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Title: National estimates of nonurgent emergency department utilization for sports-related injuries in high school-age population

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Abstract

Context:

Athletic trainers (ATs) can manage nonurgent, musculoskeletal emergency department (ED) visits. Little is known about what populations are most likely to use the ED for nonurgent, sports-related musculoskeletal injuries.

Objective

Our object is to provide national-level evidence on whether high-school age population with public insurance or lower socioeconomic status were more likely to have ED visits for nonurgent injuries.

Design

Cross-sectional study.

Setting

Secondary data analysis of the 2017-2019 Nationwide Emergency Department Sample (NEDS).

Patients or Other Participants

ED visits for high school-age patients with a sports-related musculoskeletal injury.

Main Outcome Measure

We used a multi-step process and AT scope of care threshold to classify ED visits for musculoskeletal injuries as urgent and nonurgent. National estimates of the proportions of visit, patient, and hospital characteristics by urgent, nonurgent, and total injury ED visits were reported. Survey weighted logistic regression was used to calculate odds ratios of an ED visit being for a nonurgent injury based on a patient's insurance type and socioeconomic status.

Results

For ED visits for musculoskeletal injuries in a high school-age, sports exposed population, 52.93% (95% CI: 51.11, 54.73) were for nonurgent injuries. Patients with public insurance were more likely (OR = 1.39; 95% CI: 1.35, 1.44) to have an ED visit for a nonurgent injury compared to ED visits for patients with private insurance. Patients from the lowest estimated neighborhood income quartiles were more likely (OR = 1.10; 95% CI: 1.02, 1.20) to have an ED visit for a nonurgent injury compared to ED visits for patients in the highest estimated income quartile.

Conclusions

Our results suggest opportunities to reduce nonurgent ED use using AT services exist, especially in high school-age athletes from vulnerable populations.

Key Words: emergency department utilization, insurance type, national estimates, nonurgent injury, socioeconomic status

Key Points

- Over half of high school-age, sports-related emergency department visits were for nonurgent injuries.
- Patients with public insurance were more likely to have an ED visit for a nonurgent injury compared to patients with private insurance.
- Patients from the lowest estimated neighborhood income quartile were more likely to have an ED visit for a nonurgent injury compared to patients from the highest estimated neighborhood income quartile.

Nonurgent emergency department (ED) utilization poses a significant challenge for the U.S. healthcare system. Despite higher average costs compared to other forms of healthcare delivery, an estimated 50% of ED visits are potentially avoidable and contribute to approximately $38 billion in wasteful spending annually[1]. In adolescent populations, sports injuries are a major cause of ED visits. Over 7.6 million students participate in high school athletics each year[2]. An estimated 1.3 million annual high school sports-related injuries occur across 9 sports alone[3]. Despite the lack of a consistent definition for nonurgent ED use, the relationship between patient characteristics such as socioeconomic status and insurance type and nonurgent ED use have been studied across a variety of populations[4], but little research has focused specifically on high school sports-related nonurgent ED visits.

Athletic trainers (ATs) are allied healthcare professionals who provide healthcare services that include primary care, injury and illness prevention, emergent care, examination and clinical diagnosis, and management and rehabilitation of musculoskeletal injuries in physically active populations under the direction of a physician[5]. High schools are a predominant practice setting for ATs[6], and they can be an effective source of injury prevention and management in high school populations[7]. Two-thirds of high schools have access to a full-time or part-time AT[8], but disparities in high school AT access based on socioeconomic status, insurance status, school size, and graduation rates exist[9,10]. Less severe musculoskeletal ED visits may be manageable by ATs. A previous study of patterns in nonurgent musculoskeletal ED use only included conditions that are low severity and nonacute[11]. These criteria may be inadequate for studying high school sports-related injuries as it excludes acute conditions that could be managed by high school ATs making ED use unnecessary.

It is also unclear how patterns in ED use for high school sports-related injuries may differ based on insurance type and socioeconomic status. While some studies have found no differences[12], some evidence suggest higher income and privately insured patients may be more likely to use the ED for sport-related injuries[13]. Authors have suggested increased sports-related injuries may be associated with socioeconomic status because of increased exposure based on increased access to sports and recreation opportunities[14]. In contrast, a comparison of high and low-income socioeconomic high schools found that athletes from low socioeconomic high schools were twice as likely to use the ED despite similar rates of injury and injury severity[15]. There may be differences in high school sports-related ED use by income and insurance status based on the urgency of the injury.

Framing nonurgent high school sports-related ED use through the lens of an AT's skillset can provide a definition for nonurgent ED care specific to sports exposures that is missing from the literature. Nonurgent sports-related ED visits in a high school population could alternatively be managed by ATs. Understanding what population characteristics are associated with nonurgent sports-related ED visits can inform how AT access can be used to improve healthcare utilization. For this reason, the aim of this study was to compare the likelihood that a sports-related musculoskeletal injury ED visit in a high school-age population was for an injury manageable by an AT (and therefore nonurgent) across a patient's insurance type and estimated neighborhood income status. We tested the below hypotheses that for ED visits for a population of high school-age patients with musculoskeletal sports injuries:

1) patients with public insurance were more likely to have a nonurgent injury-related ED visit compared to patients with private insurance.

