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Original Research

Athletic Trainers' Effect on Population Health: Improving Access to and Quality of Care

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Context: The scope of athletic training practice combined with the magnitude of scholastic athletic injuries means that the scholastic athletic trainer (AT) is uniquely positioned to positively affect the overall health care of this population. The AT is equipped to serve in the prevention and primary management of injuries and return to activity of scholastic athletes. However, to optimize the musculoskeletal health of all athletes within a given setting, the gaps in clinical care must be continuously evaluated. Quality improvement (QI) approaches are often used to establish a framework for delivering care that promotes the best health status of the targeted population.

Objective: To describe the creation, implementation, and early results of a QI initiative aimed at advancing the health of the scholastic athletes served in the Greenville County, South Carolina, school district.

Design: Cohort study.

Patients or Other Participants: A total of 49 793 athletes.

Main Outcome Measure(s): The QI framework consisted of a process that documented the magnitude of athletic injuries, established risk factors for injury, defined intervention steps for at-risk athletes, and evaluated the QI process before and after implementation. The results were regularly reported to participating stakeholders, including ATs, athletic directors, coaches, parents, and athletes.

Results: After the QI process, injury rates decreased (absolute risk difference between the 2011–2012 and 2016–2017 academic years = 22%) and resources were more strategically allocated, which resulted in a decrease in health care costs of more than 50%.

Conclusions: Collectively, the QI framework as described provides a systematic process for empowering the AT as the foundation of the scholastic sports medicine team.

Key Words: scholastic athletic injuries, injury prevention, tertiary care

Key Points

- The quality improvement process has established a method that fosters communication and problem solving, harnessing the strength of the entire school district team.
- In the quality improvement process, the athletic trainer has been installed as the central figure in managing all aspects of student-athletes' health, triage, care coordination, and resource use.
- Pooling resources, data, and experience has improved the efficiency of the development and implementation of prevention, treatment, and academic and athletic reintegration programs to the benefit of the entire scholastic population.

In the United States, approximately 15 million adolescents attended high school and 7.8 million participated in scholastic sports during the 2015–2016 academic year.[1,2] This suggests that approximately 50% of adolescents enrolled in high school are at risk for sport-related injuries, of which more than 2 million are estimated to occur each year.[3] These injuries result in more than 500 000 physician visits and 30 000 hospitalizations.[3] More than 50% of injuries in the youth and adolescent groups have been attributed to overuse; these injuries should be preventable.[4,5] Given the scope of athletic training practice and the magnitude of scholastic athletic injuries, the athletic trainer (AT) is uniquely positioned to serve an integral role in managing the health of our local communities.[6,7]

Athletic trainers affect athletes across the spectrum of treatment, from evaluation through primary treatment, management, and returning them to sport participation. The education and training of ATs are focused on preventive care and primary management of the musculoskeletal health of scholastic athletes from immediate care and triage for emergent situations, such as spinal injuries, to initial evaluation and treatment after an ankle sprain.[7] Athletic trainers have been the leaders of scholastic sports medicine programs and have spearheaded clinical care by maintaining the health of each student-athlete within the school's population. For ATs to meet these goals and operate at the highest level of medical practice based on their educational preparation and certification requirements, they must triage and coordinate medical care, often interacting with and depending on a cohesive medical and education team, to ensure the success of their athletes. Population health programs aim to affect the health of large homogeneous groups of individuals throughout a given system. The keys to optimizing the musculoskeletal health of all athletes within the Greenville County, South Carolina, school district (Greenville County Schools) were to continuously evaluate the gaps in preventive and clinical care[8] and identify opportunities for improving the most influential services provided at the system, provider, and school levels.[9]

Quality improvement (QI) approaches are often used to establish a framework for a systematic process to assess the current status of an agenda and advance the methods, programs, and delivery of consistent superior care while ensuring the health of the targeted population.[10] When applied to a sports medicine program, the QI process aimed at providing community-level health services must document specific steps that can be used to operationalize population-level data. The primary goals of the sports medicine program are to create plans for preventing injury and managing the needs of individual athletes and groups of athletes while maintaining and promoting a cost-effective strategy. The QI framework systematically identifies processes and measures that can potentially affect large numbers of athletes.[9] The resulting data are the basis for evaluating and modifying the programs the sports medicine providers deliver in order to ideally supply more effective and efficient health care delivery.

