

Lean Six Sigma and Athletic Training: A Primer for Athletic Training Educators

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Context: Lean as a quality improvement philosophy is new to athletic training despite widespread use in health care for many years.

Objective: To introduce the concepts of Lean and Lean Six Sigma and create a primer document for athletic training educators in the classroom.

Background: Lean requires organizations to exercise effort along with several dimensions simultaneously to improve patient quality and efficiency while controlling costs and reducing waste. When appropriately executed, Lean transforms how an organization and its employees work, creating an avid quest for quality improvement and, ultimately, patient safety.

Synthesis: Lean is a cultural transformation that changes how an organization operates. It requires new habits, skills, and attitudes throughout the organization, from executives to front-line staff. Lean is a journey, not a destination. The culture of Lean involves the relentless pursuit of continuous quality improvement and is composed of 6 principles and numerous tools.

Recommendation(s): Whether athletic trainers approach Lean or Lean Six Sigma in a leadership role, or as a stakeholder in a Kaizen event, all should have a working knowledge of the principles, methods, elements, philosophy, and tools of robust process improvement. Moreover, while no best-practice statement exists about how to incorporate Lean Six Sigma into a curriculum, addressing process improvement early may allow immersive-experience students an opportunity to engage in a process improvement initiative, facilitating a greater appreciation of the content, and offer opportunities to engage professionals from other disciplines.

Conclusion(s): Lean is reproducible in sports medicine clinics, orthopedic practices, and outpatient and athletic health care facilities, but only when athletic trainers understand the application. Moreover, for this reason, athletic training programs should strongly consider adding a robust process improvement course/content to their graduate curriculums.

Key Words: Robust process improvement, kanbans, visual systems, Kaizen, value stream mapping

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Full Citation:

Noller C, Berry DC. Lean Six Sigma and athletic training: a primer for athletic training educators. *Athl Train Educ J*. 2020;15(4):259–268.

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KEY POINTS

- Lean is a process improvement approach seeking to optimize (efficiency and effectiveness) the production and delivery of a product or service by identifying and eliminating waste via several different strategies.
- Lean requires new habits, skills, and attitudes throughout the organization, from executives to front-line staff.
- As athletic trainers assume more significant leadership roles, Lean Six Sigma process improvement opportunities will abound, but their ability to contribute may be limited without the requisite knowledge, skills, and abilities.
- Athletic training educators and programs should strongly consider adding a Lean Six Sigma process improvement course or at least some of the critical content to their graduate curriculum either as a standalone course or within an organization and administration course.

INTRODUCTION

Lean is a multifaceted framework used to identify opportunities to provide value in health care (Figure 1). Lean requires organizations to exercise effort along several dimensions simultaneously to improve the quality of care while controlling costs and reducing waste. In essence, Lean is a process improvement approach seeking to optimize the production and delivery of a product or service by identifying and eliminating waste and improving efficiency. Lean principles provide customers exactly what they need when they need it. In fact, the concept of operational improvement has been applied successfully to a variety of industries, including and most notably, the automotive industry, specifically Toyota.^{1,2}

When appropriately executed, Lean transforms how an organization and its employees work, creating a commitment to quality improvement and patient safety. Lean has even been used in sports medicine to improve patient scheduling.³ By identifying unnecessary steps, a sports medicine practice uncovered several points of waste of valuable resources that directly affected patients.³ Removing these bottlenecks increases the value for patients, who benefit from improved patient care experience.

So, why address the principles of operational improvement in athletic training education? Simply put, Domain 5 of the Board of Certification's *Practice Analysis, 7th Edition* states that athletic trainers should have "knowledge of organizational management styles and processes (eg, Lean, Six Sigma)."^{4(p162)} Within athletic training, the concept of operational improvement is either not studied or underused despite many reports of its application in health care.^{3,5–10} Therefore, to optimize patient care, future athletic trainers should be exposed to foundational knowledge on how to implement organizational process improvement models like Lean and Six Sigma.³

Therefore, this paper builds upon the foundational context outlined in the previous article examining High-Reliable

Organizations (HRO) in *High reliability: a primer for athletic training educators*.¹¹ Second, this paper creates a primer document for athletic training educators to use in the classroom setting as a learning module. This introductory module would introduce to students the language and concepts needed to speak to and understand the continuous quality improvement (CQI) lexicon while offering the knowledge, skills, and tools necessary to actively participate in quality improvement initiatives to improve patient and workplace outcomes and satisfaction.

ROBUST PROCESS IMPROVEMENT

Organizations achieve high reliability through robust process improvement (RPI) via 3 distinct yet complementary methods. These complementary methods include Lean, Six Sigma (sometimes combined to form Lean Six Sigma), and change management.¹² We will focus on Lean and Six Sigma.

