doi:10.4085/1062-6050-0587.24

TREATMENT AND COST CHARACTERISTICS OF ATHLETIC TRAINING SERVICES IN SECONDARY SCHOOLS FOR KNEE AND ANKLE CASES

Katie Sniffen, PhD, ATC (corresponding author)
Assistant Professor, Program Director
Saint Louis University
Katie.sniffen@health.slu.edu
(209) 505-7128
@katie_atc
Christy Collins, PhD
President
Datalys Center
ccollins@datalyscenter.org
Michael Rozier, PhD
Associate Professor, Department Chair
Department of Health Management & Policy
Saint Louis University
michael.rozier@slu.edu
@RozierSJ
Katie Stamatakis, PhD, MPH
Associate Professor
Department of Epidemiology & Biostatistics
Saint Louis University
katie.stamatakis@slu.edu
Paula Buchanan, PhD
Professor
Department of Health and Clinical Outcomes Research
Saint Louis University
paula.buchanan@health.slu.edu
Leslie Hinyard, PhD, MSW
Professor, Department Chair
Department of Health & Clinical Outcomes Research
Saint Louis University
leslie.hinyard@health.slu.edu

TREATMENT AND COST CHARACTERISTICS OF ATHLETIC TRAINING SERVICES IN SECONDARY SCHOOLS FOR KNEE AND ANKLE CASES

ABSTRACT

Context: The monetary costs of sport-related injuries are significant, but complexity in public and private payers and disparate injury-reporting systems create challenges in accurately estimating their economic impact. Few studies have characterized the cost of athletic training services for sport-related injuries.

Objective: To describe the treatment and cost characteristics of high school athletic training services provided to student-athletes for knee and ankle cases.

Design: Cross-sectional study

Setting: Secondary schools

Patients: High school student-athletes receiving athletic training services for knee and ankle cases

Main Outcome Measure(s): Treatment and costs characteristics of athletic training services provided to high school student-athletes for knee and ankle cases, including comparison of total cost of care by gender, sport, and injury severity outcome.

Results: Between 2014-2019, 219 knee and 400 ankle cases and their associated treatments were documented by athletic trainers in the National Athletic Treatment, Injury and Outcomes Network Surveillance Program. Therapeutic exercises and ankle strapping were the most commonly documented services. The median estimated total cost of care was $124.20 (IQR $75.44-$231.64) per knee case and $148.58 (IQR $27.00-287.10) per ankle case. Median total cost of care varied across injury severity.

Conclusion: This study provides insights into the cost characteristics of high school athletic training services. While costs were generally lower than previous reports, the findings highlight the worth of athletic training services in managing knee and ankle cases and underscore the need for improved documentation and cost data collection to further demonstrate the economic value of athletic training services.

Key Words: affordable healthcare, healthcare services, secondary school

Abstract Word Count: 246 words

Body of Manuscript Word Count: 3,569 words

Key Points:

1. Athletic trainers provide a wide range of comprehensive services to manage high school student-athlete lower extremity injuries, yet the costs of these services are generally underestimated.
2. Improved documentation and cost data collection are needed to fully capture the economic impact of athletic training services and advocate for appropriate resources.

The monetary costs of sport-related injuries are believed to be significant despite difficulties in accurately capturing the true amount of this burden. Variability in the cost, coverage, and access to care between public and private medical insurance payers and disparate injury-reporting systems create challenges in estimating the total economic impact of sport-related injuries. Emergency departments (ED) are a common source of data for economic analyses of illness and injuries because they capture a wide range of patient conditions across a broad sample of the population and use standardized electronic health records for simplified data collection.[1] An estimated $447 million is spent each year on adolescent (13-19 years old) ED visits for sport-related injuries.[2] However medical care for sport-related injuries also occurs outside the ED in ambulatory facilities such as urgent cares, physician offices, and athletic training clinics. Sport-related injury medical costs are further exacerbated by indirect costs, including human capital costs and loss of quality of life.[3,4] By limiting these analyses to EDs, current evaluations may under-estimate the true scope of sport-related injury epidemiology, cost of healthcare services, and patient outcomes.[5,6] Furthermore, estimations of services provided by non-physician healthcare providers (e.g. athletic trainers) that are specifically trained in the prevention, assessment and management of sport-related injuries are even less understood, but may illuminate opportunities for more appropriate and cost-effective musculoskeletal healthcare.

Athletic trainers are an example of non-physician healthcare professionals trained in the prevention, assessment, and management of emergent, urgent, and nonurgent musculoskeletal injuries. Athletic trainers can be employed by high schools to provide athletic training (AT) services to student-athletes to manage sport-related injury. However, few studies have attempted to capture the cost characteristics of AT services for sport-related injuries in this setting. Traditionally, school-based AT services come at no out-of-pocket cost to the patient, but rather

are paid through school, school district, or affiliated healthcare system budgets. School-based athletic trainers are hired at a base salary and provide services without third-party reimbursement or fee-for-service business models. While athletic trainers document the services they provide, documentation is not always done in a way that facilitates medical claims data that can be used to demonstrate the worth and value of AT services.[7-9] One group of researchers has attempted to evaluate the economic impact of hiring athletic trainers in secondary school settings. Using Oregon's All Payer All Claims data, Medicaid and commercial claims were evaluated at the zip code level during periods of time when athletic trainers were and were not employed.[10] While no statistically significant differences were found under this analysis, a secondary study using microsimulation exposed an average $64 per patient savings for Medicaid payers and reduced emergency visits for both Medicaid and commercial insurance payers.[11]

