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Managing Through a Pandemic: A Daily Management System for COVID-19 Response and Recovery

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SUMMARY

Goal: This study explored the use of a Lean daily management system (DMS) for COVID-19 response and recovery in U.S. hospitals and health systems. Originally developed in manufacturing, Lean is an evidence-based approach to quality and process improvement in healthcare. Although Lean has been studied in individual hospital units and outpatient practices, it has not been examined as a whole system response to crisis events.

Methods: We conducted qualitative interviews with 46 executive leaders, clinical leaders, and frontline staff in four hospitals and health systems across the United States. We developed a semistructured interview guide to understand DMS implementation in these care delivery organizations. As interviews took place 6–8 months following the onset of the pandemic, a subset of our interview questions centered on DMS use to meet the demands of COVID-19. Based on a deductive approach to qualitative analysis, we identified clusters of themes that described how DMS facilitated rapid system response to the public health emergency.

Principal Findings: There were many important ways in which U.S. hospitals and health systems leveraged their DMS to address COVID-19 challenges. These included the use of tiered huddles to facilitate rapid communication, the creation of standard work for re-deployed staff, and structured problem-solving to prioritize new areas for improvement.

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We also discovered ways that the pandemic itself affected DMS implementation in all organizations. COVID-19 universally created greater DMS visibility by opening lines of communication among leadership, strengthening measurement and accountability, and empowering staff to develop solutions at the front lines. Many lessons learned using DMS for crisis management will carry forward into COVID-19 recovery efforts. Lessons include expanding telehealth, reactivating incident command systems as needed, and efficiently coordinating resources amid potential future shortages.

Practical Applications: Overall, the Lean DMS functioned as a robust property that enabled quick organizational response to unpredictable events. Our findings on the use of DMS are consistent with organizational resilience that emphasizes collective sense-making and awareness of incident status, team decision-making, and frequent interaction and coordination. These features of resilience are supported by DMS practices such as tiered huddles for rapid information dissemination and alignment across organizational hierarchies. When used in conjunction with plan-do-study-act methodology, huddles provide teams with enhanced feedback that strengthens their ability to make changes as needed. Moreover, gaps between work-as-imagined (how work should be done) and work-as-done (how work is actually done) may be exacerbated in the initial chaos of emergency events but can be minimized through the development of standard work protocols. As a facilitator of resilience, the Lean DMS may be used in a variety of challenging situations to ensure high standards of care.

INTRODUCTION

COVID-19 has resulted in a pandemic of unprecedented societal impact. Increases in new cases and hospitalizations throughout 2020, followed by surges of variants, have severely challenged the U.S. health-care system (Artenstein, 2020; Emanuel et al., 2020; Scott, 2020). By September 2022, the nation cumulatively reported more than 94 million cases and more than 1 million deaths from COVID-19 (Johns Hopkins University & Medicine, n.d.). Hospitals and health systems are first responders to this crisis, playing a key role in caring for both COVID-19-infected and noninfected patients. Mounting an effective response depends on high levels of coordination between operational and clinical units to deliver timely patient care

while protecting staff safety at the front lines.

In this article, we describe early efforts to use a Lean daily management system (DMS) for COVID-19 response and recovery. Originally developed in manufacturing, Lean is an evidence-based approach used by healthcare organizations to address concerns about patient safety and medical errors, rising costs, and optimal use of time and resources (Leite & Vieira, 2015; Liker, 2021; Womack & Jones, 2003). A Lean DMS is designed to support daily operations, thus enabling teams to identify problems and implement changes to work processes. A DMS includes regular huddles, standardized work, the visual display of performance metrics, and plan-do-study-act (PDSA) rapid cycle

improvements. A well-functioning DMS can guide and support this activity at all levels—executive leadership, senior clinical leadership, middle management, and frontline staff.

Although Lean has been studied in individual hospital units and outpatient practices (D'Andreamatteo et al., 2015; Hung et al., 2017; Hung et al., 2018; Hung et al., 2021; Isfahani et al., 2019), and more recently linked to overall hospital performance (Rundall et al., 2021; Shortell et al., 2021), it has not been examined as a whole system response to crisis events. We had a unique opportunity to explore the use of Lean management to address the COVID-19 public health emergency. By aligning daily activities to overall strategic priorities, the Lean DMS offers practical methods and tools that can be used to assess, monitor, and implement standard work to achieve organizational goals. In this article, we describe how DMS was used to support an organizational imperative for timely COVID-19 response and recovery.

