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# Referral Patterns for Pediatric Sports-Related Concussion in One New England Health Care System

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## ORIGINAL RESEARCH

# Referral Patterns for Pediatric Sports-Related Concussion in One New England Health Care System

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**Introduction:** Patients with concussion may benefit from care provided by professionals from multiple disciplines based on the constellation of symptoms being reported. This study analyzed referral patterns from primary care and sports medicine clinicians for pediatric patients with sports-related concussion in one health care system.

**Methods:** A retrospective chart review identified referrals placed to physical therapy, occupational therapy, speech pathology, optometry, psychology, neuropsychology, audiology, neurology, ophthalmology, otolaryngology, psychiatry, and sports medicine for pediatric patients with sports-related concussion. These patients were evaluated at MaineHealth family medicine, internal medicine/pediatrics, pediatrics, and sports medicine clinics in southern Maine between February 2019 and June 2022.

**Results:** We identified 375 patients with concussions. These patients were most often evaluated by pediatrics (199; 53.1%) and sports medicine (160; 42.7%), with fewer evaluated by family medicine (28; 7.5%), internal medicine/pediatrics (8 patients; 2.1%), or internal medicine (6; 1.6%). The most common referrals were to physical therapy (40; 10.7%), sports medicine (21; 5.6%), psychology (11; 2.9%), and neurology (9; 2.4%). Sports medicine placed a significantly higher number of referrals ( $P < .0001$ ) than non-sports medicine disciplines.

**Discussion:** Compared to prior research, fewer referrals were placed in this cohort of patients with concussion. Possible explanations include a larger population of uncomplicated concussions, the more rural setting in which this study occurred, or a lack of awareness of resources for further concussion care.

**Conclusions:** Further investigation should be done to evaluate the causes of the reduced referrals and their impact on the recovery of pediatric athletes with concussion.

**Keywords:** brain concussion, athletes, referral, pediatrics

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Sports-related concussion represents a serious pathology within the pediatric population. An estimated 1.0 to 1.8 million sports/recreation-related concussions occur annually in the United States, with the true incidence possibly higher due to the number of people who do not seek care for their injuries.<sup>1</sup> Incidence ranges from 0.03 to 4.18 (overall 0.23) per 1000 athletic exposures, depending on the sport.<sup>2</sup> Most of these patients are

managed by their primary care provider,<sup>3,4</sup> with 75% of 5- to 17-year-old patients with sports-related concussion entering the health care system via their primary care provider.<sup>5</sup> Although the expected duration of symptoms in children with sports-related concussion is up to 4 weeks,<sup>6</sup> a subset of patients will develop symptoms that persist for longer. For these patients with complicated recovery, existing guidelines support referral to a concussion specialist.<sup>7-9</sup> Studies suggest these recommendations are at least partially followed, with most pediatric primary care providers stating

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that they refer at least some of their patients with concussion to physician specialists.<sup>10,11</sup>

Furthermore, more attention has been given to referring patients to appropriate complementary professional disciplines to further the recovery process. Notably, the most recent American Medical Society of Sports Medicine (AMSSM) position statement on concussion discusses 6 clinical profiles that may share overlapping features: vestibular, ocular, headache-migraine, anxiety-mood, fatigue, and cognitive.<sup>12</sup> By recognizing which profiles a patient may fit, their treatment can be more targeted. The AMSSM statement includes level C evidence for using these clinical profiles and associated targeted treatment. This evidence agrees with other guidelines, including the Concussion in Sport Group consensus, which states that children with persistent symptoms for more than 4 weeks “should be managed in a multidisciplinary collaborative setting.”<sup>13</sup>

Unfortunately, no research has looked at referral patterns to these disciplines for sports-related concussion. Two studies looked at referrals to rehabilitation disciplines in a more generalized population with traumatic brain injury. One study showed physical therapy,<sup>14</sup> and the other showed occupational therapy,<sup>15</sup> as the most common referral destination. No studies looking at referral patterns in sports-specific or pediatric-specific populations were identified. Thus, our study looked at referral patterns by primary care and sports medicine providers for pediatric patients with sports-related concussion, since the publication of the AMSSM statement, within one health care system. This information about guideline adherence provides the foundation for potential improvements to patient care in the future.

