Scaling Lean in Primary Care: Impacts on System Performance

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ABSTRACT

OBJECTIVES: We examined a wide range of performance outcomes after Lean methodology—a leading strategy to enhance efficiency and patient value—was implemented and scaled across all primary care clinics in a nonprofit, ambulatory care delivery system.

STUDY DESIGN: Using a stepped wedge approach, we assessed changes associated with the phased introduction of Lean-based redesigns across 46 primary care departments in 17 different clinic locations. Longitudinal analysis of operational metrics included: workflow efficiency, physician productivity, operating expenses, clinical quality, and satisfaction among patients, physicians, and staff.

METHODS: We used interrupted time series analysis with generalized linear mixed models to estimate Lean impacts over time. Projected outcomes in the absence of changes (ie, counterfactuals) were compared with observed outcomes after Lean redesigns were implemented, and mean differences were assessed using 95% bias-corrected bootstrap confidence intervals (CIs).

RESULTS: We observed systemwide improvements in workflow efficiencies (eg, 95% CI, 5.8-10.4) and physician productivity (95% CI, 3.9-27.2), with no adverse effects on clinical quality. Patient satisfaction increased with respect to access to care (95% CI, 15.2-20.7), handling of personal issues (95% CI, 2.1-6.9), and overall experience of care (95% CI, 11.0-17.0), but decreased with respect to interactions with care providers (95% CI, −13.4 to −5.7). Departmental operating costs decreased, and annual staff and physician satisfaction scores increased particularly among early adopters, with key improvements in employee engagement, connection to purpose, relationships with staff, and physician time spent working.

CONCLUSIONS: Lean redesigns can benefit primary care patients, physicians, and staff without negatively impacting the quality of clinical care. Study results may lead other delivery system leaders to innovate using Lean techniques and may further enhance support for Lean learning among public and private payers.

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In the past decade, Lean methodology has emerged as one of the leading strategies for redesigning care to increase efficiency and patient value. Several prominent health system leaders have championed Lean's potential contribution to reducing waste, enhancing quality, and facilitating patient and provider engagement.[1-3] In the past several years, Lean has been highlighted by the National Academy of Medicine (formerly the Institute of Medicine) and the President's Council of Advisors on Science and Technology as a powerful system approach.[4,5]

Adapted from manufacturing, Lean is a change strategy with roots in continuous quality improvement. System leaders who adopt Lean provide frontline staff with training on how to use analytic tools and methods to identify and remedy sources of waste. In healthcare, waste is defined as anything that does not add value for patients or the process of delivering their care. Aided initially by Lean experts, staff members learn to pinpoint sources of waste and develop solutions to operational problems; these solutions often streamline work processes to enhance efficiency and workflow. Other aspects of Lean management include standardizing tasks to ensure reliability and coordination across roles and units, creating common baselines for measuring continuous improvements, and redefining roles to empower staff to improve quality and efficiency, as well as to accept shared responsibility for improving outcomes.[6-8]

Despite widespread interest and growing use, only a few articles and a handful of books provide empirical details on systemwide Lean initiatives.[9-14] These were ambitious programs lasting 5 years or more, driven by visionary leaders who were also highly effective managers. However, most research on Lean in peer-reviewed journals reports on the effects of specific Lean interventions on a few selected metrics, typically in 1 or a few sites. Also, most studies examine inpatient settings or integrated systems in which incentives are aligned for improving efficiency,[6,15,16] but the implications of such research for fee-for-service (FFS) primary care are unclear. Most of the work on Lean in healthcare is anecdotal or relies on weak before-and-after study designs, and published studies rarely

TAKEAWAY POINTS

Lean is emerging as a leading strategy to enhance efficiency and patient value. Using a stepped wedge design, we assessed changes associated with the phased introduction of Lean-based redesigns across 46 primary care departments in a nonprofit, ambulatory care delivery system.

- We observed systemwide improvements in workflow efficiencies, physician productivity, and patient satisfaction measures.
- Operating costs decreased, and staff and physician satisfaction scores increased in key domains, including employee engagement and physician time spent working.
- Study findings may lead other delivery system leaders to innovate using Lean techniques and may enhance support for Lean learning among public and private payers.

provide information on Lean's effects on overall care quality and satisfaction among patients and providers.