In Greenville County, the need to develop a better understanding of our sports medicine program for managing scholastic athletes became a priority when sharp increases in secondary insurance premiums occurred. Improving the health of the scholastic athletes and managing costs related to providing services were part of the impetus for developing the QI process. The initial work to appreciate the scope of the problem began with evaluating the district's use of health resources, which was characterized by school, sport, and injury type. The goal was to examine patterns of injuries, treatments, and services for trends and outliers of need, timing, and access to care. The findings of these initial efforts formed the basis for developing a QI process designed to improve the quality and efficiency of the health services delivered within the scholastic sports medicine program. Therefore, the purpose of our study was to describe the creation, implementation, and early results of a QI initiative aimed at advancing the health of the scholastic athletes in the Greenville County Schools.

METHODS

Developing a QI Process

The steps for designing and planning the implementation of the QI process were informed by our experiences with monitoring and describing injury incidence and patterns in scholastic softball and baseball players in Greenville County.[11,12] From our original internal study to establish injury rates, risk factors, treatment, and services, we uncovered inconsistencies and incomplete information. The available information was not organized or defined in such a way that sustainable reporting was feasible. The process of accessing the data required aggregating injury and service information from several sources, including athletic training, physical therapy, and hospital electronic medical records and insurance claims collected over 9 years for more than 67 000 athletes. This information required analysis by school and sport participation. Therefore, creating an aligned data system and specific program goals was critical for establishing a QI process. The QI process required representatives from the athletic training network, medical staff, school district, and the Center for Effectiveness Research in Orthopedics (CerOrtho; Greenville, SC). These representatives collaborated to (1) define a mission, purpose statement, and goal for the sports medicine program and (2) identify a sufficient set of information with consistent data definitions for *participation*, *injury*, and *service information* throughout the district.

The overarching goal for the sports medicine QI process was to identify meaningful and actionable measures that would positively affect the health of our student-athlete population. This would be achieved by operationalizing program-level data and creating plans to address the prevention and management of the injuries of individual and groups of high school athletes while maintaining a cost-effective strategy. The QI effort established a singular process to (1) identify and manage the important or modifiable injuries within the district, (2) establish the AT as the primary triage and case-management personnel for all scholastic sport-related illness and injury episodes, (3) aggregate population data to inform decisions and program development, (4) reduce the incidence and effects of sport-related injuries within the district, and (5) provide sustainable health care services to student-athletes. The QI steps were (1) documenting the magnitude of injuries treated by the ATs (done by retrospective review of data in the Athletic Trainer System [ATS; ATS-Keffer Development Services, LLC, Grove City, PA]); (2) establishing the risk factors and injury mechanisms related to injuries within the high school scholastic population; (3) defining the steps used to intervene with at-risk athletes, monitor the health care services provided, and evaluate the postintervention injury rate; (4) examining pre– and post–QI process health care expenditures for each injury condition being studied; and (5) reporting the results of the QI process to ATs, athletic directors, coaches, parents, and athletes.

Overall Cohort for QI Process

We describe using a QI process within the Greenville Health System Sports Medicine Program in partnership with Greenville County Schools to provide an athletic training network covering 33 middle and high schools and more than 8000 individual athletes per year. The high schools ranged from 3A to 5A schools, with an average of 490 athletes per school. Each year, approximately 1000 of the athletes (13%) receiving care in this program were middle school and approximately 7000 (87%) were high school athletes participating in 21 sports. Approximately 3000 athletes (35%) participated in multiple sports throughout each academic year.

Program Organization and Operations

The network of ATs was an integral part of the sports medicine program within the health system. The sports medicine program comprised an interdisciplinary team of health care professionals, including primary care sports medicine physicians, orthopaedic surgeons, and other specialized care professionals in addition to the primary

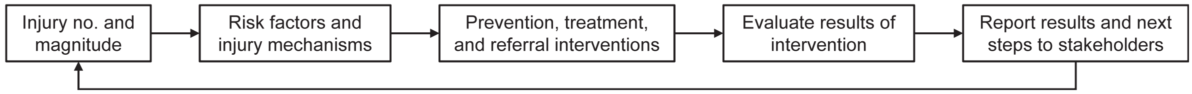

Figure 1. Steps of the quality improvement process to inform practice.

AT charged with providing health care as needed. The program had been managed by 2 supervising ATs, and medical oversight was supplied by the primary care sports medicine practice of the hospital system. Each high school was staffed with a minimum of 1.0 full-time equivalent AT. Middle schools were served by a minimum of 0.5 full-time equivalent ATs. Additional full-time equivalent resources were provided to each 4A and 5A high school to make available supplemental prevention, event coverage, triage, and treatment services throughout the year.

The ATS electronic medical record was the repository for documentation of athlete demographics, participation, exposures, injuries, and health care services provided or referred. This system has been used at each of our school locations and medical facilities to inform care and communicate efficiently. Additional medical (physician electronic medical record), eligibility (state eligibility information technologies system), and cost (secondary insurance claims) data were provided through an interface with the secure CerOrtho server. This information was used to inform the QI efforts (in a deidentified manner through a unique linking athlete identification number).