## METHODS

This study is a retrospective chart review of referrals placed between February 2019 and June 2022 for patients with an sports-related concussion in a setting of family medicine, internal medicine/pediatrics, pediatrics, and sports medicine clinics within one health care system in southern Maine. The electronic medical record was queried to identify all patients who were 8 to 18 years old, played competitive organized sports, and had an International Classification of Diseases, 10<sup>th</sup> Revision, code for concussion (S06.0, S06.OX, S06.OX0, S06.OX0A, S06.OX0D, S06.OX0S,

S06.OX1, S06.OX1A, S06.OX1D, S06.OX1S, S06.OX9, S06.OX9A, S06.OX9D, S06.OX9S, S06.89) linked to their visit at one of these clinics. Also, the mechanism of concussion was noted as a sports-related injury on chart review of clinic notes. For these visits, the following electronic data was obtained from the health record: patient age at the time of injury, sex (male/female collected by the electronic health record), concussion visit dates, provider type (physician, nurse practitioner, physician assistant), provider specialty (family medicine, pediatrics, internal medicine/pediatrics, sports medicine), referral dates, and provider type and specialty placing the referrals. Information on referrals to physical therapy, occupational therapy, speech pathology, optometry, psychology, neuropsychology, audiology, neurology, ophthalmology, otolaryngology, psychiatry, and sports medicine for were collected for up to 6 months after the initial concussion visit. This time range was selected as initial referrals placed beyond 6 months were believed to be either (1) unrelated to the initial injury or (2) sufficiently delayed and representative of inadequate management. A chart review was conducted to collect the injury mechanism, type of sport, and time from injury to each visit. Patients were excluded if the mechanism of injury was either (1) not sports-related or unknown or (2) if they were noted to have more severe head injuries than an isolated concussion.

This project was deemed exempt by the MaineHealth Institutional Review Board.

## Analytic Methods

Total numbers and percentages were used for descriptive statistics (demographics, number of concussions per sport, type of practice seen, type of referral placed).

The number of referrals placed to non-physician disciplines by sports medicine was compared to all of primary care and each primary care specialty using Fisher’s exact tests.

## RESULTS

We evaluated 614 unique patients with concussions for possible inclusion in this study. Of these, the mechanism was documented as sports-related for 380 (62%) patients, and the remainder were either not sports-related or unknown. Five additional patients were excluded due to a more

severe injury than concussion (2 skull fractures, 1 epidural hematoma, 1 subdural hematoma, and 1 intracranial bleed), resulting in 375 patients with concussion for analysis. Sports-related concussion tended to occur in older teens and males (Table 1).

**Table 1.** Demographics of Patients with Concussion Included in Study (N=375)

Characteristic	Data value
Age, y, No. (%)	
8-11	24 (6.4)
12-14	107 (28.5)
15-16	148 (39.5)
17-18	96 (25.6)
Age, y, mean (SD)	15.0 (2.1)
Sex, No. (%)	
Female	167 (44.5)
Male	208 (55.5)

A wide range of sports were represented. The most common were football (65 patients; 17%), soccer (65 patients; 17%), lacrosse (50 patients; 13%), ice hockey (37 patients; 10%), and basketball (35 patients; 9%) (Table 2).

The most common practice types where patients were seen for sports-related concussion were pediatrics (199 visits; 53.1%) and sports medicine (160 visits; 42.7%), with fewer evaluated by family medicine (28 visits; 7.5%), internal medicine/pediatrics (8 visits; 2.1%), or internal medicine (6 visits; 1.6%). Also, 358 patients were evaluated by physicians, 20 by nurse practitioners, and 4 by physician assistants. Among the patients, 172 (45.9%) were initially seen within 3 days of injury and another 107 (28.5%) were seen within 1 week of injury. Most patients only had 1 visit related to their concussion (254 patients; 67.7%) (Table 3). Also, 64 patients (17%) had a concussion-related visit more than 4 weeks after injury.

Of the 375 patients with concussion analyzed, 40 (10.7%) had a referral placed to physical therapy, of which 35 (86%) came from sports medicine. The next most common referral types were to sports medicine (21 patients; 5.6%), psychology (11 patients; 2.9%), and neurology (9 patients; 2.4%). Complete information about referrals is found in Table 4.

**Table 2.** Number of Concussions by Sport

Sport	No. (%)
Baseball	6 (1.6)
Basketball	35 (9.3)
Biking	4 (1.1)
Cheerleading	14 (3.7)
Cross country	1 (0.3)
Dance	2 (0.5)
Field hockey	10 (2.7)
Flag football	1 (0.3)
Football	65 (17.3)
Gymnastics	1 (0.3)
Horseback riding	3 (0.8)
Ice hockey	37 (9.9)
Lacrosse	50 (13.3)
Motocross	4 (1.1)
Rugby	3 (0.8)
Sailing	4 (1.1)
Skateboarding	2 (0.5)
Skiing	25 (6.7)
Snowboarding	9 (2.4)
Soccer	65 (17.3)
Softball	13 (3.5)
Table tennis	1 (0.3)
Track and field	4 (1.1)
Ultimate frisbee	1 (0.3)
Volleyball	9 (2.4)
Wrestling	6 (1.6)