Research out of the Athletic Training Practice-Based Research Network (AT-PBRN) has described the direct costs of care for knee and ankle injuries across a variety of AT practices, but 83% of their reported data is from secondary school settings.[12,13] Applying the Centers for Medicare and Medicaid Services (CMS) Physician Fee Schedule to Current Procedural Terminology (CPT) codes in the electronic medical record (EMR), researchers estimated median direct costs of care for knee injuries at $73 per visit and $564 per injury. Estimated median direct costs for ankle injuries were $65 per visit and $359 over the duration of care. Specific to high school AT services, the High School National Athletic Treatment, Injury and Outcomes Network – Surveillance Program (NATION-SP), a high school injury surveillance database managed by the Datalys Center, captures injury surveillance, treatment, and patient-reported outcomes. While AT service characteristics have been described using this data source, cost characteristics have not been documented.[14]

To date, only one medical record resource has been used in two studies to quantify potential costs of administered athletic training services.[12,13] Similar processes need to be conducted in other data sources to expand upon the current knowledge of AT service costs and move the needle on demonstrating the value of AT services in the high school setting. Currently, only about one third of public high schools in the US have a full-time athletic trainer.[15] Economic analyses of AT services would enable athletic trainers and advocates of the profession to quantify the worth of AT services and use them in combination with patient outcomes to characterize their value. This type of information helps to articulate the importance of access to AT healthcare services in secondary school settings.[16]

The purpose of this study was to describe the treatment and cost characteristics of AT services provided for knee and ankle cases to high school student-athletes. Knee and ankle cases were chosen because of the ability to compare results to previous literature.[12,13] An additional objective was to examine the total cost of AT services across patient and injury characteristics, specifically gender, sport, and injury severity. We hypothesized that estimated costs will be similar to those of previous studies using different data sources and that there would be differences in total cost of care across sport and injury severity.

METHODS

Data Source

The NATION-SP is an injury surveillance program that captures injury and treatment data documented in electronic medical record systems by athletic trainers in the high school setting. NATION-SP is maintained by the Datalys Center for Sports Injury Research and funded by the National Athletic Trainers' Association. The NATION-SP is made up of a convenience sample of high schools with access to an athletic trainer that are recruited using a rolling

recruitment model.[17] Participating athletic trainers complete daily reports that include athlete exposures (e.g., practice, training, or competition), injury information, and AT services provided. Demographic information collected on the patient includes age, gender, height, mass, and sport. Reportable injuries are those that occurred during participation in an organized high school athletic event and that required the attention of an athletic trainer or physician, regardless of whether the injury prevented the patient from continuing to participate or not.[17] Injury information includes diagnosis, time loss in days, mechanism of injury, and anatomical side. In addition to reportable injuries, cases that received an AT service as part of preventative care but were not associated with an injury diagnosis were also documented. An AT service is defined as any type of manual therapy, modality, exercise, and evaluation, testing, or skills session administered by an AT (Table 1).[17] Treatment information includes the number of days in which a patient received one or more AT services (*treatment sessions)* and the number of times a specific AT service was provided. Data exported out of the EMR are de-identified and securely transferred to the Datalys Center for quality control processing to verify and review the data for accuracy and completeness.[17] Inclusion criteria for this study were knee and ankle cases that received AT services between the 2014/15 and 2018/19 academic years for all sports. The sample includes cases that were associated with an injury diagnosis and that were part of preventative care to capture the full scope of AT services provided for each body part. Since this protocol used an existing data source, it was determined non-human subjects research and deemed exempt from full review by the organization's Institutional Review Board.

Variables/Measures

Patient *gender* (male/female) and sport were included as patient demographic variables. In addition to the *injury diagnosis*, an existing categorical *outcome* variable in the dataset was

used as a proxy for *injury severity,* where increasing amounts of time loss due to injury indicated increased severity. This 9-level variable included 'did not interfere with activity,' 'returned to team activity within same session,' 'removed from team activity session (returned within 24 hours),' 'prevented participation 1-6 days, prevented participation 7-13 days,' 'prevented participation 14-29 days,' 'prevented participation 30+ days,' 'out for remainder of season,' and 'unknown.'

The number of *treatment sessions* was identified as the number of days in which a patient received one or more AT services. *Athletic training services* were categorized into applicable CPT codes that appropriately captured the type of service (Table 1). Similar categorizations have been used previously to describe treatment characteristics documented in the NATION-SP.[14] The *type of service* was also described as time- or service-based, where service-based services incur a unit of service regardless of the time they are administered, and time-based services incur a unit of service for every increment of time the service is provided (e.g., 15-min increments of ultrasound). The NATION-SP treatment data only indicates the number of times a service was provided, so an assumption was made that a single time-based service represented the corresponding increment of time for one unit of that service.

Cost of services were identified using the national Physician Fee Schedule values for non-institutional services reported by the CMS. While there are current CPT codes of AT evaluations (97169-97171), cost estimates for AT evaluations were based on those for physical therapy evaluations (97161-97163) because CMS does not currently recognize AT evaluations as a reimbursable service and therefore they are not included in the Physician Fee Schedule Look-up Tool.[18] Physician Fee Schedule values vary from year to year, so a *cost per unit of service*

variable was created by applying the Physician Fee Schedule value to each CPT code category for the corresponding years that it was documented.