The data collected at each step of the QI initiative represented the real-time decision-making process at the individual school level. Aggregating the injury and service information into regional patterns helped to inform program health care practices and costs through a feed-forward and feedback loop (Figure 1). Examples of specific studies highlighting the steps and execution of the QI process appear later in this manuscript.

Statistical Analysis

Cumulative incidence rates with 95% confidence intervals (CIs) were calculated for the entire district over the QI process time frame. Yearly trends were calculated and compared for each scholastic year. We used a χ^2 analysis to determine the differences in injury frequency between groups. Risk reductions were calculated to establish trends over time. All statistical analyses were conducted using SPSS (version 22.0; IBM Corp, Armonk, NY). We set the α level a priori at .05 for all statistical comparisons.

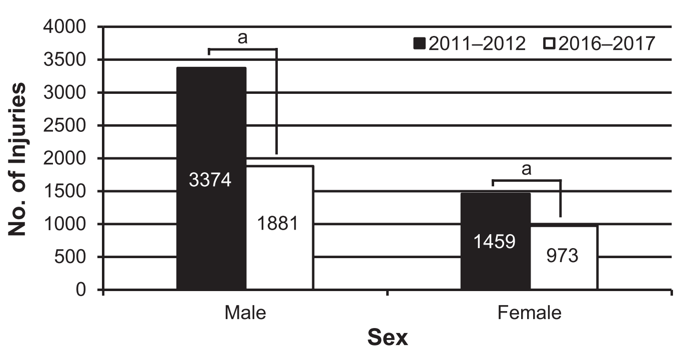

Figure 2. Injuries by sex. [a] Denotes within-comparison difference of $P < .05$.

RESULTS

Over 6 academic years, 49 793 individual athletes participated in at least 1 sport in the Greenville County Schools. The total number of injuries documented for these athletes during the 6-year period was 22 758. On average, our athlete population remained stable, with 8300 individual participants (range, 7913–8547) playing sports in Greenville County Schools yearly. The cumulative incidence of all injuries over the 6-year time frame was 46 injuries per 100 individual athletes (95% CI = 45, 47 injuries per 100 athletes). Only 7% (n = 1593) of the injuries occurred in middle school athletes. Sixty-nine percent (n = 15 703) of the injuries were attributed to males, with the greatest frequency of injuries found in football players (41%, n = 9331). The 5 sports with the greatest frequency of injury were football (41%, n = 9331), basketball (14%, n = 3186), soccer (10%, n = 2276), wrestling (6%, n = 1366), and track (6%, n = 1366).

More athletes reported an injury (time loss or non–time loss) requiring the attention of an AT in the school year before our QI process was instituted (cumulative incidence for July 2011–June 2012 = 58 injuries per 100 athletes [95% CI = 56, 59 injuries per 100 athletes]) than in the 2016–2017 academic year (July 2016–June 2017 = 36 injuries per 100 athletes [95% CI = 35, 37 injuries per 100 athletes]). The absolute risk difference in cumulative incidence between the 2011–2012 and 2016–2017 academic years was 22%. This risk reduction was noted not only for the cohort but also during a comparison by sex (Figure 2).

The 6-year trends in health care use, or the consumption of health care resources compared with the quality and cost of care, showed that a QI process focused on preventing, treating, and carefully managing sport-related injuries was successfully implemented for a large population of middle and high school athletes. Greenville County Schools insurance premiums declined yearly from the 2011–2012 academic year, for which the total premium was nearly \$500 000, to a low in 2016–2017, when the total premium was reduced by approximately 50%. Yearly participation was relatively stable (within 10%) over this time while the percentage of premiums, claims, and losses decreased, whereas the frequency of initial medical referrals to specialists increased (Figure 3).

Steps 2 to 5 of the QI framework are demonstrated as practical examples of team decision making, cooperation, implementation, and modification of the QI process over a 5- to 6-year period. All projects were designed by the athletic training and coaching staffs in cooperation with the QI teams. Each project had a minimum of 6 steps: (1) problem identification or agreement, (2) baseline data collection, (3) project implementation, (4) data download and reduction, (5) data analysis and team evaluation, and (6) reporting of results from specific projects, discussion of program implications, and feedback on the QI process.

