# Access to Athletic Trainers and Emergency Medical Services Activations for Sport-Related Injuries

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**Context:** Having athletic trainers (ATs) employed at secondary schools is associated with improved preparedness for sport-related emergencies. The use of emergency medical services (EMS) in settings with different access to athletic training services remains unknown.

**Objective:** To compare the incidence of EMS activations for patients with sport-related injuries among zip codes with various levels of access to athletic training services.

Design: Descriptive epidemiology study.

**Setting:** Data were obtained from the National EMS Information System and the Athletic Training Location and Services Project.

**Patients or Other Participants:** Zip codes where 911 EMS activations for sport-related injuries among individuals 13 to 18 years old occurred.

*Main Outcome Measure(s):* Incidence of EMS activations, athletic training service level (no ATs employed [NONE], less than full-time employment [PARTIAL], all ATs employed full time [FULL]), and athletic training employment model (independent contractor [IC], medical or university facility [MUF], school district [SD], mixed employment models [MIX]) for each zip code.

**Results:** The EMS activations were  $2.8 \pm 3.6$  per zip code (range = 1–81, N = 4923). Among zip codes in which at least 1

AT was employed (n = 2228), 3.73% (n = 83) were IC, 38.20% (n = 851) were MUF, 27.24% (n = 607) were SD, and 30.83% (n = 687) were MIX. Compared with SD, MUF had a 10.8% lower incidence of EMS activations (incidence rate ratio [IRR] = 0.892; 95% CI = 0.817, 0.974; P = .010). The IC (IRR = 0.920; 95% CI = 0.758, 1.118; P = .403) and MIX (IRR = 0.996; 95% CI = 0.909, 1.091; P = .932) employment models were not different from the SD model. Service level was calculated for 3834 zip codes, with 19.5% (n = 746) NONE, 46.2% (n = 1771) PARTIAL, and 34.4% (n = 1317) FULL. Compared with NONE, FULL (IRR = 1.416; 95% CI = 1.308, 1.532; P < .001) and PARTIAL (IRR = 1.368; 95% CI = 1.268, 1.476; P < .001) had higher incidences of EMS activations.

**Conclusions:** Local access to athletic training services was associated with an increased use of EMS for sport-related injuries among secondary school-aged individuals, possibly indicating improved identification and triage of sport-related emergencies in the area. The difference in EMS use among employment models may reflect different policies and procedures for sport-related emergencies.

*Key Words:* prehospital care, ambulance, athletes, secondary school, youth

### **Key Points**

- Areas with access to athletic training services used emergency medical services more frequently for secondary school-aged athletes who sustained sport-related injuries than areas without such services.
- Areas in which athletic trainers were employed by a medical or university facility used emergency medical services for sport-related injuries less often than their counterparts in areas employed by school districts.
- The positive influence of access to athletic training services was not limited to school-based sport activities but also reached recreational and non-school-based athletics.

M ore than 2800 catastrophic sport-related injuries and fatalities have been documented by the National Center for Catastrophic Sport Injury Research in its 30+-year history, 79% of which occurred in high school athletes.<sup>1</sup> Among the patients with lifethreatening injuries presenting to emergency departments (EDs), 14% were attributed to sport activities.<sup>2</sup> Although it is likely that some of these injuries and fatalities necessitated care and transportation by emergency medical services (EMS), the involvement of EMS was not directly examined.

In 1 study,<sup>3</sup> sports accounted for >35% of school-based EMS activations; however, the investigation was limited to

a single state. In a national examination of high school sport–related injuries documented by athletic trainers (ATs), 0.3% resulted in transportation by EMS.<sup>4</sup> High school ATs activated EMS more frequently than ATs working in the collegiate setting.<sup>5</sup> Activation of the emergency action plan (EAP) was reported by 54% of ATs,<sup>6</sup> and nearly 40% of high school ATs activated EMS an average of 1 to 2 times per year for football alone.<sup>5</sup> Yet the authors of these studies used either data sets that were limited to information entered by ATs at their institutions<sup>4–6</sup> or an EMS-based data set in which the presence of ATs was not recorded.<sup>3</sup>