Data Analysis

All analyses were performed for knee and ankle cases separately. Distribution of case's total cost and cost per session were evaluated for potential outliers using three times the length of the IQR to identify potential outlier cases. Mean, standard deviation, and range of fees were reported for 23 AT services provided for knee and ankle cases in the high school setting. Two calculations were performed to further describe the AT services provided within the sample. The number of services per case and the number of services per treatment session were reported using median and interquartile range due to the skewed distribution of the data. These variables were created in line with previous studies using alternative data sources to describe cost characteristics of AT services.[12,13]

Costs were reported per visit and per patient case using median and interquartile range for knee injuries and ankle cases separately to allow for comparison to previous studies.[12,13] For cases associated with an injury diagnosis, median total cost for care for knee and ankle treatments were reported across *gender*, *sport*, and *injury severity*. Preventative care cases were excluded from this analysis because these cases lacked the *outcome* variable. All analysis was completed in IBM SPSS Statistics for Windows, version 29.[19]

RESULTS

Athletic trainers provide a wide range of services for knee and ankle cases with several factors contributing to the costs associated with such services (Table 2).

Knee and Ankle Cases

Between the 2014/15 and 2018/19 academic years, 1,532 knee cases and 1,854 ankle cases were documented by ATs participating in the NATION-SP. AT services were recorded for 219 unique knee cases and 400 unique ankle cases. Observation of the distribution of *total cost of care* and *cost of care per session* outcomes revealed a positively skewed distribution for both knee and ankle cases. Cases that fell outside three times the length of the IQR were evaluated as potential outliers. These included one knee case with a *total cost of care* of $2617.91and two ankle cases with *total costs of care* of $2,884.53 and $2,727.05 that had a greater than $1,000 gap above other cases. However, we decided to include these cases as the treatments provided and number of sessions were within a clinically acceptable standard of care. In addition, the inclusion of outliers does not have an effect on the median costs being reported. Of the 219 unique knee cases, 177 cases were associated with an injury diagnosis and 42 cases were associated with preventative care without injury diagnosis. Of the 400 unique ankle cases, 260 cases were associated with an injury diagnosis and 140 cases were associated with preventative care without injury diagnosis (Figure 1).

Most knee and ankle cases were football athletes (81/219, 37.0%; 193/400, 48.3%; Table 3). Of the knee cases associated with an injury diagnosis, the most common knee injuries were medial collateral ligament sprain (24/177, 13.6%) patellar tendinopathy (24/177, 13.6%), and anterior cruciate ligament sprain (20/177, 11.3%; Table 4). Of the ankle cases associated with an injury diagnosis, the most common ankle injury was a sprain of the lateral ligament complex (189/260, 72.5%; Table 5).

Approximately 40% of diagnosed knee and ankle injuries did not prevent the athlete from participating in their sport for more than one day (77/177; 108/260). However, 17.5% (31/177) of diagnosed knee injuries and 31.5% (82/260) of diagnosed ankle injuries prevented participation

for 1-6 days. Nearly 15% (26/177) of diagnosed knee injuries kept student-athletes out for the remainder of the season (Table 6).

Treatment Characteristics

A total of 1,916 AT services were documented for the treatment of 219 knee cases across 1030 treatment visits. There was a median of 2 treatment visits (IQR 1-5) per patient case. There was a median of 4 AT services (IQR 2-8) provided per patient case and a median of 1.5 AT services (IQR 1.17-2.28) provided per visit. Therapeutic exercises were the most commonly documented AT service for knee cases (617/1916, 32.2%; Table 7).

A total of 3,303 AT services were documented for the treatment of 400 ankle cases across 1,892 treatment visits. There was a median of 2 treatment visits (IQR 1-6) per patient case. There was a median of 4 AT services (IQR 1-10) provided per patient case and a median of 1.33 AT services (IQR 1-2) provided per visit. Ankle strapping was the most commonly documented AT service for ankle cases, followed by therapeutic exercises (1206/3303, 36.5%; 759/3303, 23.0%; Table 7).

Treatment Costs

The median estimated total cost of care for knee cases was $124.20 (IQR $75.44-$231.64) per case with a median estimated cost of care per session of $52.02 (IQR $28.60-$82.54). The median estimated total cost of care for ankle cases was $148.58 (IQR $27.00-287.10) per case with a median estimated cost of care per visit of $43.87 (IQR $27.00-77.79). Median total costs of care across *gender, sport,* and *severity* are presented in Table 8.

DISCUSSION

This study is among the first to characterize the costs of AT services provided to patients in the high school setting, specifically using NATION-SP data. Similar to studies using AT-

PBRN data, therapeutic exercises and hot or cold packs were the most commonly documented AT service for knee cases.[13] For ankle cases, Marshall et al. previously reported hot or cold packs, therapeutic exercise, and AT reevaluation as the top three AT services provided for ankle sprains.[12] In this study, ankle strapping emerged as the most common AT service provided for ankle cases. Previous research using NATION-SP data also reported therapeutic exercises and ankle strapping among the most common types of AT services provided for ankle cases.[14] Ankle strapping is often provided as a prophylactic service, so the inclusion of preventative care in the NATION-SP data may explain the differences in the most common AT services provided for ankle cases between these two data sources. The combination of therapeutic exercise and ankle support interventions is supported as evidence-based and effective strategies to for the treatment of acute and recurrent ankle sprains.[20]

