Journal of Athletic Training 2015;50(12):1310–1318
doi: 10.4085/1062-6050-51.1.08

www.natajournals.org

original research

Methods and Descriptive Epidemiology of Services Provided by Athletic Trainers in High Schools: The National Athletic Treatment, Injury and Outcomes Network Study

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Context: Research is limited on the extent and nature of the care provided by athletic trainers (ATs) to student-athletes in the high school setting.

Objective: To describe the methods of the National Athletic Treatment, Injury and Outcomes Network (NATION) project and provide the descriptive epidemiology of AT services for injury care in 27 high school sports.

Design: Descriptive epidemiology study.

Setting: Athletic training room (ATR) visits and AT services data collected in 147 high schools from 26 states.

Patients or Other Participants: High school student-athletes participating in 13 boys' sports and 14 girls' sports during the 2011–2012 through 2013–2014 academic years.

Main Outcome Measure(s): The number of ATR visits and individual AT services, as well as the mean number of ATR visits (per injury) and AT services (per injury and ATR visit) were calculated by sport and for time-loss (TL) and non–time-loss (NTL) injuries.

Results: Over the 3-year period, 210 773 ATR visits and 557 381 AT services were reported for 50 604 injuries. Most ATR visits (70%) were for NTL injuries. Common AT services were therapeutic activities or exercise (45.4%), modalities (18.6%), and AT evaluation and reevaluation (15.9%), with an average of 4.17 $\pm$ 6.52 ATR visits and 11.01 $\pm$ 22.86 AT services per injury. Compared with NTL injuries, patients with TL injuries accrued more ATR visits (7.76 versus 3.47; $P < .001$) and AT services (18.60 versus 9.56; $P < .001$) per injury. An average of 2.24 $\pm$ 1.33 AT services were reported per ATR visit. Compared with TL injuries, NTL injuries had a larger average number of AT services per ATR visit (2.28 versus 2.05; $P < .001$).

Conclusions: These findings highlight the broad spectrum of care provided by ATs to high school student-athletes and demonstrate that patients with NTL injuries require substantial amounts of AT services.

Key Words: medical coverage, sports, injury surveillance, NATION

Key Points

- Among 147 high schools from 26 states, 210 773 athletic training room visits and 557 381 athletic trainer services were reported during the 2011–2012 through 2013–2014 school years.
- Common athletic trainer services were therapeutic activities or exercise (45.4%), modalities (18.6%), and athletic trainer evaluation and re-evaluation (15.9%).
- Compared with non–time-loss injuries, patients with time-loss injuries accrued more athletic training room visits and athletic trainer services per injury. However, non–time-loss injuries required a larger average number of athletic trainer services per athletic training room visit.

Over the past 40 years, a variety of surveillance systems have documented the epidemiology of sport-related injuries.[1–5] However, sports injury-surveillance systems have been hindered by 2 main limitations. First, most injuries included in such systems were limited to time-loss (TL) injuries, or those resulting in restriction from participation in sport-related activities for at least 24 hours.[2] Second, although the athletic trainers (ATs) who contributed data to these injury-surveillance systems captured in-depth information regarding sport-related injuries, there was no provision within these systems for tracking information on the evaluations, assessments, modalities, and other services provided by ATs for injuries (hereafter termed *AT services*).

Few authors have attempted to quantify the nature and extent of AT services in the high school[6,7] and collegiate settings.[8] It is clear that AT or physician coverage in high schools is less prevalent than at the college level.[9] However, data are very limited at this point as to the frequency and nature of the services provided by ATs. Systematically documenting AT services, for both TL and non–time-loss (NTL) injuries, is important to obtain a

better understanding of the extent to which ATs provide care to student-athletes in the high school setting. The National Athletic Treatment, Injury and Outcomes Network (NATION) project aims to provide a comprehensive examination of all TL and NTL injuries and the associated AT services in the high school setting.[5] A previous publication[5] detailed the methods for documenting injuries sustained by high school student-athletes via the NATION surveillance program. The purpose of this article is to (1) describe the methods of NATION related to documenting AT services and (2) describe the care provided for TL and NTL injuries reported to NATION in 27 high school sports.

METHODS

During the 2011–2012 through 2013–2014 school years, NATION captured injury and AT service data for 27 high school sports during preseason, regular season, and postseason practices and competitions.[5] Participating ATs, who were responsible for covering practices and competitions that occurred at home and away, were employed at 147 high schools in 26 states. These ATs were either full time or part time and were internally hired or contracted from nearby clinics or university graduate programs. Most of the high schools at which the ATs were employed were public (84.4%), coeducational (98.6%), set in nonurban areas (75.5%; rural = 37.4%, suburban = 38.1%), and enrolled fewer than 1000 students (51.0%).

Data Collection

Rather than create a custom software application, the developers embedded the NATION data-collection tools within commercially available athletic training room (ATR) software.[5] Thus, the data collection is seamlessly integrated into routine ATR recordkeeping. Software vendors participating in NATION modified their software and underwent annual certification using benchmarking transmission datasets developed by the Datalys Center for Sports Injury Research and Prevention (hereafter called *Datalys Center*). They also embedded secure data-transmission protocols that sent deidentified records to secure Datalys Center servers on an ongoing and routine basis.[5] This process is Health Insurance Portability and Accountability Act (HIPAA) compliant.

Athletic trainers completed detailed reports on each injury, including condition (eg, site, diagnosis, severity) and circumstances (eg, activity, mechanism, event type [ie, competition or practice], playing surface). They were able to view and update previously submitted information as needed during the course of a season. The data collection also captured the number of ATR visits and the number of AT services provided for each injury.

