Utilization of Lean Techniques in Pharmacy Residency Training: Modifying the PGYI Management and Leadership Experience

Hospital Pharmacy
2018, Vol. 53(4) 247–255
© The Author(s) 2017
Reprints and permissions:
sagepub.com/journalsPermissions.nav
DOI: 10.1177/0018578717741568
journals.sagepub.com/home/hpx

Karen J. Arthur¹, Deanna S. Kania^{1,2}, and Christina A. White¹

Abstract

Purpose: The purpose of this study was to utilize lean process improvement principles to enhance the health-system pharmacy administration learning experience within a postgraduate year 1 (PGY1) residency program. **Summary:** The Richard L. Roudebush VA Medical Center adopted the use of lean to improve customer service and workplace efficiency. The Residency Advisory Council, overseeing the 6 pharmacy residency programs, felt that training residents in a proven process improvement technique would benefit the service and assist in developing problem-solving skills. Yellow Belt training was incorporated into the residency programs in 2012, and the Yellow Belt project for the 2014-2015 residency class was the modification of the PGY1 Health-System Pharmacy Administration learning experience. Residents focused on a few key areas as part of their completion plan: educating residents and preceptors on the importance of leadership activities, establishing a list of consistent topic discussions to be held during the administration learning experience, confirming a topic list for the pharmacy practice management and leadership seminars, piloting collaborative precepting for the administration experience, revising the staff development program, and increasing resident involvement in the PGY1 interview process. Two portions of the project lacked effective and timely communication, and as a result, those areas were not fully implemented. The remainder of the items achieved 100% completion. **Conclusion:** Lean techniques were effectively utilized within a residency program to enhance the health-system pharmacy administration learning experience. Successful implementation of lean requires engagement of stakeholders within the health-system, timely communication, frequent reassessments, and accountability.

Keywords

CQI, pharmacists, education, management, residency training/programs, staff development

Lean is a set of principles and behaviors utilizing “tools” to continuously advance processes and services over time, with the goal of improving product performance, customer service, and workplace efficiency through elimination of waste.¹ The 5 principles of lean thinking were introduced by Womack and Jones in 1996 and include (1) value is determined by the end customer, (2) processes or steps that provide value can be linked in a value stream, (3) value should be a streamlined experience with a focus on eliminating waste, (4) pull systems are created so a customer can pull as needed rather than pushing, and (5) a continuous pursuit of perfection exists to build reliable and sustainable systems design.¹ The application of these principles was later presented in *The Toyota Way*,² which expanded on the 5 principles and provided a management structure to improve an organization.

Lean thinking has evolved from the automotive and other manufacturing industries and has been incorporated into health care organizations to review operational processes and value-added systems.³⁻¹¹ Hintzen and colleagues utilized

lean process improvement techniques to modify procedures within a sterile products and inventory area of an inpatient pharmacy. General workflow in the sterile products area was modified to include standard work, accountability, and one-piece flow movement. By increasing the number of intravenous batches, there was a 40% decrease in intravenous wastage due to a reduction in outdated products, changed dosages, and discontinued medications. Missing sterile products also significantly decreased, and patient safety was improved with an 83% reduction in the number of production errors.⁵ At another facility, implementation of lean was also shown to reduce chemotherapy turnaround times by

¹Richard L. Roudebush VA Medical Center, Indianapolis, IN, USA

²Purdue University, West Lafayette, IN, USA

Corresponding Author:

Christina A. White, Richard L. Roudebush VA Medical Center, 1481 W. 10th Street, Dept 119, Indianapolis, IN 46202, USA.

Email: Christina.White4@va.gov

Title: Owner:		Event Date:
1. Reasons for Action	4. Gap Analysis	7. Completion Plan			
2. Initial State	5. Solution Approach	8. Confirmed State			
3. Target State	6. Rapid Experiments	9. Insights			

Figure 1. Roudebush Veterans Affairs A3 template.

