher with a career in academia (TC), one clinical specialist who oversees concussion management for the athletics department and general health services at a university (BV), and two licensed athletic trainers who practice in Pennsylvania (KB, GJ). The research team considered the feedback provided by these qualified individuals and completed a second round of revisions on the assessment.

The final component analysis guide included 67 total items. The first seven items specifically assessed compliance with the Pennsylvania Safety in Youth Sport Act (Table 2). The Safety in Youth Sports Act is Pennsylvania’s SRC state law that was signed into law in 2011 and includes five mandatory tenets. The act requires high schools to make various SRC educational documents available to student-athletes and their parents/legal guardians. In return, these individuals must acknowledge receipt of information stating they reviewed the material and understand the risks of sport participation. Additionally, the most important components of the law are removal of play for any athlete showing the signs and symptoms of a SRC with no return to athletic participation written clearance is provided by an appropriate medical professional. The
state law defines an appropriate medical professional as “a licensed physician who is trained in
the evaluation and management of concussions or a licensed or certified health care professional
trained in the evaluation and management of concussions and designated by such licensed
physician.” The act also requires coaches to complete SRC training courses before each sport
season and outlines that school districts must develop and implement penalties for coaches who
do not abide by the removal and RTP state law tenets. A mandatory state law component score
(max = 5) was determined based upon the number of mandatory items included in each protocol.
The remaining 60 items were used to calculate a total component score of the number of
included items in the following areas: education, preparticipation assessment, prevention and
reducing exposure to head trauma, on-field recognition, off-field assessment, general follow-up
care, RTL, and RTP. The maximum total component score was 60 and higher scores indicated a
greater number of included protocol items. These items were further broken down into subscores
of preparticipation and prevention components (max score = 20), recognition and assessment
components (max score = 19), and management components (max score = 21).

Artifact Analysis Procedure

Four athletic trainers (CP, NH, IS, RG) independently analyzed the content of the included high school SRC protocols. At the time of protocol analysis, all assessors were
practicing in the high school setting with clinical experience ranging from 1.5 to 5 years. These
individuals were not involved in the development of the assessment instrument. Prior to
completing the document analyses, the assessors completed a 1-hour initial training session with
the principal investigator. This training was comprised of an item-by-item breakdown of the
component analysis guide that included an explanation of the intended interpretation for each
item. Following the initial training session, all assessors independently completed a practice
evaluation of the same protocol (Protocol 1). Feedback was provided to the assessors regarding
26 items that had less than 100% agreement (7 items with 50% agreement; 19 items with 75% agreement). Two additional protocols were scored by all assessors and used to determine inter-
rater reliability. Fleiss’ kappas indicated that there was good protocol analysis item agreement
between the four assessors (Protocol 2: K = .75 [95% CI: .66, .84]; Protocol 3: K = .74 [95% CI:
.65, .83]).

For document analysis, the included protocols were given a unique number code and then
randomly allocated to an assessor. Each protocol was evaluated by one assessor, and each
assessor performed artifact analyses of approximately 35-50 SRC protocols over a 60-day
period. For each included protocol, all outcome data was recorded on a deidentified component
analysis guide and submitted for data entry by the assessors. The outcome data from each
protocol was then entered into a spreadsheet by a research assistant. In addition to the artifact
analysis outcomes, the sports medicine coverage information provided by the responding high
school representative and school demographic information obtained through the PIAA [i.e.,
PIAA district (1-12), school type (private, public), total number of enrolled students] were also
recorded into the spreadsheet.

Data Analysis

Descriptive statistics were computed for demographic information of participating high
schools. Frequencies were used to describe the proportion of included SRC protocols that
included each item assessed in the component analysis guide. Means and standard deviations for
the entire sample were calculated for the mandatory state law component score, total component
score, preparticipation and prevention subscore, recognition and assessment subscore, and
management subscore. The mean total component score was also broken down by PIAA district.
Additionally, Mann-Whitney U tests were conducted to investigate differences in scores (median [interquartile range]) for full-time versus part-time sports medicine coverage for the mandatory state law component score, total component score, preparticipation and prevention subscore, recognition and assessment subscore, and management subscore. While kurtosis and skewness values for the component score variables were within normal limits, the data did not appear to be normally distributed when histograms were constructed for each component score by sports medicine coverage group. Therefore, non-parametric statistical approaches were employed. Statistical significance was set aprior at $p < .05$. All analyses were completed using IBM SPSS (version 26).