Operational Improvement Philosophy

Lean focuses on eliminating waste; Six Sigma seeks to reduce variations by decreasing defects (errors) to a specific statistical measure. The 2 approaches have been combined into the hybrid improvement process called "Lean Six Sigma."¹³ But is one system better than the other for health care process improvement? One early Lean adopter, Virginia Mason Medical Center, makes the case that Lean is the better overall approach for improvement as it values all members of the patient care team and can be implemented by anyone.¹⁴ Unlike Six Sigma, Lean does not require statistical methods and can be applied incrementally toward value-based health care.⁸

Lean: An Organizational Cultural Transformation

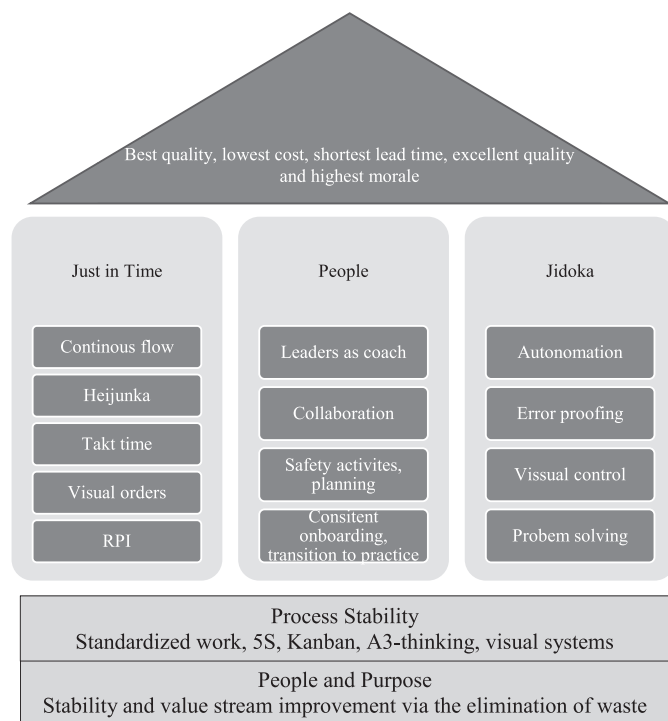
Simply put, Lean is not a program. It is not a set of quality improvement tools. It certainly is not a quick fix. It is not a responsibility to be delegated to outside consultants. Lean is a cultural transformation that changes how an organization operates. Everyone participates in efforts to improve daily work.¹⁰ It requires new habits, skills, and attitudes throughout the organization, from executives to front-line staff. Lean is a journey, not a destination. Lean is continuous, with no defined endpoint. Once 1 Lean initiative ends, another begins. The culture of Lean involves the relentless pursuit of CQI^{10,15} and is composed of 6 principles (Table 1) and numerous tools.

Lean Tools

Three commonly used Lean tools applicable to athletic training include 5S methodology, kanbans, and visual systems.

5S Methodology. The 5S methodology is a core tool needed to achieve improvement. Part of the Toyota Production System, 5S encourages streamlined inventories, clutter-

Figure 1. House of Lean.



free workspaces, and processes to maintain housekeeping standards, specifically by eliminating the 8 wastes commonly seen in health care as defined by the Lean Manufacturing System (Table 2).^{7,21} This stepwise process is used in health care to reduce inventory, create space, and reduce travel and search times while attempting to improve patient safety.^{6,7} Having an organized workplace facilitates the effort to reduce waste and leads to improvements in all forms of waste. It reduces transportation, inventory, motion, waiting, and defects while enabling the reduction of overprocessing and overproduction.⁶ The 5S methodology focuses upon Sort, Straighten, Shine, Standardize, and Sustain (Table 3).^{6,7,19}

Kanban (Signal). Related to the 5S process is the emphasis on visual controls, in this case, a Kanban (signboard or billboard in Japanese). A kanban is a visual signal used to replenish systems or supplies. Kanbans include cards, lights, empty bins, color-coded squares, and alerting devices, for example. They provide clarity and transparency of terms and are associated with inventory control or are a part of the process for prominently displaying an identified problem.⁶ Kanbans may also be used to signal the need to advance a patient or a product to the next downstream process step.¹⁹ For example, for an athletic trainer working in a physician practice with multiple providers, the color flag system on a doorway may indicate a provider or additional services that need to be rendered to streamline patient care.

Visual Systems. Visual systems provide concise communications to prevent medical errors as well as document valuable information.⁶ Visual systems include indicators, signals, controls, and guarantees (Table 4). Visual controls limit behavior, although they cannot necessarily prevent undesirable consequences. Visual guarantees are mistake-proof. For example, color-coded gas ports are visual indicators, but key gas ports are visual guarantees because they prevent staff from connecting a patient to the wrong gas.¹⁹

Lean Applications

Takt Time. *Takt time* means providing products and services dictated by the overall rate of patient demand.²⁰ Takt time is calculated by dividing available time by patient demand and considers waste within the process.²⁰ *Cycle time*, however, is the actual time required to provide a service to 1 patient. Table 5 illustrates an example of cycle time versus takt time in athletic training by examining the time necessary to strap an ankle joint.