We report here on a longitudinal study using a wide range of efficiency, quality, and satisfaction measures to assess the implementation of Lean-based redesigns as they were spread across primary care clinics in a large FFS ambulatory care delivery system. Executive leaders envisioned the Lean initiative as a systemwide transformation, which began with the redesign of existing work spaces and care processes in all primary care departments and clinic locations throughout the system. These redesigns were intended to improve the work environment and process of delivering care among physicians and staff and to achieve tangible improvements in patient experiences of care.

Specifically, redesigns that were introduced as part of the Lean initiative included: 1) standardization of medical equipment, supplies, and health education materials in patient exam rooms; 2) redesign of patient call center functions; 3) co-location of physician and staff care teams in a shared workspace; and 4) redesign of care team workflows. Standardized workflows included daily morning huddles to review patient schedules, agenda setting with patients by the medical assistant (MA) at the start of each office visit, and retrieval by the MA of all incoming items (eg, patient messages, lab/imaging results, prescription refills, referral requests) from the physician's electronic inbox to address tasks as appropriate or to prepare them for the physician's attention.

The implementation of Lean redesigns was formally staged: first, they were developed and implemented in 1 pilot clinic, then refined in 3 "beta" test clinics, and finally, scaled to 13 remaining clinics across the system. Each clinic location housed 1 to 3 primary care departments (Family Medicine, Internal Medicine, and/or Pediatrics) for a total of 46 primary care departments in which Lean redesigns were introduced.