**Results**

**Sample Demographics**

Of the 184 high schools that submitted protocols for inclusion in this study, 87.5% ($n = 161$) were public and 12.5% ($n = 23$) were private. The sample had a median (IQR) student population of 526 (690). The PIAA Districts with the most included schools were 3 (20.7%, $n = 38$), 1 (16.8%, $n = 31$), and 7 (13.0%, $n = 24$). PIAA Districts 8 (1.1%, $n = 2$), IX (2.7%, $n = 5$), 2 (2.7%, $n = 5$), and 9 (2.7%, $n = 5$) were the least represented (Figure 1). The vast majority of included high schools reported that they had an athletic trainer (99.4%, $n = 178/179$ responses) and, of those, 92.0% ($n = 149/162$; missing, $n = 16$) indicated they had full-time sports medicine coverage. High school demographic information by study response category can be found in Table 1. Although the 26 high schools who responded that they did not have a SRC protocol were not included in any analyses, it is pertinent to note that 19.2% ($n = 5$) of those schools did not have an athletic trainer, 34.6% ($n = 9$) reported having a part-time athletic trainer, and 38.5% ($n = 10$) are in PIAA Districts 5 and 6.
Only 41.3% (n = 76) of SRC protocols directly mentioned or referenced the Pennsylvania state law (Table 2). Moreover, 23.4% (n = 43) were considered fully compliant with the state law. The most commonly included state law item was written medical clearance prior to RTP (71.7%, n = 132) and the least common inclusion was the penalties for coaches in violation of the removal and RTP guidelines (25.0%, n = 46). The mean number of mandatory state law items included in the protocol sample was 2.5 ± 1.8 (50.6% of 5 possible). Additionally, there was an average of 15.6 ± 9.8 (26.0% of 60 possible) total components for the SRC protocol sample. Figure 1 presents the total mandatory state law component score and total component score by PIAA district. Furthermore, the subscore results were as follows: 4.2 ± 3.6 (21.0% of 20 possible) preparticipation and prevention components, 5.0 ± 4.1 (26.3% of 19 possible) recognition and assessment components, and 6.4 ± 4.3 (30.5% of 21 possible) management components. See Tables 2-5 for a complete frequency itemization of all individual components.

There was a significant difference in the median number of mandatory state law components in SRC protocols between high schools that had full-time (3 [1-5]) versus part-time athletic trainers (0 [0-4.5]; 5 possible; U = 647.5, p = .044). When considering the broader components, schools with full-time sports medicine coverage had significantly more preparticipation and prevention (full-time = 5 [1-7] versus part-time = 0 [0-4.5]; 20 possible; U = 590.0, p = .018), recognition and assessment (full-time = 5 [2-8] versus part-time = 0 [0-3]; 19 possible; U = 416.0, p < .001), follow-up management (full-time = 6 [3-10] versus part-time = 3 [2-4]; 21 possible; U = 493.0, p = .003), and total components (full-time = 15 [8.5-22.5] versus...
Discussion

The primary findings from this study suggest that school-level written SRC protocols are often missing state law components and additional emerging best practice recommendations. The issue of inadequate level of compliance with state laws and best practice recommendations in high schools is not unique to SRC and may be a more systemic issue as similar findings have been reported for state physical education mandates and heat acclimatization guidelines for high school football athletes. The results of this study further highlight the slow-pace of clinical practice evolution that contrasts the high rate of sports medicine literature being produced annually, which researchers have also cited as an issue in the collegiate setting regarding a lack of fully developed multimodal SRC assessment and management approaches and RTL strategies. Additionally, this study provides more evidence that having access to a full-time high school athletic trainer may be essential to elevating care standards through the development of high-quality SRC protocols.

Pennsylvania Safety in Youth Sport Act

Regarding the mandatory state law components, the majority of high school SRC protocols highlighted the importance of immediate removal from play and the need for written medical clearance before RTP. Additionally, Pennsylvania law requires SRC education for student-athletes, parents, and coaches, but this element was lacking in more than 50% of protocols. The state law also directs governing bodies to establish penalties for coaches who violate the state law and is a key aspect of enforcement and coach accountability, yet only 25% of SRC protocols included language regarding violation repercussions. In total, approximately...
one-fourth of protocols included all mandatory components of the state law. This indicates that local-level policies may not be written to the rigor necessary to ensure athlete safety as state laws intended. In a similar study investigating protocols from 71 nationally representative high schools, researchers reported that a high percentage of SRC protocols complied with the immediate removal from play, RTP medical clearance, and SRC education tenets of state laws.5,20 The proportions of inclusion of the three main state law components from the SRC protocols examined in that study were approximately 20-35% higher than those observed in our Pennsylvania-specific sample. This significant variation in findings highlights the importance of considering SRC law implementation from both the state and national perspective. Information gleaned from SRC law implementation from a national sample can help inform a universal minimum standard of care, while a more local assessment enables state lawmakers, interscholastic athletic associations, and school districts to assess their unique strengths and needs in order to develop effective SRC awareness initiatives and increase the quality of injury management in their respective geographical region based upon the resources available.

It is pertinent to note that the introduction of SRC state laws in the United States has had a positive effect on managing this public health concern. From 2008 to 2012, there was a significant 92% increase in healthcare utilization for concussion-related injuries in children within states that had legislation in place.21 In Ohio, patients with a concussion sought care approximately five days sooner and recovered 14 days quicker on average following the adoption of a pediatric SRC law in 2013.22 Additionally, a study by LaRoche et al.23 found that high school and college athletes in Wisconsin were significantly more likely to report SRCs following the introduction of the state’s SRC law and more than half of athletes in the sample directly cited the state law as a motivating factor for SRC disclosure. A study examining SRC
trends from 2005-2016 also noted that the introduction of SRC state laws and the associated increased publicity may have also influenced increased reporting of new and recurrent SRC prior to and for an extended period following law adoption. The study outcomes described above clearly show the impact of these laws, so while the novelty of SRC state laws may have faded overtime the importance of their purpose has not. Highlighting the key components of these legislations in SRC protocols and awareness initiatives should remain a focal point to continue promoting immediate injury identification and safe RTP processes.

