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RESEARCH ARTICLE

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Patient experiences after implementing lean primary care redesigns

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Abstract

Objective: To examine the effect of Lean primary care redesigns on patient satisfaction with care and timeliness of care received.

Data/Setting: We used patient surveys and time-stamped electronic health record (EHR) data in a large ambulatory care system.

Design: Lean-based changes to clinical spaces and care team workflows were implemented in one pilot site and then scaled to all primary care departments across the system. Redesigns included standardizing equipment and patient education materials in examination rooms, streamlining call management functions, co-locating physician and medical assistant dyads in a shared workspace, and creating new care team workflows. We used a non-randomized stepped-wedge study design and segmented regression with interrupted time series analysis to examine Lean impacts on patient outcomes.

Data Collection: We analyzed patient satisfaction ratings and wait times as documented by the EHR. These longitudinal data were collected for 317 physician-led teams in 46 primary care departments from January 2011 to December 2016.

Principal Findings: After implementation of Lean redesigns, patients reported a 44.8 percent increase in satisfaction with the adequacy of time spent with care providers during office visits ($P < .05$). They also reported 71.6 percent higher satisfaction with their care provider's ability to listen to their concerns, and a 55.4 percent increase in perceived staff helpfulness at the visit ($P < .01$). Based on monthly EHR data, the amount of time elapsed between a patient request for a routine appointment and the scheduled visit day decreased from baseline by an average 2 percent per month ($P < .01$). On the day of the visit, patient wait times to be seen also decreased gradually by an average 1.2 percent per month ($P < .05$).

Conclusions: Patient experiences of care after Lean implementations have not been widely studied in primary care settings. We found that Lean redesign yielded improvements that may strengthen clinical operations while enhancing value for patients.

KEYWORDS

lean implementation, longitudinal time-stamped EHR data, patient satisfaction/experiences, quality improvement, stepped-wedge study design, timeliness of care

1 | INTRODUCTION

Self-reported patient experiences of care are important indicators of the quality of primary care delivery. Perceived connectedness with physicians and degree of care continuity are associated with higher patient satisfaction, patient engagement, and optimal health-related behaviors (eg, adherence to treatment regimens).[1,2] Physician practice style, or "bedside manner," also largely affects patient experiences with care. Key attributes valued by patients include a physician's ability to listen and address health concerns, as well as the amount of time spent during office visits.[3-6] These factors have been largely associated with patient reports of high quality of care received.[7]

Challenges to patient experiences in primary care have included access issues and adequacy of time spent with physicians. Most patients have a usual source of care, but less than a third report being able to easily contact their physician over the telephone, obtain care or medical advice after hours, and receive timely office visits.[8] Difficulty gaining access to primary care is a growing concern particularly with increasing national shortages of primary care practitioners.[9] Adequacy of time spent during office visits is a strong predictor of patient satisfaction; in contrast, long wait times to see a physician are associated with low satisfaction.[10-15] Moreover, the combination of a long wait time followed by a short visit results in particularly low overall satisfaction reported by patients.[10,16] Despite its importance to patient experience, timeliness of care in primary care settings has not been widely examined.[17]

In this study, we examined the impact of Lean redesigns on key aspects of patient-reported satisfaction and on objective measures of timeliness of care. This inquiry was motivated by the Lean tenet of maximizing operational efficiency, which has led to higher product reliability, quality, and customer satisfaction in many industries.[18-21] In the past decade, Lean techniques have been adopted to improve service quality for patients as consumers of health care.[22-25] Focusing on the primary care setting, we studied Lean implementation in all primary care departments at a large ambulatory delivery system. Lean-based changes included 5S standardization ("sort, sweep/set in order, shine, standardize, sustain") of patient examination rooms, redesign of call management functions, and modification of work roles and responsibilities among primary care team members. These interventions aimed to enhance practice efficiency, care team functioning, and quality of services delivered to patients.

What is Known on This Topic

- Challenges to patient experience include difficulties accessing primary care, adequacy of time spent with primary care physicians during visits, and physicians' ability to listen well to patient concerns.
- Patient experiences, including timeliness of care, following Lean implementations have not been widely studied in primary care settings.
- We examined the effects of Lean primary care redesign on patient-reported satisfaction and access to care as measured by time-stamped EHR data.