METHODS

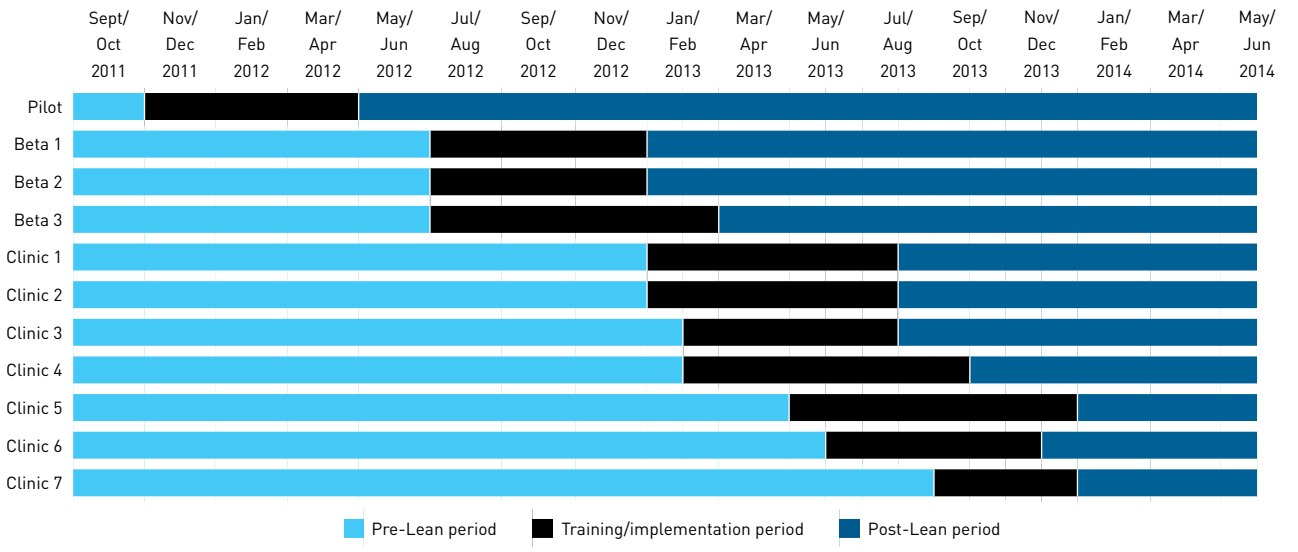
Performance Metrics and Data Sources

As indicated above, the implementation of Lean in primary care focused largely on efforts to improve workflow. Targeted improvements included reductions of physician time required for each patient encounter, with the aim to improve patient access to care. Reductions of other forms of waste during office encounters were also aimed to increase efficiency and productivity while reducing operating costs. It would not be acceptable, however, if Lean were to achieve these objectives at the expense of worsening clinical quality, patient satisfaction with services delivered, or physician and staff satisfaction. As the organization did not expend resources in developing major new metrics to monitor these outcomes, we relied on operational dashboards, billing and financial sources, scheduling systems, electronic health records (EHRs), and routinely administered surveys to study the effects of Lean implementation. The advantage in doing so is that we had longitudinal, uniformly collected measures across all clinics, both before and after Lean redesigns were implemented.

Workflow efficiency data were sourced from the EHRs and measured physicians' timely completion of tasks associated with 4 types of patient encounters. These were the percentages of: 1) office visit charts closed within 2 hours of seeing the patient, 2) electronic reply to patient messages within 4 business hours, 3) prescription medications renewed within 4 business hours, and 4) telephoned patient care items resolved within 4 business hours. Physician productivity was measured by monthly work-relative value units (wRVUs) (restated to CMS 2012 valuation) per physician full-time equivalent (FTE) and per office visit. Departmental operating expenses, consisting mainly of nonphysician staff compensation and supply costs, per total RVU (tRVU), were calculated using data provided by the Finance department and adjusted for inflation using the Western Urban Consumer Price Index for medical care commodities.[17] Clinical quality was assessed using pay-for-performance metrics routinely reported by the organization to the Integrated Healthcare Association (see the **eAppendix**, available at **www.ajmc.com**). Finally, physician, staff, and patient satisfaction data were collected by third-party survey administrators—the American Medical Group Association (physicians), Hay Group (staff), and Press-Ganey (patients). The physician and staff surveys are conducted annually, while Press-Ganey surveys are fielded to patients on an ongoing basis, with data aggregated by month.

To minimize the effects of turnover, metrics were based on physicians continuously employed during the study period. Continuous employment was defined as more than 5% FTE for at least two-thirds of the months both pre- and post-Lean implementation at a given clinic location. The number of qualifying months depended on when the clinic implemented Lean, with post-Lean periods ranging from 4 to 25 months. A total of 328 primary care physicians were included during the study period (2011-2014).

FIGURE. Stepped Wedge Design of Lean Implementation[a]



[a]Most listed clinics (except 4 and 7) have additional satellite clinic sites that were included for analysis.

Statistical Analysis

We assessed the effects of implementing Lean redesigns using an interrupted time series. In such analyses, an outcome is monitored over time and may have "interruptions" following an intervention that can be modeled in a segmented regression.[18] Because Lean was deployed in phases, the data were analyzed using a nonrandomized stepped wedge design with 1-way crossover; thus, the observation period began with all locations initially without exposure to the intervention, with sequential training and "crossover" of clinics from control to intervention groups, until all clinics were exposed by the end of the study period (**Figure**).

For most analyses, generalized linear mixed models were used with the physician-month as the unit of observation. Fixed effects included the terms used for the segmented regression and potential confounders, including covariates such as physicians' scheduled clinic hours, the mean age of patients on a physician's panel, and the proportion of new patient visits. The nested structure of physicians working in departments within clinic locations was accounted for using random effects in the models. The autocorrelation of repeated measures over time was accounted for using a first-order autoregressive R-side covariance structure.

A projected value for each performance outcome in the absence of Lean was estimated as of the end of the observation period, adjusting for secular trends and the potential confounders described above. This counterfactual was compared with the observed values at the end of the study period after Lean redesigns had been implemented in all clinic locations. To determine whether the mean difference was statistically significant, a 95% bias-corrected bootstrap confidence interval (CI) was calculated using 2000 samples.[19]

Annual staff and physician satisfaction survey data were provided by vendors at aggregated levels to protect respondent confidentiality, so these data were analyzed at either the clinic or the overall system level. As physician satisfaction data were available at the clinic level, results were grouped by the 3 phases of Lean implementation. All data management and statistical analysis for all metrics were conducted using SAS version 9.3 (SAS Institute, Cary, North Carolina).