METHODS

We conducted qualitative interviews with 46 executive leaders, clinical leaders, and frontline staff in four U.S. hospitals and health systems participating in the Lean Action Research Learning Collaborative organized by the Center for Lean Engagement and Research at the University of California at Berkeley (UC Berkeley). The Lean Action Research Learning Collaborative members included Indiana University Health, an academic health system consisting of 16 hospitals and a wide network of ambulatory clinics; Lancaster General Hospital, a community hospital affili-

ated with Penn Medicine; University of California at San Francisco (UCSF) Health, part of a large academic medical center serving as both a tertiary and quaternary referral center and community hospital; and Zuckerberg San Francisco General Hospital and Trauma Center, a public health academic safety net providing inpatient, outpatient, emergency, diagnostic, and behavioral health services.

We conducted all interviews via Zoom in the fall of 2020. We used snowball recruitment to identify interview participants, beginning with senior leaders who initially served as key informants. Sessions lasted 45–60 min and were transcribed verbatim for qualitative analysis. We used a semistructured interview guide to understand DMS implementation across health systems, hospitals, and affiliated outpatient clinics. Because interviews took place 6–8 months following the onset of the COVID-19 pandemic in the United States, a subset of interview questions focused on the use of DMS to address new challenges during this time.

We analyzed interview transcripts using a deductive approach. This began by developing an initial set of codes based on major interview topics, followed by iterative refinement based on emergent themes discovered in interviews. The coding involved attaching summary labels to segments of text to reflect the themes of each interview, which were then synthesized to produce an aggregate understanding of topics relevant to DMS implementations. To ensure reliability, we engaged another researcher to independently code each transcript (Thomas, 2006). During this validation, we paid special attention to factors identified in the initial coding

scheme and achieved agreement on >80% of these codes. Any discrepancies were discussed and reconciled. Relevant codes were grouped into clusters of themes that identified ways in which DMS facilitated organizational responses to the pandemic. This research was approved by UC Berkeley's institutional review board.

RESULTS

There were many similarities in how organizations used their Lean DMS to address challenges that were often unpredictable, especially in the early days of the pandemic. Notably, all interviewees also described “reverse impacts” of the pandemic, referring to challenges presented by COVID-19 itself that affected DMS implementations in unexpected ways. In this article, we present our study findings according to three main themes: (1) how hospitals and health systems used their DMS to respond to the COVID-19 crisis, (2) how the crisis itself affected DMS implementation at the front lines, and (3) plans to continue using DMS to improve care going forward.

Use of DMS in Responding to COVID-19

Tiered Huddles

Organizations in this study universally leveraged their Lean management systems to support rapid communication and coordination. This was accomplished using the DMS feature of tiered huddles—regular, structured meetings that occur within and across levels of the organization ranging from executive management teams to hospital floor staff. These huddles became critical during COVID-19 surges as they

allowed information to be shared rapidly down and back up the organizational hierarchy. For hospitals that already had a DMS in place, tiered huddles served as a platform for incident command systems. In this sense, interviewees felt that having DMS gave them “a running head start” and provided organizations an advantage in responding to the crisis. As a senior leader noted regarding one of the hospitals in a large multisite health system:

They had that tiered huddle system already in place and it was an immediate method for them The other places were completely flat-footed as they didn't have that structure And it was 7 days a week for 3 months. Every day looking at the data, looking at counts, looking at ICUs [intensive care units] and how many events we had That was all cascading out when you had that DMS system set up. It was a built-in 2-way communication system that already existed, and all we did was plug in the incident command structure to it.

Floor staff and unit managers also leveraged tiered huddles to convey important changes to the front line. Influxes of patients with COVID-19 threatened to overwhelm staff, so changes were made not only to care protocols but also to the structure and role of huddles that had served prepandemic as a forum for quality improvement work. One nurse manager described how huddles evolved to meet new demands:

Since the onset of COVID-19, huddles really morphed into a lot of informative sort of sessions. We had a ton of

process and procedure changes and a ton of communication that we needed to get out to the staff to maintain our function and ensure all our staff were coordinated and well informed.