**Table 3.** Number of Concussion-Related Visits Among Patients

Number of visits	No. (%)
1	254 (67.7)
2	68 (18.1)
3	29 (7.7)
4	8 (2.1)
5	6 (1.6)
6	1 (0.3)
7	4 (1.1)
8	1 (0.3)
9	2 (0.5)
10	2 (0.5)

**Table 4.** Number of Referrals Placed to Each Discipline by Referring Specialty

Referrals	Patients Referred by Specialty, No. (% evaluated patients referred) <sup>1</sup>					
	Total (N=375)	Family medicine (N=28)	Pediatrics (N=199)	Sports medicine (N=160)	Internal medicine/ Pediatrics (N=8)	Internal medicine (N=6)
Audiology	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Neurology	9 (2.4)	0 (0.0)	6 (3.0)	3 (1.9)	0 (0.0)	0 (0.0)
Neuropsychology	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Occupational therapy	1 (0.3)	0 (0.0)	0 (0.0)	1 (0.6)	0 (0.0)	0 (0.0)
Ophthalmology	3 (0.8)	0 (0.0)	2 (1.0)	1 (0.6)	0 (0.0)	0 (0.0)
Optometry	3 (0.8)	0 (0.0)	0 (0.0)	3 (1.9)	0 (0.0)	0 (0.0)
Otolaryngology	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Physical therapy	40 (10.7)	1 (3.6)	4 (2.0)	35 (21.9)	0 (0.0)	0 (0.0)
Psychiatry	1 (0.3)	0 (0.0)	1 (0.5)	0 (0.0)	0 (0.0)	0 (0.0)
Psychology	11 (2.9)	0 (0.0)	5 (2.5)	6 (3.8)	0 (0.0)	0 (0.0)
Speech pathology	1 (0.3)	0 (0.0)	0 (0.0)	1 (0.6)	0 (0.0)	0 (0.0)
Sports medicine <sup>2</sup>	21 (5.6)	2 (7.1)	15 (7.5)	2 (1.3)	1 (12.5)	0 (0.0)

<sup>1</sup> Total number of patients (N) evaluated overall and by each specialty is included, with some patients evaluated by multiple specialties.

<sup>2</sup> Total for Sports Medicine does not equal 21 due to one referral missing referral source provider specialty

Sports medicine placed a significantly higher number of referrals to non-physician specialties than all primary care combined ( $P < .0001$ ) and family medicine, pediatrics, or internal medicine/pediatrics individually ( $P < .0001$ ).

## DISCUSSION

This study identified 375 patients with sports-related concussions in the study time period from February 2019 through June 2022. The sports with the highest number of concussions in our study were football, soccer, ice hockey, and lacrosse, as seen in other studies.<sup>2,16</sup> Substantial numbers of injuries were in basketball and skiing, which suggests increased regional participation in these sports may contribute to a greater number of injuries.

More than one-half of the patients with concussion were initially seen within 1 week of injury, with more than one-third seen within 3 days of injury. Most patients had only 1 concussion-related visit with a physician or mid-level provider. This finding suggests that most patients evaluated in our study had short, uncomplicated recoveries that did not require ongoing or repeat interactions with the health care system. This finding is also consistent with existing research and current consensus guidelines that most pediatric patients will recover

from sports-related concussion within 4 weeks.<sup>6,12,13</sup> For these patients, conservative management may not include referral for more specialized treatment.

However, as 64 athletes had at least 1 visit more than 28 days after injury, a subset of our population may have benefited from referral for more targeted treatment. For these patients with a complicated recovery timeline, many systems have expanded the treatment team to include members from multiple disciplines.<sup>17,18</sup> More recent recommendations state that a concussion specialty clinic should include a multidisciplinary team.<sup>7,13</sup> This team can include physical therapy, occupational therapy, speech language pathology, optometry, psychology, neuropsychology, audiology, and multiple physician specialties.

These findings make the overall lack of referrals for patients in our study population interesting. The largest referral destination was physical therapy, with 40 patients (10.7%) referred. Psychology was the second most common discipline with 11 patients (2.9%) referred. No other discipline had more than 10 patients with referrals. For referrals to other physicians, 21 patients were referred to sports medicine. No other specialty had double-digit referrals. These numbers of referrals represent lower percentages of total patients than previously

reported in other studies. In one study, 46% of patients seen at a concussion clinic were referred to at least 1 discipline, the most common of which was physical therapy (28% of patients).<sup>14</sup> A separate study found that 43% of patients seen at a concussion clinic were referred for occupational therapy based on medical assessment.<sup>15</sup>

The lower referral numbers could be related to a number of factors. Those prior studies looked at referral patterns from concussion clinics, whereas our study looked at referrals placed by primary care and sports medicine. Also, most patients in our study were seen within 1 week of injury, and most had only 1 encounter. These findings suggest that many of these patients had a quick, uncomplicated resolution of symptoms that would not have required management by additional professionals. By comparison, patients referred to a specialty concussion clinic may have a more complicated recovery course and would more likely benefit from referral for more specialized management.