Sport-Related Concussion Preparticipation and Prevention Considerations

Given the cumulative nature and potential short and long-term issues associated with concussion, documentation of previous head injuries during preparticipation exams is imperative. Despite this, less than 13% of SRC protocols outlined the documentation of previous SRC history and concussion-related health conditions (e.g., migraines, mental health disorders). Going beyond the medical history, baseline neurocognitive and symptom assessments were present in ~38-50% of included protocols with balance and oculomotor exams being far less common. Ultimately, a preparticipation SRC assessment may aid in the identification of athletes that need further SRC care, education, and/or individualized behavioral sport adaptation interventions.

We found that a little over 40% of SRC protocols included annual education. The most commonly cited modes of SRC education were information sheets and/or in-person lectures. Additionally, 70% of SRC protocols did not require signed acknowledgement of SRC education. Given that an acknowledgement of receipt requirement is outlined in the state law, this is one component that may warrant more immediate attention. While a handout or online course may be cost effective and fulfill state law and athletic association requirements, these options may not be
as effective as in-person training sessions for coaches and parents of athletes.\textsuperscript{25} Educational strategies that go beyond passive information including face-to-face interactive lectures, peer-to-peer instruction, or active learning games should be considered.\textsuperscript{26-28}

There is speculation that an increased understanding of SRC consequences may lead athletes to adopt safer styles of play, but there are no investigations that support education alone as a primary prevention strategy for SRCs.\textsuperscript{4} Due to the lack of evidence-based SRC prevention interventions available at this time, it is not surprising that only three protocols in our study addressed this facet of SRC care. As high schools seek to add prevention strategies into their SRC protocols, there are a number of factors to consider, including that a multi-faceted approach may be more beneficial than solely focusing on protective equipment.\textsuperscript{29} There is growing evidence in support of behavioral tackling/blocking interventions for reducing head impact frequency in football,\textsuperscript{30,31} as well as the adoption of full-contact practice limitation rules.\textsuperscript{32,33}

Another recent prevention strategy is the restriction, penalization, and/or elimination of high-concussion risk sporting maneuvers, such as heading in youth soccer\textsuperscript{34} and checking in peewee ice hockey.\textsuperscript{35} Given the complexity of this issue and lack of available evidence, high school administrators should partner with their athletic trainer and/or local sports medicine healthcare providers to determine which prevention strategies are most appropriate to include in their protocols for their athlete population.

\textit{Sport-Related Concussion Recognition and Assessment}

The use of a multimodal assessment for SRC recognition was outlined in less than half of the submitted SRC protocols. While not part of the state law requirements, this is an area of concern as the use of multiple assessments focused on different areas of potential dysfunction may more accurately identify individuals with a SRC.\textsuperscript{1} Nonetheless, while these results indicate
areas for improvement in protocol design, they do not speak to the actual actions being
performed within real-life injury scenarios. For example, even though a written SRC protocol is
established, it may not accurately reflect the level of implementation occurring within the
system. Additional SRC recognition and assessment strategies may be used that are not directly
outlined in their written protocol. Overall, these findings highlight the need for potential annual
analysis and consistent improvement of SRC protocols to ensure they reflect current practice
recommendations.

*Sport-Related Concussion Follow-up Management*

With respect to the follow-up management areas of the reviewed protocols, better
compliance was noted with these elements. Nearly three-fourths of protocols including a graded
RTP progression. These findings are similar to those reported in New York State where between
78% of schools in Westchester County and 90% of big city school districts included SRC
management procedures in their written policies. Similarly, two additional studies found that
98.6% of reviewed policies included the RTP tenet, and between 74.6-98.6% of schools had
specific items that were considered equal to or stronger than the language used in their respective
state law. These higher compliance rates with the RTP items are not surprising since the focus
of many state laws has been to avoid premature RTP. However, analysis of additional practice
recommendation items identified several areas of lower compliance primarily related to the
inclusion of follow-up vestibular or oculomotor assessments and the inclusion of RTL
procedures. Less than 10% of reviewed protocols included mention of oculomotor or vestibular
assessments, compared to over 50% including neurocognitive assessments. The emphasis on
neurocognitive assessments in Pennsylvania is to be expected, since one of the most commonly
used computerized neurocognitive test platforms was developed in state. Interestingly, as the
emphasis on neurocognitive assessment has decreased in recent years,\textsuperscript{1,36} the evidence regarding oculomotor and vestibular deficits has increased.\textsuperscript{37-39} It is likely that this newer evidence has not necessarily translated into routine clinical practice nor made its way into written SRC protocols at this point in time.

This may also be the case with respect to returning athletes to the classroom as only one-third of protocols included a statement that academic adjustments may be required. This is contrary to suggestions that some level of academic support should be applied in all cases of concussion\textsuperscript{40} and surprising as Pennsylvania is one of the few states with a state-wide program, BrainSTEPS, to assist schools in returning students with acquired brain injuries to the classroom.\textsuperscript{41} As more literature emerges, it becomes clearer that academic support should be a keystone element of SRC management for athletes who are also students. A recent study by Holmes et al.\textsuperscript{42} found that approximately 84.5\% of college athletes and 68.6\% of high school athletes reported difficulty concentrating in an academic setting after sustaining a SRC. Furthermore, greater than 50\% of both college and high school athletes reported headaches, feeling slow down, and increased sensitivity to light while in the classroom and difficulties were noted with math, reading, writing, paying attention, and engaging with digital interfaces.\textsuperscript{42} The vast majority of high school athletes will not go on to pursue professional sports careers, therefore, returning to academics should be the highest priority at the high school level. While not all athletes will encounter academic challenges following a SRC, the establishment of a school-level RTL approach could help to identify those that need support and help alleviate the potential negative repercussions that can accompany premature RTL. Due to the lack of RTL approaches in the included SRC protocols, it is recommended that high school athletic trainers...
collaborate with school psychologists, counselors, nurses, and physicians to develop a plan that meets the academic needs of the student population they serve.