The AT service data went through the same data quality checks as the injury data, in which data were deidentified and passed through an automated verification process of consistency checks.[5] Datalys Center data quality-assurance staff assisted ATs in resolving any concerns about invalid values. The ATs were not compensated for their data-collection efforts.

Definitions

Injury. Injuries that are reported in NATION must have occurred within a school-sponsored sport and must have been evaluated or provided care (or both) by an AT, physician, or other health care professional. A TL injury required the student-athlete to be restricted from participation for at least 24 hours past the day of injury. To be consistent with other surveillance systems,[10] the TL injuries also included all dental injuries, fractures, and concussions, regardless of TL. Injuries restricting participation for less than 24 hours were considered NTL injuries.

Athletic Trainer Service. An *AT service* was defined as the application of any type of manual therapy, modality, exercise and evaluations, testing, or skill session that the player received with interaction of the AT due to the injury or illness. For example, if the student-athlete was provided a hot pack, massage, and stretching, that counted as 3 AT services. If the time spent by the AT was less than 2 minutes, the AT service was not reported.[8]

Statistical Analyses

Data were analyzed using SAS Enterprise Guide software (version 4.3; SAS Institute Inc, Cary, NC). Although the injury data presented in our previous publication[5] were restricted to school-sanctioned organized varsity competitions and scheduled team practices (about 97.0% of all injury data collected), AT service data are presented for additional event types, such as captain practices, scrimmages, strength and conditioning sessions, skill instruction, and junior varsity competitions. Including these additional sessions offered a more complete picture of the amount of care provided.

We compiled the number of ATR visits and AT services. Services provided by ATs were examined by categories based on previous research.[6] We calculated the average number of ATR visits per injury, defined as

$$\text{Average ATR visits} = \frac{\sum \text{ATR visits}}{\sum \text{Injuries}},$$

where Σ ATR visits is the sum of all ATR visits and Σ Injuries is the sum of all injuries. We also computed the average number of AT services per injury, defined as

$$\text{Average AT services} = \frac{\sum \text{AT services}}{\sum \text{Injuries}},$$

where Σ AT services is the sum of all AT services. We last computed the average number of AT services per ATR visit, defined as

$$\text{Average AT services per ATR visit} = \frac{\sum \text{AT services}}{\sum \text{ATR visits}},$$

where Σ AT services is the sum of all AT services and Σ ATR visits is the sum of all ATR visits. These 3 statistics were calculated overall and for TL and NTL injuries. Statistics for TL and NTL injuries were compared using independent-samples t tests.[11] All t statistics yielding P values $<.05$ were considered statistically significant.

RESULTS

Over the 3-year period (2011–2012 through 2013–2014), boys' sports contributed 1185 team-seasons across 13

Table 1. Athletic Training Room (ATR) Visits in High School Sports by Injury Type, National Athletic Treatment, Injury and Outcomes Network (NATION), 2011–2012 Through 2013–2014

Sport	ATR Visits, No.	Team Seasons, No.	Average No. Players per Team	Player-Seasons, No.[a]	Average No. ATR Visits per Team per Season[b]	Average No. ATR Visits per Player per Season[c]
Boys' sports						
Baseball	4364	120	30.37	3644	36.37	1.20
Basketball	9009	144	30.17	4344	62.56	2.07
Crew	402	13	23.92	311	30.92	1.29
Cross-country	4530	125	17.60	2200	36.24	2.06
Football	81 976	163	77.30	12 600	502.92	6.51
Golf	10	62	11.37	705	0.16	0.01
Indoor track	6820	62	26.67	1654	110.00	4.12
Lacrosse	7036	61	41.74	2546	115.34	2.76
Outdoor track	6881	105	36.48	3830	65.53	1.80
Soccer	6205	102	35.35	3606	60.83	1.72
Swimming and diving	360	56	19.74	1105	6.43	0.33
Tennis	416	53	16.16	856	7.85	0.49
Wrestling	9720	123	25.76	3168	79.02	3.07
Girls' sports						
Basketball	10 385	143	24.76	3541	72.62	2.93
Crew	1231	17	28.05	477	72.41	2.58
Cross-country	5741	122	15.40	1879	47.06	3.06
Field hockey	7325	75	34.00	2550	97.67	2.87
Golf	5	39	7.43	290	0.13	0.02
Gymnastics	1039	62	12.90	800	16.76	1.30
Indoor track	8567	52	23.44	1219	164.75	7.03
Lacrosse	6177	57	34.93	1991	108.37	3.10
Outdoor track	7256	103	29.78	3067	70.45	2.37
Soccer	8902	101	32.73	3306	88.14	2.69
Softball	4796	118	24.06	2839	40.64	1.69
Swimming and diving	659	55	22.62	1244	11.98	0.53
Tennis	660	59	18.10	1068	11.19	0.62
Volleyball	10 301	143	27.00	3861	72.03	2.67

[a] Average number of players per team multiplied by number of team seasons.
[b] Number of ATR visits divided by number of team seasons.
[c] Number of ATR visits divided by number of player-seasons.

sports; girls' sports contributed 1141 team-seasons across 14 sports. Overall, 51 997 injuries were reported, of which 50 604 (97.3%) had AT service data captured. The sports with the largest proportions of injuries with missing AT service data were boys' basketball (10.6%), girls' softball (7.1%), boys' soccer (5.4%), and boys' baseball (5.3%).