What this Study Finds / Adds

- After implementation of Lean redesigns, patients reported a 44.8 percent increase in satisfaction with the adequacy of time spent with physicians during office visits, 71.6 percent higher satisfaction with physicians' ability to listen to their concerns, and a 55.4 percent increase in perceived staff helpfulness at the visit.
- Based on time-stamped EHR data, patient access to routine appointments and time spent in the waiting room decreased gradually by 1.2 percent and 2 percent per month, respectively, during annual observation periods.
- Comprehensive quality initiatives that involve workspace standardization and workflow redesign may increase care team functioning while enhancing value for patients as consumers of health care.

2 | METHODS

2.1 | Study sample

Our sample included 317 physicians in 46 internal medicine, family medicine, and pediatric departments at a multispecialty ambulatory care system serving nearly one million patients in Northern California. To minimize the effects of physician turnover during the study period, analyses were based on physicians who were continuously employed before and after Lean redesigns were implemented. Continuous employment was defined as being more than 5 percent FTE for at least half of the time periods both before and after Lean redesigns were introduced in each department. Moreover, individuals were included if they were employed for a minimum of 6 months during the pre-Lean period, and a minimum of 12 months in the post-Lean period. The full study period spanned a 6-year timeframe from January 2011 to December 2016.

2.2 | Intervention

Lean redesigns were implemented as a system-wide strategic initiative beginning in primary care. These redesigns sought to increase operational efficiency and care team functioning, with the ultimate goal of improving service quality and patient experience of care (Figure 1). Lean intervention formally began with redesigning work environments and processes, including "5S" standardization ("sort, sweep/set in order, shine, standardize, sustain") to organize medical equipment, supplies, and health education materials in all patient examination rooms. This was done to maximize physician time spent with patients during visits by eliminating need to search for supplies

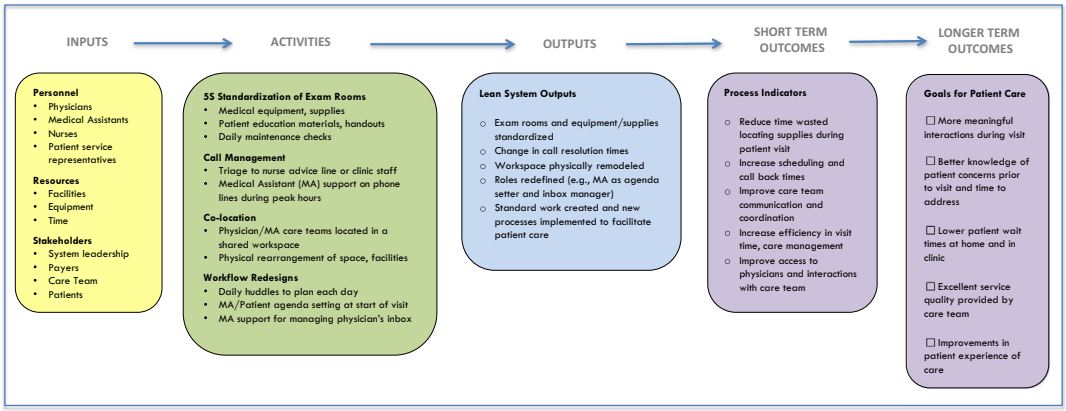

FIGURE 1 Conceptual framework for lean primary care redesigns [Color figure can be viewed at wileyonlinelibrary.com]

and attend to other distractions due to improper room setup. Call management functions were streamlined by simplifying protocols for triaging patients to clinic staff or nurse advice lines, and by enlisting the help of available medical assistants (MAs) to support phone lines during peak hours. Physician and MA care teams were physically co-located in a shared workspace to facilitate real time coordination between patient visits and to communicate patient concerns that should be addressed by the physician during the visit.

Finally, care team roles and workflows were redesigned to promote a higher level of team functioning and service quality for patients. Specifically, these new workflows included (a) morning huddles between the physician and MA to review patient schedules for each day; (b) agenda setting with patients at the start of each visit to identify priority concerns that would optimize time later spent with the physician in the exam room; and (c) joint management of the physician's electronic inbox by both the physician and MA. In this capacity, MAs provided support by immediately addressing incoming items as appropriate (eg, patient messages and requests for letters) or preparing items for the physician to act on (eg, laboratory/imaging results, prescription refills, and referral requests). Changes to both the organization of clinical spaces and care processes were made to increase overall functioning among team members, while enhancing the quality of services and patient experiences of care.