57% through improved workflow and efficiency.⁷ For training purposes, lean principles have been utilized in internal medicine residency programs to engage residents in health-system quality improvement initiatives.¹² Adding lean thinking to pharmacy residency training programs can prepare residents to utilize these concepts throughout their future career in health care.

Background

The pharmacy service at the Richard L. Roudebush VA Medical Center in Indianapolis, Indiana, has 6 accredited pharmacy residency programs: a postgraduate year 1 (PGY1) residency (both traditional and nontraditional residents) and postgraduate year 2 (PGY2) programs in health-system pharmacy administration, ambulatory care, internal medicine, hematology/oncology, and ambulatory care/education. Annually, these programs train an average of 16 residents with the assistance of 30 preceptors. The facility serves as a tertiary referral center with more than 200 authorized beds and more than 60 000 veterans enrolled. It is a teaching facility for Indiana University schools of medicine, dentistry, and nursing and for both Butler and Purdue colleges of pharmacy.

The Veterans Affairs (VA) hierarchy of lean training includes 3 “belts.” The yellow belt training includes lean basics such as 5S (sort, set-in-order, shine, standardize, and sustain), process mapping, voice of the customer, and plan-do-study-act (PDSA) cycles. The green belt training builds on yellow belt concepts and focuses on facilitating process improvement teams. Black belt training focuses on outcomes analysis and transformational planning for change. Yellow belt training is required for all pharmacy residents at the facility, with green belt training offered as an optional activity to PGY2 residents who have already completed yellow belt training. The facility’s standard improvement process for lean utilizes a 9-box A3 (Figure 1). Box 1 is the “Reasons for Action” where the problem and scope are defined. Box 2 is the “Initial State” where the current process is mapped out as it is known today. Box 3 is the “Target State” where the ideal future process is mapped. Box 4 includes the “Gap Analysis” or the barriers that exist when moving from Box 2 to 3. Boxes 5 and 6 include the “Solution Approach” and “Rapid Experiments,” where the effects of various actions are hypothesized and a few PDSA cycles are tested for sustainability and spread. Boxes 7 and 8 include the “Completion Plan” and “Confirmed State,” the latter of which includes the metrics and how success will be measured. Finally, Box 9,

Table 1. Activities and Topic Discussions Currently in Place to Meet Outcome R3.

Mechanisms to address previous American Society of Health-System Pharmacists standards for management and leadership	Activities and topic discussions occurring within each mechanism to meet the standard
Chief/assistant chief of pharmacy meetings	Self-evaluation process Organizational structure review Strategic and tactical planning Procurement process
Medication safety program manager discussions	Medication safety self-assessment Politics, culture, and accreditation Negotiation and leading teams Quality metrics
Pharmacy practice management and leadership seminars	Strategic and tactical planning Departmental management How to manage clinical practice effectively
Committee involvement	Residency committees Residency interview process Hospital and/or national committees
Research project and drug information experiences	Identifying departmental needs Departmental management How to manage clinical practice effectively Strategic and tactical planning
Staff development	Identifying pharmacy service needs Yellow and green belt training

“Insights,” is an opportunity to review what went well and did not go well throughout the project.

As the pharmacy service planned to train more of its staff, the pharmacy residents were considered an important component. The Residency Advisory Council (RAC) believed that training residents in a proven process improvement technique would not only benefit the service during their tenure but also produce pharmacists who would have problem-solving skills that could be applied to any health care organization.

Yellow belt training was initially incorporated into the residency programs in 2012. The goal was to utilize the lean process to review and improve residency-related and/or pharmacy service issues. The purpose of this yellow belt project was to utilize lean techniques in the modification of our PGY1 Health-System Pharmacy Administration learning experience to incorporate the newly revised 2014 American Society of Health-System Pharmacists (ASHP) PGY1 residency standards, to enhance the overall rotation, and to prevent preceptor burnout due to the expansion of the PGY1 class from 5 to 9 residents.