Athletic Training Room Visits

In total, 210 773 ATR visits were reported. The majority of ATR visits were for NTL injuries (70.0%) and participants in boys' sports (65.3%). However, this sex disparity was primarily due to football, which contributed 59.5% of all ATR visits in boys' sports. Among boys' sports, football had the highest average number of ATR visits per team (502.92) and per player (6.51; Table 1). Among girls' sports, indoor track had the highest average number of ATR visits per team (164.75) and per player (7.03; Table 1).

Average Number of ATR Visits per Injury. Overall, an average of 4.17 ± 6.52 ATR visits were required per injury (Table 2). The largest average number of ATR visits required per injury in boys' and girls' sports were football (4.74) and indoor track (4.65), respectively. The average number of ATR visits per injury was higher among TL injuries than among NTL injuries, overall, by sex, and among most sports (Table 2). The only exceptions were boys' crew ($P = .09$), girls' crew ($P = .82$), girls' swimming and diving ($P = .12$), and girls' tennis ($P = .08$).

Athletic Trainer Services

In total, 557 381 AT services were provided (Table 3). Therapeutic activities or exercise were the most common type of AT service (45.4%), followed by modalities (18.6%), AT evaluation and reevaluation (15.9%), strapping (9.3%), and neuromuscular reeducation (6.6%). The most frequent specific AT services were independent range of motion (15.2%), consultation (14.8%), ice bag (10.5%), isotonic strength (9.7%), tubing strength (8.8%), and proprioception device (5.5%).

The majority of AT services were for NTL injuries (72.8%). Distributions of AT service types varied by sport and whether injuries resulted in time loss or no time loss (Table 4). Most AT services (64.0%) were for participants in boys' sports. Again, this was primarily due to football, which contributed 56.7% of all AT services in boys' sports.

Average Number of AT Services per Injury. Overall, an average of 11.01 ± 22.86 AT services were required per injury (Table 5). The largest average numbers of AT services per injury in boys' and girls' sports were for outdoor track (12.02) and indoor track (13.99), respectively. The average number of AT services per injury was higher among TL injuries than among NTL

Table 2. Athletic Training Room (ATR) Visits for Injured Student-Athletes in High School Sports, by Injury Type, National Athletic Treatment, Injury and Outcomes Network (NATION), 2011–2012 Through 2013–2014

Sport	ATR Visits, No.	ATR Visits for Nontime-Loss Injuries, %	Average (± SD) No. ATR Visits per Injury			*P* Value[a]
			Total	Time Loss	Nontime Loss	
Boys' sports						
Baseball	4364	84.1	3.51 ± 5.59	4.57 ± 5.82	3.36 ± 5.55	.01
Basketball	9009	64.3	3.37 ± 5.47	6.83 ± 8.10	2.63 ± 4.38	<.001
Crew	402	83.1	2.17 ± 3.39	3.40 ± 3.36	2.02 ± 3.37	.09
Cross-country	4530	83.9	3.65 ± 6.17	6.17 ± 9.01	3.38 ± 5.74	.001
Football	81 976	61.9	4.74 ± 7.57	8.70 ± 11.25	3.70 ± 5.84	<.001
Golf	10	100.0	1.67 ± 1.03	NA	1.67 ± 1.03	NA
Indoor track	6820	88.6	3.90 ± 6.36	7.57 ± 9.89	3.67 ± 6.01	<.001
Lacrosse	7036	70.1	3.54 ± 4.57	6.44 ± 6.18	2.97 ± 3.93	<.001
Outdoor track	6881	86.2	3.87 ± 5.22	6.24 ± 7.30	3.64 ± 4.92	<.001
Soccer	6205	74.3	3.00 ± 4.02	5.89 ± 6.78	2.57 ± 3.21	<.001
Swimming and diving	360	78.3	2.63 ± 2.82	5.16 ± 3.67	2.22 ± 2.44	.003
Tennis	416	88.7	2.68 ± 3.92	5.88 ± 5.36	2.51 ± 3.78	.02
Wrestling	9720	64.7	3.26 ± 4.58	6.19 ± 7.44	2.59 ± 3.28	<.001
Total	137 729	67.4	4.11 ± 6.55	7.77 ± 10.04	3.35 ± 5.24	<.001
Girls' sports						
Basketball	10 385	63.0	4.34 ± 6.76	8.49 ± 11.48	3.37 ± 4.55	<.001
Crew	1231	94.1	3.20 ± 5.30	3.04 ± 3.37	3.21 ± 5.40	.82
Cross-country	5741	79.9	4.24 ± 5.91	6.48 ± 8.69	3.90 ± 5.29	<.001
Field hockey	7325	72.9	3.94 ± 6.36	7.08 ± 9.70	3.38 ± 5.38	<.001
Golf	5	100.0	1.67 ± 1.15	NA	1.67 ± 1.15	NA
Gymnastics	1039	71.6	3.04 ± 3.91	5.57 ± 6.95	2.57 ± 2.83	.003
Indoor track	8567	87.2	4.65 ± 6.44	7.72 ± 8.70	4.39 ± 6.15	<.001
Lacrosse	6177	74.6	4.53 ± 6.06	8.17 ± 7.71	3.94 ± 5.53	<.001
Outdoor track	7256	85.0	4.40 ± 6.20	7.14 ± 11.52	4.12 ± 5.31	.002
Soccer	8902	70.2	4.34 ± 5.90	7.72 ± 7.64	3.66 ± 5.22	<.001
Softball	4796	74.8	4.39 ± 6.32	6.84 ± 7.14	3.91 ± 6.03	<.001
Swimming and diving	659	77.7	3.51 ± 5.38	4.90 ± 5.03	3.24 ± 5.42	.12
Tennis	660	85.5	2.89 ± 3.57	5.33 ± 5.92	2.69 ± 3.23	.08
Volleyball	10 301	69.1	4.43 ± 8.00	9.48 ± 15.59	3.58 ± 5.38	<.001
Total	73 044	74.8	4.28 ± 6.46	7.73 ± 10.43	3.72 ± 5.35	<.001
Overall	210 773	70.0	4.17 ± 6.52	7.76 ± 10.16	3.47 ± 5.28	<.001

[a] Independent-samples *t* test comparing the average number of ATR visits per injury between time-loss and non–time-loss injuries.

injuries, overall, by sex, and among most sports. The only exceptions were boys' baseball ($P = .22$), boys' crew ($P = .81$), boys' swimming and diving ($P = .06$), boys' tennis ($P = .15$), girls' crew ($P = .69$), girls' softball ($P = .11$), girls' swimming and diving ($P = .81$), and girls' tennis ($P = .08$).