RESULTS

Table 1 displays comparisons of several performance outcomes. Across the system, provider workflow efficiency improved in the majority of metrics examined. Timely office visit chart closures attributable to Lean implementation increased by roughly 10% (95% CI, 0.9%-8.2%), from 51.2% to 56.2%. Similar results were observed for prescription medications renewed and for telephone encounters resolved within 4 business hours; there was no statistically significant change in responsiveness to patient messages. One measure of physician productivity—monthly wRVU production per physician—increased approximately 5%, from 252.3 to 265.0, while wRVUs per office visit remained unchanged. Total operating expenses and its major components (ie, nonphysician compensation, drugs and supply costs) were lower per department, although these reductions were not statistically significant.

Overall, patient satisfaction increased from 49.1% to 63.2% following implementation of Lean redesigns. Patient perceptions of access to care via appointments, phone calls, online messages, and referrals

TABLE 1. System Performance After Implementation of Lean Redesigns

Topic	Performance Metric[a]	Projected Values	Observed Values	Mean Difference[b]	95% CI	% Diff
Workflow efficiency	Office visit charts closed <2 hours	51.2%	56.2%	5.0%[c]	0.9-8.2	10.0%
	Electronic reply to patient message <4 hours	79.5%	77.7%	–1.9%	–4.1 to 0.6	–3.4%
	Prescription medication renewed <4 hours	63.4%	71.4%	8.0%[c]	5.8-10.4	12.6%
	Telephone response <4 hours	57.3%	62.3%	5.1%[c]	3.2-6.5	8.9%
Physician productivity	wRVU per physician FTE per month	252.3	265.0	13.9[c]	3.9-27.2	5.5%
	wRVU per office visit	1.52	1.50	0.0	–0.04 to 0.00	0%
Operating expenses[d]	Total operating expenses per tRVU	100%	87.5%	–	–	–
	Staff compensation expenses per tRVU	100%	88.2%	–	–	–
	Drug and supplies expenses per tRVU	100%	94.0%	–	–	–
Patient satisfaction	Access to care	37.4%	55.5%	18.1%[c]	15.2-20.7	48.4%
	Interactions with care provider	79.0%	69.8%	–9.2%[c]	–13.4 to –5.7	–11.6%
	Moving through visit	50.9%	49.3%	–1.6%	–5.7 to 1.3	–3.1%
	Nurse/assistant	66.2%	68.0%	1.7%	–1.5 to 4.0	2.6%
	Handling of personal issues	69.0%	74.5%	5.5%[c]	2.1-6.9	8.0%
	Overall satisfaction[e]	49.1%	63.2%	14.1%[c]	11.0-17.0	28.7%
Clinical quality[f]	Diabetes care: A1C control <8%	64.5%	67.9%	3.4%[c]	1.4-5.1	11.0%
	Diabetes care: A1C control <7%	35.5%	39.4%	3.9%[c]	1.6-6.0	5.3%
	Diabetes care: LDL-C control <100 mg/dL	48.1%	53.1%	5.0%[c]	3.1-6.7	10.4%
	Diabetes care: nephropathy monitoring	75.7%	79.9%	4.2%[c]	2.4-6.4	5.5%
	Cervical cancer screening (all ages)	71.9%	71.1%	–0.8%	–1.7 to 0.1	–1.1%
	Chlamydia screening (ages 16-20)	61.7%	60.7%	–1.0%	–7.2 to 4.8	–1.6%
	Meningococcal immunization (adolescents)	77.9%	69.0%	–8.9%[c]	–12.2 to –4.2	–11.4%

A1C indicates glycated hemoglobin; CI, confidence interval; FTE, full-time equivalent; LDL-C, low-density lipoprotein cholesterol; tRVU, total relative value unit; wRVU, work-relative value unit.
[a]All metrics analyzed at the provider level, except for operating expenses (department level).
[b]Shown in percentage points. For each metric, this is the mean (across all departments) of all differences between projected and observed values.
[c]$P < .05$.
[d]Dollar values are restated as percentages; statistical inferences on dollar amounts are omitted for confidentiality.
[e]Averaged across all domains.
[f]Quality metrics are shown for all univariate results that were statistically significant.

increased markedly by 48.4%. Patient satisfaction with the handling of personal issues regarding safety, privacy, and exam room cleanliness also improved by nearly 8%; however, patient satisfaction with interactions with care providers decreased by approximately 11.6%.