*Sports Medicine Coverage*

A risk reduction strategy to mitigate the mismanagement of injuries and potentially catastrophic events related to sport participation is to employ a full-time athletic trainer to provide on-site sports medicine services during practices and competitions. Athletic trainers play a vital role in SRC management as they are often present from the time of injury through the RTP process. Athletic trainers are also typically tasked with the organization and review of preparticipation examination information for athletes, as well as coordinating and documenting SRC education efforts. We were pleased that around 81% of our sample reported that they provided full-time athletic training services to their student-athletes, which was greater than the total state-wide 67% outlined in the ATLAS study for the 2018-2019 academic year. SRC protocols from high schools that reported full-time sports medicine coverage included more mandatory state law tenets and had over two times the total number of components as schools that employed part-time athletic trainers. Additionally, high schools with full-time athletic trainers included significantly more items for all sub-categories of SRC protocols assessed in this study. This is encouraging given that previous literature has suggested that schools with stronger and more comprehensive wellness policies have greater success with implementation.\(^\text{43}\) While our findings do not represent the actual standard of SRC care provided at the participating high schools, well-developed policies and procedures provide a solid foundation to guide appropriate evidence-based clinical practices. If present daily, athletic trainers can integrate themselves into the school community, survey the unique needs of their athletic population, seek out the resources available to them, identify barriers that inhibit healthcare implementation and
compliance, and ultimately aid in the development of high-quality policies and procedures geared towards preserving the health and wellbeing of their patients.

When considering those responding high schools that indicated they did not have an established SRC protocol, approximately 50% reported that they also did not have an athletic trainer or only provided part-time coverage. These findings highlight the critical role that athletic trainers may play in the establishment, development, and implementation of sports medicine policies and procedures in high schools. This relationship has been observed in a previous study of Oregon high schools which concluded that having an athletic trainer was significantly associated with greater implementation of sport-related emergency preparedness recommendations compared to those without an athletic trainer. Additionally, the positive influence of having frequent access to an athletic trainer was also documented in relation to SRC identification and management, as one study found that schools with high athletic trainer availability had a greater incidence of reported SRCs, significantly quicker initial assessment times, longer recovery periods, and a higher likelihood of using a RTP protocol compared to those with low athletic trainer availability. These findings suggest that having full-time access to an athletic trainer may lead to better SRC recognition, quicker care initiation, and more rigorous management approaches.

Protocol Implementation and Barriers

While having a written policy is an important element of compliance with state law and best practice recommendations, simply having an SRC protocol does not equate to implementation of the elements within that written document. The differentiation between having an established protocol and actually implementing that protocol into clinical practice is an important consideration, with implementation being the more important piece in ensuring athlete
safety and providing quality healthcare. The primary goal of this study was to evaluate the presence of elements of the Pennsylvania state law and SRC awareness and management practice recommendations, but the methodology did not allow us to determine whether these policies were being implemented or if contributing high schools were using additional practices that were not outlined in their written policies. While there are several studies of SRC protocol compliance,\textsuperscript{5,8,20} literature regarding implementation in areas of sports safety, including SRC, are limited.\textsuperscript{20,46} Sullivan et al.\textsuperscript{20} assessed the degree of compliance with state laws and the relationship between policy compliance and implementation. It was noted that most written school-level SRC protocols complied with state law components, but self-reported implementation of policy items “well” or “very well” was not ideal, with only 46.2\% of schools ensuring that the healthcare provider granting RTP clearance was trained in SRC management.\textsuperscript{20} Additionally, a qualitative study by Davies et al.\textsuperscript{46} found that immediate evaluation, notification of key individuals, communication among personnel, and reliance on an athletic trainer’s assessment were all important strategies used to implement SRC laws in the high school setting.

To make improvements, the barriers that inhibit policy implementation should be considered. High school officials (i.e., athletic directors, athletic trainers) identified that tenets of the SRC state laws that required greater resources or were outside of the control of the school district, such as the healthcare provider to which athletes visited for clearance, were less likely to be implemented.\textsuperscript{20} This finding is similar to work done with other safety policies, such as emergency action plans, where athletic trainers and athletic directors noted financial barriers in successful implementation of policy.\textsuperscript{47} Additionally, the following items were identified by Coxe et al.\textsuperscript{48} as the most common barriers that inhibit the implementation of the three primary SRC state law tenets (i.e., education, removal from play, safe RTP) from a sample of 64 high schools.
from across the United States: lack of quality SRC education, lack of buy-in to complete educational requirements, lack of time for educational meetings, lack of communication, resistance from parents and coaches, “old school” sport culture mentality, cost of and access to healthcare, and a general lack of SRC understanding. Moving forward, it is recommended that school personnel work together to identify and overcome site-specific barriers in order to improve sports medicine policy implementation. This collaborative effort should include the development of a SRC management team, which could include the athletic trainer, physicians, athletic director, school nurse, school psychologist, school administrators, etc.