When comparing the average number of AT services per injury between TL and NTL injuries, findings by AT service type were similar (Table 6). The greatest differences were in therapeutic activities or exercise (7.96 versus 4.44, $P < .001$) and AT evaluation and reevaluation (4.29 versus 1.27, $P < .001$). The 1 exception was wound care, in which the average number of AT services per injury for NTL injuries (0.31) was larger than that for TL injuries (0.12, $P < .001$).

Average Number of AT Services per ATR Visit. Overall, an average of 2.24 ± 1.33 AT services were provided per ATR visit (Table 5). The largest average numbers of AT services per ATR visit in boys' and girls' sports were for golf (4.39) and lacrosse (2.53), respectively. The average number of AT services per ATR visit was higher among NTL injuries than among TL injuries, overall and by sex (all $P < .001$). The average number of AT services per ATR visit varied by AT service type (Table 6). There was more AT evaluation or reevaluation and greater use of treatment modalities, such as hot or cold packs and strapping, for TL than NTL injuries.

DISCUSSION

The purpose of this study was to comprehensively document AT services provided for TL and NTL injuries in the large sample of schools included in the NATION surveillance program. To care for injured student-athletes, ATs in our study provided a variety of services that included evaluation, modalities, strapping, and wound care. The findings draw attention to the high volume of services provided by onsite ATs. Such staff may help to reduce the burden of care provided in other settings such as hospitals, emergency departments, and specialty clinics.[12] Additionally, there is a large productivity gain for the parents of injured student-athletes, who would have to take time to transport their children to other service providers if ATs were not present in the schools.

Common AT Services

Our results regarding the most common services provided by ATs varied from previous results of the Athletic Training Practice-Based Research Network (AT-PBRN),[6,7] which also examined the high school student-athlete

Table 3. Types of Athletic Trainer Services for Injured Student-Athletes in High School Sports, by Injury Type, National Athletic Treatment, Injury and Outcomes Network (NATION), 2011–2012 Through 2013–2014

Type of Athletic Trainer Services	Current Procedural Terminology Code	n (%)
Athletic trainer evaluation or reevaluation	97005, 97006	88 865 (15.9)
Consultation		82 623 (14.8)
Functional evaluation		6242 (1.1)
Physical performance test or measurement	97750	99 (0.0)
Therapeutic activities or exercise	97110, 97530	253 300 (45.4)
Independent range of motion		84 966 (15.2)
Isotonic strength		53 811 (9.7)
Tubing strength		48 864 (8.8)
Passive range of motion		17 200 (3.1)
Bicycle range of motion		13 648 (2.4)
Bicycle conditioning		13 381 (2.4)
Isometric strength		8008 (1.4)
Manual resistance exercise		8005 (1.4)
Treadmill conditioning		1723 (0.3)
Proprioceptive neuromuscular facilitation range of motion		1548 (0.3)
Stair climber		1106 (0.2)
Isokinetic strength		1040 (0.2)
Neuromuscular reeducation	97112	36 687 (6.6)
Proprioception with device		30 677 (5.5)
Basic proprioception		6010 (1.1)
Manual therapy techniques or massage	97140, 97124	8309 (1.5)
Massage		7101 (1.3)
Mobilization		1208 (0.2)
Modalities		103 753 (18.6)
Hot or cold packs	97010	87 969 (15.8)
Ice bag		58 735 (10.5)
Hot pack		24 530 (4.4)
Ice massage		2507 (0.4)
Cryocuff		2197 (0.4)
Whirlpool	97022	9496 (1.7)
Slush bath		6456 (1.2)
Hot whirlpool		1921 (0.3)
Cold whirlpool		1119 (0.2)
Electrical stimulation	97014	3948 (0.7)
Electrical stimulation		3848 (0.7)
Electric modality (other)		100 (0.0)
Ultrasound	97035	1227 (0.2)
Vasopneumatic devices	97016	607 (0.1)
Paraffin bath	97018	254 (0.0)
Contrast bath	97034	247 (0.0)
Iontophoresis/phonophoresis	97033	5 (0.0)
Strapping	29280, 29260, 29240, 29540, 29520, 29230, 29550	51 857 (9.3)
Taping		35 294 (6.3)
Wrap		10 198 (1.8)
Padding		4702 (0.8)
Splint		1663 (0.3)
Gait training or crutch fitting	97116	549 (0.1)
Wound care	97597, 97598, 97602	13 962 (2.5)
Total		557 381 (100.0)

population. Although therapeutic activities or exercise, AT evaluation and reevaluation, and hot or cold packs were the most common AT services used, research from the AT-PBRN demonstrated larger proportions of AT evaluation and reevaluation services (45.9%[6] and 53.9%[7] versus 18.6%) and smaller proportions of therapeutic activities or exercise (15.3%[6] and 5.7%[7] versus 45.4%). Like the AT-PBRN, our study used electronic medical record systems to collect injury and treatment data. However, differences may be attributable to varying school-related characteristics. For example, most high schools in NATION were in nonurban areas (75.5%), whereas most high schools in the study by Lam et al[6] were in urban areas (71%). As a result, continued research within different high school populations will help to identify commonly used AT services.

