A Reflective Perspective of Lean Principles in Medical Education: Insights from a Preclinical Internship

Amber Howell B.S., Oklahoma State University Center for Health Sciences, College of Osteopathic Medicine, Tulsa, Oklahoma

Kelly Fonk B.A., Oklahoma State University Center for Health Sciences, College of Osteopathic Medicine, Tulsa, Oklahoma

Jacob Kopenksi M.S., Oklahoma State University Center for Health Sciences, College of Osteopathic Medicine, Tulsa, Oklahoma

Myka Heimbach B.S., Oklahoma State University Center for Health Sciences, College of Osteopathic Medicine, Tulsa, Oklahoma

Garrison Hall B.S., Oklahoma State University Center for Health Sciences, College of Osteopathic Medicine, Tulsa, Oklahoma

Kedrick Klassen B.S., Oklahoma State University Center for Health Sciences, College of Osteopathic Medicine, Tulsa, Oklahoma

Josie Wagner B.A., Oklahoma State University Center for Health Sciences, College of Osteopathic Medicine, Tulsa, Oklahoma

Ashlee Bradley B.A., Oklahoma State University Center for Health Sciences, College of Osteopathic Medicine, Tulsa, Oklahoma

Elizabeth Oberlander B.S., Oklahoma State College of Osteopathic Medicine at Cherokee Nation, Tahlequah, Oklahoma

Aaron Steininger B.S., Oklahoma State College of Osteopathic Medicine at Cherokee Nation, Tahlequah, Oklahoma

Juliet Agadagba B.S., Oklahoma State College of Osteopathic Medicine at Cherokee Nation, Tahlequah, Oklahoma

Corresponding Author: Amber Howell, Oklahoma State University Center for Health Sciences, College of Osteopathic Medicine
Address: 1111 W 17th St. Tulsa, OK 74107
Email: Amber.Howell@okstate.edu Phone: (817) 890-8378
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Abstract:

This reflection highlights the value of integrating Lean principles into undergraduate medical education through a preclinical internship. Despite varied prior healthcare experiences, participating medical students recognized a significant gap in understanding system-based practices (SBP). The Lean Healthcare Internship addressed this gap through lectures, simulations, and immersive hospital projects. Working alongside multidisciplinary teams, students applied Lean methodology to investigate two different workflow inefficiencies, including the signed-and-held order process and the delivery of the Important Message from Medicare. Through challenge-based learning, students developed critical thinking, teamwork, and problem-solving skills while gaining early exposure to hospital operations. This internship strengthened their knowledge of quality improvement and prepared them for clinical rotations and residency programs. Embedding systems thinking and Lean methodology early in medical training fosters adaptable, improvement-oriented physicians and offers a scalable approach to enhancing SBP education.

Introduction

The implementation of systems-based practice (SBP) in undergraduate medical education has undergone continuous evolution due to the challenges of integrating it into a medical school curriculum.[1,2] SBP is an approach to healthcare that focuses on improving the systems in which care is delivered, aiming to enhance quality, safety, and efficiency by addressing systemic issues rather than individual performance. SBP is a profoundly integral part of healthcare and patient safety, yet there are many gaps in the SBP curriculum throughout both undergraduate and graduate medical education.[3] These gaps, as identified by Johnson et al. (2008), include factors such as a lack of clear understanding of SBP, inadequate assessment, a limited understanding of the relationship between SBP and patient safety, and an absence of integration into daily practice. It is important to note that SBP education continues to be lacking, despite becoming a core competency of the Accreditation Council for Graduate Medical Education in 1999.[4]

Lean, a SBP philosophy, seeks to maximize value while minimizing waste. In healthcare, it emphasizes process efficiency, improved outcomes, and enhanced patient satisfaction. The Lean Healthcare Internship at Oklahoma State University College of Osteopathic Medicine has been effective in building SBP skills among undergraduate medical students. It seeks to continue developing medical students' systems-based thinking skills, further preparing them for rotations and clinical practice.[4]

This reflection aims to share the insights of medical students on the Lean Healthcare Internship experience, focusing on how it shaped our understanding of SBP, improved our problem-solving skills, and influenced our perspective on integrating Lean principles into medical education as a way to address gaps in SBP education within traditional medical curricula.