The median estimated total cost of care and cost of care per visit for knee cases was lower in this study ($124.20, IQR $75.44-$231.64; $52.02, IQR $28.60-$82.54) than the estimates reported by Lam et al. ($562, IQR $267-1080; $73, IQR $53-$92).[13] Similarly, the median estimated total cost of care and cost of care per visit for ankle cases was also lower in this study ($148.58, IQR $27.00-287.10; $43.87, IQR $27.00-77.79) than previously reported by Marshall, et al ($359.17, IQR $145.90-572.45; $65.08, IQR $33.79-$96.37).[12] These cost estimate differences may be due to the lower number of treatments per case reported in the NATION-SP data. In the AT-PBRN, there was a reported median 16 (IQR 8-17) treatment services per knee case compared to the median 4 (IQR 2-8) treatment services per knee case reported in the NATION-SP.[13] For ankle sprains there were an average of 18.6 (SD 13.7) treatment services per case reported using the AT-PBRN.[12] Median was not reported by Marshall, et al, but the low median of 4 (IQR 1-10) treatment services per ankle case reported in

the NATION-SP implies substantial differences in treatments per case between the two data sources. The AT-PBRN studies also only capture AT services provided for diagnosed injuries, while this study includes treatments for preventative care.[12,13] Preventative care largely included taping services or hot and cold packs that do not have a CMS-identified reimbursement rate. The higher volume of zero-cost services could result in lower median treatments per case and lower median costs per case as reported in the present study. Finally, the AT-PBRN studies, although made up largely of high school AT service documentation, did include a small sample of collegiate AT service documentation. Colleges and universities are typically better resourced to provide a greater number of treatment services, further contributing to these differences.[15,21]

Injury severity, as captured by the amount of time an injury prevented a patient from participating in their sport, may be an important determinant of the total cost of care. Previous literature has reported differences in the number and type of AT services provided for time-loss versus non-time loss injuries using the NATION-SP data.[14] In the present study, knee injuries that prevented participation in sport for 30 or more days and ankle injuries that prevented 7-29 days of sport participation had the highest median total costs of care. Injuries that require less than one week out of activity reflect shorter periods of time to accumulate services and may subsequently accrue fewer costs. Additionally, patients with season-ending injuries may be referred to physical therapy services as part of post-operative care, thus reducing the number and cost of AT services provided to these patients.[22] However, non-time loss injuries do still have costs associated with them and should be included in future investigations to provide a comprehensive characterization of AT healthcare service delivery.

Limitations and Future Directions

The results of this study may be under- or over-estimations of the true costs of AT services. Of the total 3,386 knee and ankle cases reported during the data collection period, only 619 cases included documentation of the AT services provided. ATs that contribute to the NATION-SP may opt to only report exposure and injury data and elect not to report treatment data. The resulting large proportion of cases without treatment data reduces sample representativeness and introduces a threat to validity. Furthermore, quality of patient care documentation in AT is inconsistent and influenced by a number of perceived factors including lack of expectation and accountability, low prioritization, lack of time, and uncertainty.[7] Subsequently, AT services may be underreported and are difficult to accurately describe. Having more inclusive treatment data for all patient encounters would increase the accuracy of the cost estimates. Additionally, applying national CMS physician fee schedules may underestimate the cost of care compared to state-specific CMS physician fee schedules or private third-party payers. The CMS physician fee schedules also did not include fees for athletic trainer evaluation. Using physical therapy evaluation fees may have overestimated the fee for this service. Future studies should consider alternative payer estimates to better characterize the cost of care for AT services for their specific location.

Misestimations may have also occurred because dates of service were not available in the data source. This is particularly important for services that have limits on the number of services that can be reimbursed over a period of time. For example, an evaluation can only be reimbursed once over a 14-day period. Without dates of service available, we were unable to identify if any AT evaluations should have been excluded from analyses. This may have resulted in an overestimation of the total cost of care.

Furthermore, the sample sizes for the regression analyses were relatively small. This may have contributed to the original violation of assumptions for regression analysis, resulting in the decision to conduct a log transformation of the outcome variable. Lower sample sizes also reduce the statistical power of the analyses. Future studies would benefit from increased sample sizes.

CONCLUSION

This study contributes to the knowledge of treatment and cost characteristics of high school AT services. While estimated costs were generally lower than previous reports, this was likely due to differences in injury severity, treatment patterns, and methodological differences. The wide range of services provided, from therapeutic exercises to injury support interventions, demonstrate the comprehensive nature of AT services. However, the results also underscore the need for improved documentation and cost data collection to fully capture the economic value of AT services. ATs need to be cognizant of the essential role that accurate and complete documentation of provided services plays in describing cost characteristics. Without the same incentives as other healthcare providers for detailed patient documentation, ATs may underreport the breadth of services they deliver. Future research should explore strategies to enhance documentation, potentially leveraging electronic medical record systems, to strengthen the evidence base supporting the role of ATs in optimizing outcomes and reducing the overall burden of sport-related injuries. Continued efforts to quantify the costs and value of AT services will be crucial for advocating for appropriate resources and positioning ATs as integral members of the sports medicine team.

Acknowledgements

This study would not be possible without the assistance of the many high school athletic trainers who participated in the program. This project was funded by the National Athletic Trainers' Association Research and Education Foundation, and the Central Indiana Corporate Partnership Foundation in cooperation with BioCrossroads. The content of this report is solely the responsibility of the authors and does not necessarily reflect the views of the sponsors.