Athletic trainers are the preferred on-site medical providers for secondary school-aged athletes.<sup>7</sup> In the second annual Athletic Training Location and Services (ATLAS) Project report,<sup>8</sup> only 66% of secondary schools in the United States had access to athletic training services, ranging from 13% to 90% within states. Athletic training services vary greatly by service level and employment model across the United States, and research on the latter is lacking in the current literature. Most ATs are employed through a medical or university facility or directly by a school district.<sup>8</sup> The employment model may affect the relationships ATs have with their administrative staff, coaches, and student-athletes as well as the resources available to provide care at their school. Athletic trainers are typically the individuals responsible for EAP development and automated external defibrillator (AED) maintenance, storage, and use.<sup>9,10</sup> Further, the presence of an AT is associated with having venue-specific EAPs and AEDs in secondary schools.<sup>11,12</sup> Thus, in schools with limited or no access to an AT, it is unlikely that the proper steps have been put in place to respond to a sport-related emergency. In lieu of ATs, 49% of private and 80% of public high schools had EMS present during athletic competitions.<sup>13</sup> Relationships with key stakeholders (eg, athletic director, school resource office, local EMS) and available resources (eg, AED, emergency equipment) can directly affect the ability to provide care in an emergency and are therefore worth examining in relation to EMS activations.

Hence, the primary purpose of our study was to compare the incidence of EMS activations for sport-related injuries among high school-aged patients (ie, 13–18 years old) among zip codes by athletic training service level and employment model. We hypothesized that zip codes with greater access to athletic training services would have fewer EMS activations than those with less access to athletic training services. We also hypothesized that the number of EMS activations would not differ by employment model.

#### METHODS

For this study, as part of a larger examination of EMS activations for sport-related injuries, we used a retrospective cohort design with selected data from the National EMS Information System (NEMSIS)<sup>1</sup> database and the ATLAS Project<sup>2</sup> from 2017 to 2018. Cases were limited to 911 EMS activations for sport-related injuries among high school–aged patients (ie, aged 13–18 years). The NEMSIS database contained data voluntarily reported by EMS agencies across the United States. The ATLAS Project included information on 16076 public secondary schools and 4196 private schools across all 50 states and the District of Columbia; however, only schools with an interscholastic athletics program for grades between 9 and 12 were included in its database.<sup>14</sup>

#### **Study Procedures**

We submitted a data request to the NEMSIS for the 2017 and 2018 public-release datasets. Sport-related injuries were identified using selected International Classification of Diseases, Tenth Revision (https://www.cms.gov/ Medicare/Coding/ICD10) codes for incident location type and cause of injury. In total, 14791 EMS activations due to sport-related injuries were identified during the time period for individuals aged 13 to 18. A data request was also submitted to the Korey Stringer Institute for the most recent high school data from the ATLAS Project (2018). The ATLAS data requested was for school zip code, presence of an AT (ves or no), and athletic training services information. Athletic training service information included the level of service the school received (full or part time), the number of ATs employed, and the employment model (ie, school district, school district with teaching responsibilities, medical/university facility). Full-time athletic training services were defined as "a school who receives athletic training services for  $\geq 30$  hours per week,  $\geq 5$  days per week,  $\geq 10$  months per year" by the ATLAS Project, and part-time services were anything less than full-time services.8

Once we received the data from the Korey Stringer Institute, we created a file to aggregate and code athletic training services information by zip code. The public data sets provided by the NEMSIS did not include the zip code for each EMS activation. However, the NEMSIS Technical Assistance Center was able to provide a substitute for the zip code in which each EMS activation occurred so that we would be blinded to the actual zip code. To accomplish this, the data from ATLAS were aggregated by zip code, sent to the NEMSIS Technical Assistance Center to create the new blinded variable, and then returned to us for analysis.