Corroborating this experience, interviewees from other organizations shared that one of their greatest achievements was the ability to communicate and address emergent problems via huddles. According to a nurse manager, this provided an important means for quick, accurate updates and planning to address highly fluid situations:

With COVID, the most important aspect of our huddle . . . was getting out the information and getting it out fast. Disseminating [information] to all our staff [and] letting them know the changes—whether it’s a protocol on how we’re checking-in [on] the patient and what symptoms they need to have or should not have for scheduling—brought a lot of value during our huddles because everyone would come to find out the news of the day.

Other comments included: “We are part of a really good response to COVID because we had tiered huddles in place”; “It gave people confidence, a way of keeping things under control”; and “Literally, the communication is what kept us all going.” Ultimately, tiered huddles were crucial to alignment and coordination of urgent matters during the pandemic. As one ICU staff member summarized:

We huddled more than ever, we communicated more than ever, and we used our [huddle] board to write ev-

erything we needed to know because communication was the absolute key to success.

Standard Work

The DMS feature of standard work also helped with the need to standardize emergency department (ED) workflows, develop policies for using personal protective equipment (PPE), establish hospital visitation rules, and set up pop-up triage tents or mobile testing sites. Clear descriptions of standard work were especially needed to guide staff members who had been asked to fill new roles or sent to different units. As one nurse recounted, “We had so many staff members being redeployed and doing different jobs that you had to have the standard work, otherwise they would have been clueless.”

An important application of DMS standard work involved redesigning patient care and staff safety protocols, ranging from ensuring availability and proper donning of PPE to developing standard practices on what to do about staff exposures or symptoms of COVID-19. In primary care clinics, standard work helped with the transition to telemedicine. Modifying protocols for scheduling appointments, determining how and when clinicians communicate with patients, and initiating virtual visits increased access to care while ensuring patient and staff safety. In addition, hospital room cleaning standards have continued to be important in facilitating patient flow and bed availability. One nurse described the discovery of a lack of existing protocols for room turnover in medical–surgical units. As the nurse explained, the need for a DMS standard work in this area to facilitate

patient flow and bed availability became clear during the pandemic:

All of a sudden, we had to create our own staff roles to assist environmental services with room cleaning, and it just brought up the fact that we didn't have any standards around room cleaning in terms of process Using DMS, we created a framework We talked about it with frontline staff and environmental services, which helped identify things that you [had] just accepted for all these years.

A3 Problem-Solving and PDSA Improvement

The DMS approach to problem-solving and PDSA rapid cycles of continuous improvement also helped create and refine policies from ED wait time and overflow to N95 mask decontamination and redistribution. A3 thinking, which is a comprehensive DMS approach to structured problem-solving, serves as a starting point for many initial solutions that might undergo revision with PDSA methodology. Amid the many demands of COVID-19, one ED manager commented on how helpful these DMS features were in prioritizing action:

We're a little bit more thoughtful about the things we're going to work on. Like in the ED, there are 300 things that are a problem every day Thoughtful change for us has been, "Okay; what are the top three things I'm going to focus on?" And then we—100% of the time—end up using A3 or Lean [PDSA] methodology to find a solution.

Final comments included widespread agreement that a Lean management system can provide necessary structure and consistency, particularly during crises. One executive described DMS as providing a foundational, common platform for work to be continuously improved upon in the future, saying, "We created a lot of new protocols for everything we want to change going forward."

Impact of COVID-19 on DMS Implementation

Disruption to Ongoing Improvement Efforts

The pandemic itself also had an impact on DMS implementations in a variety of ways. The first was to disrupt ongoing DMS projects as staff pivoted to meet more pressing demands. According to a nurse in a hospital that adopted DMS prior to COVID-19, "In the NICU [neonatal intensive care unit], we were 'implemented,' meaning we were using all the components [of DMS], and then COVID hit, and [implementation] took a large pause." Other effects of the pandemic included decreases in face-to-face contact, notably among top management, which limited informal follow-up discussions that would typically occur after huddles on performance improvement initiatives. Yet, while COVID-19 was a barrier to these previous activities, the underlying DMS approach to improvement prevailed. As summarized by a medical director:

The ability to adapt and adjust has been quite interesting. The first 6 weeks of the pandemic, most of us said, "Am I even allowed to talk about performance improvement and quality

improvement? Is that even a thing? Can we do that?” And as an organization, right around 7–8 weeks, we said, “Absolutely. Improvement work is the way we will respond.”