Internship Overview

The Lean Healthcare Internship is a four-week intensive quality improvement (QI) program in which a select cohort of second-year medical students learn Lean Healthcare methodologies. The students work in a team to solve a hospital problem, aiming to improve patient care and safety within a healthcare setting.[4] As interns, we completed a three-part Lean education curriculum that included lectures (2 days), simulations (1 day), and in-field practice (3 1/2 weeks). The lectures taught us the history and methodology of Lean system-based practices. Next, we participated in two simulations where we entered simulated hospital rooms and identified areas for improvement by applying the Lean principles we learned in class. The final step in our training was the real-world implementation of Lean work-based practices in actual hospital settings, building on the knowledge and skills we had learned and simulated.

Teams were assigned to one of two hospitals in Oklahoma that volunteered to host the internship. Leaders from each hospital challenged their Lean team with a significant issue that is currently problematic to patient care. Both groups engaged in identifying workflow WASTE: "Worthless Activities that Steal Time and Energy." These wastes can include rework, defects, excess motion, overproduction, waiting, underutilization of available resources, transportation, and inadequate inventory.

Our Experience

As a group of diverse medical students, each of us has had some healthcare experience prior to undergraduate medical education. Our group's individual experiences range from shadowing physicians, being a nurse's aide, a certified nursing assistant, a medical assistant, and an emergency medical technician.

While these experiences provided a foundation in patient care, they did not fully prepare us for understanding system improvements, a knowledge gap that the Lean methodology helped bridge. Even with these various experiences and the completion of our first year, our group reported a lack of proper understanding of how healthcare networks could be improved using SBP. Despite only one member of our group having heard of the Lean methodology, it quickly showed itself as a pivotal factor in filling the gap of knowledge in SBP, as one student reports:

> *"The project opened my eyes to how complex the processes within a hospital can be, and how minor inconsistencies in a process can have a great impact on the system as a whole."*
> -2025, Lean Healthcare Internship Student

This manuscript presents the collective experience of all of the authors; additional individual author perspectives on internship value are detailed in Table 1. Beyond theoretical learning, the internship offered hands-on engagement with hospital staff, which proved invaluable in combination with Lean methodology.

Working within the hospital setting allowed us to collaborate with a diverse team of direct-patient care workers, department managers, information technology specialists, and C-suite members to address two previously identified workflow problems. Gaining experience in a real hospital represents a fantastic opportunity rarely afforded to medical students so early in their education, and this aspect of the internship was appreciated and valued by all of the medical students. Building on this immersive experience, our teams tackled two critical workflow challenges identified by the hospitals.

Our teams worked on two hospital-identified challenges: improving the signed and held order process to reduce delays in patient care and prevent adverse events, and streamlining the workflow for obtaining the Important Message from Medicare form to ensure compliance. These projects provided real-world opportunities to apply Lean principles, collaborate with multidisciplinary teams, and understand how small inefficiencies can impact patient safety and hospital operations.