Methods

A process improvement team consisting of 6 PGY1 and 5 PGY2 residents was given the project aim statement by the lean facilitator (Box 1 of the A3 template). For this project, the aim statement was “to incorporate the new PGY1 residency goals and objectives into the pharmacy administration learning experience, to find opportunities to enhance the residents’ appreciation for leadership and management, and to utilize a collaborative precepting model.” The team

originally met for 4 hours, where Boxes 1 through 7 were completed.

Traditionally, Box 2 of the A3 would be a process map where one step builds upon another. For this project, the lean facilitator listed the 6 different mechanisms currently being used by our program to address the previous ASHP Residency Standards for management and leadership (Outcome R3: Exercise leadership and practice management skills).¹³ These mechanisms included chief and assistant chief of pharmacy meetings, discussions with the medication safety program manager, pharmacy practice management and leadership seminars, committee involvement, research projects and drug information experiences, and staff development. The team was then asked to identify specific topic discussions or activities currently in place to meet Outcome R3 (Table 1). To complete Box 2 (the initial state), the lean facilitator then asked the team to determine whether the current activities would match the new PGY1 standards for the management and leadership objectives.^{14,15} The new ASHP objectives were matched to each activity meeting the intent of the standard.

After the initial state (Box 2) was mapped, the team focused on Box 3, the target state. The goal for this project was to provide a management and leadership learning experience that would meet the intent of the ASHP standards, enhance the residents’ appreciation for leadership and management within the VA and the private sector, and give the resident the opportunity to collaborate with all members of the pharmacy administration team (chief of pharmacy, assistant chief of pharmacy, pharmacy procurement staff, clinical coordinator, medication safety program manager, and operations managers in both the inpatient and outpatient pharmacies).

Table 2. Gaps Identified Between the Initial and Target States in Meeting ASHP Standards for Management and Leadership.

Lack of standard topics
Private sector information lacking
Too much downtime during training/discussions
Resident interest in topics
Patient care demands competing with time to devote to other activities
Unawareness of all committees available for resident participation
Limited opportunities for all residents
Chief resident too accessible
Understanding research project ideas created by pharmacy preceptors
Size/scope of project may be too large for a 1-year project
IRB barriers can delay project implementation
Resident assigned a staff development topic versus selecting one on their own
Staff disengagement during large group talks
Staff development attendance not valued
Supervisor buy-in needed for staff development talks
Yellow and green belt training occurs too late in the year

Note. ASHP = American Society of Health-System Pharmacists; IRB = Investigational Review Board.

To complete Box 4, the Gap Analysis, the facilitator asked participants to reflect on their experiences and create a list of the associated challenges or barriers that were occurring. The gaps identified in Box 4 between the initial and target states are listed in Table 2. Overall, these gaps created occasional disengagement by both residents and staff. An example of this disengagement was identified upon review of the pharmacy practice management and leadership (PPM&L) seminar activity. This seminar is a required monthly meeting the department implemented in which an invited speaker would come and talk to the residents about various administrative topics not being addressed during the course of their usual rotations. Speakers could be from inside or outside the organization. Topics included, but were not limited to, writing business plans, patient assistance programs, comparing the VA with private sector institutions, work-life balance, and stress management. One of the barriers identified for the PPM&L activity included residents being unable to attend due to competing patient care demands. In addition, a voice of the customer analysis indicated that there was a lack of interest in some of the selected topics.

After all gaps and barriers were identified, it was time for the solution approach, Box 5. The residents hypothesized that the establishment of a core list of topic discussions would increase knowledge and provide more uniform exposure to various management and leadership topics, regardless of when the resident had the health-system pharmacy administration rotation throughout the year. In addition, they believed the implementation of collaborative precepting would maximize their learning experience with accessibility to a variety of leadership styles and levels of practice experience. Finally, the residents felt committee involvement and

taking ownership of departmental projects would allow them to improve their individual leadership skills.