Showcasing of DMS Practices

The pandemic also served as a showcase for DMS capabilities in all organizations we studied. Because responding to COVID-19 required extensive use of Lean tools to facilitate communication and coordination, DMS received much greater visibility among leadership and frontline staff as a result of the pandemic. In many health systems, COVID-19 was attributed as “opening up lines of communication” from the top-down to build a deeper understanding of the DMS for executive teams as they worked to address common challenges. For example, in one academic medical center, pressures of COVID-19 led to the development of a fourth-tier huddle that allowed university leaders and C-suite executives to actively participate together in the DMS. Moreover, the demands of the situation underscored a need for DMS to concentrate on measurement and accountability in decision-making. As one executive said:

During COVID-19, the chancellor would call in, the CEO would call in, and [they would] be able to get those daily briefings. That opened people’s eyes to the power of the system of tiered communication There is also a much greater appreciation for measurement, accountability, reporting, which is an important part of the [DMS] structure of how you make decisions, how you communicate,

how you report up, and all of these pieces.

Engagement of Frontline Staff

The pandemic also had a universally cited impact of increasing staff engagement and empowering them to achieve set goals at the front lines. Interviewees consistently described how responding together to COVID-19 created a sense of camaraderie among team members while increasing their use of DMS practices such as huddles, development of standard work, and PDSA rapid-cycle improvements. One ED manager described a new enthusiasm as participants saw the benefits of DMS:

A lot has changed with COVID. The team’s engagement with the Lean management system definitely increased. Trying to elicit ideas from the team and participating in A3 activities, and [then] seeing the changes implemented and seeing the increase in productivity or the decrease in events that we didn’t want to see . . . really got them engaged and enthusiastic about the process. There has been a big shift in our huddle In the beginning, it was, “I’m too busy. I don’t have time to go to huddle.” But now, the attitude is more positive. They are excited to see their ideas play out and see how that impacts our goals and contributes to us reaching our goals.

Many interviewees described how COVID-19 had the unexpected effect of empowering care teams. Although some may have reported being burned out by the pandemic, one organization reported its highest physician engagement scores ever. Overall, healthcare

providers felt appreciated, protected, and heard as they worked together using DMS tools to respond to the crisis. In this sense, COVID-19 highlighted the value of DMS and featured frontline staff as key problem-solvers. As one staff member noted:

COVID has brought some of our units a lot closer Our huddles, using standard work, PDSA, and all these tools have actually become a lot stronger We did a lot of PDSA and changing workflows, too: How many patients can fit in our waiting room? Is our waiting room safe? Do we need to move patients at a certain time? Are there certain hours in the day that get super busy? That's where the staff engagement came in as well because they were at the front line and knew what was going on. They knew how to solve the problems.

Future Plans for Lean DMS

Expansion of Virtual Capabilities

Given the unique lessons of COVID-19, an important plan for DMS going forward is to help expand virtual formats for data visualization and management, telemedicine, and DMS staff training via remote learning.

Regarding *data visualization*, the virtual nature of tiered huddles had drawbacks, but interviewees noted that data displays were better during the pandemic. One organization will continue to incorporate such visualization into face-to-face meetings and virtual huddle boards going forward by using a hybrid approach to DMS. According to one manager, such enhancements were considered prior to the pandemic: "There were many things

we wanted to change that we thought would take 5 years that we got done in 6 months."

Similar sentiments were expressed regarding the implementation of *telemedicine*. With the high risk for COVID-19 community transmissions, health systems developed virtual platforms in record time and have continued to improve implementation by using their DMS. Telemedicine also aligned with broader organizational priorities to address health equity issues, with one medical director describing plans to reach more patients via virtual care. In yet another organization, primary care staff believed that their experience responding to COVID-19 would lead to a different model of care delivery altogether, including a virtual model enabled through online meeting and communication applications. At the time of interview, they were already engaged in a pilot study to integrate their mobile videoconferencing app directly into the electronic health record.

Other plans for using DMS to expand virtual platforms included more online staff training and remote learning on topics such as A3 thinking and structured problem-solving. There were plans to use virtual training to increase DMS participation by all staff members. Among all health systems, A3 problem-solving was viewed as a building block for any future improvement work, particularly transitions from in-person to virtual formats.

Continued Rapid Communication and Coordination

Finally, other interviewees cited plans to continue the use of DMS as a platform for incident command. COVID-19

highlighted the DMS as a valuable structure for facilitating information flow throughout organizations, and interviewees indicated that this would again be used in future situations. As one senior leader predicted:

Moving forward, we'll stand up incident command when it's needed. We'll have a lower threshold for standing it up There was huge value in doing that and in the communication to all departments and aligning everybody with the same message We're not going back to the old way of doing business. We cut through all the bureaucracy by having this daily incident command structure and making decisions, in many cases, within 24 hours that historically would have taken really long periods of time.