2) patients in the lowest neighborhood income quartile were more likely to have a nonurgent injury-related ED visit compared to patients in the highest neighborhood income quartile.

METHODS

Data Source

Our study is a pooled, cross-sectional analysis of 3 years (2017-2019) of high school-age, sports-related ED visits for musculoskeletal injuries. The data source was the Nationwide Emergency Department Sample (NEDS) from the Healthcare Cost and Utilization Project (HCUP) sponsored by the Agency for Healthcare Research and Quality. NEDS is the largest all-payer ED database in the United States containing over 28 million annual ED visits that can be weighted to get estimates of national, hospital-owned ED visits. Observations in NEDS are reported at the discharge level and cannot be tracked across unique patient identifiers[16].

NEDS is constructed using a stratified, single-stage cluster design. Discharge weights were applied to get national level estimates of ED use, and NEDS' complex survey design was accounted for during analysis to avoid biasing results and to correctly calculate standard errors.

Sample Population

The sample population included ED visits for high school-age patients that (1) had a primary diagnosis of musculoskeletal injury and (2) a diagnosis of sports-related injury. Because our definition of nonurgent uses an AT's "scope of care", a sample population that is likely to suffer from sports-related injuries relevant to ATs was chosen. High school age was estimated by limiting the sample to visits with patient ages 14-18 years. A primary diagnosis of a

musculoskeletal injury was approximated by only including visits with an International Classification of Diseases 10th edition (ICD10) code as the primary diagnosis starting with "M" or "S" that limits diagnoses to injuries and diseases of the musculoskeletal system. Musculoskeletal injuries related to postprocedural complications were excluded. Only visits with an ICD10 sports activity code on one of the 35 diagnoses variables for an observation were included in the sample to estimate sports-related injuries. Sports activity codes were only included for sports found on the National Federation of State High School Associations (NFHS) website list of high school activities and sports for which the NFHS issues rules[17]. The list of sports was used to define a categorical variable for type of sports participation and was included as a covariate.

Variable Specification

The outcome of interest is a dichotomous variable for nonurgent and urgent injuries based on an AT "scope of care" threshold (Figure 1). The primary author reviewed ICD10 codes creating a list of musculoskeletal injuries defined as AT "scope of care" injuries using the following criteria: 1) A musculoskeletal injury an AT could treat without additional healthcare use or 2) A musculoskeletal injury that an AT could manage and refer to another healthcare provider, but same day care is not needed based on the urgency of the condition.

Two other ATs (average professional experience of 24.5 years) independently reviewed the list of nonurgent injury ICD10 codes. A conservative approach was taken where any differences in whether a code required ED care went to the more conservative decision of ED care being appropriate. For observations with a primary diagnosis code for an unspecified injury ICD10 code (e.g., Unspecified ankle injury) or an injury that needed additional context to determine nonurgent/urgent status (e.g., concussion), Current Procedural Terminology

147 (CPT)/Healthcare Common Procedure Coding System (HCPCS) evaluation and management
148 codes that consider the severity of the visit and complexity of the medical decision-making were
149 used to assign codes to nonurgent and urgent groups. The list of nonurgent ICD10 codes was
150 searched across the primary diagnosis variable for each observation to determine if an injury
151 was nonurgent. The list of nonurgent injury ICD10 codes and unspecified injury ICD10 codes
152 used can be found in the supplemental files.

153 Several precautions were taken to ensure urgent injuries were not incorrectly coded as
154 nonurgent. Figure 1 illustrates the processes used to ensure correct classification of nonurgent
155 and urgent injuries in the sample population. The following checks were used:

156 • A list of ICD10 codes for urgent injuries and symptoms (e.g. fractures, dislocations, coma)
157 underwent the same review process as the list of nonurgent injury ICD10 codes. The list of
158 urgent injury ICD10 codes were searched across all 35 diagnoses variables to ensure no ED
159 visits for an urgent injury that appeared on a secondary diagnosis were classified as
160 nonurgent.
161 • CPT/HCPCS codes for evaluation and management of ED services that classify ED visits as
162 “high severity and require urgent evaluation”, “high severity and pose an immediate
163 significant threat to life or physiologic function”, or required critical care services were
164 searched across all 35 procedure variables and classified as urgent. ED visits that required
165 transfer to another facility for more advanced care were also classified as urgent.
166 • NEDS provides Clinical Classification Software (CCS) services and procedures codes that
167 group CPT procedure codes into 244 clinically significant groups [18]. CCS services and
168 procedure codes for services that indicate a medical condition of increased severity (e.g.,

surgical interventions) were searched across all procedure variables for an observation and classified as urgent.

The list of urgent injury ICD10 codes, CPT/HCPCS Evaluation and Management codes, and CCS services and procedure codes used can be found in the supplemental files. We used the same criteria on unspecified injury codes. Any observation with an unspecified injury where the severity of the visit could not be determined using CPT Evaluation and Management codes and were not flagged using the above criteria was removed from the sample because nonurgent/urgent status could not be determined.