Standard Work. By establishing standard work, health care organizations fulfill the criteria set forth by the Institute of Medicine to ensure that health care is safe, effective, patient-centered, timely, efficient, and equitable.²² Standard work applies to processes (standard operating procedures) involving testing, medication delivery, care transitions, and administrative practices. Furthermore, processes must be scrutinized to identify and eliminate waste and always focused on adding value for the patient.¹⁹

While standard work can eliminate waste and reduce risk, it requires effort from all parties involved in the process. Failing to provide adequate onboarding training (ie, new hire) or lack of training when new work task procedures are implemented affects standard work. Failure to provide the necessary training to new employees or recent athletic training graduates transitioning to practice increases the risk of error and waste, thus putting athletes at risk.

Value Stream Mapping. Value stream maps or mapping (VSM) is used to distinguish between discrete steps in a process that either do or do not provide value, thereby exposing waste through a flow diagram.²³ A process improvement team creates a visual map of each step in an existing process, known as the current state map (Figure 2). A value stream map is distinct from other maps, including the classic flow chart, as it combines information about how people and material flow through the process.²³ By analyzing the value stream map, process improvement team members can ask key questions. "Why do we do this step?" Perhaps even more important, "Would a patient be willing to pay for this part of the process if he/she had a choice?" "Is there a better, more efficient, and effective alternative?" Also, "Which process steps are most susceptible to error?"¹⁰

A value stream encompasses all the processes necessary to provide a product or service. Value streams usually cross departmental boundaries, so improvement efforts are necessarily collaborative or interprofessional. The value stream includes all departments involved in delivering value to the patient. To be able to identify specific value streams from the strategic objectives of the organization, leaders must determine what actions the organization would need to take to demonstrate excellence in clinical care, enhance revenue, and contain cost, for example. Strategically, Lean focuses upon performing many small tasks better, thereby creating value through the cumulative effect of small improvements.¹⁰

Once the value streams are identified, their current and future states can be mapped.²³ The current state map illustrates the value stream as it is presently operating (Figure 2).^{19,24} The future state map portrays the desired state of the value stream once "non-value-added time" and "waste" are removed.^{19,24}

Table 1. Six Principles of Lean

Principles	Descriptions	Athletic Training Examples
Lean is an attitude of continuous improvement and entails implementing processes that are value-added ¹⁶ from the patient's perspective and eliminating those that are not.	<p>Plan-do-check-act (PDCA)^a is a 4-step cycle allowing an organization to implement change, solve problems, and continuously improve processes. Its cyclical nature empowers the staff to speak up about problems to ultimately create patient-centered processes.¹⁷</p> <p>Plan. Identify a problem and develop a plan to solve it.</p> <p>Do. Implement a plan on a small scale.</p> <p>Check. Evaluate the results and compare them with the desired results.</p> <p>Act. Analyze the results and adopt, abandon, or alter the plan.</p>	<p>Plan. The problem is inaccurate and inaccessible medical records during travel with athletic teams. The goal is to develop and implement the use of electronic medical records (EMR) and metrics to assess outcomes.</p> <p>Do. Implement EMR on a small scale with limited staff.</p> <p>Check. Assess metrics on a daily, weekly, or monthly basis and compare against desired results.</p> <p>Act. Readjust implementation of EMR, based on past results; continue to monitor metrics; roll out to entire staff for use.</p>
Lean is value-creating.	Focus is upon the elimination of steps and processes that DO NOT contribute to patient satisfaction and outstanding care. Leaders seek and appreciate the perspectives of front-line staff. ¹⁸	Using a PDCA cycle, a secondary school athletic trainer can remove barriers to accessing primary and specialist care by offering an initiative in which both providers agree to treat athletes 2 nights a week using the athletic trainer as the conduit to schedule and prepare the necessary documentation.
Lean is a unity of purpose.	Lean provides clarity with focused work and established priorities for resource allocation. Lean projects, thereby, must fit within this strategic construct. The specific process improvement project moves the organization forward in the prioritized goal categories.	<p>Using an A3 document (named for the paper size, 11.7 × 16.5), details background, and current conditions are documented for each strategy under study.</p> <p>For example, the scheduling of patients in an orthopedic clinic as an athletic trainer working in a physician's office can be a multistep process, which does not contribute to patient satisfaction and outstanding care. A3 completion seeks to address strength, opportunities, weakness, and threats to the process, thereby defining the new strategy while building consensus, understanding, buy-in, and engagement with the new strategic priorities.¹⁰</p>
Lean is respect for the people who do the work.	<p>Lean systems differ from the traditional hierarchical management model in which higher-ups tell staff members what to do and how to do their jobs.¹⁰</p> <p>Respect for people, empowerment, is the cornerstone of Lean.^{1,6,10,18,19}</p> <p>Respect for people means recognizing that all people are experts at their particular job.</p>	<p>When requesting the implementation of EMR, invite organizations' higher-level managers and directors to learn firsthand about the problems and barriers to improvement from the staff members with the most direct knowledge.¹⁰</p> <p>Once decision makers understand the best way to complete job duties, what does and does not work, and the associated problems, they usually can offer practical suggestions to best address problems to improve job processes.</p>
Lean is visual.	Lean organizations post tracking displays of performance in staff-only areas. ^{1,10,20}	When initiating an EMR, present daily and trend performance data on key metrics (eg, patient satisfaction, costs, and quality metrics). Tracking displays also provide a dedicated space for staff members to communicate an issue needing attention or post improvement ideas. Staff meetings are often held in front of a tracking center so that metric data is easily referenced via a practice called "working the wall." ¹⁰
Lean is a flexible regimentation.	The essence of Lean is to take nonstandard work and transform it into standard work that improves performance. Standard work can be described as flexible regimentation.	Providing onboarding for newly hired staff or transition to practice for newly credentialed athletic trainers would be an example of standard work that can improve outcomes due to an understanding of the organization culture.