Table 4. Athletic Trainer (AT) Services Provided for Injured Student-Athletes in High School Sports, by Injury Type, National Athletic Treatment, Injury and Outcomes Network (NATION), 2011–2012 Through 2013–2014

			Types of Treatments Within TL or NTL Injuries, %											
			Therapeutic Activities or Exercise		AT Evaluation or Reevaluation		Hot or Cold Packs		Strapping		Neuromuscular Reeducation		Other	
Sport	AT Services, n	AT Services for NTL Injuries, %	TL	NTL	TL	NTL	TL	NTL	TL	NTL	TL	NTL	TL	NTL
Boys' sports														
Baseball	13 435	85.2	44.7	48.1	21.4	15.8	14.6	18.8	5.3	4.9	7.1	6.6	6.9	5.8
Basketball	23 543	66.8	39.7	40.5	19.0	14.9	13.1	17.0	11.8	12.4	9.9	6.9	6.5	8.3
Crew	1027	88.0	32.5	53.9	39.0	15.7	16.3	13.7	0.8	3.7	2.4	6.5	9.0	6.5
Cross-country	12 908	84.8	51.5	54.9	13.0	14.6	14.7	15.8	3.4	3.1	7.0	5.2	10.4	6.4
Football	202 516	63.4	41.9	41.4	23.1	12.6	13.8	16.8	9.8	13.9	7.1	5.7	4.3	9.6
Golf	35	100.0	NA	57.1	NA	28.6	NA	2.9	NA	0.0	NA	11.4	NA	0.0
Indoor track	20 664	89.2	54.1	55.2	13.2	12.8	14.3	17.8	2.0	2.3	6.3	5.6	10.1	6.3
Lacrosse	19 481	73.9	44.5	48.8	30.9	13.0	9.9	14.4	3.3	9.1	7.4	7.0	4.0	7.7
Outdoor track	21 387	86.4	53.7	55.4	13.5	13.5	13.7	15.7	3.1	2.8	7.9	6.3	8.1	6.3
Soccer	17 439	77.4	42.3	46.9	25.3	14.8	10.8	15.7	8.4	8.5	8.3	7.5	4.9	6.6
Swimming and diving	908	75.3	46.0	47.8	29.9	18.3	11.6	19.7	0.4	2.8	3.6	2.2	8.5	9.2
Tennis	1208	83.9	52.6	47.7	3.1	13.5	6.7	15.6	8.8	9.5	20.1	5.0	8.7	8.7
Wrestling	22 357	67.6	40.0	39.0	30.6	16.7	12.7	19.6	4.4	11.0	6.1	3.6	6.2	10.1
Total	356 908	69.8	42.5	45.0	23.1	13.5	13.4	16.8	8.6	10.4	7.3	5.9	5.1	8.4
Girls' sports														
Basketball	26 998	66.6	43.5	43.7	23.0	13.7	12.8	15.7	7.4	13.0	9.2	7.6	4.1	6.3
Crew	3363	94.5	47.8	53.4	30.6	13.8	8.1	15.8	3.8	3.7	1.6	6.5	8.1	6.8
Cross-country	15 421	81.6	50.5	55.1	17.0	12.3	14.4	15.6	2.9	3.9	6.3	6.6	8.9	6.5
Field hockey	20 352	74.7	41.0	45.0	26.0	13.2	14.6	17.2	6.2	10.0	7.8	6.1	4.4	8.5
Golf	7	100.0	NA	14.3	NA	14.3	NA	71.4	NA	0.0	NA	0.0	NA	0.0
Gymnastics	2656	70.5	44.7	39.6	22.6	16.4	8.4	17.0	6.0	13.8	13.2	4.4	5.1	8.8
Indoor track	25 791	86.2	52.9	54.1	14.3	11.1	15.6	19.3	1.6	3.2	8.1	6.3	7.5	6.0
Lacrosse	18 801	78.9	43.1	48.9	27.0	13.0	9.9	13.5	5.8	10.0	9.6	8.2	4.6	6.4
Outdoor track	20 707	86.8	52.0	53.2	12.7	12.4	16.6	18.5	2.5	3.6	9.0	5.8	7.2	6.5
Soccer	25 498	74.8	41.6	47.9	25.9	11.7	10.1	14.2	10.0	10.7	7.7	8.9	4.7	6.6
Softball	12 974	80.6	37.3	50.4	33.4	13.8	13.5	17.7	5.4	7.2	3.1	5.8	7.3	5.1
Swimming and diving	1668	85.0	36.7	52.2	50.6	16.7	9.6	19.5	1.2	3.8	0.8	3.5	1.1	4.3
Tennis	1976	86.6	44.9	42.7	19.2	18.6	7.2	12.4	7.2	12.8	17.7	8.5	3.8	5.0
Volleyball	24 261	74.5	37.2	42.1	22.9	14.5	13.5	17.0	13.3	16.4	9.6	5.2	3.5	4.8
Total	200 473	78.1	43.4	48.8	23.1	12.9	12.9	16.6	7.1	8.7	8.3	6.7	5.2	6.3
Overall	557 381	72.8	42.8	46.4	23.1	13.3	13.2	16.7	8.2	9.7	7.6	6.2	5.1	7.7

Abbreviations: NA, not applicable; NTL, nontime loss; TL, time loss.
Note: No injuries in boys' or girls' golf resulted in time loss.