A range of clinical quality metrics were examined to determine whether changes, particularly in efficiency or productivity, adversely affected quality of care. Univariate analyses were first conducted on a range of pay-for-performance metrics, as noted previously, with significant differences initially found in metrics involving coordinated diabetes care, cervical cancer screening, chlamydia screening, and meningococcal immunization among adolescents. After adjusting for potential confounders, statistically significant differences were observed only among diabetes care metrics, where glucose and cholesterol control and rates of nephropathy screening all increased anywhere from 3.4% to 5%. Meningococcal vaccination among adolescents decreased.

Staff and Physician Satisfaction

There is a yearly survey of all clinical and nonclinical nonphysician staff members to assess their experience of work. As these data were provided on an annual basis and only in aggregate across the organization, a counterfactual was not generated for these results (shown in the eAppendix). Overall staff satisfaction in all primary care clinics, as measured by the composite score, increased between surveys conducted at baseline and after Lean was implemented. Across specific domains, nearly all dimensions of primary care staff satisfaction improved, with the largest being in credible leadership, followed by the domains of employee engagement, connection to purpose, growth and development, healthy partnerships, and empowerment and autonomy. All domains, except for pay and benefits, showed improvements following implementation of Lean redesigns.

Physician satisfaction data were available by clinic location, allowing more detailed assessments based on the clinic's phase

TABLE 2. Physician Satisfaction Results (by phase of Lean implementation)

	Implementation Phase (time since completion of Lean redesigns)								
	Pilot Clinic (25 months)			Beta Clinics (13-15 months)			All Remaining Clinics (4-11 months)		
Domain	2011	2014	% Diff	2011	2014	% Diff	2011	2014	% Diff
Leadership and communication	2.96	3.22	9%	3.52	3.43	–3%	3.35	3.28	–2%
Quality of care	4.43	4.30	–3%	4.46	4.59	3%	4.42	4.48	1%
Time spent working	3.54	3.64	3%	3.66	3.80	4%	3.73	3.67	–2%
Patient interaction	4.15	4.05	–2%	4.36	4.38	0%	4.24	4.15	–2%
Administrators	3.10	3.36	8%	3.43	3.27	–5%	3.37	3.41	1%
Compensation	3.44	3.66	6%	3.43	3.50	2%	3.61	3.31	–8%
Relationship with staff	4.03	4.06	1%	4.03	4.26	6%	4.06	4.05	0%
Resources available	3.85	3.82	–1%	3.75	3.93	5%	3.85	3.81	–1%
Acceptance by colleagues	4.19	4.09	–2%	4.21	4.27	1%	4.13	4.20	2%
Paperwork	3.34	3.30	–1%	3.22	3.31	3%	3.32	3.19	–4%
Computers	4.53	4.48	–1%	4.49	4.56	2%	4.48	4.52	1%
Preauthorization process	3.72	2.88	–23%	3.63	3.59	–1%	3.70	3.52	–5%
Overall satisfaction	3.99	4.08	2%	4.13	4.20	2%	4.20	4.04	–4%

Diff indicates difference.

of Lean implementation (Table 2). When examined in aggregate, ignoring phase, physician satisfaction scores remained virtually unchanged. However, overall physician satisfaction in the pilot and beta clinics increased by approximately 2%, but decreased by nearly 4% in the last clinics to implement Lean redesigns. Physicians in the pilot phase reported improved satisfaction in areas targeted by Lean, including leadership and communication, perception of administrators, time spent working, and relationships with staff members. Physicians in the beta clinics did not report improved perceptions of leadership or administrators, but reported improved relationships with staff, available resources, time spent working, and quality of care. Physicians in the remaining clinics displayed smaller changes in Lean-targeted areas, with slight decreases in satisfaction with leadership and communication and time spent working, as well as slight increases in perceptions of administration and quality of care. A summary of all study results is displayed in Table 3.