REFERENCES

1. Hirshon JM, Warner M, Irvin CB, et al. Research using emergency department-related data sets: current status and future directions. *Acad Emerg Med*. Nov 2009;16(11):1103-9. doi:10.1111/j.1553-2712.2009.00554.x

2. Nalliah RP, Anderson IM, Lee MK, Rampa S, Allareddy V, Allareddy V. Epidemiology of hospital-based emergency department visits due to sports injuries. *Pediatric emergency care*. 2014;30(8):511-515. doi:10.1097/PEC.0000000000000180

3. Knowles SB, Marshall SW, Miller T, et al. Cost of injuries from a prospective cohort study of North Carolina high school athletes. *Inj Prev*. Dec 2007;13(6):416-21. doi:10.1136/ip.2006.014720

4. Bell DR, DiStefano L, Pandya NK, McGuine TA. The Public Health Consequences of Sport Specialization. *Journal of athletic training*. 2019;54(10):1013-1020. doi:10.4085/1062-6050-521-18

5. Wiersma AJ, Brou L, Fields SK, Comstock RD, Kerr ZY. Epidemiologic comparison of ankle injuries presenting to US emergency departments versus high school and collegiate athletic training settings. *Injury Epidemiology*. 2018/09/03 2018;5(1):33. doi:10.1186/s40621-018-0163-x

6. Rui P, Ashman JJ, Akinseye A. Emergency Department Visits for Injuries Sustained During Sports and Recreational Activities by Patients Aged 5-24 Years, 2010-2016. *Natl Health Stat Report*. Nov 2019;(133):1-15.

7. Bacon CEW, Eppelheimer BL, Kasamatsu TM, Lam KC, Nottingham SL. Athletic Trainers' Perceptions of and Barriers to Patient Care Documentation: A Report From the Athletic

Training Practice-Based Research Network. *Journal of athletic training*. Jul 2017;52(7):667-675. doi:10.4085/1062-6050-52.3.15

8. Eberman LE, Neil ER, Nottingham SL, Kasamatsu TM, Bacon CEW. Athletic Trainers' Practice Patterns Regarding Medical Documentation. *Journal of athletic training*. Jul 2019;54(7):822-830. doi:10.4085/1062-6050-230-18

9. Kasamatsu TM, Nottingham SL, Eberman LE, Neil ER, Bacon CEW. Patient Care Documentation in the Secondary School Setting: Unique Challenges and Needs. *Journal of athletic training*. Oct 2020;55(10):1089-1097. doi:10.4085/1062-6050-0406.19

10. Li T, Norcross MF, Johnson ST, Koester MC. Cost-Benefit of Hiring Athletic Trainers in Oregon High Schools From 2011-2014. *Journal of athletic training*. Feb 2019;54(2):165-169. doi:10.4085/1062-6050-390-17

11. Li T, Johnson ST, Koester MC, Hommel A, Norcross MF. The impact of high school athletic trainer services on medical payments and utilizations: a microsimulation analysis on medical claims. *Inj Epidemiol*. 2019;6:15. doi:10.1186/s40621-019-0194-y

12. Marshall Ashley N, Kikugawa Teresa M, Lam Kenneth C. Patient, Treatment, and Cost Characteristics Associated With Sport-Related Ankle Sprains: A Report From the Athletic Training Practice-Based Research Network. *Athletic Training & Sports Health Care*. 2020/07/01 2020;12(4):173-180. doi:10.3928/19425864-20190521-01

13. Lam KC, Marshall AN, Welch Bacon CE, Valovich McLeod TC. Cost and Treatment Characteristics of Sport-Related Knee Injuries Managed by Athletic Trainers: A Report From the Athletic Training Practice-Based Research Network. *Journal of athletic training*. Aug 1 2021;56(8):922-929. doi:10.4085/1062-6050-0061.20

14. Simon JE, Wikstrom EA, Grooms DR, Docherty CL, Dompier TP, Kerr ZY. Athletic Training Service Characteristics for Patients With Ankle Sprains Sustained During High School Athletics. *Journal of athletic training*. Jun 2019;54(6):676-683. doi:10.4085/1062-6050-449-16

15. Huggins RA, Coleman KA, Attanasio SM, et al. Athletic Trainer Services in the Secondary School Setting: The Athletic Training Locations and Services Project. *Journal of athletic training*. 2019;54(11):1129-1139. doi:10.4085/1062-6050-12-19

16. Secondary School Value Model: Principles and Best Practices for Defining Worth and Value of Athletic Training Servces in the Secondary School. National Athletic Trainers' Association; 2021.

17. Morris SN, Chandran A, Wasserman EB, Quetant SL, Robison HJ, Collins C. Methods of the National Athletic Treatment, Injury and Outcomes Network Surveillance Program (NATION-SP), 2014–2015 Through 2018–2019. *Journal of athletic training*. 2020;56(5):529-533. doi:10.4085/284-20

18. Physican Fee Schedule Look-Up Tool. US Centers for Medicare and Medicaid Services. Accessed January, 2025. https://www.cms.gov/medicare/physician-fee-schedule/search

19. IBM Corp. IBM SPSS Statistics for Windows, Version 28.0. Armonk, NY: IBM Corp; Released 2021.

20. Doherty C, Bleakley C, Delahunt E, Holden S. Treatment and prevention of acute and recurrent ankle sprain: an overview of systematic reviews with meta-analysis. *Br J Sports Med*. Jan 2017;51(2):113-125. doi:10.1136/bjsports-2016-096178

21. Baugh CM, Kroshus E, Lanser BL, Lindley TR, Meehan WP. Sports Medicine Staffing Across National Collegiate Athletic Association Division I, II, and III Schools: Evidence for the

Medical Model. *Journal of athletic training*. Jun 23 2020;55(6):573-579. doi:10.4085/1062-6050-0463-19