The use of hot and cold packs may be the result of the AT practice setting. Heat is often used to warm tissue before activity, and ice (cold) treatments are commonly used to combat the effects of inflammation after activity. Most physical therapy practices work with patients who have subacute or chronic conditions, in whom activity-related inflammation is less of a concern. Therefore, usage patterns for these services appear to suggest appropriate care patterns.

According to the American Physical Therapy Association, passive physical agents, such as modalities, should be used only as an evidence-based facilitation to an active rehabilitation program (ie, therapeutic activities and exercises).[13] Both our findings and those of Lam et al[6] indicate that ATs are following this guideline. Our results show that the number of therapeutic activities or exercise services was more than double that of modality services. This suggests that ATs are either (1) more often than not, conducting rehabilitation without the use of modalities or (2) using modalities in conjunction with an active rehabilitation program.

Comparison With College-Level Treatment Data

Our study was similar to a previous study[8] that examined AT services provided to collegiate student-athletes who sustained sports injuries during the 2000–2001 and 2001–2002 academic years. Powell and Dompier[8] noted that 52.6% and 66.1% of AT services in men's and women's sports, respectively, were provided for NTL injuries. Over 3 seasons of high school sports, we found higher percentages for boys and girls (69.8% and 78.1%, respectively). Also, the average number of treatments for boys and girls was similar to that described by Powell and Dompier,[8] although we estimated a lower average number of treatments for TL injuries. These differences may be attributable to variations in playing level and study period, as well as in the distributions of student-athletes by sport within the study populations. Also, because many high

Table 5. Athletic Trainer (AT) Services per Injury and per Athletic Training Room (ATR) Visit, by Sport, National Athletic Treatment, Injury and Outcomes Network (NATION), 2011–2012 Through 2013–2014

Sports	AT Services per Injury (Mean ± SD)			*P* Value[a]	AT Services per ATR Visit (Mean ± SD)			*P* Value[b]
	Total	Time Loss	Nontime Loss		Total	Time Loss	Nontime Loss	
Boys' sports								
Baseball	10.79 ± 24.27	13.06 ± 22.92	10.48 ± 24.44	.22	2.44 ± 1.48	2.23 ± 1.66	2.47 ± 1.45	.09
Basketball	8.81 ± 18.59	16.61 ± 25.45	7.14 ± 16.29	<.001	2.28 ± 1.37	2.20 ± 1.54	2.30 ± 1.33	.17
Crew	5.55 ± 11.69	6.15 ± 7.67	5.48 ± 12.10	.81	2.36 ± 1.37	1.88 ± 1.27	2.41 ± 1.38	.10
Cross-country	10.39 ± 21.28	16.63 ± 26.36	9.74 ± 20.58	.007	2.37 ± 1.33	2.31 ± 1.49	2.38 ± 1.31	.62
Football	11.70 ± 26.40	20.68 ± 40.94	9.35 ± 20.36	<.001	2.06 ± 1.23	1.96 ± 1.34	2.08 ± 1.20	<.001
Golf	5.83 ± 6.40	NA	5.83 ± 6.40	NA	4.39 ± 6.27	NA	4.39 ± 6.27	NA
Indoor track	11.82 ± 27.32	21.66 ± 29.39	11.21 ± 27.08	<.001	2.44 ± 1.34	2.63 ± 1.29	2.42 ± 1.34	.13
Lacrosse	9.79 ± 17.87	15.57 ± 26.43	8.66 ± 15.41	<.001	2.42 ± 1.34	2.09 ± 1.44	2.48 ± 1.31	<.001
Outdoor track	12.02 ± 21.04	19.11 ± 32.44	11.35 ± 19.53	.004	2.55 ± 1.44	2.43 ± 1.51	2.56 ± 1.43	.26
Soccer	8.44 ± 14.97	14.52 ± 25.37	7.52 ± 12.44	<.001	2.44 ± 1.41	2.03 ± 1.47	2.51 ± 1.39	<.001
Swimming and diving	6.63 ± 8.25	11.79 ± 12.56	5.80 ± 7.05	.06	2.35 ± 1.50	1.98 ± 1.29	2.40 ± 1.52	.21
Tennis	7.79 ± 15.83	24.25 ± 30.33	6.90 ± 14.30	.15	2.38 ± 1.42	3.53 ± 2.31	2.31 ± 1.34	.18
Wrestling	7.49 ± 14.19	13.07 ± 23.59	6.22 ± 10.58	<.001	2.00 ± 1.23	1.84 ± 1.19	2.03 ± 1.24	.001
Total	10.65 ± 23.32	18.66 ± 36.00	8.98 ± 19.26	<.001	2.19 ± 1.31	2.01 ± 1.38	2.23 ± 1.29	<.001
Girls' sports								
Basketball	11.28 ± 22.91	19.89 ± 37.88	9.27 ± 17.09	<.001	2.22 ± 1.33	2.00 ± 1.40	2.27 ± 1.31	<.001
Crew	8.74 ± 17.18	7.75 ± 12.08	8.80 ± 17.48	.69	2.43 ± 1.33	2.13 ± 1.38	2.45 ± 1.33	.26
Cross-country	11.40 ± 18.66	15.95 ± 24.07	10.71 ± 17.61	.006	2.31 ± 1.35	2.24 ± 1.45	2.32 ± 1.33	.49
Field hockey	10.94 ± 25.43	18.42 ± 40.83	9.61 ± 21.34	<.001	2.28 ± 1.35	2.19 ± 1.48	2.30 ± 1.33	.23
Golf	2.33 ± 0.58	NA	2.33 ± 0.58	NA	1.67 ± 0.58	NA	1.67 ± 0.58	NA
Gymnastics	7.77 ± 13.73	14.77 ± 25.11	6.48 ± 9.94	.02	2.21 ± 1.34	2.26 ± 1.29	2.20 ± 1.35	.79
Indoor track	13.99 ± 23.98	25.06 ± 35.09	13.07 ± 22.58	<.001	2.47 ± 1.27	2.65 ± 1.44	2.46 ± 1.25	.12
Lacrosse	13.79 ± 24.78	20.65 ± 29.64	12.67 ± 23.71	<.001	2.53 ± 1.47	2.30 ± 1.64	2.56 ± 1.44	.04
Outdoor track	12.56 ± 20.62	17.98 ± 36.46	12.01 ± 18.19	.05	2.44 ± 1.35	2.05 ± 1.39	2.48 ± 1.35	<.001
Soccer	12.42 ± 21.02	18.75 ± 27.11	11.15 ± 19.33	<.001	2.51 ± 1.45	2.19 ± 1.56	2.58 ± 1.42	<.001
Softball	11.87 ± 21.50	14.23 ± 22.82	11.41 ± 21.22	.11	2.29 ± 1.34	1.82 ± 1.33	2.39 ± 1.33	<.001
Swimming and diving	8.87 ± 18.81	8.37 ± 10.88	8.97 ± 19.99	.81	2.09 ± 1.36	1.75 ± 1.35	2.16 ± 1.36	.13
Tennis	8.67 ± 15.20	14.72 ± 17.65	8.15 ± 14.91	.08	2.30 ± 1.55	2.44 ± 2.26	2.29 ± 1.48	.79
Volleyball	10.43 ± 20.15	18.48 ± 27.73	9.08 ± 18.24	<.001	2.11 ± 1.26	2.07 ± 1.59	2.11 ± 1.20	.62
Total	11.74 ± 21.93	18.46 ± 31.93	10.65 ± 19.63	<.001	2.34 ± 1.36	2.14 ± 1.49	2.37 ± 1.33	<.001
Overall	11.01 ± 22.86	18.60 ± 34.86	9.56 ± 19.40	<.001	2.24 ± 1.33	2.05 ± 1.41	2.28 ± 1.31	<.001