^a PDCA is also referred to as PDSA (plan-do-study-act).

Table 2. Eight Wastes of Lean and Its Application in Athletic Training

Concept	Definition	Health Care Examples	Athletic Training Examples
Overproduction of the product	Producing unnecessary work or deliverables	Excessive paperwork, redundant processes, unnecessary tests, using intravenous when oral meds would suffice, multiple transfers, and so on	Printing medical documentation and paperwork before it is needed; failure to adopt electronic medical records
Excess inventory (any form of batch processing)	Work or product waiting to be used or processed	Specimens awaiting analysis, emergency department patients awaiting bed assignments, excess supplies kept on hand “just in case”	Excessive inventory of perishable or expendable supplies (eg, athletic tape, medications, adhesive bandages, items with an expiration)
Unacceptable waiting times between operations	Human resources, waiting for information to perform work	Waiting for bed assignments, waiting for treatment, waiting for diagnostic tests, waiting for supplies, waiting for a doctor or nurse	Waiting for athletes between coaches’ meetings, waiting for an appointment with a health care provider, waiting for administrative decisions from senior leadership
Corrections due to manufacturing errors	Any work that did not accomplish its purpose or was not correct the first time	Medication errors, wrong-site surgeries, improper labeling of specimens, multiple sticks for blood draws, injury caused by restraints or lack of restraints	Restrapping or rebracing a patient due to failure to place in the correct anatomical position
Awkward or unnecessary operator motions	Unnecessary movement of items or human resources	Searching for charts, supplies, delivering medications, traveling throughout the hospital to care for patients	Moving between patient stations, incorrect setup of taping station
Wasteful conveyance practices (transportation)	Movement of work	Transporting lab specimens, patients, medications, supplies, and so on	Moving patients within and between athletic health care facilities to provide medical care
Overprocessing (unnecessary processing due to unclear customer requirements)	Unnecessary effort to get the work done (ie, signatures, data entry, frequently revising documents)	Mixing drugs in anticipation of patient need	Collecting medical documentation from athletes before the beginning of an athletic season
Underused human resources	Capabilities of human resources that are not used or leveraged appropriately		Rehabilitation services outsourced to another midlevel provider (eg, physical therapy) when athletic health care could be completed in-house by a certified athletic trainer

As noted above, current state maps depict the value stream as it presently operates. They also expose waste (eg, waiting times or avoiding unnecessary process steps [distances]) and provide a baseline from which improvement can occur. A properly drawn value stream map is the starting point for any process improvement implementation plan and should be collaborative. The map represents the value stream including all pertinent information about the process steps in the value

stream (eg, number of steps, transitions, cycle times, takt times, wait times, and changeover times).^{19,24}

The future state map represents the desired state of the value stream. It reflects what we want process improvement projects to achieve, which in health care is to ultimately to improve the quality of the process for patients (eg, face-to-face contact with health care providers).²⁵ These are services that patients

Table 3. 5S Methodology and Its Application in Athletic Training

Concept	Definition	Athletic Training Example 1	Athletic Training Example 2
Sort	Determine what is needed to accomplish work and what is not needed; remove unneeded items.	Staff meeting in supply/storage closet to determine items that are necessary for the organization to function.	Staff meeting in athletic health care facility casting room to determine items necessary for the organization to perform orthopedic casting for the day.
Straighten	Locate a place for all needed items and ensure that everything is put in its place.	Staff members organize supply/storage closet to limit excess inventory, wasteful conveyance practices, and overprocessing (Table 2).	Staff members organize the casting room to limit excess material waste, awkward or unnecessary operator motions, and excessive waste time to collection of materials, wasteful conveyance practices (Table 2).
Shine (sweep)	Clean the workplace and keep it clean!	Staff members encouraged to maintain a clean supply/storage closet to avoid waste and improve workplace satisfaction.	Staff members encouraged to limit materials on casting trays to what is needed for the day, organize casting tools so they are easily and quickly accessible, ensure furniture is designated as casting room only, establish a plan for cleansing between patients and at the end of business.
Standardize	Develop system(s) to apply the first 3 Ss to the entire workplace.	Develop process (visual signal, Kanbans) to avoid waste and ensure the first 3 Ss are maintained.	Includes a checklist of daily necessary casting equipment, marking furniture and equipment to a designated location; standardize cleaning process with a visual signal.
Sustain	Develop processes to maintain the gains (ie, ensures workplace stays in order).	Are all staff members accountable (buy-in) for ensuring everything has a place and is in its place at the start and end of the shift?	Assign individual tasks to athletic training staff, conducting a "time-out" before and ending work shift.