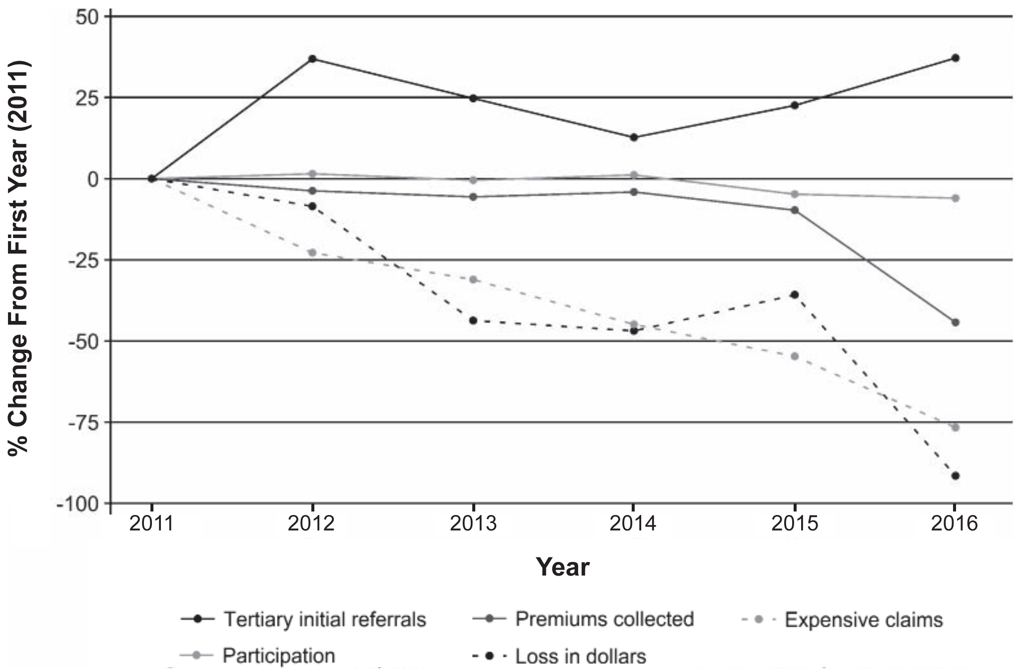

Figure 3. Health care use.

Project 1: Understanding and Modifying Muscle-Strain Rates in Scholastic Athletes

The initial step for implementing the QI process was understanding the magnitude and factors related to injuries and their management throughout the school district.[13,14] The burden of injury management and tracking in the Greenville County high schools had fallen to each school's AT, but the process of aggregating and analyzing the data at the local and regional levels to understand the current status had not been outlined. The goals for conducting this project within the QI process were to (1) establish a process for managing the injury information recorded in the ATS, (2) evaluate the effect of the project, and (3) modify the process based on evaluation of the program.

Given our coaches' observations, the peer-reviewed literature,[15] and the modifiable nature of the problem, the early QI focus was to understand the problem of lower extremity muscle strains within Greenville County Schools. The purpose of the project was to reduce the incidence and effects of lower extremity overuse injuries in a large school district in Greenville County, South Carolina.

Methods. All lower extremity muscle strains documented in the ATS were retrospectively reviewed from the beginning of the 2011–2012 school year to the end of the 2012–2013 school year. This information was paired with the total athlete participation over the 2-year period to create a cumulative rate of lower extremity muscle strains per 100 athletes during the review period (3.0; 95% CI = 2.7, 3.2 per 100 athletes). The rates of hamstrings and quadriceps muscle strains were 0.91 per 100 athletes (95% CI = 0.78, 1.1 per 100 athletes) and 0.55 per 100 athletes (95% CI = 0.45, 0.68 per 100 athletes), respectively.

An interdisciplinary team of ATs, physical therapists, and strength and conditioning coaches developed a dynamic warm-up, functional activity, and balance program appropriate for male and female teams participating in all seasons. This injury-prevention program was designed to provide controlled flexibility, eccentric lengthening, and dynamic balance of the lower extremity and core musculature of each athlete in preparation for sport-specific activities. The exercises were tested for efficiency and feasibility and were implemented by the beginning of the 2013–2014 school year. All coaches and ATs attended educational programming on properly directing and performing the 10-minute program before all practices and games. A video link (https://www.ghs.org/healthcareservices/orthopaedics/steadman-hawkins-clinic-of-the-carolinas/sports/injury-prevention/) and posters addressing proper exercise timing and performance were provided to all athletic directors, ATs, coaches, and athletes at each school. The duration or number of repetitions for each exercise used during warm-up sessions is detailed in Figure 4.

Lower extremity muscle-strain injury information was prospectively documented in the ATS by each school's AT and analyzed after the 2015 season. Cumulative incidence rates with 95% CIs were calculated for overall rates of lower extremity, hamstrings, and quadriceps muscle strains per 100 athletes for the baseline and postintervention periods. Muscle-strain rate ratios (RRs) were compared between the preintervention and postintervention periods.