Abbreviation: NA, not applicable.

[a] Independent-samples *t* test comparing the average number of AT services per injury between time-loss and non–time-loss injuries.

[b] Independent-samples *t* test comparing the average number of AT services per ATR visit between time-loss and non–time-loss injuries.

school student-athletes do not have access to a full-time AT,[9] they may seek therapy offsite.[12] This contrasts with collegiate student-athletes, who have access to a full-time AT and may receive onsite care.

Comparisons Between TL and NTL Injuries

The average number of ATR visits and AT services per injury were higher among TL than among NTL injuries. In particular, TL injuries required more therapeutic activities or exercise and AT evaluation and reevaluation. These findings emphasize the severity of injuries that result in TL, which may require further examination and more extensive rehabilitation than NTL injuries. At the same time, the average number of AT services per ATR visit was higher for NTL than for TL injuries, which highlights the amount of care that ATs provide to manage certain injuries so that they do not result in TL and the athlete is able to remain active. Many injuries require ongoing management throughout a season or high school career in spite of the athlete's ability to return to full participation. Some of the services provided for NTL injuries may be related to ongoing maintenance and prevention of reinjury.

LIMITATIONS

Our findings document the enormous volume of care and management that ATs provide to student-athletes. At the same time, it is important to realize that not all high schools have access to ATs.[9] These results may not be representative of the typical US high school setting. If no AT is available, then high school student-athletes and their parents are forced to seek care elsewhere in the health care system, which results in more inconvenience and greater costs, difficulties in care coordination, and challenges in communicating an athlete's participation limitations to coaches. In some settings, the evaluation and management of acute injuries may thus fall upon coaches or part-time volunteer health care providers, who may have varying levels of first-aid knowledge.[14,15]

Numerous factors may have influenced the reported AT services documented in this study. Overall staffing and

Table 6. Athletic Trainer (AT) Services per Injury and per Athletic Training Room (ATR) Visit, by Type of AT Service, National Athletic Treatment, Injury and Outcomes Network (NATION), 2011–2012 Through 2013–2014