#### **Statistical Analysis**

Descriptive statistics (frequencies and proportions) were calculated for each descriptive variable. We computed an aggregate score using the ATLAS data to identify the athletic training service level for each zip code: schools with full-time athletic training services received a 1, schools with part-time athletic training services received a 0.5, and schools with none received a 0. The average score across all schools within each zip code was then determined (numerical; range = 0-1). The athletic training service level was then categorized as NONE (0.00; no ATs employed), PARTIAL (0.01–0.99; less than full-time employment), or FULL (1.00; all ATs employed full time). Athletic trainer employment model was treated as a categorical variable with the following options: independent contractor (IC), medical or university facility (MUF), school district (SD), and mixed employment types (MIX).

We performed separate negative binomial regressions to establish whether the incidence of EMS activations for sport-related injuries differed based on the athletic training service level and employment model. The dependent variable was the incidence of EMS activations, and the predictor variables were athletic training service level and

Table 1. Athletic Trainers (ATs) Employed Within Zip Codes (n =  $3836)^a$ 

No. of ATs	No. (%) of Zip Codes <sup>t</sup>
None	747 (19.5)
1	1810 (47.2)
2	703 (18.3)
3	313 (8.2)
4	137 (3.6)
5	58 (1.5)
6	44 (1.1)
7	14 (0.4)
8	5 (0.1)
9	5 (0.1)

<sup>a</sup> Mann NC. Data from: The National Emergency Medical Services Information System (NEMSIS). 2017–2018.

<sup>b</sup> No data were available for 1088 zip codes.

employment model. Evidence of overdispersion of the dependent variable (mean = 2.81, variance = 12.59) indicated that a negative binomial regression was more appropriate than a Poisson regression for analysis. Cases with missing data were excluded. Incidence rate ratios (IRRs) with 95% CIs excluding 1.00 and P < .05 were considered significant.

#### RESULTS

The sample consisted of 4924 unique zip codes. The number of EMS activations within each zip code ranged from 1 to 255 (mean =  $2.86 \pm 5.05$ ). However, the single zip code with 255 EMS activations was considered an outlier and excluded from the regression analyses. With the outlier removed (n = 4293), the average number of EMS activations per zip code was  $2.8 \pm 3.6$  (range = 1-81), totaling 13 823 EMS activations for sport-related injuries in the sample.

Data on the number of ATs employed were available for 3836 zip codes. On average,  $1.4 \pm 1.3$  ATs were employed within each zip code, ranging from 0 to 9 ATs. Most zip codes had 1 (n = 1810, 47.2%), 2 (n = 703, 18.3%), or no ATs (n = 747, 19.5%) employed (Table 1). The average athletic training service level data were available for 3835 zip codes. The average athletic training service level was 0.6  $\pm$  0.4, with 19.5% (n = 746) categorized as NONE, 46.2% (n = 1771) PARTIAL, and 34.4% (n = 1318) FULL. There were 2983 zip codes with athletic training employment model data, 2375 of which had ATs employed. The most prevalent employment models were MUF (n = 852, 28.6%), SD (n = 752, 25.2%), and MIX (n = 688, 23.1%; Table 2).

The regression model to determine if the number of EMS activations differed based on the athletic training service

Table 2. Prevalence of Employment Models Among Zip Codes With Athletic Trainers  $(n = 2983)^a$ 

Employment Model	No. (%) of Zip Codes <sup>t</sup>
Independent contractor	83 (2.8)
Medical or university facility	852 (28.6)
School district	752 (25.2)
Mixed employment models	688 (23.1)

<sup>a</sup> Huggins RA. Data from: Athletic Training Locations and Services (ATLAS) Project. 2017–2018.

<sup>b</sup> No data were available for 1949 zip codes.