Table 1. Provide a quote that demonstrates the value of the Lean Healthcare Internship (LHI) program, or share what you think the next class of first-year medical students should know about the program and/or your experience with it:	
#	**Response:**
1	The Lean internship gave me valuable insight into how interdisciplinary teams operate within hospitals. I learned how essential collaboration is among different departments to ensure comprehensive patient care. It also helped me recognize that each group may not fully understand the responsibilities and challenges faced by others. Gaining hospital experience during my pre-clinical years was incredibly valuable as it allowed me to better understand the complexities of medical systems. Through this internship, I had the opportunity to contribute to real-world solutions for improving medical processes.
2	The Lean internship allowed me the opportunity to learn about the importance of workflow processes and how to collaborate with a team when addressing these problems. This experience has an immense positive effect on my career growth.
3	Initially, I was unsure what the LEAN internship would involve or what I might gain from the experience. After reflecting on my month in the program, I can confidently say it was one of the most rewarding experiences I have had in medical school. I gained a deeper understanding of the complexity of hospital systems and how even small issues can significantly impact patient care. Beyond simply identifying these challenges, I learned how to apply Lean methods to approach and develop solutions to these problems, creating meaningful improvements within the community. Working with some of my wonderful classmates and mentors allowed me to develop valuable skills that will undoubtedly benefit me in my future as a physician.
4	LHI is valuable first of all because of the applicability of Lean healthcare to your future career as a physician. The program is additionally valuable because you acquire certifications in LEAN healthcare which can be included on an application, as well as research and publication opportunities which are valuable when applying for residency. Lastly LHI is valuable because you get to spend a month in OSU Medical Center learning how the hospital works and interact with staff and physicians which is important as you will be rotating there eventually and potentially applying for residency there.
5	To me, the Lean Internship was invaluable to my education, and it's something I cannot recommend enough, if given the opportunity. I had previous healthcare experience, but I was never aware of the many systems at play to keep patient care top quality. This opportunity highlighted the importance of clear communication. Communication was important between my fellow interns and everyone we collaborated with. When there were gaps, mistakes and added work to provide patient care were evident. I move forward from this internship with a heighted awareness of not only making sure I communicate with people, but also *"how"* I communicate with people. As a future physician, I want to be someone who efficiently communicates with hospital staff to ensure quality patient care. I am so grateful for an amazing experience!
6	I had a great time with the Lean program! I thought it was a great opportunity to learn about the hospital system of OSU and learn the many pieces of patient care that must work together. It allows you to see the many different systems of a healthcare organization and how it can properly operate!
7	The Lean Healthcare Internship allowed me to gain valuable insight into the vast number of roles, and how essential each role is within a process in a health care system. Being able to fully immerse myself in one process throughout the internship really illuminated this, and I left with a better understanding of how a hospital works and how complex the processes are within it.
8	During my internship in Lean Healthcare, I gained several meaningful lessons that will stay with me throughout my career. I learned how to identify the root cause of complex problems and translate them into clearer, more manageable processes. This not only improves efficiency in the workplace but also strengthens patient safety, which is the highest priority. Beyond these skills, I was fortunate to build strong connections with my team and engage in valuable networking opportunities with hospital administrators, residents, and more. All experiences that will continue to shape my professional growth!
9	It represents one of the only ways to get to meet and work with a lot of the top brass of a healthcare system, helping you to understand what they want and how they see the healthcare system. These interactions will undoubtedly help understand the “C Suite” throughout your career.

10	Lean is a great opportunity to get to know leaders in the healthcare industry. Through the program, I was able to meet with members of the hospital board and staff who help in the healthcare process on the administration side, which was a side of healthcare I was not super familiar with. I realized there's so much more to running a hospital than direct patient care, even though patient care remains the number one goal. I also gained many skills that I believe will help me as a future physician, such as better stepwise processing, how to determine where a problem is occurring in a process, and how to engage with higher-ups in the field to facilitate change. It is a great opportunity to do something with your summer that you won't get to see in a classroom.
11	If you're looking to applying to the Lean Health Program just know Lean Health isn't just about fixing problems as they appear, it's about training yourself to see the bigger picture while also trusting the process. Stay curious, ask better questions, and look for root causes, not just symptoms. Small, consistent improvements add up to big change, so balance your eye for detail with a vision for long-term impact.

Takeaways

From these projects, we identified several key lessons that extend beyond the specific workflows and highlight broader principles of SBP and Lean methodology.

Realization of the Risk for Adverse Events Due to Coordination Lapses. Electronic medical records can improve communication, but inefficiencies and user errors can still lead to delays and serious adverse patient events. Our experiences reinforced how small coordination lapses can escalate patient safety risks, underscoring the importance of SBP thinking to prevent harm.

Recognizing the vulnerability of healthcare systems underscores the emotional and professional impact that adverse events can have on healthcare providers. This phenomenon is seen in medical malpractice stress syndrome. Medical malpractice stress syndrome, as named by Liang et al., is an emotional and/or physical reaction that physicians or nurses can experience during or after medical malpractice lawsuits against them. It can be very debilitating and has been shown to negatively impact healthcare providers and the care they provide their patients.[5] Preventing these events through proactive system improvements is critical for both patients' safety and provider well-being.

Discovery of the Utilities of Teamwork and Visual Mapping to Simplify Complex Work and Identify Solutions. Visual mapping and collaborative teamwork proved invaluable for simplifying complex processes and identifying high-impact solutions. These tools helped us to see inefficiencies clearly, prioritize changes, and appreciate how structured problem-solving can empower both frontline staff and leadership.