2.3 | Data sources and measures

Data were extracted from the health system's operational quality improvement and appointment scheduling databases. During the 6-year study period, self-reported patient experiences were collected by two third-party survey administrators: Press-Ganey® and NRC Health, which administers the Clinician and Group version of the Consumer Assessment of Healthcare Providers and Systems (CG-CAHPS®) developed by the Agency for Healthcare Research and Quality (AHRQ). These patient-reported data are routinely linked to individual physicians in each department and shared in patient anonymized form. As both surveys assess similar aspects of patient care, we began by examining the face validity and consistency of items across surveys with regard to both the content and wording of each item. Although Press-Ganey® frames survey questions in terms of patient satisfaction while CG-CAHPS® frames them in terms of patient experiences of care, many items were identical with respect to the topic queried (eg, perceived adequacy of time spent with the care provider, provider's ability to listen, and helpfulness of office staff).

We selected for analysis only items that each survey held in common. This yielded seven domains including patient reports of: (a) Access to care, for example, ease of appointment scheduling for both urgent and non-urgent visits; (b) Office staff courtesy and helpfulness to patients; (c) Care provider friendliness and respect for patients; (d) Clarity of provider's explanations to patients; (e) Ability of provider to listen to patients; (f) Adequacy of time spent with provider; and (g) Overall rating or likelihood of recommending care provider to others. All response options were measured on Likert scales (eg, 5-point with "neutral" as the middle option). We analyzed all domains according to the proportion of "top-box" scores, or highest score possible (eg, "Very satisfied") as rated by patients.

Based on longitudinal time-stamped EPIC® EHR data, we also created objective measures of patient experience with timeliness of care received. These measures included the following: (a) time elapsed from a patient's request for a non-urgent, routine appointment until the scheduled appointment date; and (b) time that a patient spent waiting to be seen after arriving at the clinic on the day of the appointment. These measures were sourced directly from EHR patient encounter and scheduling log data using a number of fields such as: date the patient contacted the clinic for an appointment by telephone or online patient portal; date and time of the scheduled appointment; time the patient checked-in on the day of the appointment; and a calculated variable of the total minutes between check-in and "roomed" time, which was the time that a patient was brought to the examination room by a medical assistant to begin the visit. All fields were extracted from operational data sources and vetted. This included manual checks for accuracy by iteratively sampling calculated times followed by verification of start/end points, and resolution of missing data where possible by linking to alternative data sources (eg, care team access logs).

2.4 | Statistical analysis

We employed segmented regression with interrupted time series analysis[26-28] to assess impacts of Lean redesign on patient experiences and timeliness of care received. Since Lean was implemented in sequential phases across the system, the data were analyzed using a non-randomized stepped-wedge design with one-way crossover.[29,30] We adopted generalized linear mixed models to account for the multilevel nature of the data (eg, monthly data points for physicians clustered within primary care departments).

With the physician-month as the unit of observation, our main effects included both immediate effects of Lean (represented by model intercepts comparing baseline and post-Lean changes) and gradual impacts over time (slopes measuring changes in outcomes per month) for three consecutive periods of observation. These three periods included the first, second, and third year and beyond of Lean implementation in each site. After obtaining model estimates, coefficients were log transformed into % changes from baseline: $\beta_{it} = \log Y_2 - \log Y_1$ or $\log(Y_2/Y_1)$; then $Y_2/Y_1 = \exp(\beta_{it})$; $Y_2 = \exp(\beta_{it})Y_1$; % change in outcome = $1-\exp(\beta_{it})$.

In all models, we adjusted for secular trends and potential confounders across physicians in each department. These included physician scheduled clinic hours; mean age of patients on a physician's panel; physician demographics (eg, age, gender, and tenure in department); physician workload as measured by monthly number of office visits, telephone messages, prescription refills, and patient emails; productivity as measured by average number of RVUs per visit; and monthly proportion of new patient visits. The nested structure of departments within distinct clinic locations was included as random effects. We accounted for autocorrelation of repeated measures over time by using a first-order autoregressive R-side covariance structure.