The regression model to determine if the number of EMS activations differed significantly based on employment model in zip codes in which at least 1 AT was employed included 2228 cases. Employment model was significantly associated with the incidence of EMS activations (deviance value/df = 0.923, Pearson  $\chi^2$  value/df = 1.457; likelihood ratio  $\chi^2 = 9.203$ , df = 3, P = .027). Compared with SD, MUF had a 10.8% lower incidence rate (IRR = 0.892; 95% CI = 0.817, 0.974; P = .010) of EMS activations. The number of EMS activations for IC (IRR = 0.920; 95% CI = 0.758, 1.118; P = .403) and MIX (IRR = 0.996; 95% CI = 0.909, 1.091; P = .932) did not differ compared with SD.

## DISCUSSION

### Level of Access to Athletic Training Services

We are the first to examine whether the presence of an AT within a zip code was associated with EMS use for secondary school-aged individuals. Previous authors<sup>15</sup> investigated EMS use among the secondary school-aged population; however, they included only institutions with ATs employed. Secondary schools without access to athletic training services are heavily reliant on EMS to provide coverage at sports events, more so among public than private schools.<sup>13,16</sup> Also, a number of schools do not have a designated licensed or certified medical provider present at sports events; instead, they rely on coaches, athletic directors, or parents who may or may not have a medical credential to volunteer and make triage decisions for the athletes.<sup>13,16,17</sup> Although the cases in this study were aggregated at the zip code level and not specific to each unique secondary school, these data provide compelling evidence that access to ATs influenced EMS use for patients with sportrelated injuries.

Zip codes without access to athletic training services had fewer EMS activations than those with access to athletic training services, which also held true for partial and full athletic training service levels. Access to athletic training services varied depending on urbanicity, with rural schools having the lowest percentage of secondary schools with ATs and less access to full-time athletic training services.<sup>18</sup> Although the data were limited to athletes with high school football injuries, full-time ATs employed by their schools reported higher injury rates than their part-time outreach counterparts,<sup>19</sup> suggesting that full-time ATs were able to identify more injuries than ATs who were hired in only a part-time capacity. The difference between full-time and part-time ATs demonstrated in the earlier research may not have been reflected in our work because of the focus on sport-related emergencies. Higher-risk events, such as football games, are typically prioritized when determining medical coverage, meaning an AT is more likely to be present during these events than for regular daily services. Previous authors showed that having access to athletic

training services resulted in fewer ED visits compared with not having access to athletic training services,<sup>20,21</sup> suggesting that ATs effectively triaged patients with injuries that did not need to be seen in the ED. Reliance on untrained personnel to recognize and triage sport-related emergencies puts athletes at risk of delayed or improper emergency care. Even more concerning, coaches tended to be more confident than they were knowledgeable regarding how to handle sport-related emergencies.<sup>22</sup> Our findings may indicate better recognition of emergent conditions requiring treatment and transportation by EMS in areas with ATs versus those without.

We captured all EMS activations for individuals aged 13 to 18 who sustained a sport-related injury within a zip code, and these were not limited to school-based EMS activations. It is possible that sports programs not affiliated with the local schools may experience an indirect benefit of ATs being employed in the area. Athletic directors have noted that seeing how other schools implemented their emergency planning was a facilitator of their own EAP development.<sup>23</sup> Further, high school athletics coaches were more prepared for sport-related emergencies and more frequently had an AT available at practices and competitions than their club sport counterparts.<sup>17</sup> The presence of an AT was associated with better preparedness for sport-related emergencies.<sup>11,12</sup> Although all schools and athletic organizations should strive for some level of access to athletic training services, having ATs employed in a locality may offer a positive indirect effect.

# Athletic Training Employment Model

Zip codes in which all ATs were employed using the MUF model had a lower incidence of EMS activations compared with those in which all ATs were employed by the SDs. The incidence of EMS activations between zip codes in which ATs were only employed by the SD and those in which MIX models were present did not differ. Most secondary school ATs were employed by an MUF, followed by SDs, and a small proportion were employed as ICs.8 Employment models vary by state. At the time of the ATLAS second annual report,  $8 \ge 85\%$  of the ATs employed in the District of Columbia, New Jersey, New Mexico, and Texas were employed through SDs, whereas >85% of ATs were employed by an MUF in Alaska, Indiana, Minnesota, Mississippi, North Dakota, Ohio, and Wisconsin. These results suggest associations among AT employment model, state, and EMS use. Only 10 states mandated that secondary schools develop and coordinate their EAP with local EMS.<sup>24</sup> Athletic trainers were more closely aligned with best practices for emergency planning in states with requirements for developing an EAP.<sup>24</sup> To our knowledge, non-school-based sports have no equivalent mandates, leaving these recreational populations unprotected and underserved. Future researchers should examine the relationships among athletic training services, employment, state health and safety policies, and EMS use for sportrelated emergencies in school and non-school-based athletics.