Results. The cumulative muscle-strain rate per 100 athletes during the 2013–2014 and 2014–2015 scholastic years was 2.1 (95% CI = 1.9, 2.4 per 100 athletes). Comparison of muscle-strain rates from pre-exercise to the postexercise program demonstrated a reduced injury rate expressed as an RR (0.70; 95% CI = 0.61, 0.80). The hamstrings and quadriceps muscle-strain rates per 100 athletes for the 2013–2015 scholastic year were 0.3 per 100 athletes (95% CI = 0.2, 0.4 per 100 athletes) and 0.1 per 100 athletes (95% CI = 0.06, 0.16 per 100 athletes), respectively. Comparison of hamstrings muscle-strain rates from pre-exercise to the postexercise program revealed a reduction in RR (0.33; 95% CI = 0.24, 0.45). Similarly, the

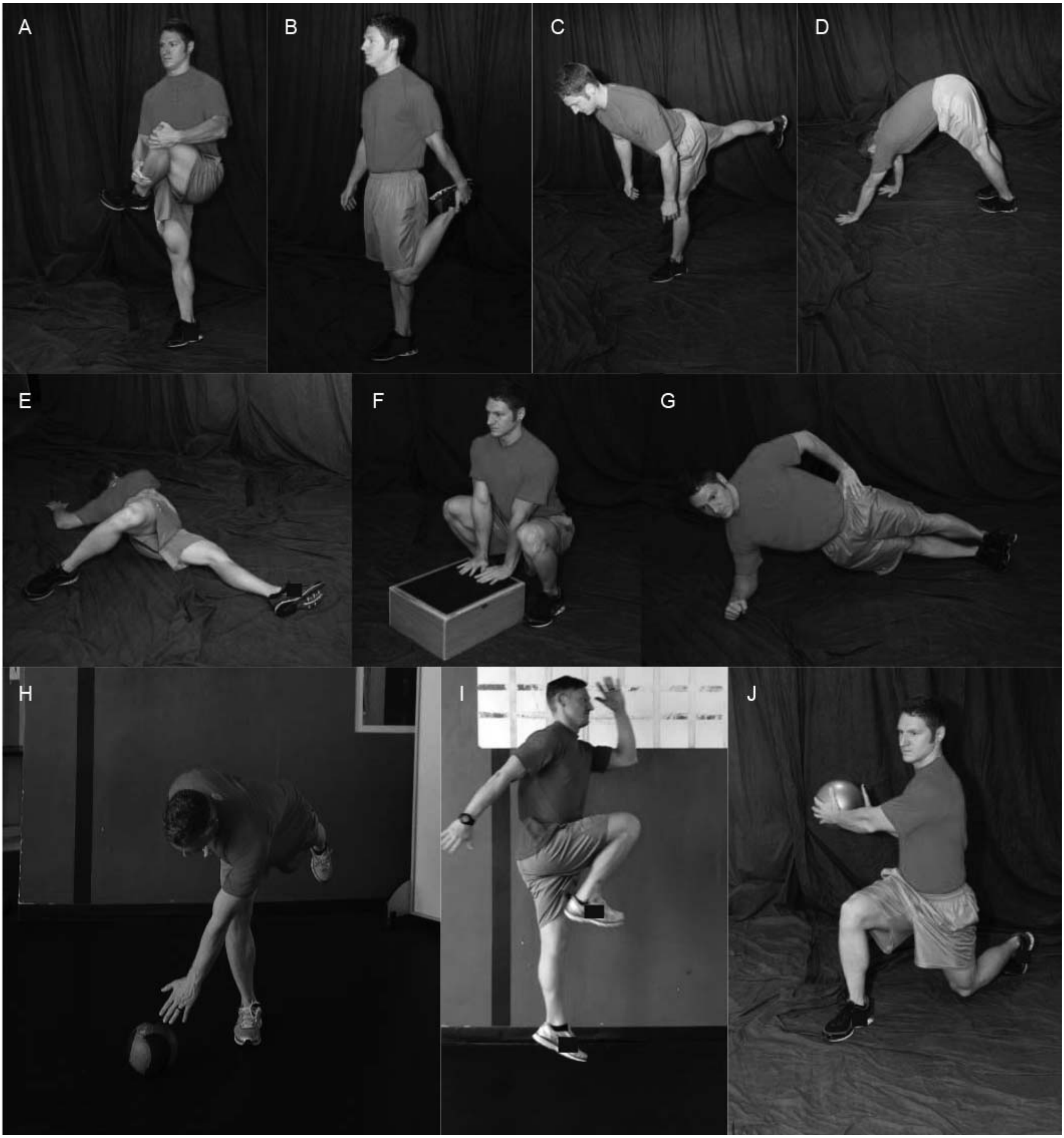

Figure 4. High school sports functional warm-up program. A–D, Dynamic warm-up. Two sets of 10 yd (9 m). E–G, Function. Three sets of 30 repetitions or 30 s. H–J, Balance and agility. Three sets of 15 repetitions or 2 sets of 10 yd (9 m).

rate of quadriceps muscle injuries was reduced when comparing pre-exercise and postexercise (0.18; 95% CI = 0.10, 0.29).