The independent variables of interest were categorical variables defined by HCUP for patient insurance type and estimated neighborhood income. Insurance type consists of groups for public insurance (Medicare and Medicaid were collapsed together), private insurance, self-pay, and other (includes no charge, government programs for veterans, worker's compensation, and other government programs). HCUP separates estimated neighborhood income into four income quartiles (the 1st quartile being the lowest level of income and the 4th quartile being the highest) based on the estimated household median income of residents in a patient's zip code[16]. We selected covariates based on previous findings of factors that influence nonurgent ED use[4] and their availability within NEDS. Covariates for patient sex, injury region, sport participation, urban/rural location (rural includes any non-metropolitan county under 50,000 residents), weekend discharge, hospital region, and hospital trauma designation were included.

Analysis

Missing values were assessed using tabulation commands and missingness pattern tables. Within the sample population, we calculated nationally weighted estimates of the

191 percentages of nonurgent, urgent, and total injuries with corresponding confidence intervals for
192 different visit, patient, and hospital characteristics.

193 We reported weighted counts and frequencies of the five most frequent primary
194 diagnoses for urgent and nonurgent sports-related injuries. Diagnoses that were similar such as
195 left and right ankle sprains or different types of fractures of the same bone and region were
196 grouped together.

197 Unadjusted and adjusted odds ratios of a sports-related ED visit being for a nonurgent
198 injury across insurance type and estimated neighborhood income were calculated using survey
199 weighted logistic regression. Previous studies have found race to be a significant factor in both
200 sports-related ED use[19] and ED use for nonacute, low severity musculoskeletal conditions[11].
201 However, a race variable is only available in the 2019 NEDS. To test the sensitivity of our results,
202 an additional model using only data from 2019 that included a covariate for a patient's race was
203 analyzed.

204 Taylor linearized standard errors were used to calculate 95% confidence intervals (CIs).
205 The "svy" command in STATA was used during analyses to account for complex survey design.
206 Multicollinearity was assessed visually using tabulation commands and unweighted variance
207 inflation factors. All analyses were conducted using STATA software (version 17.0; StataCorp,
208 LLC, College Station, TX). The study protocol was reviewed by the Institutional Review Board at
209 [*hidden for blind review*] and determined the project met the definition of research but did not
210 involve human subjects.

211

212 **RESULTS**

The final sample included 251,472 observations that when weighted represent an estimated 1,070,263 high school-age, sports-related, musculoskeletal injury ED visits nationwide from the years 2017-2019. Of the observations that fit the population of interest, 7,619 observations were removed because nonurgent/urgent injury status could not be determined for the primary diagnosis. After removing observations with missing covariate values (4,753 observations), the final sample was missing under 5% (12,372 observations) of observations that fit our population of interest. Within the sample of estimated ED visits, 52.85% (95% CI: 51.02%, 54.68%) were for nonurgent injuries and 47.15% (95% CI: 45.32%, 48.98%) were for urgent injuries.

As shown in Table 1, just under three-fourths (71.77%) of all sports-related musculoskeletal injury ED visits were for male patients. The three most common forms of sport participation for musculoskeletal injury ED visits regardless of patient sex were basketball (29.40%), football (23.02%), and soccer (13.77%). The lower extremity was the most common body region of injury (40.31%) and among those lower extremity injuries a majority (67.81%) were nonurgent injuries. 80.78% of ED visits were for patients who lived in an urban area (metropolitan areas with over 50,000 people). The South region had the most sports-related ED visits (35.56%) of the four hospital regions.

46.66% of all sports-related musculoskeletal injury ED visits were for patients with private insurance compared to 44.31% with public insurance. Self-pay and other forms of insurance combined for less than 10% of ED visits. Among privately insured patients, a greater proportion of sports-related musculoskeletal injury ED visits were for urgent injuries (51.92%) compared to nonurgent injuries (48.08%), but the opposite was true for publicly insured

patients where 57.89% of ED visits were for nonurgent injuries and only 42.11% were for urgent injuries. Among estimated neighborhood income quartiles, the 1st quartile (lowest level of income) made up the largest percentage of all sports-related musculoskeletal injury ED visits (29.87%) when compared to other income quartiles.

Table 2 contains the five most common primary diagnoses by urgent and nonurgent injury status. Ankle sprain was the most common diagnosis making up 14.71% (132,616 nonurgent and 24,827 urgent ED visits) of all ED visits in the population of interest and 23.44% of ED visits for only nonurgent injuries. Both ankle sprains and concussions were a major source of injury for both urgent and nonurgent ED visits.

The survey weighted multivariate regression analysis included 251,472 observations representing an estimated 1,070,525 national ED visits. A single stratum was omitted from calculations of standard errors because a stratum from the 2018 NEDS where hospital trauma designation could not be determined was set to missing. When reviewed, the exclusion of this stratum did not significantly affect the calculation of coefficients or standard errors in the model.