Table 4. Visual Indicators and Its Application in Athletic Training

Concept	Definition	Athletic Training Examples
Visual indicators	Bracelets for patients at risk of falling and NPO stickers on patient charts.	<ul style="list-style-type: none"> • Color-coded chart medical records • Allergy alerts • Health care insurance type (ie, HMO, PPO, EPO)
Visual signals	Lights and alarms are used to attract attention.	<ul style="list-style-type: none"> • Bell for therapeutic interventions • Alarms for whirlpool overflow
Visual controls	Limit behavior, but do not necessarily prevent undesirable action	<ul style="list-style-type: none"> • Hazardous waste container limits improper disposal of hazardous waste but does not ensure proper disposal.
Visual guarantees	Mistake-proof (color-coded gas ports are visual indicators, but keyed gas ports are visual guarantees because they stop staff from connecting a patient to the wrong gas).	<ul style="list-style-type: none"> • Color-coded electrical wires for electrical stimulation units • Medical grade supplemental oxygen in a green tank or with a green top with yellow USP label

Abbreviations: EPO, exclusive provider organization; HMO, health maintenance organization; NPO, nothing by mouth; PPO, preferred provider organization; USP, United States Pharmacopeia.

Table 5. Cycle Time Versus Takt Time and Its Application to Athletic Training^a

Cycle Time	Takt Time
Time needed to provide service to a patient	Time actually needed to provide patient service Takt time = available time/patient demand Available time must account for waste conveyance, awkward/unnecessary motion, correction due to error, underused human resources.
<p>Ankle taping example</p> <p>Athletic trainer requires 3 minutes to provide a service (ie, ankle taping), and the athletic health care facility must process 20 athletes per shift (2-hour interval).</p> <p>2 ankles per athlete × 3 minutes per procedure = 6 minutes/athlete</p> <p>120 minutes per shift / 6 minutes per athlete = 20 athletes per shift</p> <p>Ankle taping services can be provided to 20 athletes (40 ankles) in 2 hours.</p>	<p>Available time</p> <p>Three interruptions/shift × 5 minutes = 15 minutes = 105 minutes</p> <p>Time actually allocated</p> <p>105 minutes per shift / 20 athletes^b = 5.25 minutes</p> <p>Cycle time (time needed to provide the service) is 6 minutes, so 20 athletes cannot be serviced in 2 hours; thus, the athletic trainer cannot fulfill his/her obligations.</p>

^a Review cycle time first and then takt time.

^b Based on cycle time.

would be willing to pay for,²⁶ thereby adding value to their experience. Future state mapping is based on the strategic objectives of improved patient flow. It does not represent an ideal state that is unrealistic or unlikely to occur. Further, process improvement objectives should always adhere to SMART criteria, such that they are (1) Specific, (2) Measurable, (3) Attainable, (4) Relevant, and (5) Time-bound.¹⁹

Kaizen Event. A Kaizen event is also known as a Lean event, Kaizen blitz, or rapid improvement event. It entails the assignment of a team of stakeholders and subject matter experts who implement Lean tools and concepts to improve a

process. Kaizen events generally run for 3 to 5 consecutive days. Kaizen events are conducted to develop standard work criteria, create user-friendliness and established unobstructed throughout to improve efficiency, eliminate waste, and establish a smoother flow.¹⁹ The responsibility for Kaizen is evenly shared within all levels of the organization. Thus, everyone's voice and input are considered. Ongoing collaboration to improve patient care reflects the essence of a Lean culture. In this sense, Kaizen events encourage employee suggestions and application by following a plan-do-check-act (PDCA) cycle.¹⁹ Figure 3A outlines the 5-day event while Figure 3B offers an example of how a Kaizen event may unfold in athletic training.

Figure 2. Value stream mapping—current state.