22. Bullock GS, Mobley JF, Brooks JM, et al. Uses of Health Care System Medical Care Services by Athletes After Injury at the High School Level. *Journal of School Health*. 2023;93(1):5-13. doi:https://doi.org/10.1111/josh.13255

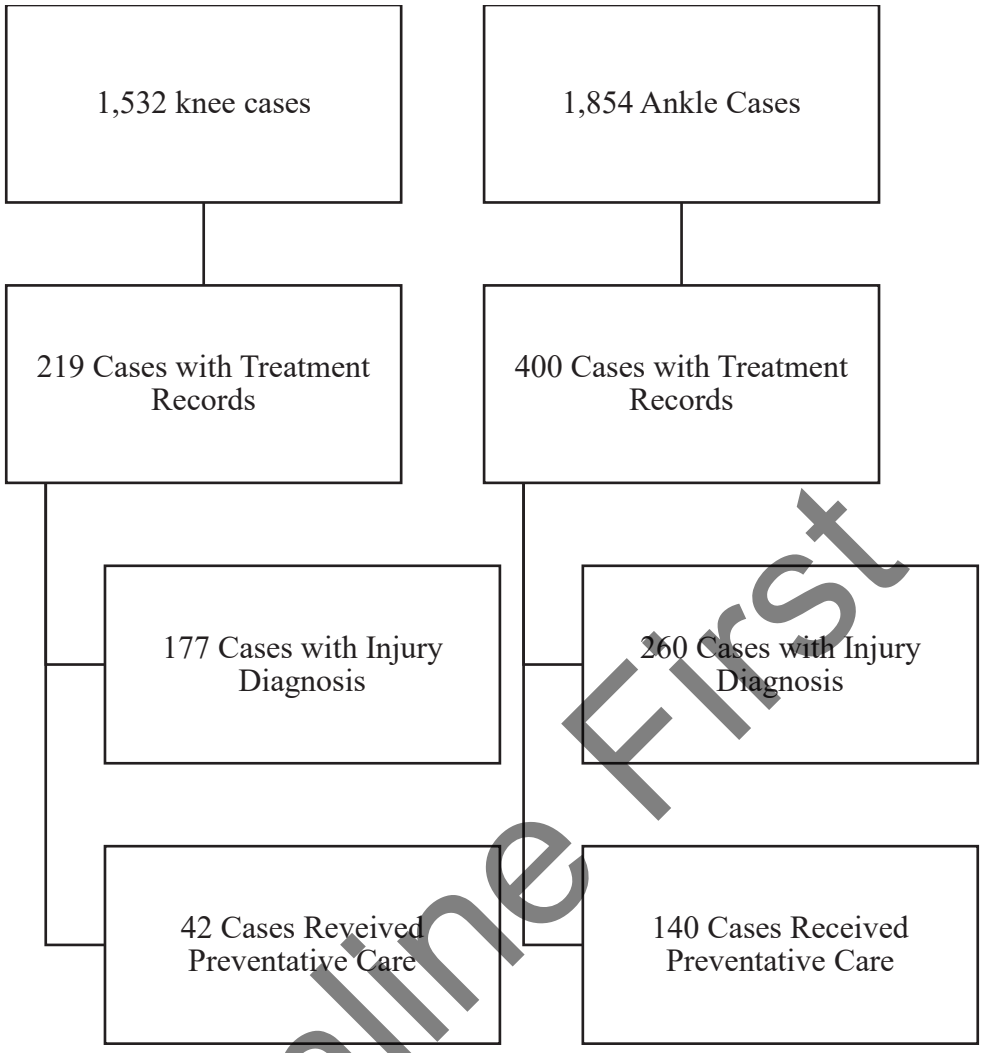

Figure 1. Consort Diagram

Table 1. Categorization of NATION-SP Treatment Variables into CPT Services

CPT Service	CPT Code	NATION-SP Treatment
Athletic trainer evaluation	97169-71	Athletic trainer evaluation
Non-physician office visit, 10-19 minutes	99212	Consultation
Electrical stimulation	97032	Electrical stimulation
Gait training	97116	Crutch fitting
Hydrotherapy	97036	Slushbath, Contrast bath
Hot or cold pack	97010	Ice bag, Ice massage, CryoCuff, Hot pack
Electric current therapy	97033	Electric modality (other), Iontophoresis/phonophoresis
Long leg splint	29505	Knee splint
Lower leg splint	29515	Ankle splint
Manual therapy techniques	97140	Mobilization
Massage	97124	Massage
Neuromuscular reeducation	97112	Proprioception with device, Basic proprioception, proprioceptive neuromuscular facilitation
Paraffin	97018	Paraffin
Physical performance test or measurement	97750	Functional evaluation
Strapping: ankle	29540	Ankle: taping, wrap, padding
Strapping: knee	29530	Knee: taping, wrap, padding
Therapeutic activities	97530	Bike conditioning, Treadmill conditioning, Stair climber,
Therapeutic exercises	97110	Passive ROM, Independent ROM, Bike ROM Isometric strength, Isotonic strength, Isokinetic strength, Tubing strength, Manual resistance exercises,
Ultrasound	97035	Ultrasound
Vasopneumatic devices	97016	Vasopneumatic device
Whirlpool	97022	Cold whirlpool, Hot whirlpool
Wound care	97602	Wound care

NATION-SP: National Athletic Treatment, Injury and Outcomes Network - Surveillance Program
CPT: Current Procedural Terminology