TABLE 1 Description of practice characteristics

	Mean (or N)	SD (or %)
Department type		
Internal Medicine	(15)	(32.6)
Family Medicine	(16)	(34.8)
Pediatrics	(15)	(32.6)
Practice Size (FTE)	19.7	2.65
Staff:Physician Ratio	1.5	0.62
Study Months Post-Lean Redesigns	43.6	1.41
Patient Satisfaction Top-Box Ratings (%, baseline)		
Access to care	58.4	18.5
Staff courtesy and helpfulness	63.6	18.1
Provider's respect for patients	83.5	14.7
Provider's clarity of explanations	85.3	13.8
Provider's ability to listen	78.9	15.9
Adequacy of time spent with provider	74.0	17.4
Overall rating of care provider	79.7	16.1
Patient Wait Times (baseline)		
For non-urgent, routine visit (days)	14.3	8.05
In waiting room on visit day (minutes)	12.0	3.38

Abbreviation: FTE, Full-time equivalent practice members (physicians and non-physician staff).

3 | RESULTS

Table 1 presents a description of all study sites. The 46 primary care departments were evenly represented by Internal Medicine, Family Medicine, and Pediatrics, with an average practice size of approximately 20 full-time equivalent staff members. The average number of months post-Lean implementation in each site was 43.6 months, or roughly 3.5 years. At baseline prior to Lean redesign, mean proportions of top-box patient satisfaction ratings were 58.4 percent for overall access to care and 63.6 percent for perceived levels of staff courtesy and helpfulness. Care providers received average top-box scores of 83.5 percent in the area of respect for patients; 85.3 percent on clarity of explanations to patients; 78.9 percent on ability to listen to patients; 74.0 percent on adequacy of time spent with patients; and 79.7 percent as an overall rating of the care provider.

After Lean implementation, we found more favorable perceptions of physicians' ability to listen to patient concerns, amount of time spent during office visits, and level of staff courtesy and helpfulness at the visit. These results are reported in more detail below. Improvements were observed in later years following Lean implementation, which may be consistent with the timing of satisfaction surveys that are fielded on a delayed timeline of up to 6 months after the visit. For all domains, statistically significant changes in trends were detected in the second year post-Lean, with more dramatic increases in the third year of observation.

Table 2 shows that during the second year of Lean redesigns, patients were 4.4 percent more likely *over time* (ie, measured by the slope) to report being very pleased with the care provider's ability to listen to their concerns ($P < .05$). Effects were more pronounced by the third year of observation, when patients reported a 71.6 percent increase in their likelihood of giving a top-box score, as compared with scores prior to Lean implementation ($P < .01$). During this final period, patient satisfaction in this area continued to increase incrementally by roughly 2 percent per month ($P < .10$).

Table 3 shows similar patient experiences with perceived adequacy of time spent with care providers during the office visit. In the second year of Lean redesigns, patients were 3.5 percent more likely each month to report being very satisfied with the amount of time spent with their physician ($P < .05$). By the third year post-Lean, we

TABLE 2 Care provider's ability to listen to patient concerns

Main effects[a]	Change in score (%)	*P*-value
Baseline (pre-lean)		
Intercept	—	<.001
Slope	—	.201
1st year post-lean		
Intercept	5.23	.534
Slope	−0.60	.575
2nd year post-lean		
Intercept	−2.37	.797
Slope	4.41	.029
3rd year + post-lean		
Intercept	71.6	.002
Slope	2.34	.072

Note: Model adjusted for factors such as physician scheduled clinic hours, mean age of patients on a physician's panel, physician demographics, physician workload and productivity, and proportion of new patient visits.

[a]"Intercepts" estimate immediate changes in each time period, as compared with baseline values. "Slopes" estimate gradual changes (per month) in each time period.

TABLE 3 Adequacy of time spent with care provider

Main effects[a]	Change in score (%)	*P*-value
Baseline (pre-lean)		
Intercept	—	<.001
Slope	—	.003
1st year post-lean		
Intercept	−10.6	.173
Slope	0.0	.982
2nd year post-lean		
Intercept	6.29	.416
Slope	3.53	.037
3rd year + post-lean		
Intercept	44.8	.041
Slope	0.20	.901

Note: Model adjusted for factors such as physician scheduled clinic hours, mean age of patients on a physician's panel, physician demographics, physician workload and productivity, and proportion of new patient visits.

[a]"Intercepts" estimate immediate changes in each time period, as compared with baseline values. "Slopes" estimate gradual changes (per month) in each time period.

found a more pronounced increase of 44.8 percent in top-box scores of patient satisfaction, as compared with baseline scores ($P < .05$).

Finally as shown in Table 4, during the second year of Lean redesigns, patients were 4.4 percent more likely per month to report being very satisfied with levels of staff courtesy and helpfulness ($P < .05$).