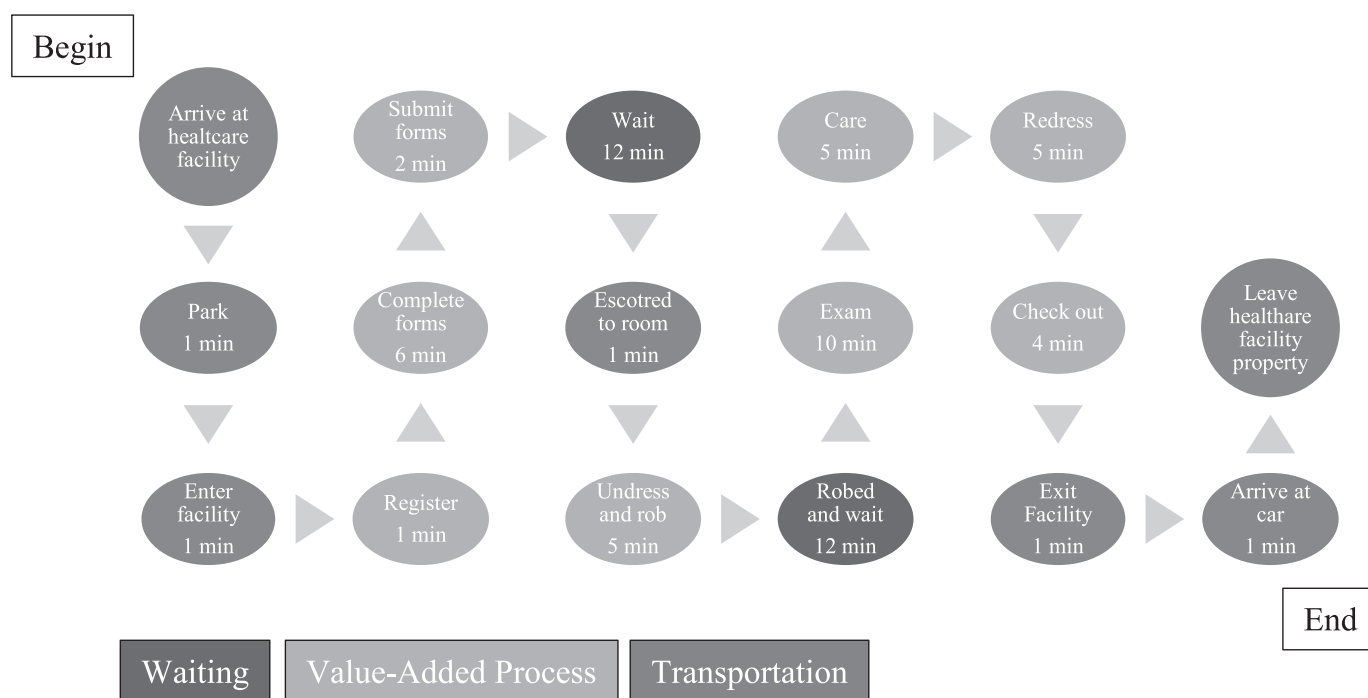
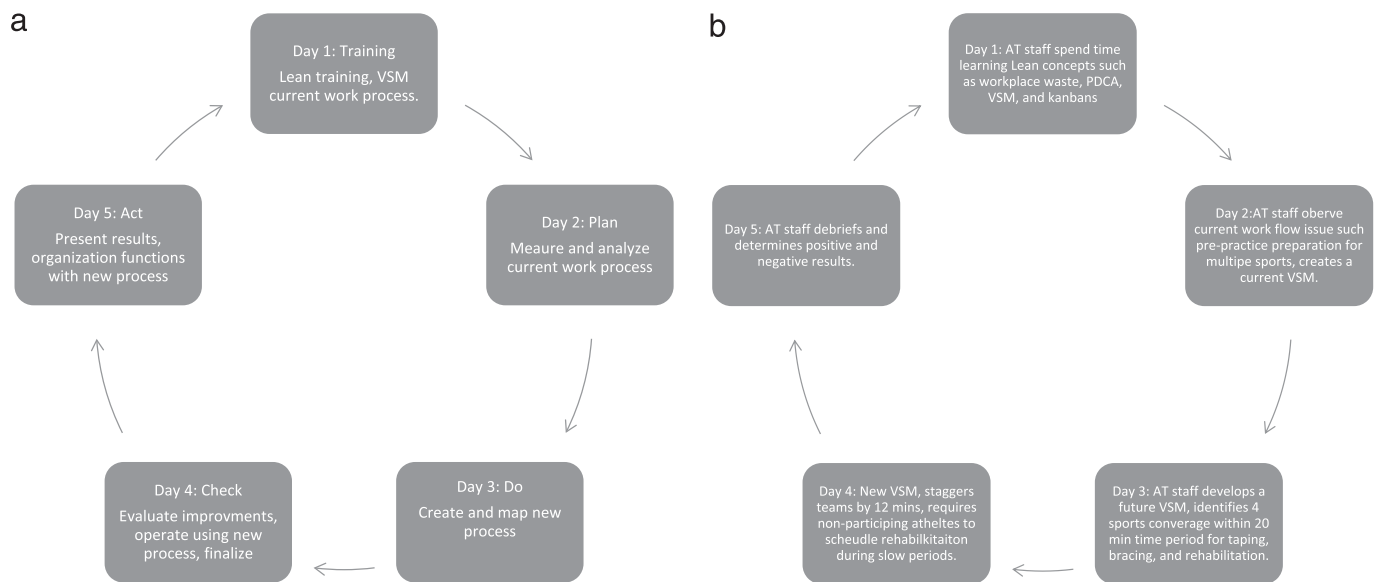


Figure 3. A, Kaizen event overview. B, Kaizen event in athletic training.