The next step was Boxes 6 and 7, Rapid Experiments and the Completion Plan. Table 3 shows the “just do its” (JDIs) and PDSA cycles that the residents brainstormed to address the identified problems and achieve the ideal future state. The residents could take action on the JDIs immediately while the PDSAs required additional planning and evaluation before implementation. Each task listed was assigned an owner and a target completion date, the “who, what, and by when” of the desired plan. Residents were reminded that the overall plan should be something that is manageable in the amount of time targeted. The ownership of these tasks was determined and delegated by all members of this yellow belt team. For example, the chief resident, who represents the residents on the RAC, agreed to present the desired changes for the longitudinal research project experience. The 3 PGY1s who had upcoming administration rotations agreed to own the PDSA cycle related to collaborative precepting among all pharmacy administrative staff. Their task was to pilot the administration learning experience with the inclusion of multiple preceptors from the department as compared with a single preceptor, the chief of pharmacy. Members of the yellow belt team worked on their action plans, and the lean facilitator continued to monitor their progress through monthly meetings for the next 4 months.

Results

Of the 10 action items listed on the completion plan, the residents did an excellent job of successfully accomplishing 80% of them in 2015 (Table 3). The first of these included educating residents and preceptors on the importance of leadership activities. It was reiterated by the RAC that PPM&L attendance was required. This was then clearly communicated to all residents, preceptors, and pharmacy supervisors by the residency program directors (RPDs). Second, a core list of topics was created by the residents for the administration learning experience. Topics from this list were then assigned among the pharmacy administration preceptors to pilot collaborative precepting to expose residents to several educators and to decrease preceptor burnout. Next, the residents made a schedule for PPM&L topics and confirmed speakers for the remainder of the year. Another action item was utilization of a resident huddle board for communicating and tracking process improvement ideas concerning the residency program. Next, a tip sheet was developed by the residents to assist future residents with navigating the Investigational Review Board (IRB) process. To establish a standard process for identifying and assigning resident research projects, project proposal and closeout documents were created. Finally, annual yellow belt training for the residents was moved from December to August.

There were 2 action items within the completion plan that were started by the residents, but not completed during the year (Table 3). The first was revising the staff development

Table 3. Completion Plan for Management and Leadership Experience Revision.

Action item	JDI or PDSA	Owner of action item	Target completion date	Project status
Projects addressing Goal R3.1: Demonstrate leadership skills				
Educate residents and preceptors on the importance of leadership activities	JDI	Chief resident and Residency Advisory Council	1/1/2015	Completed in 2015
Establish list of topic discussions for the administration learning experience	JDI	2 PGY1s	1/15/2015	Completed in 2015
Confirm PPM&L topics	JDI	2 PGY1s	1/15/2015	Completed in 2015
Pilot collaborative precepting among pharmacy administration preceptors	PDSA	3 PGY1s	4/30/2015	Completed in 2015
Projects addressing Goal R3.2: Demonstrate management skills				
Utilize huddle board for process improvement ideas	JDI	All residents	1/1/2015	Completed in 2015
Make IRB tip sheet	JDI	2 PGY2s	1/15/2015	Completed in 2015
Establish standard process for identifying/assigning/continuing resident projects to facilitate completion of the department's strategic plan	JDI	1 PGY1 and 1 PGY2	5/1/2015	Completed in 2015
Adjust timing of yellow belt training	JDI	Residency Advisory Council and lean trainer	8/28/2015	Completed in 2015
Projects addressing Goal E2.1: Apply leadership and practice management skills to contribute to management of pharmacy services				
Revise staff development program	PDSA	3 PGY1s	6/30/2016	Completed in 2016
Increase residents' roles in PGY1 interview process	JDI	RAC	11/30/2016	Completed in 2017

Note. JDI = just do it; PDSA = plan, do, study, act; IRB = Investigational Review Board.

program. The residents did make some advancements on this action item, as they developed an ongoing list of educational topics for the residents to present to the staff. This list of topic ideas was not communicated to the clinical coordinator, RPDs, or to residents who were preparing their staff development presentations. In addition, a system for vetting topics and a plan for increasing supervisor support and interest for staff attendance at these sessions was not developed. This action plan was then assigned to the 2015-2016 residents who piloted a more spontaneous staff development program, providing topics needed by the department, and utilizing various educational techniques instead of giving programs at a predetermined schedule or with a required format. This pilot program was adopted as the new staff development program and is still in existence today.