In our high school-age, sports-related musculoskeletal injury population, patients with public insurance had a 39% higher odds (OR=1.39; 95% CI: 1.35,1.44) of having an ED visit for a nonurgent injury compared to ED visits for patients with private insurance when adjusting for other visit, patient, and hospital characteristics (Table 3). Our sensitivity analysis model that also included patient race had similar results (OR=1.40; 95% CI: 1.33,1.48). ED visits for self-pay patients and patients with “other” forms of insurance also had statistically significant higher odds of having an ED visit for a nonurgent injury when compared to private insurance. Patients

from the lowest estimated neighborhood income quartile had a 10% higher odds (OR=1.10; 95% CI: 1.02,1.20) of having an ED visit for a nonurgent injury compared to ED visits for patients in the highest estimated income quartile. This result was statistically significant across all models. ED visits for patients in the 2nd and 3rd quartiles had higher odds of having an ED visit for a nonurgent injury compared to ED visits for patients in the highest estimated income quartile though the results were not significant for the 2nd quartile in our adjusted model (OR=1.04; 95% CI: 0.98,1.10). For our model that included patient race as a covariate, Black patients and Hispanic patients had significantly higher odds of having an ED visit for a nonurgent injury when compared to White patients. Covariates for patient sex, injury region, hospital trauma designation, and hospital teaching status were also statistically significant across all three models.

DISCUSSION

In this study, we analyzed over 250,000 observations representing more than 1 million national, sports-related ED visits in a high-school age population across three years. Similar to previous study findings, ankle sprains were the most common type of injury and football and basketball were the most common sports associated with healthcare use[20]. Our study population had similar proportions of sports-related ED visits for patients with private insurance (46.66%) and public insurance (44.31%) and an increased proportion of sports-related ED visits for the lowest estimated neighborhood income quartile when compared to higher quartiles. These findings contrast with studies that have found higher percentages of ED visits for sports-related injuries in privately insured and higher income populations[13,21].

These differences may be driven by the parameters of the study population and year of study. Previous findings have focused on pediatric and adult populations that include younger and older age groups than our high school-age population. While the availability of school-based sports has declined recently, they still are often an important source of sport access for lower-income youth[22,23]. Lower income populations at the high school age may have increased sport exposure and chance for injury compared to other age groups that do not have access to school sports. Additionally, previous studies that were conducted before the expansion of Medicaid under the Affordable Care Act may not reflect current levels of publicly insured individuals. Differences in how the sport participation was defined and what sports or recreational activities were included likely play a role as well[13,21].

Our findings showed that patients with public insurance and the lowest estimated neighborhood income status both had higher odds of an ED visit being for a nonurgent injury when compared to patients with private insurance and the highest estimated neighborhood income status in a high-school age, sports-related musculoskeletal injury population. These findings stayed constant when controlling for other visit, patient, and hospital characteristics and in our sensitivity analysis that included a covariate for patient race.

Lack of access to primary care has been identified as an important factor in nonurgent ED use in Medicaid and lower socioeconomic status patients[24]. Medicaid patients were more likely to have trouble accessing follow-up orthopedic care after an ED diagnosed injury compared to privately insured patients[25]. Even more specific to our study population, disparities in high school AT access based on socioeconomic status have been identified at the national level[9]. Lack of access to primary care, orthopedic-specific care, and AT services likely contribute

to the increased likelihood of ED use for nonurgent, sports-related injuries by publicly insured and lower socioeconomic status individuals in the study population though data limitations do not allow us to measure the impact of the availability of different types of care. Previous research has suggested that AT availability may reduce ED visits and healthcare spending per patient for patients with Medicaid[26]. Future studies should measure the effect of the availability of different sources of healthcare on nonurgent, sports-related ED use to inform prevention efforts.

Given our definition of nonurgent using an AT "scope of care" threshold, it is likely that the nonurgent ED visits identified could be alternatively managed by ATs if accessible. Our definition also captures acute ED events not previously identified by other studies of low-severity, musculoskeletal ED visits. ATs have the skillset to successfully prevent and manage musculoskeletal injuries in high school populations[7,27,28] and there is evidence that they can be a cost-effective form of care[29]. High school ATs provide services within school settings and largely serve as non-reimbursable providers. These attributes remove barriers to care that may inhibit primary care and other orthopedic health professionals from reducing unnecessary musculoskeletal ED visits in lower income and publicly insured populations. Nonurgent injuries can also impose significant costs and result in low-value care for these vulnerable patient populations. A recent study of Florida ED utilization suggested ACL tears that presented to the ED were only correctly diagnosed less than 5% of the time and resulted in an average of $4000 of additional costs per patient[30]. Nondescript primary diagnoses such as "knee sprain", "unspecified head injury", and "knee pain" were the third, fourth, and sixth most common nonurgent injury diagnoses in our sample despite more specific ICD10 codes being available for

knee and head injuries. These may be opportunities to improve patient care while also saving medical costs. Future studies should look to quantify the financial burden of nonurgent, sports-related ED visits and the effect that AT access have on ED use to better inform resource allocation decisions related to ATs.