In order for policies and procedures to have an impact on patient safety and injury recovery outcomes, they must be enforced. While implementation is the act of putting a plan into action, enforcement is needed to ensure that the proposed plan is carried out effectively as designed. It is clear from the results that there may be limited policing of the SRC state laws within Pennsylvania high schools. At a minimum, efforts to improve compliance with the state law should be developed to ensure appropriate polices are implemented and enforced appropriately and consistently across the state. Presently, the responsibility for the development of SRC protocols, implementation of the state law components, and enforcement falls to individual school districts to manage. More support from and oversight by centralized entities, such as secondary school athletic associations and/or boards of medicine for example, could enhance the SRC care provided to adolescent athletes state-wide.

Limitations and Future Research

Although this study included the largest sample of high school SRC protocols to date, there are several limitations to consider. First, this investigation was specific to the state of Pennsylvania, and results are not generalizable to all high schools nationally. Also, we did not...
provide a definition for part-time versus full-time sports medicine coverage, therefore, responses were self-defined by the respondents. It is also plausible that schools who responded to our participation request may have had a greater presence of athletic trainer(s) and/or more complete policies at their schools than those who did not respond or participate. This should be considered when interpreting the generalizability of the study results. Furthermore, the results only represent components included in written SRC protocols. The omission of specific language of the state law within a protocol may not necessarily be an oversight, but rather a deliberate decision to decrease redundancy with what is already available in legal public documents. Additional SRC awareness and management strategies that are not included in the written protocol may be done at high schools, therefore, the results of this study should not be interpreted to represent policies implementation. It is also worth noting that the component analysis guide should not be considered an exhaustive list of best practices or gold standards for SRC management. They may be considered practice recommendations, but the true purpose of this document was to extract information for data collection purposes. Additionally, while the interrater reliability was sufficient for this study, more extensive assessor training exercises may have enhanced scoring proficiency. Future research should adopt a mixed methods approach to investigate the congruency between written protocols and clinical practice approaches that are actually being implemented. This study only captures information relative to the 2018-2019 academic year, and the evaluation of SRC protocols should be conducted regularly as practice recommendations continue to develop based upon available research evidence.

Conclusion

To the best of our knowledge, this was the first study to conduct a comprehensive assessment of high school SRC protocols that went beyond state law constructs and investigated
the degree of sports medicine coverage as an influencing factor on protocol quality. Establishing and adhering to a document that outlines the available SRC resources and post-injury management guidelines may not only increase the efficiency and quality of healthcare provided to student-athletes, but may also play a role in protecting high schools, state athletic associations, and healthcare providers from litigation. These efforts at the individual school-level may be enhanced by the presence of a full-time athletic trainer. When evaluating SRC protocols, it is important to understand the types that exist and the layered nature of these policies. For example, some laws include very specific language regarding SRC management practices, whereas others delineate a specific entity to develop state level policies for schools to follow. In addition to the state laws, state athletic associations may have policies that include elements above what is written in the state law. Further, sport governing bodies may have additional sport-specific policies, such as practice contact restrictions, that fit within the context of SRC policy. At the local level, an individual school may have a detailed policy that provides guidance specific to SRCs occurring during sponsored events. Ideally each level of policy contains the specifics from the higher levels so that a school-level policy outlines any required elements from the state law and interscholastic association policy. Although just one piece of the healthcare puzzle, high quality SRC protocols have the potential to protect both the health and wellbeing of high school student-athletes, which must remain of the upmost priority moving forward.
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Table 1. High School Characteristics by Study Response Category