DISCUSSION

Process Changes Underlying Improvements in Efficiency, Productivity, and Patient Satisfaction

Using a stepped wedge design, we assessed the changes associated with the phased introduction of Lean redesigns in 17 primary care clinics at a nonprofit, ambulatory care delivery system. Study findings are consistent with the intent of changes that were implemented as part of the organizational initiative. Although Lean was initiated with strong support from executive leadership, the Lean approach is to solicit extensive input from frontline physicians and staff to identify wasted resources, including excessive time spent by staff and physicians in delivering patient care. In this organization, the Lean approach led to a focus on creating new workflows and reassigning tasks among all care team members. Chief among these changes was a new role for medical assistants who, as "flow managers," maintained a constant flow of work by directly addressing tasks they were trained to handle and preparing all other patient care items for the physician to address. Such changes aimed to create a just-in-time approach to workflow, including real-time completion of visit documentation and avoidance of work task "batching."

These workflow changes resulted in tangible improvements among the examined metrics on efficiency and may have also increased productivity as measured by physician wRVUs generated per month. Physician compensation was largely based on wRVUs throughout the study period (ie, the financial incentive for productivity was always present), so workflow efficiencies likely facilitated physicians' abilities to accommodate more patients into their clinic schedules. The finding of increased efficiency and productivity is consistent with previous reports in other settings where the "system" was capacity constrained. For example, Lean intervention in emergency departments led to increases in physician wRVUs and improved workflow, as measured by reduced patient wait times and the proportion of patients leaving without being seen.[20,21]

TABLE 3. Summary of Findings

Topic	Conclusions
Workflow efficiency	Increase in timeliness of completing 3 of 4 patient encounter measures: office visit chart closures, medication renewals, and telephone responses.
Physician productivity	Higher wRVUs generated per physician per month. No change in wRVUs per office visit.
Operating expenses	Lower total operating expenses (including staff compensation, drugs, and supply costs) standardized per tRVU.
Clinical quality	Improvements in coordinated diabetes care metrics, no change in preventive screening metrics, and decreased meningococcal immunization among adolescents.
Patient satisfaction	Higher satisfaction overall and in specific domains, including access to care and handling of personal issues. Lower satisfaction with interactions with care providers.
Staff satisfaction	Higher satisfaction overall and in specific domains, including credible leadership, employee engagement, growth and development, connection to purpose, healthy partnerships, empowerment, and autonomy.
Physician satisfaction	In pilot and beta clinics, higher satisfaction overall and in specific domains, including time spent working and relationships with staff. Lower satisfaction overall among all remaining clinics (final implementation phase).

tRVU indicates total relative value unit; wRVU, work relative value unit.

Observations in Other Areas: Clinical Quality, Staff and Physician Satisfaction

Clinical quality improvements were observed in measures of diabetes care, likely reflecting specific Lean redesigns (eg, co-location, shared workflows) that aimed to improve communication and coordination between care teams. The quality improvement literature frequently cites enhanced communication between care team members, use of multidisciplinary teams or nonphysician staff, and expansion or revision of professional roles as the greatest facilitators for improving diabetes outcomes relative to other strategies.[22-25] The only quality area in which a decline occurred was adolescent immunization for *meningococcus*. However, this decline was likely related to changes in immunization guidelines that coincided with the study period. Beginning in 2011, new clinical guidelines recommend a meningococcal booster between ages 16 and 18 years following the initial injection originally given once to 11- to 12-year-old adolescents.[26] Thus, over time, the criteria for completing these immunizations have become more stringent and potentially more difficult to achieve.

We observed significantly higher patient satisfaction in the domains of access to care, handling of personal issues, and overall satisfaction. Improvements in perceived access aligned with our objective findings on workflow efficiencies. Patient satisfaction with the handling of personal issues, which included the cleanliness of the practice, protection of patient safety and privacy, and sensitivity to patient needs, reflected Lean standardization activities that focused on the proper ordering and maintaining of patient exam rooms and all spaces where patient care is provided. However, patients reported lower satisfaction with their interactions with care providers. This domain consisted of survey items assessing the perceived concern for patient questions or worries; explanation of medical problems, medications, and follow-up care; and time spent with the patient.