Though increased access to AT services may be beneficial with respect to mitigating ED use for nonurgent, sports-related injuries, access alone may be insufficient to fully maximize their potential impact on nonurgent ED use. Uscher-Pines et al[4] created a conceptual framework for understanding factors that lead to nonurgent ED use. Perceived severity, convenience, beliefs and knowledge about alternatives, access/availability, cost, and advice/referral are all considered causal pathway factors in a patient's selection of healthcare. Factors such as insurance, sex, race, and income are considered associated factors that influence ED use through a causal pathway[4]. ATs should account for how their clinical practices may impact both causal pathways and associated factors in nonurgent ED use. For example, knowledge and trust in an AT's skillset are likely a causal pathway factor. A study found only 36% of patients seen in the ED for low severity musculoskeletal conditions believed their primary care provider could manage their musculoskeletal condition[11]. Similarly, gaps in understanding the skillset of ATs and trust in their medical knowledge have been identified[31].

An AT's clinical environment may impact their ability to address causal pathways and associated factors for nonurgent ED use. Budget constraints or hours of availability may limit an AT's ability to address patient needs that may lead them to seek care elsewhere. Injuries that require an AT to refer a patient for additional orthopedic care may have difficulty finding a provider if there are limited healthcare choices in the area. Emphasis on patient education,

culturally competent care, and evaluation of referral networks within AT practices may improve patient care while also reducing unnecessary ED use. Future research should focus on directly measuring the impact of AT services versus no AT services on healthcare utilization and examine how different patient and practice setting characteristics modify health outcomes.

There are several limitations to this study. There is only so much clinical detail that can be gleaned from ICD10 codes in determining the urgency of a musculoskeletal condition. Our use of both expert input from experienced ATs and a multi-step process that accounted for CPT and CCS procedures and services codes in defining nonurgent and urgent ED visits helps account for complexity not captured by ICD10 codes alone and have been used to evaluate ED visit severity in previous studies[32]. For example, while ankle sprains were included in our list of nonurgent injuries, a significant amount were coded as urgent injuries based on our review process that accounted for secondary urgent injuries, the complexity and severity of the visit, and the intensity of the treatment received. This likely captures injuries like severe ankle sprains where an ankle fracture may be suspected and referred to the ED out of caution. When conducting more conservative analyses including only observations that had CPT evaluation and management codes, our main results did not significantly differ.

Another limitation is that because we do not know a patient's access to care outside the ED, it is possible that a patient who utilized the ED for a nonurgent injury was referred to the ED by an AT despite our definition of nonurgent using an AT "scope of care" threshold. For example, some ankle sprains or concussions classified as nonurgent could have been referred to the ED by an AT based on findings using Ottawa Ankle Rules or a concussion assessment tool. Our review process accounts for urgent injury symptoms and other indicators of the complexity and

severity of a case that may account for cases referred by ATs. We acknowledge that being unable to directly identify patients' AT access remains a limitation that current data cannot fully address. We envision future research that directly measures how AT access can affect healthcare utilization, towards which our current study is a key step. Our definition of nonurgent also assumes an AT works to the full level of their expertise, though this may not be the case based on an AT's experience level and clinical environment factors mentioned previously. Our use of ICD10 activity codes for identifying sport participation also does not allow us to differentiate between school, club, or recreational sports. Different sport participation settings may impact both the availability of immediate medical care like ATs and what populations are exposed. Future studies should look to differentiate between types of sport participation to determine its effects on nonurgent ED use and other healthcare use.

CONCLUSION

In our study population of high school-age patients with a sports-related, musculoskeletal injury, patients with public insurance and from the lowest estimated neighborhood income quartile had higher odds of having an ED visit for a nonurgent injury when compared to patients with private insurance and the highest estimated neighborhood income quartile respectively. A likely contributor to our results are socioeconomic disparities in access to orthopedic and AT-specific care documented in previous studies[9,25]. Expanding AT services access as well as addressing factors that limit an AT's ability to practice to their full level of expertise may be help decrease nonurgent ED use, reduce wasteful healthcare spending, and improve patient care in vulnerable populations in the United States.