| Characteristic                        | Responding high schools that provided protocol documents (n = 184) | Responding high schools that indicated they had a protocol but provided no documents (n = 74) | Responding high schools that did not have a protocol (n = 26) | Responding high schools that did not provide any usable information (n = 49) | Responding high schools that declined participation (n = 71) | Non-responding high schools (n = 353) |
|--------------------------------------|-----------------------------------------------------------------|------------------------------------------------------------------------------------------|-----------------------------------------------------------------|------------------------------------------------------------------|------------------------------------------------------------------|--------------------------------------|
| Total Student Enrollment             | Median (IQR)                                                    | 526 (690)                                                                                 | 469 (661)                                                      | 209 (278)                                                       | 372 (505)                                                        | 411 (455)                            | 374 (457)                            |
| School Type                          | % (n)                                                          | 87.5 (161)                                                                                 | 85.1 (63)                                                     | 65.4 (17)                                                      | 71.4 (35)                                                        | 84.5 (60)                            | 72.2 (255)                           |
|                                      | Public                                                         | 8.5 (2)                                                                                    | 14.9 (11)                                                    | 34.6 (9)                                                       | 28.6 (14)                                                        | 15.5 (11)                            | 27.8 (98)                            |
|                                      | Private                                                        | 12.5 (23)                                                                                  | 10.8 (5)                                                     | 34.6 (9)                                                       | 71.4 (35)                                                        | 84.5 (60)                            | 72.2 (255)                           |
| PIAA District                        | % (n)                                                          | 16.8 (31)                                                                                  | 10.8 (8)                                                     | 7.7 (2)                                                        | 8.2 (4)                                                          | 7.0 (5)                              | 12.5 (44)                            |
|                                      | 1                                                              | 2.7 (5)                                                                                    | 6.8 (5)                                                     | -                                                              | -                                                               | -                                    | 7.6 (27)                             |
|                                      | 2                                                              | 20.7 (38)                                                                                  | 21.6 (16)                                                   | 11.5 (3)                                                      | 26.5 (13)                                                        | 8.5 (6)                              | 13.0 (46)                            |
|                                      | 3                                                              | 4.9 (9)                                                                                    | 10.8 (8)                                                     | -                                                              | -                                                               | -                                    | 7.6 (27)                             |
|                                      | 4                                                              | 4.9 (9)                                                                                    | 2.7 (2)                                                     | 15.4 (4)                                                      | 2.0 (1)                                                          | -                                    | 2.3 (8)                              |
|                                      | 5                                                              | 8.2 (15)                                                                                  | 12.2 (9)                                                    | 23.1 (6)                                                      | -                                                               | -                                    | 5.9 (21)                             |
|                                      | 6                                                              | 13.0 (24)                                                                                  | 24.3 (18)                                                   | 11.5 (3)                                                      | 26.5 (13)                                                        | 5.6 (4)                              | 21.2 (75)                            |
|                                      | 7                                                              | 1.1 (2)                                                                                    | -                                                           | -                                                              | -                                                               | 2.8 (2)                              | 0.6 (2)                              |
|                                      | 8                                                              | 2.7 (5)                                                                                    | 5.4 (4)                                                     | 7.7 (2)                                                       | 6.1 (3)                                                          | -                                    | 6.5 (23)                             |
|                                      | 9                                                              | 11.4 (21)                                                                                  | 1.4 (1)                                                     | 11.5 (3)                                                      | 8.2 (4)                                                          | 1.4 (1)                              | 5.1 (18)                             |
|                                      | 10                                                             | 10.3 (19)                                                                                  | 1.4 (1)                                                     | 3.8 (1)                                                       | 12.2 (6)                                                         | -                                    | 8.2 (29)                             |
|                                      | 11                                                             | 3.3 (6)                                                                                    | 2.7 (2)                                                     | 7.7 (2)                                                       | 2.0 (1)                                                          | 74.6 (53)                            | 9.3 (33)                             |
| Sports Medicine Coverage             | % (n)                                                          | 96.7 (178)                                                                                 | 98.6 (73)                                                   | 80.8 (21)                                                      | 95.9 (47)                                                        | 1.4 (1)                              | 74.8 (264)                           |
|                                      | Yes                                                            | 83.7 (149)                                                                                 | 68.5 (50)                                                   | 42.9 (9)                                                      | 34.0 (16)                                                        | 1.4 (1)                              | 76.1 (201)                           |
|                                      | Full-time                                                      | 7.3 (13)                                                                                   | 9.6 (7)                                                     | 42.9 (9)                                                      | 8.5 (4)                                                          | -                                    | 23.5 (62)                            |
|                                      | Part-time                                                     | 9.0 (16)                                                                                    | 21.9 (16)                                                   | 14.2 (3)                                                      | 57.4 (27)                                                        | -                                    | 0.3 (1)                              |
|                                      | Missing                                                       | 0.5 (1)                                                                                    | 1.4 (1)                                                     | 19.2 (5)                                                      | 2.0 (1)                                                          | -                                    | 10.5 (37)                            |
|                                      | No                                                             | 2.7 (5)                                                                                    | -                                                           | -                                                              | 2.0 (1)                                                          | 98.6 (70)                            | 14.7 (52)                            |

a Percentage of high schools that responded ‘yes’ when asked if they had an athletic trainer.
b Sports medicine coverage frequency data for responding high schools is comprised of information reported by responding administrators. Frequency data for non-responding high schools was acquired via the Korey Stringer Institute ATLAS Survey.
Table 2. Frequency of Safety in Youth Sport Act Components in Pennsylvania High School Sport-Related Concussion Protocols from 2018-2019

| Section component                                      | Included in protocol |          |          |
|--------------------------------------------------------|----------------------|----------|----------|
|                                                        | All included protocols (n = 184) | High schools with full-time athletic trainers (n = 149) | High schools with part-time athletic trainers (n = 13) |
| Direct reference to the Pennsylvania Safety in Youth Sport Act | 41.3 (76)            | 45.6 (68)          | 23.1 (3)          |
| **Mandatory components**                               |                      |          |          |
| Concussion education for athletes and parents/legal guardians | 44.6 (82)            | 47.7 (71)          | 30.8 (4)          |
| Removal from play if a concussion is suspected         | 71.2 (131)           | 75.8 (113)         | 38.5 (5)          |
| No return to play until medical written clearance is obtained | 71.7 (132)           | 75.8 (113)         | 38.5 (5)          |
| Completion of a concussion management certification training course by coaches | 41.2 (74)            | 44.3 (66)          | 30.8 (4)          |
| Penalties for coaches in violation of removal and return to play guidelines | 25.0 (46)            | 27.5 (41)          | 23.1 (3)          |
| **Recommended component**                             |                      |          |          |
| Concussion informational meeting prior to the start of each athletic season | 31.5 (58)            | 32.2 (48)          | 23.1 (3)          |
### Table 3. Frequency of Preparticipation and Prevention Components in Pennsylvania High School Sport-Related Concussion Protocols from 2018-2019