The second action item that remained to be completed involved increasing the residents' roles in the PGY1 interview process. For the several years prior, PGY1 residents had attended the candidate interview breakfasts and lunches and assisted with individual interviews and hospital tours. During the yellow belt project, the residents indicated a desire to be more involved with the application review process and to participate in telephone screening interviews to understand the tools the department has developed to select the strongest candidates within the applicant pool. A failure to communicate the ideas to the RAC or RPDs resulted in an incomplete action item. These ideas were eventually brought forth to the RAC and RPDs and were implemented in January 2017.

Progress on the revisions of the management and leadership experience was measured in Box 8, the Confirmed State, by conducting a crosswalk between the PGY1 standards and the new rotation activities to ensure the goals and objectives were met for both required and elective competencies within the new standard (Tables 4 and 5).^{14,15} A voice of the customer analysis was also conducted to obtain feedback from the 2015-2016 PGY1 residents. An electronic word document survey was distributed asking residents to indicate either full, partial, or no understanding of 39 different core topics included in the administration learning experience description (Table 6). Residents were also asked to indicate how they learned about the topic (either on the administration rotation or through other meetings occurring throughout the year) and by what methods (discussions, readings, etc). Four of the 6 PGY1 residents completed the survey. For 10 of the topics (25.6%), several residents indicated "no understanding." These 10 topics included how performance requirements are formulated, evaluated, communicated, and acted upon; formulary making bodies; techniques for forecasting and monitoring budgets; contract negotiating bodies and principles of contract adherence; process for handling backorders; procurement of specialty drugs; developing a residency program; pharmacy organization memberships; compliance with controlled substance regulations; and prescription drug monitoring programs. "No opportunity for exposure" was selected by some residents for the following 9 topics: workload and productivity monitoring, scheduling

Table 4. Crosswalk of the Required Competency, R3, Dedicated to Leadership and Management Skills.¹³

Competency	Goals	Objectives	Facility-specific learning activities for inclusion
R3: Exercise leadership and practice management skills	R3.1: Demonstrate leadership skills	R3.1.1: Demonstrate personal, interpersonal, and teamwork skills critical for effective leadership	Demonstrate effective time management Manage conflict and negotiate effectively during small workgroups Lead a portion of an outpatient or inpatient huddle team Display effective communication Participate in discussion on leadership and advocacy
		R3.1.2: Apply a process of ongoing self-evaluation and personal performance improvement	Participate in discussion on personal strengths and areas for improvement Utilize the process of self-evaluation effectively for change Complete self-reflections through PPM&L Incorporate constructive feedback Demonstrate a plan for continuous professional development
	R3.2: Demonstrate management skills	R3.2.1: Explain factors that influence departmental planning	Actively participate in discussions on departmental planning, financial management, accreditation, legal, regulatory, and safety requirements, facilities design, strategic planning, and human resources Participate in pharmacy service huddles and/or rapid process improvement workgroups
		R3.2.2: Explain the elements of pharmacy enterprise and their relationship to the health care system	Identify resources for remaining current on health care trends Participate in discussion on laws and regulations Utilize external quality metrics to assist with various reports prepared by the pharmacy service Understand the current health-system governance and leadership hierarchy
		R3.2.3: Contribute to departmental management	Identify departmental needs and develop plans for them through participation in service huddles or workgroups Participate on committees or informal workgroups Understand the role of change management and quality improvement practices to achieve goals and implement change within an organization
		R3.2.4: Manage one's own practice effectively	Evaluate one's own practice Integrate acquired knowledge and skills into own practice Demonstrate effective time management Maintain work-life balance Work collaboratively with all individuals within the health care system