TABLE 4 Office staff courtesy and helpfulness to patients

Main effects[a]	Change in score (%)	*P*-value
Baseline (pre-lean)		
Intercept	—	.001
Slope	—	.014
1st year post-lean		
Intercept	5.55	.406
Slope	−0.60	.371
2nd year post-lean		
Intercept	11.7	.214
Slope	4.41	.010
3rd year + post-lean		
Intercept	55.4	.004
Slope	2.93	.001

Note: Model adjusted for factors such as physician scheduled clinic hours, mean age of patients on a physician's panel, physician demographics, physician workload and productivity, and proportion of new patient visits.

[a]"Intercepts" estimate immediate changes in each time period, as compared with baseline values. "Slopes" estimate gradual changes (per month) in each time period.

This likelihood of top-box scoring increased by 55.4 percent in the third year of Lean redesigns ($P < .01$) and was accompanied by continued 2.9 percent increases in scores per month ($P < .001$). We found no statistically significant associations between Lean primary care redesigns and patient satisfaction with other measured domains.

Using time-stamped EHR data, we also assessed objective measures of patient wait times specifically for non-urgent routine appointments. Prior to Lean implementation, the average wait time for a non-urgent visit was 14.2 days. On the day of the appointment, patients waited an average 12 minutes to be brought to the examination room after checking in at the front desk. After Lean implementation, we found a reduction in time interval between patient requests for an appointment and the scheduled appointment day. We also found slight decreases in patient wait times upon arrival to clinic on the day of the appointment.

Detailed results for patient wait times are shown below in Table 5. Based on EHR documentation, we found that the amount of time elapsed between a patient request for a routine appointment and the scheduled visit day decreased from baseline levels by approximately 2 percent per month during the first year of Lean redesigns ($P < .01$). Similarly, compared with baseline trends, the amount of time that patients spent in the waiting room on the day of the visit decreased by roughly 1.2 percent per month during the final year ($P < .05$).

4 | DISCUSSION

Lean primary care redesigns were associated with improved patient experiences in several areas, including adequacy of time spent with

TABLE 5 Patient wait times, measured using time-stamped EHR data

	Time elapsed between appointment request and scheduled visit day		Time spent in waiting room on visit day	
Main effects[a]	Change in time (%)	*P*-value	Change in time (%)	*P*-value
Baseline (pre-lean)				
Intercept	—	.002		.006
Slope	—	.001	—	.534
1st year post-lean				
Intercept	−5.92	.303	−3.15	.475
Slope	−1.98	.004	2.03	.896
2nd year post-lean				
Intercept	−1.98	.393	0.80	.664
Slope	−0.30	.461	−0.10	.727
3rd year + post-lean				
Intercept	−3.54	.290	−5.65	.060
Slope	0.50	.076	−1.24	.041

Note: Model adjusted for factors such as physician scheduled clinic hours, mean age of patients on a physician's panel, physician demographics, physician workload and productivity, and proportion of new patient visits.

[a]"Intercepts" estimate immediate changes in each time period, as compared with baseline values. "Slopes" estimate gradual changes (per month) in each time period.

physicians during visits, the physician's ability to listen to patient concerns, and perceived helpfulness of clinical and administrative staff. We also found gradual improvements in timeliness of care as documented by time-stamped EHR data. Measures included duration of time from a patient's request for a non-urgent appointment to the scheduled appointment day, and the amount of time that patients waited to be seen upon arrival at the clinic. These study findings indicate that Lean redesigns may be beneficial for patient care. Based on previous research,[10-16] physician interactions with their patients, adequacy of time spent together during office visits, and appointment wait times are all key drivers of patient satisfaction.

In our study organization, changes to physical workspaces and team workflows aimed to enhance patient care indirectly by increasing practice efficiency, care team functioning, and service quality. For example, standardizing exam rooms aimed to minimize interruptions by enabling physicians to locate all needed supplies and educational materials while seeing patients. By removing obstacles during the visit, these changes were to foster more meaningful time spent as physicians focused on listening to and addressing patient concerns. Another mechanism for improving patient experience in this area involved the use of medical assistants (MAs) for: (a) agenda setting to help patients prioritize their questions and concerns for the visit; and (b) management of incoming patient care items in the electronic inbox. These new roles for the MA, combined with care team co-location and daily huddles, were intended to improve coordination and communication with physicians about high-priority items that needed to be addressed and that patients wished to discuss during the visit. Taken together, all areas of redesign served to enhance physician knowledge of patient concerns, expand the amount of time available to address those concerns at the visit, and, ultimately, create more meaningful interactions between patients and their care providers. The redesigned roles and workflows also increased MA engagement in patient care, which may have led to the more favorable reports of staff helpfulness reported on surveys.