Location, Location, Location Matters to Process Efficiencies. Physical layout and resource placement significantly influence workflow efficiency and safety. Our observations highlighted how spatial organization and training gaps can create systemic waste, reinforcing the value of Lean strategies to optimize processes and reduce risk.

An Abundance of Quick, Easy Wins Once We Started Questioning the Process. Many inefficiencies persist simply because they go unquestioned. By asking why processes existed, we

uncovered quick, high-impact improvements and saw how engaging staff fosters empowerment and meaningful change.

Discussion

Our experience suggests that programs like the Lean Healthcare Internship can serve as a practical bridge to address persistent gaps in SBP education within undergraduate medical education. Embedding Lean principles early gives students hands-on exposure to SBP, an area often missing from traditional curriculum, and equips students with critical thinking tools. Throughout the first year of medical school, most students spend the majority of their time studying and taking tests, with limited opportunities to work on real-world healthcare problems and learn from them. Many have argued that the time spent in the classroom could be harming medical students' ability to grasp concepts of critical thinking and problem-solving skills.[6] The Lean program exposed students to many aspects of healthcare that we had not previously encountered. The internship allowed us to engage directly with and provide solutions to real issues, including improving the signed and held order process and the Important Message from Medicare form obtaining process.

Working collaboratively with a team, we investigated the problem by utilizing challenge-based learning, which emphasizes analytical skills, teamwork, and the practical application of knowledge. This will help us gain a better understanding of the systems within a hospital as we move forward in our education. Often, students are not exposed to a wide range of specialties or unit collaboration within a hospital before their clinical rotations. The Lean program provides a multi-disciplinary perspective, enabling an early and diverse perspective of the different roles involved in patient care. Beyond understanding hospital operations, we developed critical skills in communication, systems thinking, and strategic problem-solving—essential aspects of the Lean methodology.[4] The Lean Healthcare Internship provided medical students with a solid foundation for implementing quality improvement (QI) within our healthcare work environments and serves as an essential tool in our development as future physicians.

QI is a process that addresses systemic problems and seeks solutions. QI employs various strategies, including Lean, Six Sigma, and the Model for Improvement. Specific training and certification in Lean healthcare during medical school provides students with a broader scope of knowledge about healthcare administration and quality improvement that we can take with us in our future careers.

This foundation, established early on, enables students to master a technique that can be applied to concerns during medical school, residency, and even in their own practice, using a systematic approach.[4] Not only is this beneficial for the student who received the training and certification, but it is also profitable to the healthcare system as a whole. The Lean methodology identifies the root cause of the problem, implements effective changes, and delivers system-wide benefits, including improved patient outcomes, reduced costs, and waste elimination.[7]

Conclusions

Our participation in the Lean Healthcare Internship has allowed us to gain additional experiences that extend beyond those available to our peers. This internship has provided us with an early exposure to QI concepts and terminology featured on the medical licensing board exams. Since our curriculum does not include a formal class on SBP or QI, this has given us a unique advantage in understanding and implementing these principles. Additionally, many residency programs require their residents to complete QI projects within their various healthcare settings. This internship has uniquely positioned us for success. Through structured education and hands-on involvement, we feel we have developed the skills and confidence necessary to lead a team working on a QI project. We fully intend to highlight this experience on our applications for residency, recognizing that many of our peers have not had exposure to SBP methodologies or project implementation yet.

The Lean Healthcare Internship provided medical students with a solid foundation for implementing SBP and Lean principles within our healthcare work environments, enabling improved quality of care for our future patients. Beyond individual skill development, this approach offers a scalable model for integrating SBP into medical education, addressing a competency that has long been underemphasized. This training also enhances the students' investigative proficiencies, communication skills, and ability to work in a team. These additional skills are essential in becoming a competent and well-rounded physician. Ultimately, as more students are trained to adopt this mindset, quality improvement projects can operate with greater efficiency and effectiveness, as teams will share a common foundation and framework for identifying root causes and implementing the most effective solutions.

By increasing awareness of SBP and Lean methodology, integrating these concepts into didactic undergraduate medical education, and expanding SBP internship opportunities, medical schools can promote widespread adoption of Lean principles and better prepare future physicians to deliver efficient, high-quality care. Future research should explore how similar programs can be scaled across institutions to standardize SBP training in undergraduate medical education.

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