Table 2. Description of Services Provided for High School Knee and Ankle Cases (2014-2019)

Service	CPT Code	Service/Time Based	Mean Fee (SD) (2014-2019)	Fee Range (2014-2019)
Athletic trainer evaluation	97169-71	Service	$79.69 ($5.03)	$75.44 - $86.49
Consultation	99212	Service	$44.30 ($0.73)	$43.68 - $45.77
Electric current therapy	97033	Time	$27.11 ($5.65)	$21.24 - $33.06
Electrical stimulation	97032	Service	$18.25 ($1.90)	$15.14 - $19.40
Gait training	97116	Time	$29.33 ($1.12)	$28.60 - $30.99
Hot or cold pack	97010	Service	$0 .00 ($0.00)	$0.00 - $0.00
Hydrotherapy	97036	Service	$34.22 ($1.43)	$32.96 - $36.36
Long leg splint	29505	Service	$85.84 ($1.27)	$84.54 - $87.84
Lower leg splint	29515	Service	$73.50 ($0.43)	$73.08 - $74.16
Manual therapy techniques	97140	Time	$27.84 ($4.89)	$17.59 - $30.18
Massage	97124	Time	$27.69 ($1.86)	$26.50 - $31.32
Neuromuscular reeducation	97112	Time	$34.41 ($0.90)	$33.61 - $35.68
Paraffin	97018	Service	$10.56 ($1.48)	$7.21 - $11.14
Physical performance test or measurement	97750	Time	$34.46 ($1.99)	$33.25 - $38.52
Strapping: ankle	29540	Service	$28.57 ($4.14)	$26.10 - $37.61
Strapping: knee	29530	Service	$32.88 ($8.15)	$28.60 - $51.23
Therapeutic activities	97530	Time	$36.87 ($2.87)	$35.04 - $41.40
Therapeutic exercises	97110	Time	$32.25 ($0.67)	$31.32 - $33.02
Ultrasound	97035	Time	$13.18 ($0.48)	$12.87 - $14.06
Vasopneumatic devices	97016	Service	$18.04 ($2.54)	$12.97 - $19.74
Whirlpool	97022	Service	$22.35 ($2.38)	$18.38 - $24.05
Wound Care	97602	Service	$0.00 ($0.00)	$0.00 - $0.00

Table 3. Frequencies of Knee (n=219) and Ankle (n=400) Cases by High School Sport

Sport	Knee n (%)	Ankle n (%)
Football	81 (37.0)	193 (48.3)
Basketball		
Men's	22 (10.0)	42 (10.5)
Women's	15 (6.8)	27 (6.8)
Lacrosse		
Men's	11 (5.0)	10 (2.5)
Women's	35 (16.0)	43 (10.8)
Wrestling (Men's)	17 (7.8)	6 (1.5)
Volleyball (Women's)	8 (3.7)	22 (5.5)
Baseball	5 (2.3)	5 (1.3)
Softball	5 (2.3)	10 (2.5)
Track & field		
Men's	4 (1.8)	3 (0.8)
Women's	1 (0.5)	5 (1.3)
Soccer		
Men's	4 (1.8)	7 (1.8)
Women's	4 (1.8)	11 (2.8)
Cross country		
Men's	2 (0.9)	7 (1.8)
Women's	-	1 (0.3)
Cheerleading	2 (0.9)	4 (1.0)
Field hockey (Women's)	2 (0.9)	1 (0.3)
Swimming (Women's)	1 (0.5)	-
Tennis		
Men's	-	2 (0.5)
Women's	-	1 (0.3)

Table 4. Frequencies of Knee Cases with Associated Injury Diagnosis (n=177)

Injury Diagnosis	n (%)
Sprain	**55 (31.1)**
Medial collateral ligament	24 (13.6)
Anterior cruciate ligament	20 (11.3)
Lateral collateral ligament	4 (2.3)
Capsular	3 (1.7)
Lateral retinaculum	1 (0.6)
Medial retinaculum	2 (1.1)
Posterior cruciate ligament	1 (0.6)
Contusion	**31 (17.5)**
Knee contusion	17 (9.6)
Femoral head contusion	4 (2.3)
Meniscus contusion	2 (1.1)
Tibial plateau contusion	8 (4.5)
Tendinopathy	**26 (14.7)**
Patellar tendinopathy	24 (13.6)
Popliteal tendinopathy	2 (1.1)
Chronic/Inflammation	**19 (10.7)**
Arthritis/Chondromalacia	5 (2.8)
Bursitis	6 (3.4)
Capsulitis	2 (1.1)
Inflammation	6 (3.4)
Strain/Tear	**12 (6.8)**
Medial meniscus tear	5 (2.8)
Lateral meniscus tear	5 (2.8)
Patellar tendon tear	2 (1.1)
Wound	**8 (4.5)**
Abrasion	6 (3.4)
Laceration	2 (1.1)
Dislocation/Subluxation	**8 (4.5)**
Dislocation	3 (1.7)
Subluxation	5 (2.8)
Miscellaneous	**18 (10.2)**
Knee hyperextension	8 (4.5)
Patella femoral pain syndrome	5 (2.9)
Other knee injury	3 (1.7)
Knee pain	1 (0.6)
Entrapment/impingement	1 (0.6)

Table 5. Frequencies of Ankle Cases with Associated Injury Diagnosis (n=260)