Decreases in patient satisfaction in this domain may be related to the same work design factors that enabled provider efficiency, such as just-in-time workflows, which encourage physicians to move more quickly through each patient visit. Using medical assistants to offload physician work also impacts the patient-physician relationship and may result in less satisfying interactions. For example, with the new practice of "agenda setting" to streamline visits, patients are asked by the MA to identify priority concerns, with less urgent matters to be addressed at a future scheduled appointment. This procedure substitutes MA for physician time, implicitly places limits on the current office visit, and depends substantially on the skill of the MA in negotiating patient concerns. Patients may perceive that this agenda setting by the MA renders their care impersonal and unresponsive to the full range of their concerns.

The greatest improvements in nonphysician primary care staff satisfaction occurred in perceptions of credible leadership, employee engagement, growth and development, connection to purpose, empowerment and autonomy, and overall staff satisfaction. This pattern is consistent with studies of Lean in hospital settings, which show positive effects on workforce satisfaction and highlight the benefits of increased participation of frontline staff in designing and implementing standard workflows.[20,27-35] By participating in redesign efforts, staff members gain a better understanding of daily work processes relevant to both themselves and others and the rationale for needed changes and improvements. Ideally, employees become problem solvers rather than passive recipients of operational mandates, a role change that can be both empowering and rewarding.[34,36]

Satisfaction increases among physicians in clinics that implemented Lean during the first 2 phases, coupled with the decrease in satisfaction among physicians in the final phase of implementation, warrant further investigation. When the post-Lean physician satisfaction survey was administered, the pilot and beta clinics had accumulated 1 to 2 years of experience with Lean redesigns, whereas the remaining clinics had launched their redesigns as recently as 4 months prior to being surveyed. It is possible the decline in satisfaction among the physicians in this last phase reflected a period of transition and adjustment. Some disruption

and discomfort accompanied all clinics' early months of implementation, including spatial redesigns that required physicians to relinquish their offices and relocate next to their MA care team partner, as well as new workflows that called for management or delegation of tasks to nonphysicians. Benefits from such changes may only become apparent after several months of adjustment and experimentation.

Another explanation involves differences in physician engagement with Lean implementation. Those in the last phase of clinics were much less involved with actual planning and development of Lean redesigns.[37] Active involvement in identifying sources of waste and redesigning workflows—a hallmark of the Lean improvement approach—may be gratifying in itself. Research on participative decision processes and the use of participation in change management suggests that such direct engagement leads to greater commitment to new work initiatives.[38] It may, therefore, be that the process of developing a Lean workflow is as important for its acceptance as the content of that workflow itself.

Suggestions for Further Research

The observed variations in physician and patient satisfaction point to areas for further research. First, data from longer post-Lean time periods than those reported here are needed to assess more complete effects of Lean in all clinics and whether reactions to the Lean redesigns remained stable over time.[39] Second, by combining our findings with qualitative data or more fine-grained quantitative data, we can examine specific physician- and patient-level perceptions underlying their responses to the closed-ended satisfaction questions reported here. Third, availability of nonphysician satisfaction data at the clinic level would allow comparison of primary care staff satisfaction results across implementation phases (ie, pilot, beta, all remaining clinics). Last, a logic or program model identifying the steps and underlying organizational and social psychological mechanisms would help specify important stages of the Lean initiative—such as staff and leadership participation in workflow redesign, management communication of expected practice changes, practice-level coaching, and staff implementation of redesigns—at which quality, efficiency, and satisfaction outcomes could then be assessed.[40] Such a model could be used as a guiding framework for an in-depth process evaluation of the intermediate results at each step of the change process.[41]