Indeed, a surge in the delta variant caused many health systems to reactivate their incident command systems using DMS as the platform just as they had when the pandemic began. Moreover, leaders were taught the importance of coordinating resources and materials such as staff, PPE, and other supplies across the organization. Interviewees expressed hope in continuing this, as one nurse summarized:

I hope cross-departmental collaboration will remain. We have, of necessity, become hyper-focused on a mission. In theory, we all have the same shared mission, all the time, which is excellence in patient care. And I wonder if we'll be able to keep some of that focus—with cross-departmental connections—and the ways of think-

ing about our resource allocation and movement of people and supplies across departments in ways we did not before.

DISCUSSION

The Lean DMS has enabled quick responses to unpredictable events of the COVID-19 pandemic. Our findings on the use of DMS are consistent with features of organizational resilience. In their systematic review, Son and colleagues (2020) outlined four dimensions of emergency management resilience: (1) collective sense-making, (2) team decision-making, (3) interaction and coordination, and (4) harmonizing work-as-imagined as opposed to work-as-done. The DMS structures supported these dimensions by enabling the effective management of COVID-19 challenges. As an example, features of resilience involving collective sense-making (which, among first responders, is the process of attaining a joint understanding of the status of an incident; Wolbers & Boersma, 2013), team decision-making, and interaction and coordination were all facilitated by DMS practices such as tiered huddles for rapid communication and information dissemination.

Tiered huddles in healthcare settings raise the quality of information shared across teams, improve patient safety, and increase individual accountability (Aldawood et al., 2020; Goldenhar et al., 2013). Used in conjunction with PDSA rapid cycle improvements, huddles provide teams with enhanced levels of feedback that strengthen their ability to make changes to work processes as needed (Eboreime et al., 2021). Moreover,

gaps between work-as-imagined (how work should be done) and work-as-done (how work is actually done; Wreathall, 2006) that are exacerbated in the initial chaos of any emergency can be minimized through the development of DMS standard work protocols. Our study found that the creation of new standards using A3 problem-solving and PDSAs, combined with daily huddles, harmonized care processes to address emergent needs during the pandemic.

The unanticipated effects of COVID-19 on DMS implementation such as increased staff empowerment and physician engagement were also indicative of organizational resilience in our study. In their research conducted during the pandemic, Rangachari and Woods (2020) found that an environment of empowerment opens communication between employees and managers, leading to trust and psychological safety, which are prerequisites for high organizational resilience. Our interviews also described increases in collaboration and engagement during the pandemic. Thus, organizations can expect Lean DMS to provide a robust framework enabling high levels of performance during future emergencies beyond the pandemic.

Plans for DMS going forward reflect wider trends in healthcare, including expanding patient access to care via telemedicine as described in recent studies (Aziz et al., 2020; Cueto & Sanders, 2020; Doraiswamy et al., 2020; Fogel & Raymond, 2020; Fryer et al., 2020; Mahoney, 2020; Paterson et al., 2020; Steindal et al., 2020; Tauben et al., 2020; Wijesooriya et al., 2020). As noted in our interviews, telemedicine can help address

institutional priorities to advance health equity by minimizing barriers to care. However, such efforts may be less effective in segments of the population with low digital literacy or limited access to technology. The lack of national and global consensus on virtual boundaries, protocols, data privacy and monitoring issues, and reimbursement policies also hinders telemedicine efforts (Doraiswamy et al., 2020). Health systems should carefully consider these factors as they use DMS to expand the delivery of virtual care.

CONCLUSION

Given our study results, future research may include investigations of how well DMS equips organizations to address a variety of contemporary issues in healthcare. These include adjusting care delivery processes to thrive under emerging value-based payment models, optimizing patient outcomes by addressing social determinants of health at the point of care, and preparing for increased illness resulting from climate change or future pandemics. As an enabler of organizational resilience, the Lean DMS can be used in a variety of challenging situations to ensure a high standard of care while navigating changing environments.