Note. PPM&L = pharmacy practice management and leadership.

and approving leave requests, utilization of automation and contract personnel, adding a drug to the drug file, techniques for forecasting and monitoring budgets, contract negotiating bodies and principles of contract adherence, automated dispensing systems, pharmacy organization memberships, and compliance with controlled substance regulations. On 24 (61.5%) of the topics, all 4 residents documented full or partial understanding. As a result of the survey, a documentation sheet with a checklist of topics is now distributed to residents at the start of each administration rotation to facilitate resident and preceptor discussion on these 39 core topic areas throughout the learning experience.

Discussion

Utilizing lean process improvement techniques within pharmacy residency programs can be beneficial for both

the resident, and the program and site. For this yellow belt project of modifying the health-system pharmacy administration learning experience, residents learned how to use a proven process improvement method for solving an identified problem within the workplace. As the residents had a vested interest in the outcome of the project, they were thoroughly engaged throughout. The process instilled a new sense of ownership in the residency program, as each resident was involved in working on portions of the completion plan. Finally, the experience allowed for self-reflection, consideration of each other's roles, and the realization of how their actions and involvement truly can improve the residency program and pharmacy service. From a programmatic standpoint, engaging residents in lean process improvement techniques can facilitate enhancements to residency programs and ensure compliance with ASHP standards. In addition, utilizing the residents can facilitate the completion of

Table 5. Crosswalk of Other Required and Elective Competencies With Related Leadership and Management Skills.^{13,14}

Competency	Goals	Objectives	Facility-specific learning activities for inclusion
R2: Advancing practice and improving patient care	R2.1: Demonstrate ability to manage formulary and medication-use processes, as applicable to the organization	R2.1.1: Prepare a drug class review, monograph, treatment guideline or protocol	Prepare a drug class review, monograph, treatment guideline or protocol using synthesized information from the literature Communicate any necessary updates/changes to appropriate staff
		R2.1.2: Participate in a medication-use evaluation	Conduct a medication-use evaluation Communicate any necessary updates/changes to appropriate staff Implement changes, where applicable
E2: Added leadership and practice management skills	E2.1: Apply leadership and practice management skills to contribute to management of pharmacy services	E2.1.1: Demonstrate personal leadership qualities essential to operate effectively within the organization and advance the profession and practice of pharmacy	Participate in health-system committees Participate in professional associations Develop or enhance a pharmacy service through involvement in huddle boards and/or policy/procedure revision
		E2.1.3: Contribute to the pharmacy procurement process	Understand the pharmacy procurement process and contracting through discussions with procurement supervisor Appreciate inventory management issues and the handling of unique drug entities (ie, controlled substances, investigational drug products, etc)
		E2.1.4: Contribute to the financial management of the department.	Participate in the cost containment committee to develop cost reduction strategies Understand and engage in fiscal and budgetary decisions for the service
		E2.2.1: Contribute to recruitment for specified positions	Understand resident and staff recruitment Qualifications Screening tools Interview strategies Final selection process Offer letters and human resources
	E2.2: Contribute to management and development of pharmacy staff	E2.2.2: Contribute to orientation, staff development, and training activities for practice area personnel	State the purpose of orientation and training for personnel Assist with determining staff development needs Provide staff development presentations
		E2.2.3: Explain the components of an employee performance evaluation system	Explain the benefits and components of employee performance evaluations Participate in quarterly evaluations with RPD
		E2.2.4: Explain the principles and application of a progressive discipline process	Understand the disciplinary process for residents and staff
		E2.3.1: Explain the steps involved in establishing a pharmacy residency program at a particular site	Review process with RPD at PPM&L session
	E2.3: Understand the process of establishing a pharmacy residency program		

Note. RPD = residency program director; PPM&L = pharmacy practice management and leadership.

projects that advance the department toward the realization of its strategic plan. Having participation from all members of the pharmacy team permits more creativity and innovation for change. For these reasons, the organization continues to incorporate lean training and completion of a project with each residency class.