Discussion. The main outcome of this project was a reduction in the overall rates of lower extremity, hamstrings, and quadriceps muscle strains over the study period. The QI program was initially led by the school AT. The coaches then instructed their teams daily using the visual aids described in the "Methods" section. However, the reduction in muscle-strain rates cannot be specifically attributed to the institution of the intervention program. Stability in the number of participants, practices, games, and medical care providers over the monitored period suggests that the dynamic warm-up contributed to the decreased injury rates.

Conclusions. Muscle-strain rates in our district demonstrated substantial reductions, but specific mechanisms and causation were not evident. To improve the QI process, researchers need to elucidate the risk factors and mechanisms related to specific injuries. This study added to our QI process by highlighting a need to expand our data-collection process to include a consistent minimum data set. Including more information would provide a complete understanding of injury and treatment patterns.

Project 2: Risk Factors Associated With an Inability to Successfully Return to Sport After Initial Injury

Annual review of the retrospective injury data demonstrated that several of our athletes had experienced many injuries over their scholastic careers. Previous injuries have been documented as the most consistent contributor to developing a sport-related musculoskeletal injury.[16–19] Only approximately two-thirds or fewer high school and collegiate athletes recovering from anterior cruciate ligament reconstruction (ACLR) returned to participation.[20–22] Therefore, the purpose of this project was to identify the risk factors related to the ability of scholastic athletes to return to sport participation after ACLR.

Methods. All athletes with ACLR in our cohort were injured during high school sport participation and initially evaluated and triaged by the school's ATs. Seventy athletes were identified for inclusion in our study. All athletes involved in the final cohort were required to have an additional year of eligibility in their index sport. Our final cohort (n = 60) was referred directly to a specialty provider (fellowship-trained sports medicine physician or orthopaedic surgeon) for further clinical examination and treatment planning. Athletes completed their treatment plans and passed our functional criteria before beginning the return-to-sport progression.

At the time of discharge from formal rehabilitation, we documented the risk factors of demographics and time to return to sport participation. A χ^2 test was used to determine the difference in injury frequencies between those athletes returning to sport participation before and after 7 months from the date of surgery. Relative risk ratios were calculated to compare the risk of reinjury for athletes who returned to sport participation earlier than 7 months and those who did not.

Results. Athletes recovering from an ACLR were cleared by their health care team and either were able to return to participation in the sport of injury in the next available season (n = 44) or were unable to participate based on the health of their injured knee or sustaining another knee injury before full return to sport participation (n = 16). All athletes returning to scholastic sports were monitored by the scholastic AT for full participation and development of subsequent injury. Of the athletes returning to sport, 6 (14%) subsequently sustained a time-loss injury in the following season, 8 (18%) did not lose time the following season but did have a documented injury after the end of the follow-up period, and 30 (68%) did not have a documented injury during or after the next season. Six of our athletes returned to participation before 7 months after surgery, whereas 37 returned after 7 months. Athletes who returned to play before 7 months were 17 times (95% CI = 1.9, 24.5 times) more likely to not return for a full season than athletes who returned after 7 months.

Discussion. Consistent with previous reports,[23] our results showed that delaying the return to sport appeared to increase the chances of long-term success and decrease the burden of care for individual athletes and the community. These results were presented by the physicians and ATs to the school district's coaches and parents during our preseason meetings for all pivoting and cutting sports. This communication has helped to inform parent and athlete expectations and guide our treatment progression for patients after ACLR. We have recommended that scholastic athletes who undergo ACLR refrain from full participation until after 7 months from the date of surgery based on our findings and the best available evidence.[23]

Conclusions. We recommend that our scholastic athletes undergoing ACLR refrain from full participation until they pass our functional criteria and until at least 7 months after surgery. The return-to-scholastic-sports study helped to inform our decision making regarding the most appropriate treatment pathways and time frames for returning athletes to sport.