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REFERENCES

- Aldawood, F., Kazzaz, Y., AlShehri, A., Alali, H., & Al-Surimi, K. (2020). Enhancing teamwork communication and patient safety responsiveness in a paediatric intensive care unit using the daily safety huddle tool. *BMJ Open Quality*, 9(1), e000753. <https://doi.org/10.1136/bmjopen-2019-000753>
- Artenstein, A. W. (2020). In pursuit of PPE. *New England Journal of Medicine*, 382(18), e46. <https://doi.org/10.1056/nejmc2010025>
- Aziz, A., Zork, N., Aubey, J. J., Baptiste, C. D., D'Alton, M. E., Emeruwa, U. N., Fuchs, K. M., Goffman, D., Gyamfi-Bannerman, C., Haythe, J. H., LaSala, A. P., Madden, N., Miller, E. C., Miller, R. S., Monk, C., Moroz, L., Ona, S., Ring, L. E., Sheen, J.-J., ... Friedman, A. M. (2020). Telehealth for high-risk pregnancies in the setting of the COVID-19 pandemic. *American Journal of Perinatology*, 37(8), 800–808. <https://doi.org/10.1055/s-0040-1712121>
- Cueto, V., & Sanders, L. M. (2020). Telehealth opportunities and challenges for managing pediatric obesity. *Pediatric Clinics of North America*, 67(4), 647–654. <https://doi.org/10.1016/j.pcl.2020.04.007>
- D'Andreamatteo, A., Ianni, L., Lega, F., & Sargiacomo, M. (2015). Lean in healthcare: A comprehensive review. *Health Policy*, 119(9), 1197–1209. <https://doi.org/10.1016/j.healthpol.2015.02.002>
- Doraiswamy, S., Abraham, A., Mamtani, R., & Cheema, S. (2020). Use of telehealth during the COVID-19 pandemic: Scoping review. *Journal of Medical Internet Research*, 22(12), e24087. <https://doi.org/10.2196/24087>
- Eboreime, E. A., Olawepo, J. O., Banke-Thomas, A., & Ramaswamy, R. (2021). Evaluating the design and implementation fidelity of an adapted plan-do-study-act approach to improve health system performance in a Nigerian state. *Evaluation and Program Planning*, 84, 101876. <https://doi.org/10.1016/j.evalprogplan.2020.101876>
- Emanuel, E. J., Persad, G., Upshur, R., Thome, B., Parker, M., Glickman, A., Zhang, C., Boyle, C., Smith, M., & Phillips, J. P. (2020). Fair allocation of scarce medical resources in the time of COVID-19. *New England Journal of Medicine*, 382(21), 2049–2055. <https://doi.org/10.1056/nejmsb2005114>
- Fogel, J. L., & Raymond, J. K. (2020). Implementing telehealth in pediatric type 1 diabetes mellitus. *Pediatric Clinics of North America*, 67(4), 661–664. <https://doi.org/10.1016/j.pcl.2020.04.009>
- Fryer, K., Delgado, A., Foti, T., Reid, C. N., & Marshall, J. (2020). Implementation of obstetric telehealth during COVID-19 and beyond. *Maternal and Child Health Journal*, 24(9), 1104–1110. <https://doi.org/10.1007/s10995-020-02967-7>
- Goldenhar, L. M., Brady, P. W., Sutcliffe, K. M., & Muething, S. E. (2013). Huddling for high reliability and situation awareness. *BMJ Quality & Safety*, 22(11), 899–906. <https://doi.org/10.1136/bmjqs-2012-001467>
- Hung, D. Y., Harrison, M. I., Martinez, M. C., & Luft, H. S. (2017). Scaling Lean in primary care: Impacts on system performance. *American Journal of Managed Care*, 23(3), 294–301.
- Hung, D. Y., Harrison, M. I., Truong, Q., & Du, X. (2018). Experiences of primary care physicians and staff following Lean workflow redesign. *BMC Health Services Research*, 18(1), 274. <https://doi.org/10.1186/s12913-018-3062-5>
- Hung, D. Y., Truong, Q. A., & Liang, S.-Y. (2021). Implementing Lean quality improvement in primary care: Impact on efficiency in performing common clinical tasks. *Journal of General Internal Medicine*, 36(2), 274–279. <https://doi.org/10.1007/s11606-020-06317-9>
- Isfahani, M. H., Tourani, S., & Seyedin, H. (2019). Lean management approach in Hospitals: A systematic review. *International Journal of Lean Six Sigma*, 10(1), 161–188. <https://doi.org/10.1108/ijlss-05-2017-0051>
- Johns Hopkins University & Medicine. (n.d.) *Coronavirus resource center*. Retrieved September 7, 2022, from <https://coronavirus.jhu.edu/>
- Leite, H. dos, & Vieira, G. E. (2015). Lean philosophy and its applications in the service industry: A review of the current knowledge. *Production*, 25(3), 529–541. <https://doi.org/10.1590/0103-6513.079012>