Type of AT Service	AT Services per Injury (Mean ± SD)			*P* Value[a]	AT Services per ATR Visit (Mean ± SD)			*P* Value[b]
	Total	Time Loss	Nontime Loss		Total	Time Loss	Nontime Loss	
AT evaluation or reevaluation	1.76 ± 3.95	4.29 ± 6.67	1.27 ± 2.93	<.001	0.47 ± 0.52	0.59 ± 0.52	0.44 ± 0.52	<.001
Physical performance test or measurement	<0.01 ± 0.05	0.01 ± 0.11	<0.01 ± 0.03	<.001	<0.01 ± 0.01	<0.01 ± 0.02	<0.01 ± 0.01	<.001
Therapeutic activities or exercise	5.01 ± 13.56	7.96 ± 20.97	4.44 ± 11.52	<.001	0.80 ± 1.04	0.71 ± 1.02	0.82 ± 1.04	<.001
Neuromuscular reeducation	0.72 ± 3.35	1.41 ± 5.21	0.59 ± 2.84	<.001	0.09 ± 0.26	0.11 ± 0.27	0.08 ± 0.26	<.001
Manual therapy techniques or massage	0.16 ± 1.05	0.18 ± 1.18	0.16 ± 1.02	.20	0.03 ± 0.16	0.02 ± 0.15	0.04 ± 0.17	<.001
Modalities	2.05 ± 4.78	3.06 ± 6.96	1.86 ± 4.20	<.001	0.51 ± 0.52	0.41 ± 0.50	0.53 ± 0.52	<.001
Hot or cold packs	1.74 ± 4.19	2.47 ± 5.91	1.60 ± 3.76	<.001	0.46 ± 0.49	0.34 ± 0.44	0.48 ± 0.49	<.001
Whirlpool	0.19 ± 1.19	0.36 ± 2.02	0.15 ± 0.95	<.001	0.04 ± 0.17	0.04 ± 0.17	0.04 ± 0.17	.03
Electrical stimulation	0.08 ± 0.76	0.14 ± 1.17	0.07 ± 0.65	<.001	0.01 ± 0.10	0.02 ± 0.11	0.01 ± 0.09	.003
Ultrasound	0.02 ± 0.39	0.03 ± 0.44	0.02 ± 0.38	.03	<0.01 ± 0.05	<0.01 ± 0.05	<0.01 ± 0.05	.43
Vasopneumatic devices	0.01 ± 0.24	0.05 ± 0.46	0.01 ± 0.16	<.001	<0.01 ± 0.03	0.01 ± 0.06	<0.01 ± 0.03	<.001
Paraffin bath	0.01 ± 0.22	0.01 ± 0.33	<0.01 ± 0.19	.03	<0.01 ± 0.02	<0.01 ± 0.02	<0.01 ± 0.02	.21
Contrast bath	<0.01 ± 0.16	0.01 ± 0.17	<0.01 ± 0.16	.006	<0.01 ± 0.03	<0.01 ± 0.07	<0.01 ± 0.02	.19
Iontophoresis/ phonophoresis	<0.01 ± 0.01	<0.01 ± 0.01	<0.01 ± 0.01	.83	<0.01 ± 0.01	<0.01 ± 0.01	<0.01 ± 0.01	.46
Strapping	1.02 ± 3.35	1.52 ± 4.83	0.93 ± 2.97	<.001	0.22 ± 0.40	0.17 ± 0.36	0.22 ± 0.41	<.001
Gait training or crutch fitting	0.01 ± 0.13	0.04 ± 0.26	<0.01 ± 0.09	<.001	<0.01 ± 0.04	0.01 ± 0.07	<0.01 ± 0.03	<.001
Wound care	0.28 ± 1.29	0.12 ± 0.96	0.31 ± 1.35	<.001	0.12 ± 0.32	0.03 ± 0.18	0.13 ± 0.34	<.001

[a] Independent-samples *t* test comparing the average number of AT services per injury between time-loss and non–time-loss injuries.
[b] Independent-samples *t* test comparing the average number of AT services per athletic training room visit between time-loss and non–time-loss injuries.

athlete-to-AT ratios may limit the amount of hands-on treatment, such as manual therapy, that can be provided. Barriers may also exist because of the cost of certain equipment, such as ultrasound. Some high school ATRs may also be restricted by size; if only a few tables are available, athletes may have to share them while receiving different services. In addition, the services ATs can provide may be limited by the practice act in their state and standard operating procedures. At the same time, the AT services reported in this study may not include those services outsourced to other health care practitioners, such as physical therapists and chiropractors. For example, we found low use of manual therapy by ATs in the high school setting. The ATs, physicians, and parents may send student-athletes to other health care providers for such services, or they may not have the time and staff resources to provide manual therapy and instead give student-athletes activities they can perform on their own. Future researchers may benefit from examining outsourced services in addition to in-house AT services to better describe the care injured student-athletes receive. Qualitative findings could better describe the barriers to providing certain types of services. Furthermore, examining differences in the provision of AT services by full-time, part-time, and outreach ATs is warranted.

Other limitations exist in our study. Our injury definition was designed to collect the range of injuries that are seen by ATs and other team medical staff. However, it is possible that our definition did not account for some injuries, particularly those that student-athletes felt did not require presentation to ATs. Our data collection of AT services may have also missed other aspects of care and management provided to injured student-athletes, including prevention initiatives and emergency transport. As noted earlier, our findings may not be generalizable to high school sports programs without access to ATs. Both our study and the previous studies[6,7] examining care in the high school sports setting addressed schools with onsite ATs. Recent investigators[9] noted that 55% of high school student-athletes have access to a full-time AT. Our study did not account for outsourced services, differences within the type of AT coverage (eg, full time versus part time versus outreach, larger versus smaller staff sizes), or duration of care. We did not assess barriers (eg, cost) to providing certain types of AT services. Surveying ATs regarding their practice patterns may have provided information about what their ideal injury-management protocol would have been had such barriers not been present. Finally, although these findings suggest the benefits of having an onsite AT, future researchers must directly compare sport settings with and without AT coverage to determine their effect on the care of injured athletes.

CONCLUSIONS

A wide variety of AT services are used to care for athletes with sport-related injuries sustained in the high school setting. Although AT services vary by sport and between TL and NTL injuries, our results suggest that NTL injuries require substantial AT services and highlight the extensive volume of care that ATs provide to student-athletes. These data also suggest that ATs use appropriate forms of care such as therapeutic activities and exercise, the volume of which is likely driven by the high number of ATR visits per AT. Future investigation is needed to

examine barriers to providing services and differences by AT employment status and to explore the long-term effects of providing AT services on injured student-athletes.

ACKNOWLEDGMENTS

This study would not have been 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 (NATAREF) and the Central Indiana Corporate Partnership (CICP) 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 NATAREF, CICP Foundation, or BioCrossroads.

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