The AT employment model and access to emergency care also vary by urbanicity. Outreach ATs were more likely to work at smaller rural high schools compared with ATs hired by the school.<sup>19</sup> However, other investigators<sup>23</sup>

found that ATs working in suburban schools were more likely to have EAPs in place for sport-related emergencies. Urbanicity is associated with EMS scene and transport times as well as the level of EMS provider available (ie, basic or advanced life support level).<sup>25,26</sup> Only 71% of the US population had access to an ED within 30 minutes,<sup>27</sup> which does not account for the time it would take for EMS to arrive, evaluate the patient, and make a transportation decision. Together, these studies indicate disparities in access to emergency care, which could significantly affect the decision on whether to activate EMS for a sport-related emergency. Athletic trainers employed by MUFs may have improved access to emergency resources that help overcome these geographic challenges. It is also possible that physicians working in practices that support outreach ATs may be more directly involved in emergency care training and policy development for those ATs.

Access to athletic training services and athletic training employment model both fit in the context of the socioecological model, which has been applied to the prevention of sport-related deaths.<sup>28</sup> Access to athletic training services fits in the interpersonal level-who is or is not available to provide care for the athlete when a sport-related emergency occurs. This individual often determines if EMS activation is warranted. The attitudes, beliefs, and training of these individuals directly affect the intrapersonal level-the athlete and the medical care received. The broader levels-policy, environmental, and organizational-influence the level and type of athletic training services provided. Further, the athletic training employment model sits at the organizational level. Having access to athletic training services can positively influence the broader levels-organizational and environmental-as was demonstrated in our study by the difference in use of EMS for sport-related injuries between zip codes with and without access to athletic training services. A related epidemiologic examination<sup>29</sup> supplied valuable information for stakeholders that should be considered along with our findings when advocating for and developing better policies regarding the provision of medical care for secondary school-aged children.

# Limitations

This study was delimited to zip codes in which at least 1 EMS activation occurred because of the nature of the NEMSIS data sets. An emergency medical services activation occurred when EMS was dispatched to a call and a patient care report was completed, but it does not guarantee that the patient was treated and transported by EMS for the injury or illness.<sup>29</sup> It is possible that EMS activations were captured in which patients were not treated and transported by EMS; rather, they elected to take an alternative means of transportation to the ED or they refused treatment, transportation, or both by EMS. Also, because our data were delimited to zip codes, we were unable to directly attribute EMS activations to school-based incidents; thus, the influence of employment model on EMS use may have limited the generalizability. Although data from the ATLAS Project encompass all 50 states and the District of Columbia, states are not required to participate in the NEMSIS; hence, any EMS activations that occurred in

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nonparticipating zip codes could not be accounted for in this sample. The ATLAS Project collected the level of athletic training services and employment model data via a survey distributed to the secondary schools with athletic training services, which had a 58% response rate.<sup>8</sup> The results of this study may not be generalizable to locations not captured in the NEMSIS or ATLAS Project data sets.

# CONCLUSIONS

Localities with access to athletic training services, regardless of the level of services provided, had an increased incidence of EMS activations for sport-related injuries, which may indicate improved recognition and management of sport-related emergencies. These findings suggest possible indirect benefits to having ATs employed, which would include non-school-based sports activities. Areas in which ATs were solely employed using an MUF model had a lower incidence of EMS activations. These ATs may have had improved access to resources that helped overcome geographic disparities that can negatively affect access to emergency care.

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