Project 3: Athletic Trainer-Supervised Prevention Programs in Greenville County

Establishing the extent, magnitude, risk factors, and mechanisms of injury has been critical to assessing the status of and opportunities for improving the health of our student-athletes. However, the importance of the information has been proportional to the ability to modify the injury problem through effective interventions.[14] Establishing the effectiveness of a preseason conditioning program in high school baseball pitchers by comparing the targeted modifiable risk factors (shoulder range of motion and strength) before and after program implementation could inform the development of our district-wide prevention activities in the future. Therefore, it was the primary purpose of this project. The secondary purpose was to compare upper extremity injury rates between baseball pitchers participating in a preseason conditioning program[12] and a control group of pitchers.

Methods. To establish and implement a prevention program in our schools, the plan required feasible exercises with simple equipment that could be instructed and supervised by on-site personnel. The scholastic ATs assisted in identifying the study design, space, and time frame that would increase compliance with the program in their individual schools. Previous work[11,12] in which researchers identified upper extremity injury patterns and risk factors in baseball players informed the follow-up study, which was aimed at preventing injuries early in the season by addressing these side-to-side motion differences in baseball pitchers during the fall preseason.

A total of 182 high school pitchers were randomized by school into an intervention (n = 94) or control (n = 88) group. The intervention group performed an AT-supervised posterior shoulder-flexibility and -strengthening program 3 times per week for 8 weeks. The control group participated in their usual training. All pitchers participated in a 4-week interval throwing program immediately before practice started. Side-to-side differences in shoulder range of motion and strength were measured before and after the program and compared between groups and between those with and those without a history of upper extremity injury.

Repeated-measures analyses of variance were used to compare physical factors between groups. Rate ratios with 95% CIs were used to compare injury rates by group.

Results. The intervention group displayed a greater improvement in posterior shoulder flexibility (>5° of horizontal abduction) and strength (>2% of body weight in external-rotation isometric strength) over the course of the program. In addition, pitchers in the intervention group with a history of upper extremity injury showed an additional increase in range of motion (12° group difference) when compared with pitchers in the control group with an injury history (F range = 13.9–16.6, $P <$ .001). These improvements were associated with a nearly 4-fold reduction in injury risk (RR = 3.8; 95% CI = 1.3, 10.7) in those with a previous upper extremity injury when comparing groups.[24,25]

Conclusions. Combining the multiyear work in the high school baseball program resulted in a 6-fold decrease in pitchers' injury risk (25.4 to 4.2 from 2009 to 2013) and elucidated the increased diligence with respect to pitchers who had an upper extremity injury history. These findings suggested that scholastic pitchers with previous injuries reduced their injury risk when participating in a specialized preseason program that was carefully advanced by an AT. Pitchers without previous injuries seemed to benefit from participating in general preseason upper extremity care and an interval throwing program.

The results of this work were used to (1) disseminate the results of the project to all stakeholders and discuss ways of continuing and expanding the use of this and similar programs within each school; (2) alter the distribution of resources when conducting preseason screening programs, prioritizing athletes at highest risk; and (3) create a focus in the preseason program, emphasizing spending time and resources on the most beneficial exercises.

Scholastic baseball pitchers would benefit from participating in a preseason conditioning program. Pitchers with a history of upper extremity injury seemed to benefit from a specialized program targeting posterior shoulder strength and flexibility.

Project 4: Evaluating the QI Process in Greenville County

Evaluating a sports medicine program's QI process helps to highlight the gaps in prevention, care, and service management within that program. We started evaluating the QI process by considering its effect on health care use or the consumption of health resources compared with the quality and cost of care. The purpose of this project was to measure the success of the QI program in achieving the goals of reducing the magnitude and cost of services within the scholastic sports medicine program.

Methods. We developed achievable benchmarks for reducing the magnitude and cost of injury within the system. The goal was to reduce overall injuries, secondary insurance claims, and insurance cost by 10%. Longitudinal tracking of injuries, services provided, insurance claims, and costs to the school district was used to access the QI efforts of the sports medicine program. The deidentified data were aggregated from the ATS, state eligibility information technologies system (PlanetHS; PlanetHS, LLC, and ArbiterSports, LLC, Ponte Vedra Beach, FL), and cost data (secondary insurance claims) and provided for analysis through an interface with the secure CerOrtho server. Preliminary data were shared quarterly with all the stakeholders vital to aggregating and examining the data. Through monthly meetings with the scholastic ATs, the data were reviewed to identify trends in the patterns of injuries and best practices for managing recovery and resource allocation. This step was a critical component to identifying the best triage and treatment practices. Athletic trainers provided feedback to decrease the burden of aggregating data and maximize efficient allocation of resources to streamline the process. Additionally, trends for subsequent monitoring and analysis included provider type for initial entry into the health care system. These areas for QI were identified based on the type of injury and service used and provision that might offer opportunities for developing prevention or triage solutions or both.