SIX SIGMA

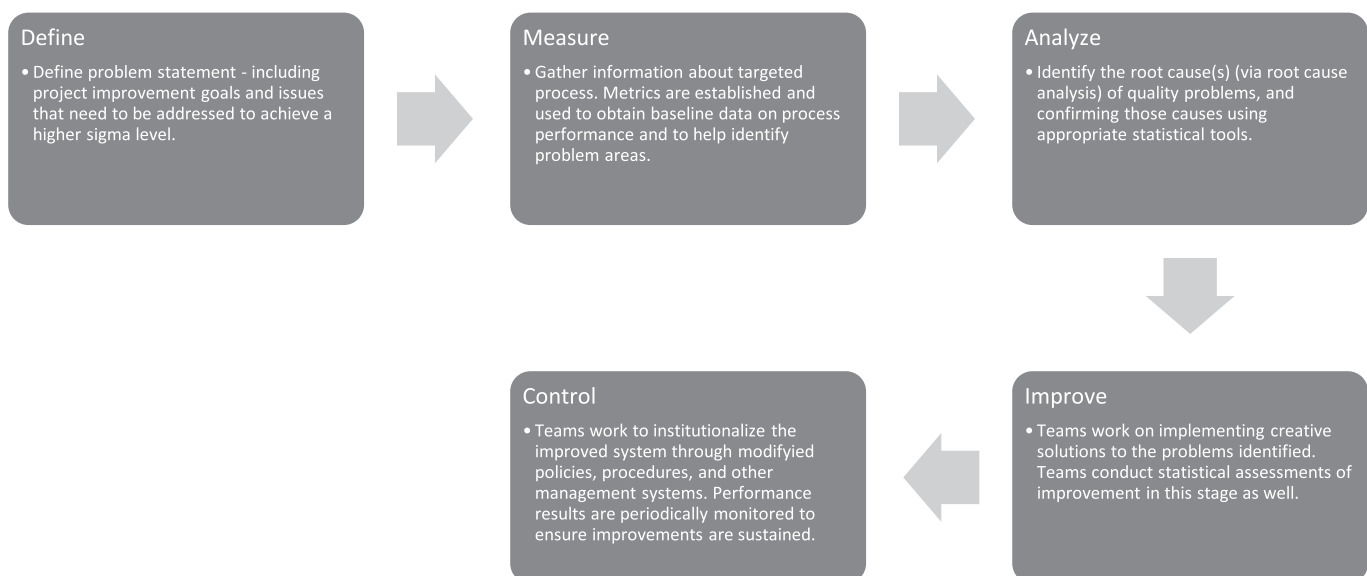
Six Sigma is a systematic method for improving the output of an organization by improving system quality. Six Sigma is accomplished by reducing variability, preventing error, solving problems, managing change, and monitoring long-term performance in quantitative terms. Thus, Six Sigma is a quantitative method that addresses quality measures.^{27,28}

Six Sigma follows a 5-phase model known as DMAIC: define, measure, analyze, improve, and control. Figure 4 emphasizes the important quality characteristics standard in health care.²⁹ Six Sigma uses many of the same Lean tools. It differs from Lean with its statistical attention to error rate and its variability for each work unit involved in each health service. As a measure of variability, highly trained Six Sigma experts can track the standard deviation of each item of interest.²⁷

The challenge of Six Sigma in health care is its complexity. The rigor required to collect usable data can be labor-intensive. Six Sigma is a heavily data-driven process intended to direct improvement efforts to eliminate defects. As a result, some organizations find achieving quality improvement goals with Six Sigma to be time-consuming and difficult. These organizations rely on professionals with Six Sigma or Lean Six Sigma certifications to maintain the requisite level of methodological rigor, especially with statistical analysis.¹⁷

Organizations, especially smaller ones, may find improvement efforts difficult to achieve if only a few certified experts are trained to analyze and monitor improvements. Small health care organizations may not have sufficient data to test the full Six Sigma to determine whether their improvement initiatives eliminated opportunities for defects. Large organizations may have the capacity to collect data; however, the time and

Figure 4. DMAIC (define, measure, analyze, improve, control) process.



personnel required to apply the rigid Six Sigma statistical tools can be challenging.¹⁷

SPORTS MEDICINE LEAN APPLICATIONS AND ATHLETIC TRAINER LEADERSHIP OPPORTUNITIES

As athletic trainers assume greater leadership roles, Lean process improvement opportunities will abound. As noted above, patient scheduling represents an ongoing challenge in all ambulatory settings. This is especially true in medical specialty clinics. One prime example is MedSport at the University of Michigan (Ann Arbor, MI).³ MedSport's patient satisfaction surveys revealed patient dissatisfaction with their scheduling system and long delays in scheduling. While providers believed the system worked well, they had not realized its inefficiencies from the patient perspective. Their team, composed of representatives of all stakeholders (including a certified athletic trainer), used "Lean thinking" to review and improve their scheduling process.³

The team determined that patients and referring physicians value prompt access to providers, while providers value an efficient system that accurately triages patients to their clinics. With value identified, a current state value stream map was created. The current state map included capturing patient and insurance information, prior medical records, test results, and imaging films collected by the clinic coordinator before an appointment was scheduled.³

As team members engaged in VSM, they discovered that the current process, with its scheduling delays, provided minimal value. They agreed that the scheduling process must be streamlined. Furthermore, reflective of Lean thinking, they realized the current scheduling system had been left unchanged because physicians and staff members were aware only of their tasks in the process, without ever considering a bigger picture. Value stream mapping allowed team members to reflect upon that bigger picture.³