| Section component | Included in protocol |  |
|-------------------|---------------------|---|
|                   | All included protocols (n = 184) | High schools with full-time athletic trainers (n = 149) | High schools with part-time athletic trainers (n = 13) |
| **General injury risk awareness and acknowledgement** | | | |
| Parents/legal guardians are informed of injury risk | 21.2 (39) | 22.8 (34) | 7.7 (1) |
| Parents/legal guardians sign assumption of risk form prior to athletic participation | 16.3 (30) | 18.1 (27) | 7.7 (1) |
| **Education** | | | |
| Concussion education | 41.8 (77) | 44.3 (66) | 30.8 (4) |
| Concussion education completed once annually | 36.4 (67) | 38.9 (58) | 23.1 (3) |
| Concussion education occurs prior to athletic activity engagement | 29.9 (55) | 32.2 (48) | 15.4 (2) |
| Delivery method of concussion education | 37.5 (69) | 38.9 (58) | 23.1 (3) |
| - Paper or e-mail information sheet | 26.1 (48) | 27.5 (41) | 15.4 (2) |
| - In-person lecture | 26.6 (49) | 26.8 (40) | 15.4 (2) |
| - Online education program | 9.8 (18) | 11.4 (17) | 0.0 (0) |
| List of individuals to receive concussion education | 38.0 (70) | 40.9 (61) | 23.1 (3) |
| - Athletes | 31.5 (58) | 34.2 (51) | 15.4 (2) |
| - Parents/legal guardians | 27.2 (50) | 30.2 (45) | 15.4 (2) |
| - Coaches | 35.3 (65) | 38.9 (58) | 23.1 (3) |
| Signed acknowledgement of concussion education by athletes and parents/legal guardians | 27.2 (50) | 30.9 (46) | 15.4 (2) |
| **Preparticipation assessment** | | | |
| Documentation of previous history of concussion, head, or brain injury | 13.0 (24) | 14.8 (22) | 7.7 (1) |
| Documentation of concussion-related medical history (e.g., migraines) | 12.0 (22) | 13.4 (20) | 7.7 (1) |
| Baseline symptom assessment | 37.5 (69) | 40.3 (60) | 15.4 (2) |
| Baseline neurocognitive assessment | 50.5 (93) | 52.3 (78) | 23.1 (3) |
| Review of baseline neurocognitive test validity | 7.6 (14) | 6.7 (10) | 0.0 (0) |
| Baseline vestibular assessment | 7.1 (13) | 8.1 (12) | 0.0 (0) |
| Baseline oculomotor assessment | 2.7 (5) | 3.4 (5) | 0.0 (0) |
| Frequency of baseline assessments | 35.3 (65) | 38.3 (57) | 15.4 (2) |
| - Every year | 8.7 (16) | 9.4 (14) | 0.0 (0) |
| - Every other year | 23.4 (43) | 24.8 (37) | 15.4 (2) |
| Information regarding collection of new baseline following a diagnosed concussion | 3.8 (7) | 3.4 (5) | 0.0 (0) |
**Prevention and reducing exposure to head trauma**

| Preventive Measures                                                                 | 1.6 (3) | 2.0 (3) | 0.0 (0) |
|-------------------------------------------------------------------------------------|---------|---------|---------|
| Coaches are trained in safe sporting techniques                                       |         |         |         |
| Contact practices are limited to a specific number of days per week                  | 0.0 (0) | 0.0 (0) | 0.0 (0) |
| Practice drills that include the potential for head impacts are limited and/or avoided | 0.0 (0) | 0.0 (0) | 0.0 (0) |
**Table 4. Frequency of Recognition and Assessment Components in Pennsylvania High School Sport-Related Concussion Protocols from 2018-2019**

| Section component                                                                 | Included in protocol | All protocols (n = 184) | High schools with full-time athletic trainers (n = 149) | High schools with part-time athletic trainers (n = 13) |
|-----------------------------------------------------------------------------------|----------------------|-------------------------|----------------------------------------------------------|--------------------------------------------------------|
| **On-field recognition**[^a]                                                       |                      |                         |                                                          |                                                         |
| Immediate removal from play if concussion suspected                                |                      | 67.4 (124)              | 71.1 (106)                                               | 38.5 (5)                                                |
| No same day return-to-play                                                        |                      | 65.2 (120)              | 69.1 (103)                                               | 38.5 (5)                                                |
| Referred to medical professional with concussion management experience             |                      | 66.3 (122)              | 69.8 (104)                                               | 30.8 (4)                                                |
| Rule out cervical spine injury                                                    |                      | 19.6 (36)               | 21.5 (32)                                                | 7.7 (1)                                                 |
| Rule out more serious brain injury                                                |                      | 23.9 (44)               | 26.2 (39)                                                | 7.7 (1)                                                 |
| Basic neurological exam is completed                                               |                      | 16.3 (30)               | 18.1 (27)                                                | 7.7 (1)                                                 |
| Description of emergency referral signs and symptoms                              |                      | 32.1 (59)               | 35.6 (53)                                                | 7.7 (1)                                                 |
| List of emergency referral locations                                              |                      | 1.6 (3)                 | 2.0 (3)                                                  | 0.0 (0)                                                 |
| Copy of or reference to a venue specific emergency action plan(s)                 |                      | 2.2 (4)                 | 2.7 (4)                                                  | 0.0 (0)                                                 |
| **Off-field assessment**[^b]                                                       |                      |                         |                                                          |                                                         |
| Off-field clinical evaluation                                                     |                      | 31.0 (57)               | 34.9 (52)                                                | 7.7 (1)                                                 |
| Location of off-field exam                                                        |                      | 8.7 (16)                | 9.4 (14)                                                 | 0.0 (0)                                                 |
| Post-injury assessment occurs in similar environment to baseline                  |                      | 0.5 (1)                 | 0.7 (1)                                                  | 0.0 (0)                                                 |
| Post-injury symptom assessment                                                    |                      | 32.1 (59)               | 34.2 (51)                                                | 0.0 (0)                                                 |
| Post-injury neurocognitive assessment                                             |                      | 25.5 (47)               | 26.1 (39)                                                | 0.0 (0)                                                 |
| Post-injury vestibular assessment                                                 |                      | 10.9 (20)               | 12.8 (19)                                                | 0.0 (0)                                                 |
| Post-injury oculomotor assessment                                                 |                      | 6.0 (11)                | 6.7 (10)                                                 | 0.0 (0)                                                 |
| Frequent monitoring during acute injury phase                                      |                      | 22.3 (41)               | 22.1 (33)                                                | 7.7 (1)                                                 |
| Home care instructions given to parents/legal guardians                           |                      | 26.1 (48)               | 28.2 (42)                                                | 0.0 (0)                                                 |
| - Oral (in-person or phone)                                                       |                      | 13.0 (24)               | 15.4 (23)                                                | 0.0 (0)                                                 |
| - Written                                                                        |                      | 17.4 (32)               | 18.8 (28)                                                | 0.0 (0)                                                 |
| - Signed acknowledgement by parents/legal guardians that instructions were received|                      | 1.6 (3)                 | 2.0 (3)                                                  | 0.0 (0)                                                 |
| - Instructions designate follow-up appointment                                     |                      | 2.7 (5)                 | 3.4 (5)                                                  | 0.0 (0)                                                 |
| Referral to physicians or neuropsychologist                                       |                      | 45.1 (83)               | 49.0 (73)                                                | 7.7 (1)                                                 |