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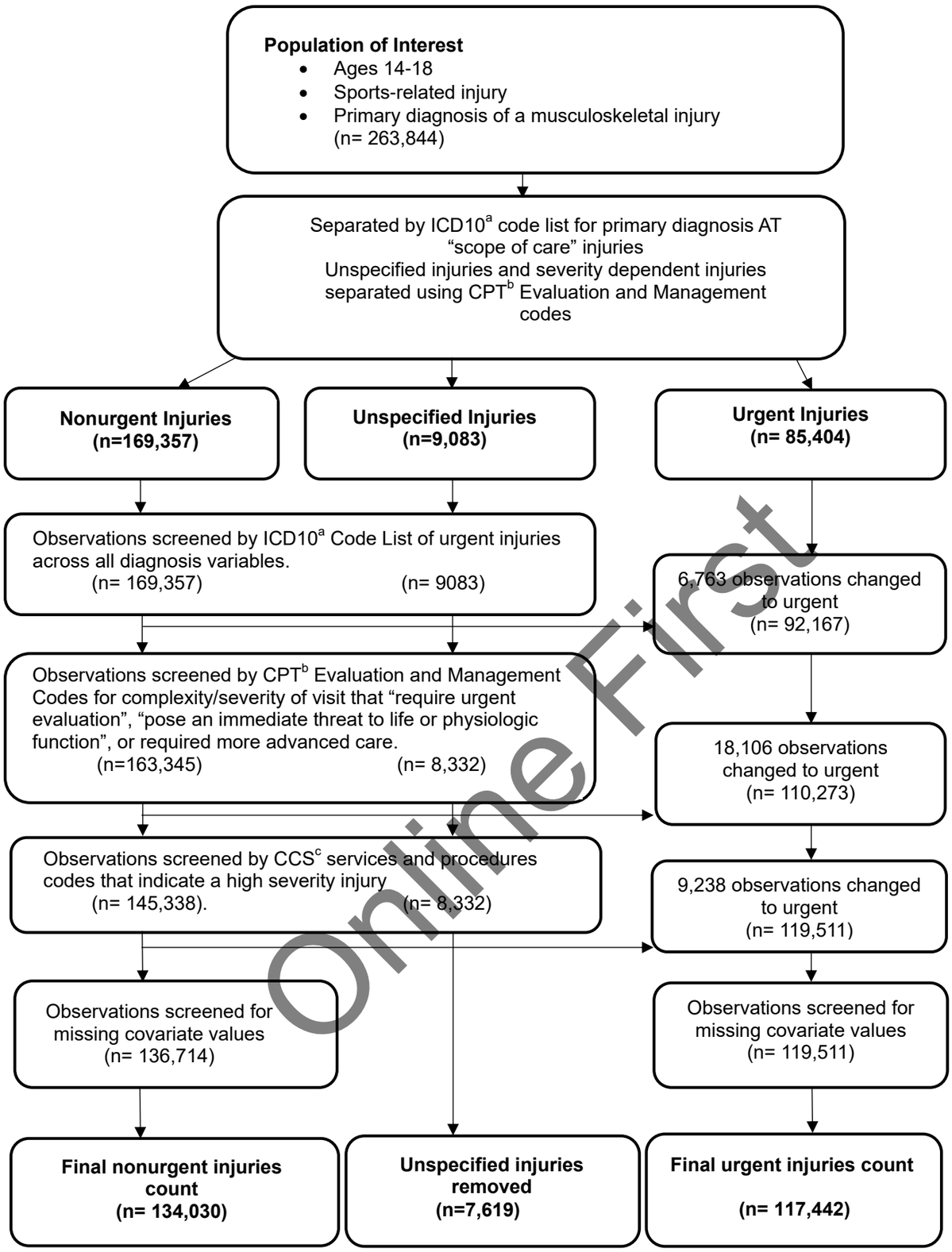
Figure 1: Process for Defining Nonurgent and Urgent Injuries Using an Athletic Trainer "Scope of Care" Threshold



a International Classification of Diseases 10th edition
b Current Procedure Terminology
c Clinical Classification Software

Table 1: Proportion of Visit, Patient, and Hospital Characteristics by Urgent, Nonurgent, and Total Injuries for National High School-age, Sports-related Injury ED Visits: 2017-2019 NEDS

Variables	**Urgent injuries** National estimate: 504,586 (n= 117,442) % (95% confidence intervals)	**Nonurgent injuries** National estimate: 565,677 (n= 134,030) % (95% confidence intervals)	**Total injuries** National estimate: 1,070,263 (n= 251,472) % (95% confidence intervals)
Insurance type			
Public insurance	39.57 (38.24,40.93)	48.53 (47.32,49.74)	44.31 (43.18,45.44)
Private insurance	51.39 (50.07,52.70)	42.44 (41.25,43.64)	46.66 (45.54,47.78)
Self-pay	6.01 (5.70,6.33)	5.76 (5.48,6.06)	5.88 (5.61,6.16)
Other	3.03 (2.65,3.46)	3.27 (2.87,3.73)	3.16 (2.78,3.58)
Estimated neighborhood Income			
1st quartile	28.36 (26.86,29.91)	31.22 (29.61,32.88)	29.87 (28.37,31.42)
2nd quartile	25.32 (24.23,26.45)	26.00 (24.83,27.21)	25.68 (24.60,26.80)
3rd quartile	22.48 (21.64,23.35)	22.06 (21.05,23.11)	22.26 (21.37,23.18)
4th quartile	23.83 (22.14,25.61)	20.72 (19.02,22.52)	22.19 (20.53,23.93)
Race[a]			
White	53.83 (51.35,56.29)	48.86 (46.07,51.66)	51.16 (48.62,53.71)
Black	20.80 (18.90,22.84)	23.07 (20.96,25.32)	22.02 (20.11,24.06)
Hispanic	17.12 (15.42,18.96)	20.22 (17.96,22.68)	18.78 (16.83,20.90)
Other	8.25 (7.25,9.37)	7.85 (6.78,9.07)	8.03 (7.04,9.15)
Sex			
Male	77.07 (76.67,77.46)	67.04 (66.63,67.46)	71.77 (71.45,72.09)
Female	22.93 (22.54,23.33)	32.96 (32.54,33.37)	28.23 (27.91,28.55)
Patient location			
Urban	81.64 (79.86,83.30)	80.01 (78.74,81.23)	80.78 (79.40,82.09)
Rural	18.36 (16.70,20.14)	19.99 (18.77,21.26)	19.22 (17.91,20.59)
Injury Region			
Upper extremity	36.28 (35.58,36.98)	25.61 (25.30,25.92)	30.64 (30.36,30.92)
Lower extremity	27.52 (26.56,28.51)	51.72 (51.23,52.21)	40.31 (39.96,40.66)
Head/neck/trunk	35.45 (34.50,36.43)	20.88 (20.35,21.41)	27.75 (27.28,28.22)
Other/Unspecified	0.75 (0.39,1.41)	1.80 (1.58,2.04)	1.30 (1.02,1.66)
Sport			
Running	6.85 (6.54,7.17)	7.59 (7.38,7.81)	7.24 (7.04,7.45)
Aquatics (swimming/diving/water polo)	1.60 (1.49,1.72)	1.00 (0.93,1.06)	1.28 (1.22,1.35)
Ice hockey	2.31 (1.99,2.67)	1.34 (1.16,1.55)	1.80 (1.57,2.05)
Gymnastics/cheerleading	3.60 (3.47,3.74)	4.43 (4.27,4.60)	4.04 (3.92,4.17)