CONCLUSIONS

Organizations ranging from private hospitals and physician practices to government health systems and agencies, including the Veterans Health Administration and CMS, are now implementing Lean to improve efficiency and value. Despite its growing popularity, few studies have addressed the concerns of healthcare leaders and practitioners, including whether Lean can help delivery systems identify waste and redesign care processes to enhance multiple performance outcomes simultaneously—particularly in FFS ambulatory settings where the vast majority of healthcare is delivered. Moreover, questions remain as to whether productivity gains achieved through Lean will undermine quality and worsen already high levels of discontent among primary care providers. Our findings indicate that an ambulatory care system can develop and scale Lean redesigns with largely beneficial consequences. These results may lead other delivery system leaders to innovate using Lean management techniques, and, if the findings replicate in other systems, they may further enhance support for Lean learning among public and private payers. Additionally, our study underscores the need for careful analysis of both desired effects and the potential unintended consequences of implementing Lean to improve value in healthcare. ■

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eAppendix

Integrated Healthcare Association Pay-for-Performance Clinical Quality Metrics
Prevention

1. Colorectal Cancer Screening
2. Breast Cancer Screening—Ages 50-69
3. Evidence-based Cervical Cancer Screening of Average Risk, Asymptomatic Women – Appropriately screened all ages
4. Chlamydia Screening – Women Ages 16-24
5. Meningococcal Immunization – Adolescents
6. Immunizations – Tdap/Td
7. HPV Vaccination for Female Adolescents

Cardiovascular

8. Annual Monitoring for Patients on Persistent Medications—ACEI/ARB, Digoxin, and Diuretics
9. Cholesterol Management—LDL Screening
10. Cholesterol Management—LDL Control <100
11. Proportion of Days Covered by Medications—ACEI/ARB
12. Proportion of Days Covered by Medications—Statins

Diabetes

13. HbA1c Testing
14. HbA1c Poor Control >9.0%
15. Blood Pressure Control <140/90 mm Hg
16. HbA1c Control <8.0%
17. HbA1c Control <7.0% for a Selected Population
18. LDL Screening
19. Optimal Diabetes Care Combination 1—LDL<100, HbA1c <8.0%, Nephropathy Monitoring
20. LDL-c Control <100 mg/dL
21. Nephropathy Monitoring
22. Proportion of Days Covered by Medications—Oral Diabetes Medications

Musculoskeletal

23. Use of Imaging Studies for Low Back Pain

Respiratory

25. Appropriate Treatment for Children with Upper Respiratory Infection
26. Asthma Medication Ratio—Ages 5-64
27. Appropriate Testing for Children with Pharyngitis
28. Avoidance of Antibiotic Treatment of Adults with Acute Bronchitis

Staff and Physician Satisfaction Results (aggregated across organization)

Metric	Domain	2011	2014	% Diff.
Staff Satisfaction	**Composite Score**	**77%**	**80%**	**3%**
	Credible Leadership	71%	76%	5%
	Employee Engagement	75%	79%	4%
	Connection to Purpose	76%	80%	4%
	Growth & Development	67%	71%	4%
	Healthy Partnerships	73%	77%	4%
	Empowerment & Autonomy	74%	78%	4%
	Experience of Work Index	77%	80%	3%
	Respect & Recognition	76%	79%	3%
	Employee Enablement	78%	81%	3%
	Work, Structure & Process	72%	75%	3%
	Quality & Customer Focus	89%	91%	2%
	Accountability & Alignment	85%	87%	2%
	Resources	76%	78%	2%
	Training	69%	71%	2%
	Pay & Benefits	71%	70%	-1%
Physician Satisfaction	**Overall Satisfaction**	**4.14**	**4.11**	**0.6%**
	Relationship with Staff	4.04	4.14	2%
	Quality of Care	4.44	4.51	2%
	Resources Available	3.81	3.86	1%
	Time Spent Working	3.67	3.72	1%
	Acceptance by Colleagues	4.18	4.21	1%
	Computers	4.49	4.53	1%
	Administrators	3.35	3.35	0%
	Leadership and Communication	3.35	3.33	-1%
	Patient Interaction	4.27	4.24	-1%
	Paper Work	3.29	3.26	-1%
	Compensation	3.51	3.44	-2%
	Preauthorization Process	3.68	3.46	-6%