As successful as lean techniques can be, there are limitations. Resistance may occur and sustainability is not always

guaranteed.¹⁶⁻¹⁸ There are several factors that can enhance sustainability. Perhaps the most critical factor is communication. Regular and consistent feedback should be provided to all of those involved. In some situations, this will mean daily interactions. During the lean process described, the residents had 2 portions of their project that lacked effective and timely communication, and as a result, those areas were not completed on schedule based on the initial completion plan. In

Table 6. Core Administrative Topics Included in the Learning Experience Description.

Organizational structure of the Department of Veterans Affairs, Veterans Health Administration, Veterans Integrated Service Network, and Roudebush
Lines of authority
Organization of pharmacy service
Committees within the VA and how they relate
How policies are formulated, approved, revised, and monitored
Various pay systems
How performance requirements are formulated, evaluated, communicated, and acted upon
Recruitment, selection, hiring, and retention
Scopes of practice for inpatient and outpatient
Scopes of practice versus collaborative practice agreements
Staff development programs for professional and nonprofessional staff
Workload and productivity monitoring
Scheduling and approving leave requests
Managing underperformers
Utilization of automation and contract personnel
Procurement differences between federal and non-federal institutions
Formulary making bodies
Adding a drug to the drug file
Techniques for forecasting and monitoring budgets
Contract negotiating bodies and principles of contract adherence
Mechanisms for control of high cost drugs
Procurement methods and inventory control
Process for handling backorders
Procurement of specialty drugs
Automated dispensing system inventory management and drug accountability
Joint Commission and Office of the Inspector General preparation
Security and safety requirements for pharmaceuticals
Internal and external disaster plans
Security measures for the facility, pharmacy, and employees
Plans and resources for a weapons of mass destruction event
Pharmacy service contingencies for a loss of utilities or computer systems
Private sector and business plans
Developing a residency program
Certifications—importance in practice
Leading from an entry-level position
Pharmacy organization memberships
Compliance with controlled substance regulations
Substance abuse recovery programs
Prescription drug monitoring programs

addition, the residents had one area within Box 2, the Initial State, that was not addressed in the completion plan, and this was committee involvement. During the lean process, residents realized the importance of exposure to multiple committees in a health-system versus long-term exposure to only 1 committee. The residency program is currently designed to

allow PGY1 residents to participate with their monthly preceptors on numerous committees, to enable them to see how each group integrates with each other and the health-system overall. In addition, patient care demands on various learning experiences may preclude full participation in a single longitudinal committee assignment. Therefore, after discussion, the residents decided not to pursue changes to this format.

Besides communication, another factor that can enhance sustainability includes driving change from the “bottom up” versus the “top down.” If individuals doing the work are involved in driving the change, there will likely be greater support over time, and this was clearly displayed during this yellow belt project based on the level of engagement among the residency class and an 80% action item completion rate. Finally, the lean process is often more successful if new procedures or methods are implemented in small incremental changes and if the entire team is held accountable for performance metrics.

Conclusion

Lean techniques were effectively utilized within a residency program to enhance the health-system pharmacy administration learning experience and maintain compliance with ASHP standards. Successful implementation of lean requires engagement of multiple individuals within the health-system, timely communication of the new processes, frequent reassessments, and appropriate accountability.

Authors' Note

The contents do not represent the views of the US Department of Veterans Affairs or the US Government.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This material is a result of work supported with resources and the use of facilities at the Richard L. Roudebush VA Medical Center, Indianapolis, Indiana.