[^a] These components refer to the immediate actions that are taken for removal from activity and the determination of emergency referral, which may occur on the field or on the sideline.

[^b] These components refer to the additional actions taken by the medical staff on the same day as the injury once the need for emergency referral is ruled out. These actions may occur on the sideline, in the athletic training facility, or in an office.
Table 5. Frequency of Follow-up Management Components in Pennsylvania High School Sport-Related Concussion Protocols from 2018-2019

| Section componenta | Included in protocol % (n) | All included protocols (n = 184) | High schools with full-time athletic trainers (n = 149) | High schools with part-time athletic trainers (n = 13) |
|--------------------|-----------------------------|---------------------------------|-----------------------------------------------------|-----------------------------------------------------|
| General            |                             |                                 |                                                     |                                                     |
| Serial follow-up with the athlete with a concussion | 40.2 (74) | 43.8 (64) | 16.7 (2) |
| Follow-up assessments completed in environment similar to baseline | 2.7 (5) | 3.4 (5) | 0.0 (0) |
| Follow-up symptom assessments | 47.8 (88) | 51.4 (75) | 16.7 (2) |
| Follow-up neurocognitive assessments | 50.5 (93) | 54.1 (79) | 16.7 (2) |
| Follow-up vestibular assessments | 8.2 (15) | 10.3 (15) | 0.0 (0) |
| Follow-up oculomotor assessments | 4.9 (9) | 6.2 (9) | 0.0 (0) |
| Signed documentation of clearance for return-to-play by physician/neuropsychologist | 60.9 (112) | 64.4 (94) | 16.7 (2) |
| Delineation of the concussion management team | 13.6 (25) | 13.0 (19) | 0.0 (0) |
| Return-to-learn |                             |                                 |                                                     |                                                     |
| Initial 24-hour period of cognitive rest | 22.8 (42) | 24.0 (35) | 16.7 (2) |
| Academic adjustments may be required | 32.6 (60) | 31.5 (46) | 25.0 (3) |
| Information provided to parents/legal guardians about potential academic accommodations | 16.3 (30) | 17.1 (25) | 0.0 (0) |
| Referral to the school’s academic accommodations point person | 14.7 (27) | 13.7 (20) | 0.0 (0) |
| Return-to-learn progression | 4.9 (9) | 4.1 (6) | 0.0 (0) |
| Adjustments and accommodations are on a case-by-case basis | 18.5 (34) | 17.8 (26) | 8.3 (1) |
| Concussion management team is trained in the BrainSTEPS program | 8.7 (16) | 10.3 (15) | 0.0 (0) |
| Return-to-play |                             |                                 |                                                     |                                                     |
| Initial 24-48 hours of physical rest | 30.4 (56) | 32.9 (48) | 25.0 (3) |
| Return-to-play progression | 74.5 (137) | 78.8 (115) | 66.7 (8) |
| Examples of appropriate activities to fulfill progression outline | 41.8 (77) | 45.9 (67) | 41.7 (5) |
| 24-hours or longer between each step of the progression | 50.0 (92) | 53.4 (78) | 33.3 (4) |
| The athlete stops and return to the previous step if symptoms worsen | 58.2 (107) | 61.0 (89) | 66.7 (8) |
| Delineation of the individual who oversees the return-to-play progression | 37.0 (68) | 39.7 (58) | 0.0 (0) |

a These components refer to the follow-up measures taken by the medical staff in the subsequent days and/or weeks following a concussive injury, including return-to-learn and return-to-play.
Figure 1. Mandatory State Law and Total Component Scores by PIAA District

A. Total Mandatory State Law Component Score by PIAA District (max score of 5)

B. Total Component Score by PIAA District (max score of 60)