- Liker, J. (2021). *The Toyota way: 14 management principles from the world's greatest manufacturer*. McGraw Hill Education.
- Mahoney, M. F. (2020). Telehealth, telemedicine, and related technologic platforms. *Journal of Wound, Ostomy & Continence Nursing*, 47(5), 439–444. <https://doi.org/10.1097/won.0000000000000694>
- Paterson, C., Bacon, R., Dwyer, R., Morrison, K. S., Toohey, K., O'Dea, A., Slade, J., Mortazavi, R., Roberts, C., Pranavan, G., Cooney, C., Nahon, I., & Hayes, S. C. (2020). The role of telehealth during the COVID-19 pandemic across the interdisciplinary cancer team: Implications for practice. *Seminars in Oncology Nursing*, 36(6), 151090. <https://doi.org/10.1016/j.soncn.2020.151090>
- Rangachari, P., & Woods, J. L. (2020). Preserving organizational resilience, patient safety, and staff retention during COVID-19 requires a holistic consideration of the psychological safety of healthcare workers. *International Journal of Environmental Research and Public Health*, 17(12), 4267. <https://doi.org/10.3390/ijerph17124267>
- Rundall, T. G., Shortell, S. M., Blodgett, J. C., Henke, R. M., & Foster, D. (2021). Adoption of Lean management and hospital performance: Results from a national survey. *Health Care Management Review*, 46(1), E10–E19. <https://doi.org/10.1097/HMR.0000000000000287>
- Scott, D. (2020, March 16). *Coronavirus is exposing all of the weaknesses in the US Health System*. Vox. Retrieved November 18, 2021, from <https://www.vox.com/policy-and-politics/2020/3/16/21173766/coronavirus-covid-19-us-cases-health-care-system>
- Shortell, S. M., Blodgett, J. C., Rundall, T. G., Henke, R. M., & Reponen, E. (2021). Lean management and hospital performance: Adoption vs. implementation. *The Joint Commission Journal on Quality and Patient Safety*, 47(5), 296–305. <https://doi.org/10.1016/j.jcjq.2021.01.010>
- Son, C., Sasangohar, F., Neville, T., Peres, S. C., & Moon, J. (2020). Investigating resilience in emergency management: An integrative review of literature. *Applied Ergonomics*, 87, 103114. <https://doi.org/10.1016/j.apergo.2020.103114>
- Steindal, S. A., Nes, A. A. G., Godskesen, T. E., Dihle, A., Lind, S., Winger, A., & Klarare, A. (2020). Patients' experiences of telehealth in palliative home care: Scoping review. *Journal of Medical Internet Research*, 22(5), e16218. <https://doi.org/10.2196/16218>
- Tauben, D. J., Langford, D. J., Sturgeon, J. A., Rundell, S. D., Towle, C., Bockman, C., & Nicholas, M. (2020). Optimizing telehealth pain care after COVID-19. *Pain*, 161(11), 2437–2445. <https://doi.org/10.1097/j.pain.0000000000002048>
- Thomas, D. R. (2006). A general inductive approach for analyzing qualitative evaluation data. *American Journal of Evaluation*, 27(2), 237–246. <https://doi.org/10.1177/1098214005283748>
- Wijesooriya, N. R., Mishra, V., Brand, P. L. P., & Rubin, B. K. (2020). COVID-19 and telehealth, education, and research adaptations. *Paediatric Respiratory Reviews*, 35, 38–42. <https://doi.org/10.1016/j.prrv.2020.06.009>
- Wolbers, J., & Boersma, K. (2013). The common operational picture as collective sensemaking. *Journal of Contingencies and Crisis Management*, 21(4), 186–199. <https://doi.org/10.1111/1468-5973.12027>
- Womack, J. P., & Jones, D. T. (2003). *Lean thinking: Banish waste and create wealth in your corporation*. Free Press.
- Wreathall, J. (2006). Properties of resilient organizations: An initial view. In E. Hollnagel, D. Woods, & N. Leveson (Eds.), *Resilience engineering: Concepts and precepts* (1st ed., p. 275–285). Taylor & Francis Group. e9781315605685