A central goal of Lean in virtually every industry where it has been applied is to enhance operational efficiency and value for consumers. In the health care sector, this often translates into the important goal of increasing patient satisfaction with care. Our findings in primary care practice are consistent with previous research in other health care settings. For example, use of Lean methodology to standardize outpatient surgical examination rooms resulted in increased physician time spent face-to-face with patients, which was accompanied by improvements in patient satisfaction scores.[31] Similarly, in a hospital-based outpatient pediatrics clinic, Lean rapid cycle methodologies were used to improve operational effectiveness among care teams. This led to patient satisfaction increases of 87-95 percent in perceived physician and staff friendliness as well as overall experience of care.[32] Moreover, patients in an inpatient facility reported improvements of 57-93 percent on several physician-related domains of a patient experience survey, including time spent during the visit, encouragement to ask questions, and respect for patients shown by care providers.[33] These findings were reinforced by our study in primary care clinics, where we found comparably sized increases in similar domains of patient experience.

Some of the most prevalent work on Lean in health care has been conducted in emergency departments (ED) where redesigns are associated with enhanced patient flow, reduced waiting times, and improved patient satisfaction.[34-37] ED and primary care settings are closely linked, as a principal cause of ED use is lack of access to primary care services. According to one study, 46 percent of patients reported that the problem bringing them to the ED might have been handled in primary care, and of these, two-thirds of patients would have seen a primary care provider instead of visiting the ED had they been able to obtain an appointment.[38] Longer wait times for primary care appointments often leave patients to rely on urgent care and are linked to more adverse health outcomes. Yet a systematic review of studies in primary care showed that changes to call management, increased patient emailing and consultation, and greater involvement of clinical support staff, similar to the changes implemented in our study, can be effective in increasing access and reducing wait times.[39]

Although we found decreases in patient wait times, these changes were relatively small and not necessarily "clinically" significant. Notably, our results focused on non-urgent visits that may have already been operating at high levels, according to baseline wait times documented by EHR data. Yet there was no distinction between access to urgent and non-urgent care as queried on patient

satisfaction surveys. Given our findings from both data sources, Lean redesigns may have done more to increase patient access specifically with regard to urgent care. This was likely accomplished through redesigned call management triage to nurse advice lines and clinic staff, as well as the addition of MA support for handling call volumes during peak hours. Other potential influences were the increased attention and management by the full care team of all incoming items in the physician's inbox, which aimed to produce faster turnaround and response times.

A primary limitation of our study is the lack of a comparison group due to the implementation of Lean in all primary care locations across the health system. Thus, we cannot determine with certainty the extent to which observed changes were due to Lean itself or to other unmeasured factors. In light of this, our use of a non-randomized stepped-wedge study design facilitated adjustments for secular trends while allowing for within-site comparisons before and after Lean intervention. These results were then aggregated to the system level. Another study limitation involves the difficulty of linking specific components of Lean redesigns to specific patient outcomes on a direct one-to-one basis. Rather, differences in patient experience were found as a result of comprehensive practice changes.

5 | CONCLUSION

Favorable experiences with care depend on key attributes valued by patients, including adequacy of time spent with physicians and a physician's ability to listen well when addressing patient concerns. There is also a known negative association between patient satisfaction and long wait times. Despite their importance, these aspects of patient experience after Lean implementation have not been studied in primary care settings. We sought to measure effects of Lean redesigns using both patient satisfaction surveys and time-stamped EHR data. We found that Lean redesigns were associated with improved patient experiences and timeliness of care received. Comprehensive quality improvements that involve workspace standardization and workflow redesign may result in a more robust clinical practice, which in turn enhances both operational efficiency and value for patients as consumers of health care. In a post-COVID-19 era that has introduced telehealth as an alternative platform for care delivery, it remains to be seen how patient experiences will be impacted with regard to access and virtual interactions with physicians and care teams. Other related issues involve effects of long-term reductions in the primary care workforce combined with larger patient panels made possible through telemedicine. Future areas of research include how Lean techniques can be used to balance “push-pull” forces as a result of changing patterns in supply and demand. Other areas include how Lean process improvement might be used to enhance the quality of patient-physician interactions during virtual visits.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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