Another possible explanation for our number of referrals is the setting in which our study occurred. This study evaluated patients within the largest health system that serves one of the most rural states in the country. Although this system offers physical therapy, it does not have a dedicated multidisciplinary concussion team, which forces a piecemeal approach to involving other disciplines. In some instances, patients come from rural communities where many resources are not available, especially patients seen by sports medicine, which has a much larger catchment area. Lack of access to specialists, lack of transportation, cost, and a lack of feasibility of recommendations are reasons for rural primary care providers and rural patients to not follow published clinical recommendations for pediatric patients with mild traumatic brain injury.<sup>19-21</sup> These factors were likely magnified by the COVID-19 pandemic, which occurred within the study period. Thus, although existing guidelines are appropriate for a large, well-resourced setting, further attention should be given to under-resourced settings where not all resources exist within one system. Guidelines should better consider these populations and address appropriate management when not all resources are available. One area that may help narrow this disparity is the incorporation of telehealth.<sup>21</sup>

A final explanation for our referral numbers is a potential lack of comfort within primary care surrounding the appropriateness of referrals to other non-physician disciplines. Among a total 56 referrals to physical therapy, occupational therapy, speech pathology, optometry, and psychology, 10 (17.9%) came from primary care, whereas the rest came from sports medicine. Primary care did refer 18 additional patients to sports medicine, whereas sports medicine placed 2 referrals to other sports medicine providers, possibly representing referrals to the sports concussion specialist within our system. As 241 patients had encounters with primary care and 160 with sports medicine, a significantly higher number of referrals came from sports medicine physicians, despite each group having the same ability to refer to each of the discussed disciplines. We expected that a proportionate number of referrals would come from both primary care and sports medicine, with very few referrals from primary care to sports medicine, which often place the same referrals without obtaining additional meaningful information. Our findings suggest that primary care in our system may not be comfortable with recent research on the most appropriate management and outcomes for pediatric patients with concussion.<sup>7-9,12,13,22,23</sup> This discomfort is consistent with prior publications showing low knowledge of and adherence to concussion guidelines in primary care with low use of referral pathways.<sup>10,24-27</sup> Further work should be done to evaluate primary care awareness and comfort with current guidelines, and to educate primary care on the value of referral to each of these disciplines as indicated.

This study is not without limitations. Due to workflows within our system, information relevant to concussion management was not readily available, including Sport Concussion Assessment Tool-5 scores, which are not routinely collected. The limited chart review did not provide additional information about the patient that may influence recovery, such as prior concussion, comorbidities, presentation of current concussion (including severity of symptoms and presence of loss of consciousness or amnesia), and post-injury clinical factors (such as development of headaches or depression, experiencing dizziness or oculomotor function).<sup>13</sup> Due to the limitations of our data, we were unable to analyze whether these patient characteristics or other factors, such as type of provider encountered, explain the referral patterns.

Also, although we made efforts to capture a representative view of sports-related concussion management in this system, multiple factors could skew these results. We took a representative sample of clinics within the system, but these clinics may not represent the whole system. As the chart review used International Classification of Diseases codes to identify concussion visits, unless a concussion-specific code was included, those visits would be missed. Also, many high school students enter the care system through their school athletic trainers. In situations of uncomplicated concussions, these students often do not require evaluation in the traditional clinic setting as they are managed through athletic training rooms staffed by a physician. Both of these situations would lead to some target patients being missed.

Further research could be directed at multiple areas. One could compare the results of this study to a similar time period before the most recent AMSSM publication<sup>12</sup> to evaluate whether referral patterns have changed with the most recent recommendations. Research could also be directed at studying whether patients with concussion in rural settings have worse outcomes as a result of the lack of access to the resources recommended in the most recent guidelines.

## CONCLUSIONS

Compared to prior research, an overall low number of referrals was placed. Possible explanations include a larger population of uncomplicated concussions, the more rural setting in which this study occurred, or a lack of awareness of resources for further concussion care. Further work is needed to determine if the patients who were not referred had different outcomes than their referred counterparts.

**Conflict of interest:** None

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