Injury Diagnosis	n (%)
Sprain	**234 (90.8)**
Lateral ligament complex	189 (72.7)
Anterior tibiofibular syndesmosis	26 (10.0)
Medial (deltoid) ligament	13 (5.0)
Capsular	8 (3.1)
Contusion	**12 (4.6)**
Ankle contusion	12 (4.6)
Fracture	**4 (1.5)**
Lateral malleolus	4 (1.5)
Miscellaneous	**8 (3.1)**
Other ankle injury	6 (2.3)
Effusion	1 (0.4)
Tarsal tunnel syndrome	1 (0.4)

Table 6. Outcome of Diagnosed High School Knee (n=177) and Ankle (n=206) Injuries

Outcome	Knee n (%)	Ankle n (%)
Did not interfere with activity	44 (24.9)	35 (13.5)
Returned to team activity within same session	27 (15.3)	61 (23.5)
Removed from team activity session (returned within 24 hrs)	6 (3.4)	12 (4.6)
Prevented participation 1-6 days	31 (17.5)	82 (31.5)
Prevented participation 7-13 days	17 (9.6)	43 (16.5)
Prevented participation 14-29 days	13 (7.3)	12 (4.6)
Prevented participation 30+ days	11 (6.2)	5 (1.9)
Out for remainder of season	26 (14.7)	8 (3.1)
Unknown	2 (1.1)	2 (0.8)

Table 7. High School Athletic Training Services Provided for All Knee (n=1,916) and Ankle (n=3,303) Cases

Service (Knee)	n (%)	Service (Ankle)	n (%)
Therapeutic exercises	617 (32.2)	Strapping: ankle	1206 (36.5)
Hot or cold pack	395 (20.6)	Therapeutic exercises	758 (23.0)
Athletic trainer evaluation	156 (8.1)	Hot or cold pack	342 (10.4)
Strapping: knee	156 (8.1)	Athletic trainer evaluation	244 (7.4)
Electrical stimulation	151 (7.9)	Neuromuscular reeducation	207 (6.3)
Vasopneumatic devices	72 (3.8)	Whirlpool	138 (4.2)
Therapeutic activities	54 (2.8)	Vasopneumatic devices	88 (2.7)
Electric current therapy	54 (2.8)	Electrical stimulation	76 (2.3)
Massage	52 (2.7)	Consultation	61 (1.8)
Ultrasound	50 (2.6)	Massage	45 (1.4)
Wound Care	44 (2.3)	Physical performance test/measurement	44 (1.3)
Consultation	42 (2.2)	Manual therapy techniques	26 (0.8)
Neuromuscular reeducation	22 (1.1)	Therapeutic activities	19 (0.6)
Physical performance test/measurement	21 (1.1)	Gait training	18 (0.5)
Whirlpool	15 (0.8)	Hydrotherapy	15 (0.5)
Knee splint	8 (0.4)	Ultrasound	5 (0.2)
Gait training	6 (0.3)	Ankle splint	5 (0.2)
Manual therapy techniques	1 (0.1)	Electric current therapy	5 (0.2)

Table 8. Median Total Cost of High School Athletic Training Services for Diagnosed Knee (n=177) and Ankle Injuries (n=260)

	Knee Injuries Median (IQR)	Ankle Injuries Median (IQR)
Gender		
Female	$164.25 ($104.42-$296.28)	$225.93 ($138.51-$442.27)
Male	$148.58 ($85.68-$283.55)	$224.46 ($148.52-$388.61)
Sport[i]		
Baseball	$207.41 ($77.41-$352.94)	$365.42 ($230.26-$378.30)
Basketball	$186.34 ($99.83-$338.86)	$196.07 ($129.17-$353.03)
Cross country	$387.37*	$181.60 ($148.32-241.33)
Cheerleading	$854.61*	$421.59 ($163.45-$2169.44)
Field hockey	$305.22*	-
Football	$179.73 ($115.56-$341.09)	$226.00 ($148.58-$547-77)
Lacrosse	$115.38 ($82.68-$205.02)	$374.06 ($158.31-$654.75)
Softball	$142.30 ($92.96-$376.17)	$134.44 ($118.58-$214.85)
Soccer	$141.07 ($79.23-$257.60)	$176.60 ($153.70-$264.68)
Tennis	-	$426.07*
Track & field	$117.00 ($55.57-$396.77)	$158.62 ($121.50-$226.12)
Volleyball	$235.60 ($147.08-$545.48)	$247.68 ($148.32-$433.72)
Wrestling	$137.63 ($82.95-$316.98)	$216.69 ($138.56-$433.72)
Severity		
Did not interfere with activity	$144.95 ($85.68-$244.65)	$185.57 ($128.91-$385.56)
Returned to team activity within same session	$146.42 ($104.04-$222.71)	$232.04 ($139.50-$429.90)
Removed from team activity session (returned within 24 hrs)	$91.71 ($75.44-$312.11)	$211.47 ($119.65-$309.29)
Prevented participation 1-6 days	$148.32 ($104.55-$230.55)	$192.60 ($139.32-$365.92)
Prevented participation 7-13 days	$148.58 ($101.16-$221.19)	$336.94 ($191.89-$658.14)
Prevented participation 14-29 days	$280.66 ($120.40-$541.14)	$456.29 ($211.63-$725.67)
Prevented participation 30+ days	$461.88 ($82.54-$941.06)	$295.34 ($116.28-$539.64)
Out for remainder of season	$178.18 ($85.68-$300.96)	$155.86 ($134.20-$372.83)
Unknown	$368.76*	$220.80*

[i] Female/male combined

*IQR undetermined, 1<n<4