Results. Annual evaluations revealed that yearly participation was relatively stable (within 10%) over this time, whereas the percentage of premiums, claims, and losses decreased (Figure 3). This appeared to be associated with the changes in initial referral types, demonstrating increasing use of specialty services with a concomitant reduction in financial burden over time. The 6-year trend demonstrated a reduction in injury frequency by more than 25% and cost by more than 50%.

Discussion. These findings were counter to some models of population health in which every patient is seen by a primary care physician. Instead, in our model, the AT appropriately triaged these patients to the correct provider, which appeared to result in a substantial reduction in cost. This finding suggested that this model delivered on the value equation of health care by providing high-quality care at the best cost.

Conclusions. The network of ATs and medical providers in collaboration with Greenville County Schools administrators, coaches, insurance professionals, and health care scientists have demonstrated good value with positive changes in both the numerator and denominator of the equation.

DISCUSSION

An early result of the QI process has been the establishment of a method that fosters communication and problem solving, harnessing the strength of the entire Greenville County Schools team. The pooling of resources, data, and experience has improved the efficiency of developing and implementing prevention, treatment, and academic and athletic reintegration to the benefit of the entire scholastic population. However, the most important result may have been the installation of the AT as the central figure in managing all aspects of student-athletes' health, triage, care coordination, and resource use.

The observations across a number of settings and injury types suggested that the QI process was efficacious in minimizing the risks and effects of injury related to our highest-risk activities and athletes. Whereas each project served to grow and improve the QI process, it was clear that the program as a whole has been more important than the individual projects in positively affecting the health of our scholastic athletes. We also believe that the QI process reduced costs, demonstrating the value of the ATs' services provided to Greenville County Schools. This information offers insight into the potential for long-term sustainability of the athletic training program. These factors were critical, as the program's priority was to operate within the financial and resource constraints of our community. If scholastic athletes were unable to obtain positive health outcomes without regard to finances or resources, the results would be difficult to justify and likely unsustainable in the emerging health care environment.

Future Directions in Greenville County

Next Steps: Creating a Sustainable Sports Medicine Program Through QI Projects. For the scholastic athlete population to gain viable benefits from the QI process, it was important to demonstrate the value of the entire QI effort to Greenville County Schools, high school teams, health care providers, and individual athletes beyond the observed decrease in injuries. The results of each project were disseminated to stakeholders through educational meetings and individual discussions with coaching staffs and parent groups. The ATs aggregated the equipment and materials for each project and stored the resources at their high schools so they would be available for use during the subsequent season(s). However, we recognize that the long-term sustainability of a program depends on its growth, adoption, and compliance.[26] Based on the suggestions in the available research, we are working to identify champions for the program, including athletes and booster club members at each school, to troubleshoot logistics, provide training feedback, and support the adoption of the projects within the QI process.[26]

The challenges in Greenville County are many, but the opportunities are as numerous. The short-term priorities are to increase the emphasis on providing local resources at the individual school level for ATs and athletic directors and to expand the longevity of our preventive programs by engaging students and school personnel to identify obstacles and challenges for continued implementation of these programs. Continuing to provide resources locally to each athletic department will allow each department to evaluate its practices in real time and prioritize the QI measures most likely to benefit its student-athlete population. Advancing the implementation of our prevention programs will help foster carryover and gain the involvement of more students and staff.

Translation to Smaller Athletic Training Practices. Greenville County Schools presented an opportunity for a collaborative program of health care and educational professionals to optimize the delivery of care to a large group of scholastic athletes. The lessons learned at this level can be translated to both smaller and larger athletic training practices and networks.

The QI process established at each athletic training venue can first benefit from the resources and guidance of the National Athletic Trainers' Association. These resources include position statements, information on medical conditions, and emergency action plans, and first and second Safe Sports Team award criteria set a foundation for an excellent quality assurance plan.[27,28] Additional lessons we learned included the following:

1. A commitment to documenting and collecting critical injury, treatment, and service information in an organized and consistent manner provides insight into opportunities for the practice.
2. Aggregating critical data supports the use of inductive logic.
3. Positioning the athletic training facility as a resource for the individual athlete, as well as the sports medicine program, affords the opportunity to be proactive in adding value by supporting the academic and athletic missions of the school.
4. Effective communication among athletes, coaches, athletic directors, and their peers fosters team collaboration in caring for their athletes.

CONCLUSIONS

Ultimately, the success of ATs as population health care leaders depends on empowering them as the foundation of the sports medicine team within the scholastic environment. The AT must be supported by a process that fosters data-based evaluation of the sports medicine program, communication, and problem solving, thereby harnessing the strength of the entire district team.

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