References

1. Womack JP, Jones DT. *Lean Thinking: Banish Waste and Create Wealth in Your Corporation*. New York, NY: Simon & Schuster; 1996.
2. Liker JK. *The Toyota Way: 14 Management Principles From the World's Greatest Manufacturer*. New York, NY: McGraw-Hill; 2004.
3. Aboumatar HJ, Winner L, Davis R, et al. Applying lean sigma solutions to mistake-proof the chemotherapy preparation process. *Jt Comm J Qual Patient Saf*. 2010;36(2):79-86.

4. Farrokhi FR, Gunther M, Williams B, Blackmore CC. Application of lean methodology for improved quality and efficiency in operating room instrument availability. *J Healthc Qual.* 2015;37(5):277-286.
5. Hintzen BL, Knoer SJ, VanDyke CJ, Milavitz BS. Effect of lean process improvement techniques on a university hospital inpatient pharmacy. *Am J Health Syst Pharm.* 2009;66:2042-2047.
6. Kanamori S, Sow S, Castro MC, et al. Implementation of 5S management method for Lean healthcare at a health center in Senegal: a qualitative study of staff perception. *Glob Health Action.* 2015;8:27256.
7. Lamm MH, Eckel S, Daniels R, Amerine LB. Using lean principles to improve outpatient adult infusion clinic chemotherapy preparation turnaround times. *Am J Health Syst Pharm.* 2015;72(13):1138-1146.
8. Mazzocato P, Savage C, Brommels M, Aronsson H, Thor J. Lean thinking in healthcare: a realist review of the literature. *Qual Saf Health Care.* 2010;19(5):376-382.
9. O'Reilly K, Ruokis S, Russell K, et al. Standard work for room entry: linking lean, hand hygiene, and patient-centeredness. *Healthc (Amst).* 2016;4(1):45-51.
10. Sullivan P, Soefje S, Reinhart D, McGeary C, Cabie ED. Using lean methodology to improve productivity in a hospital oncology pharmacy. *Am J Health Syst Pharm.* 2014;71(17):1491-1498.
11. Waldhausen JH, Avansino JR, Libby A, Sawin RS. Application of lean methods improves surgical clinic experience. *J Pediatr Surg.* 2010;45:1420-1425.
12. Kim CS, Lukela MP, Parekh VI, et al. Teaching internal medicine residents quality improvement and patient safety: a lean thinking approach. *Am J Med Qual.* 2010;25(3):211-217.
13. American Society of Health-System Pharmacists. Crosswalk: competency areas, goals, and objectives (2014) - outcomes, goals, and objectives (2005). <https://www.ashp.org/-/media/assets/professional-development/residencies/docs/crosswalk-2014-required-competency-areas-2005-outcomes>. Published 2015. Accessed November 6, 2017.
14. American Society of Health-System Pharmacists. *Required competency areas, goals, and objectives for postgraduate year one (PGY1) pharmacy residencies*. <https://www.ashp.org/-/media/assets/professional-development/residencies/docs/required-competency-areas-goals-objectives>. Published 2015. Accessed November 6, 2017.
15. American Society of Health-System Pharmacists. *Elective competency areas, goals, and objectives for postgraduate year one (PGY1) pharmacy residencies*. <https://www.ashp.org/-/media/assets/professional-development/residencies/docs/elective-competency-areas-goals-objectives-2014>. Published 2014. Accessed November 6, 2017.
16. Joosten T, Bongers I, Janssen R. Application of lean thinking to health care: issues and observations. *Int J Qual Health Care.* 2009;21(5):341-347.
17. Aij KH, Simons FE, Widdershoven G, Visse M. Experiences of leaders in the implementation of lean in a teaching hospital—barriers and facilitators in clinical practices: a qualitative study. *BMJ Open.* 2013;3:e003605.
18. Andersen H, Rovik KA. Lost in translation: a case-study of the travel of lean thinking in a hospital. *BMC Health Serv Res.* 2015;15:401.