Golf/bowling	0.25 (0.22,0.28)	0.26 (0.23,0.29)	0.25 (0.23,0.27)
Field events	0.29 (0.25,0.33)	0.32 (0.29,0.35)	0.30 (0.28,0.33)
Football	24.97 (24.50,25.45)	21.28 (20.85,21.71)	23.02 (22.63,23.42)
Baseball/Softball	7.93 (7.69,8.18)	7.24 (7.04,7.45)	7.57 (7.39,7.75)
Lacrosse/Field hockey	2.38 (2.16,2.63)	1.97 (1.79,2.16)	2.16 (1.98,2.36)
Soccer	13.17 (12.70,13.65)	14.31 (13.90,14.73)	13.77 (13.39,14.16)
Basketball	28.25 (27.71,28.80)	30.43 (29.86,30.99)	29.40 (28.90,29.90)
Volleyball	2.82 (2.71,2.93)	5.05 (4.90,5.21)	4.00 (3.88,4.11)
Wrestling	5.59 (5.35,5.83)	4.80 (4.63,4.97)	5.17 (5.01,5.33)
Discharge Quarter			
January-March	21.84 (21.47)	23.04 (22.71,23.38)	22.48 (22.19,22.76)
April-June	22.92 (22.57,23.27)	22.40 (22.07,22.73)	22.64 (22.37,22.92)
July-September	27.73 (27.33,28.12)	26.62 (26.25,26.98)	27.14 (26.82,27.47)
October-December	27.51 (27.08,27.95)	27.94 (27.54,28.35)	27.74 (27.39,28.10)
Weekend Status			
Weekday visit	73.01 (72.52,73.49)	74.12 (73.75,74.48)	73.59 (73.22,73.96)
Weekend visit	26.99 (26.51,27.48)	25.88 (25.52,26.25)	26.41 (26.04,26.78)
Hospital Region			
Northeast	19.42 (16.96,22.15)	19.34 (17.40,21.45)	19.38 (17.32,21.62)
Midwest	24.77 (21.41,28.46)	24.20 (21.93,26.62)	24.47 (21.86,27.27)
South	37.36 (32.12,42.91)	33.95 (31.66,36.33)	35.56 (32.13,39.14)
West	18.45 (16.42,20.68)	22.50 (20.64,24.48)	20.59 (18.77,22.55)
Hospital Trauma Designation			
Non-trauma center	50.23 (45.51,54.94)	58.37 (55.75,60.94)	54.53 (51.11,57.91)
Trauma center	49.77 (45.06,54.49)	41.63 (39.06,44.25)	45.47 (42.09,48.89)
Hospital Teaching Status			
Non-teaching	39.47 (35.67,43.40)	44.76 (42.37,47.16)	42.26 (39.41,45.17)
Teaching	60.54 (56.60,64.33)	55.24 (52.84,57.63)	57.74 (54.83,60.59)

a Statistics for race only use data from 2019 NEDS N=325,570 (n=75,592).

Table 2: Weighted Counts and Percentages of Most Common Principal Diagnoses by Urgent and Nonurgent Injuries in National High School-age, Sports-related Injury ED Visits: 2017-2019 NEDS

Urgent Injuries national estimate: 504,586 (n=117,442)			Nonurgent Injuries national estimate: 565,677 (n=134,030)		
Principal diagnosis description	Weighted count	Percent of urgent injuries (%)	Principal diagnosis description	Weighted count	Percent of nonurgent injuries (%)
Open wound of the head and face	54,391	10.78	Ankle sprain	132,616	23.44
Concussion	36,502	7.23	Concussion	32,776	5.79
Ankle sprain	24,827	4.92	Unspecified knee sprain	29,503	5.22
Lower end of the radius fracture	24,776	4.91	Unspecified head injury	20,764	3.67
Clavicle fracture	18,760	3.72	Other and unspecified wrist sprain	19,635	3.47