The team brainstormed and identified and scrutinized the specific steps in the scheduling process, ultimately eliminating and consolidating to reduce waste and add value. From there, they created the future state VSM with the goal of scheduling at least 90% of patients during the first phone contact. To accomplish the goal, schedulers were empowered to schedule patients without seeking approval from physicians. Physicians and the clinic coordinator designed algorithms to anticipate clinical problems that schedulers would face during that phone contact. These algorithms established physician preferences and the specific injuries and conditions each treated.³ Implementation took 10 days with Lean training, algorithm adjustment, and introduction of the streamlined process with scheduling staff. Illustrative of Lean methodologies and the PDCA cycle, continuous provider and patient feedback was sought to maintain process integrity and value.³

Before the Lean initiative, the initial patient phone contact could take as little as 5 minutes. Some patients waited up to 36 days for appointment scheduling only after up to 21 phone contact minutes with the scheduler. The lengthy physician records and image review step added value to only 10% of patients.³ In the first month, 454 patients called seeking an initial appointment. Of those patients, 305 (67%) were deemed to be appropriate sports medicine referrals and scheduled

during the initial call with an average telephone contact time of 2.5 minutes. In total, 339 (75%) patients were managed with 1 phone call.³ In the third month, 547 patients called seeking an initial appointment. Of those patients, 388 (71%) were scheduled with 1 call. They maintained an average of 2.5 minutes per call, and the number of patients managed with 1 call reached 430 (79%).³

At the end of 6 months, 435 of 535 (81%) patients were scheduled with 1 call. Schedulers managed 474 (89%) of all patient appointment requests with 1 call, maintaining the 2.5-minute average call duration. After 14 months, 392 of 517 (76%) patients were scheduled with 1 call, with 432 (84%) patient appointment requests managed in 1 call. Schedulers continued to maintain the 2.5-minute average call time.³

Completing the act (or adjust) phase of PDCA, 2 months after making the Lean improvements, the team sought verbal and e-mail feedback from patients, staff, and referral sources. Patients liked being promptly scheduled. Primary care and specialty clinics were eager to assist MedSport to implement the scheduling process changes, as they found MedSport's changes helped them streamline their processes.³ Thus was the cumulative effect of relatively small process improvements across the health care continuum.

Referring physicians quickly realized the value of MedSport's new scheduling process as it reduced their paperwork and repetitive phone calls. MedSport's call center staff enthusiastically embraced the new process as it empowered them to perform their job duties more efficiently and directly meeting patient needs.³ Not only did patient satisfaction improve; so, did employee satisfaction and that of the referral network. While the initial goal was to schedule 90% of patients during the first phone contact, by 6 months the team concluded that the goal was unrealistic. Instead, they were able to sustain an overall 85% rate due to the complexity of cases seen at the UM-Health System.³

After 9 months of sustained performance to goal, the team commenced semiannual reviews, and ultimately transitioned to an annual monitoring system. They can do so because the "Lean mindset" advanced from the first Kaizen event persists with all physicians and staff members. Of course, as new problems arise, process adjustments are made accordingly.³ So are the cycles and practice of Lean.

LIMITATIONS

MedSport's Lean experience can be easily replicated in sports medicine clinics, orthopedic practices, outpatient rehabilitation facilities, and virtually any other athletic training venue. Beyond this example, there are no other salient athletic training examples to draw upon in the literature that we are aware of at the time of this publication. We believe this primer document creates the foundational tenets for athletic trainers to begin to address how to reduce waste and improve efficiency in diverse patient care settings.

RECOMMENDATIONS AND CONCLUSIONS

Whether athletic trainers approach Lean or Lean Six Sigma in a leadership role, which was the case at MedSport, or as a stakeholder team member in a Kaizen event, all must acquire

a working knowledge of the principles, methods, elements, philosophy, and tools of Lean or Lean Six Sigma. According to the Board of Certification's *Practice Analysis 7th Edition*,⁴ entry-level athletic trainers should have knowledge of organizational management styles and processes (eg, Lean, Six Sigma); therefore athletic training educators and programs should strongly consider adding a Lean Six Sigma process improvement course or at least content to their graduate curriculum to improve their effectiveness in managing organizational processes.

And while no best-practice statement exists about how and when to incorporate Lean into any curriculum, many programs will likely attempt to add the content to an organization and administration course. Although this can be useful to introduce small segments of the concept, a course specifically designed to address RPI will allow students the opportunity to embrace the concepts thoroughly. Furthermore, offering this course before an immersive experience means students would have the opportunity to engage in an RPI initiative during their experience. Immersing a student in RPI would allow for a greater appreciation of the content, a greater understanding of the organization, and an opportunity to engage professionals from other disciplines. Thus, the sooner the information can be addressed, the more opportunities students will have to engage in the process.

Athletic training educators wishing to seek more knowledge can complete certificates in Lean, Six Sigma, or change management in health care. Many large universities and hospital systems offer a wide variety of certificate options that professors and students can complete outside the curriculum so that direct applications can be made as part of service-learning community partner projects and capstones.

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