Table 3: Odds Ratios of an ED Visit Being for a Nonurgent Injury for National High School-age, Sports-related Injury ED visits: 2017-2019 NEDS

Variables	Model 1: Unadjusted odds ratios (95% CIs)	Model 2: Adjusted odds ratios (95% CIs)	Model 3: Adjusted odds ratios (95% CIs) with race
	Years: 2017-2019 National estimate: 1,070,525 (n=251,472)	Years: 2017-2019 National estimate: 1,070,525 (n=251,472)	Years: 2019 National estimate: 325,570 (n=75,592)
Insurance type (ref= Private insurance)			
Public insurance	1.48 (1.42,1.55)	1.39 (1.35,1.44)	1.40 (1.33,1.48)
Self-pay	1.16 (1.10,1.23)	1.16 (1.10,1.22)	1.12 (1.03,1.22)
Other	1.31 (1.21,1.41)	1.30 (1.19,1.42)	1.23 (1.09,1.39)
Estimated neighborhood Income (ref= 4th quartile (highest income)			
1st quartile	1.27 (1.19,1.35)	1.10 (1.02,1.20)	1.15 (1.02,1.31)
2nd quartile	1.18 (1.12,1.25)	1.04 (0.98,1.10)	1.07 (0.96,1.18)
3rd quartile	1.13 (1.08,1.18)	1.05 (1.00,1.11)	1.09 (1.00,1.18)
Race (ref= White)			
Black			1.10 (1.02,1.19)
Hispanic			1.09 (1.00,1.17)
Other			0.94 (0.84,1.05)
Sex (ref= Male)			
Female	1.65 (1.61,1.70)	1.58 (1.53,1.63)	1.57 (1.50,1.64)
Patient location (ref= Urban)			
Rural	1.11 (1.02,1.22)	0.96 (0.90,1.02)	0.98 (0.89,1.07)
Injury Region (ref= Upper extremity)			
Lower extremity	2.66 (2.52,2.81)	2.64 (2.53,2.77)	2.71 (2.55,2.87)
Head/spine/torso	0.83 (0.80,0.87)	0.85 (0.82,0.89)	0.80 (0.76,0.86)
Other/unspecified	3.41 (1.99,5.85)	3.61 (2.39,5.46)	4.44 (3.57,5.53)
Sport (ref= Football)			
Running	1.30 (1.23,1.37)	0.74 (0.71,0.78)	0.80 (0.74,0.87)
Aquatics	0.73 (0.67,0.80)	0.63 (0.57,0.69)	0.63 (0.54,0.75)
Ice hockey	0.68 (0.62,0.76)	0.86 (0.78,0.94)	0.84 (0.71,1.00)
Gymnastics/cheerleading	1.45 (1.38,1.52)	1.02 (0.97,1.08)	1.04 (0.94,1.15)
Golf/Bowling	1.21 (1.02,1.43)	1.08 (0.91,1.29)	1.18 (0.88,1.58)
Field events	1.28 (1.09,1.51)	0.88 (0.74,1.04)	0.62 (0.44,0.88)

Baseball/Softball	1.07 (1.03,1.12)	0.95 (0.91,1.00)	1.00 (0.92,1.08)
Lacrosse/Field hockey	0.97 (0.90,1.05)	1.07 (0.99,1.16)	1.02 (0.88,1.18)
Soccer	1.28 (1.22,1.33)	0.93 (0.90,0.97)	0.97 (0.91,1.03)
Basketball	1.26 (1.23,1.30)	0.97 (0.95,1.00)	1.01 (0.95,1.06)
Volleyball	2.11 (2.00,2.21)	1.29 (1.22,1.36)	1.36 (1.24,1.50)
Wrestling	1.01 (0.96,1.06)	1.03 (0.98,1.08)	1.01 (0.93,1.10)
Discharge Quarter (ref= January-March)			
April-June	0.93 (0.90,0.95)	0.93 (0.91,0.96)	0.94 (0.89,0.99)
July-September	0.91 (0.89,0.93)	0.95 (0.92,0.98)	0.95 (0.90,1.01)
October-December	0.96 (0.93,0.99)	1.00 (0.97,1.03)	0.97 (0.91,1.02)
Weekend Status (ref= Weekday visit)			
Weekend visit	0.94 (0.92,0.97)	0.97 (0.95,0.99)	1.00 (0.96,1.04)
Hospital Region (ref= Northeast)			
Midwest	0.98 (0.88,1.09)	0.97 (0.86,1.08)	0.98 (0.84,1.15)
South	0.91 (0.76,1.10)	0.80 (0.65,0.99)	0.84 (0.72,0.98)
West	1.22 (1.13,1.33)	1.14 (1.05,1.24)	1.11 (0.97,1.26)
Hospital Trauma Designation (ref= Non-trauma)			
Trauma	0.72 (0.62,0.83)	0.75 (0.66,0.85)	0.81 (0.72,0.90)
Hospital Teaching Status (ref= Non-teaching)			
Teaching	0.80 (0.71,0.91)	0.88 (0.79,0.96)	0.86 (0.77,0.96)