



A Lean Methodology-Based Intervention to Reduce Patient Waiting Time in a Urology Outpatient Department.

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Abstract

Background: Long waiting times in outpatient departments adversely affect patient satisfaction and healthcare service efficiency. Lean methodology focuses on identifying and eliminating non-value-adding activities to improve workflow and patient experience. This study evaluated the impact of a Lean-based intervention on outpatient waiting time and patient satisfaction in a tertiary care urology outpatient department. **METHODS:** A quality improvement interventional study was conducted in the Urology Outpatient Department of Karpagam Faculty of Medical Sciences and Research, Coimbatore, from December 1 to December 29, 2025. Sixty patients were enrolled and divided equally into pre-intervention (n=30) and post-intervention (n=30) phases. Value Stream Mapping (VSM) was used to identify value-adding and non-value-adding activities in the patient flow process. In the pre-intervention phase, waiting time included registration, billing, and vital-sign assessment. The billing process was identified as a non-value-adding activity and was shifted to the post-consultation period during the intervention phase. Outpatient waiting times were measured using a stopwatch, and patient satisfaction was assessed using a 5-point Likert scale questionnaire. Statistical analyses included Welch's independent t-test and Mann-Whitney U test. **RESULTS:** The mean outpatient waiting time significantly decreased from 13.77 ± 4.13 minutes before intervention to 4.33 ± 1.56 minutes after intervention, representing a 68.5% reduction ($p < 0.001$). Patient satisfaction scores improved significantly from 3.13 ± 1.36 to 4.43 ± 0.77 , reflecting a 41.5% increase ($p < 0.001$). Large effect sizes were observed for both waiting time reduction (Cohen's $d = 3.02$) and patient satisfaction improvement (Cohen's $d = 1.18$). **CONCLUSION:** Implementation of Lean methodology through Value Stream Mapping effectively reduced outpatient waiting time and significantly improved patient satisfaction in a urology outpatient setting. The intervention was simple, cost-effective, and feasible, highlighting the potential for broader application in other outpatient departments to enhance operational efficiency and patient-centered care.

Keywords: Lean Methodology, Value Stream Mapping, Outpatient Waiting Time, Patient Satisfaction, Quality Improvement, Urology Outpatient Department, Healthcare Management.

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INTRODUCTION

Improving the quality of healthcare services has become a major priority for healthcare organizations worldwide. One of the most important determinants of patient satisfaction in outpatient settings is the waiting time experienced before consultation. Prolonged waiting times not only contribute to patient dissatisfaction but also adversely affect operational efficiency, healthcare utilization, and the overall perception of quality of care.[1]

Lean methodology is a quality improvement approach that originated from the Toyota Production System and focuses on maximizing value while eliminating waste from processes.[2] Lean principles emphasize identifying activities that add value from the customer's perspective and removing non-value-adding steps that contribute to delays, inefficiencies, and unnecessary resource utilization.[3] The five core principles of Lean include identifying value, mapping the value stream, creating continuous flow, establishing pull, and pursuing perfection through continuous improvement.[2,4]

In healthcare, Lean methodology has increasingly been adopted to streamline clinical workflows, reduce waiting times, improve patient flow, and enhance patient satisfaction. [5] Value Stream Mapping (VSM), one of the key Lean tools, enables visualization of the entire patient journey and facilitates the identification of bottlenecks and wasteful activities within healthcare processes.[4,5] Several studies have demonstrated the effectiveness of Lean interventions in improving operational performance in outpatient and specialty care settings.[6]

Within urology outpatient departments, delays may arise from registration procedures, billing processes, queue management, and consultation sequencing. Such delays can be particularly problematic because many urology patients present with painful or distressing symptoms requiring timely evaluation and management. [7] Previous studies have shown that Lean-based interventions in urology clinics can significantly reduce patient cycle times, waiting times, and process inefficiencies while improving the overall patient experience.[7,8]

Despite growing evidence supporting Lean implementation in healthcare, studies specifically evaluating Lean interventions in urology outpatient departments remain limited. Furthermore, there is a need for practical, low-cost quality improvement strategies that can be implemented in resource-constrained healthcare settings.

Aims and Objectives

The aim of this study was to evaluate the effectiveness of a Lean methodology-based intervention in reducing patient waiting time and improving patient satisfaction in the Urology Outpatient Department of a tertiary care teaching hospital. The specific objectives were to map the existing patient flow process from registration to consultation using Value Stream Mapping (VSM), identify value-adding and non-value-adding activities within the workflow, implement a Lean-based intervention by eliminating identified sources of waste and process inefficiencies, assess the impact of the intervention on outpatient waiting time, and compare patient satisfaction scores before and after the implementation of Lean principles.

MATERIALS AND METHODS

Study Design

This quality improvement interventional study was conducted in the Urology Outpatient Department of Karpagam Faculty of Medical Sciences and Research, Coimbatore, using Lean methodology. The study was carried out in the outpatient clinic of a full-time consultant to ensure uniformity of workflow, as the second consultant had variable part-time outpatient schedules. A total of 60 outpatient observations were included, comprising 30 patients in the pre-intervention phase and 30 patients in the post-intervention phase. Owing to the practical constraints of the outpatient setting, individual patient pairing was not feasible; therefore, the pre- and post-intervention groups were analysed as independent samples.

Inclusion and Exclusion Criteria

All patients attending the Urology Outpatient Department during the study period and presenting for consultation during the designated outpatient working hours were included in the study. Patients arriving consecutively during routine outpatient services were enrolled irrespective of age, sex, or diagnosis, and were observed from registration until consultation for assessment of waiting time and patient satisfaction. Patients who attended the outpatient department during lunch breaks, coffee breaks, or periods when the consultant was engaged in inpatient referral visits were excluded from the study. Additionally, patients presenting on Operation Theatre (OT) days were excluded to avoid distortion of waiting time measurements due to altered outpatient workflow and reduced consultation availability. Only patients who completed the entire outpatient process and satisfaction assessment were considered for final analysis.

Data Collection Procedure

A total of 60 patients attending the Urology Outpatient Department were enrolled consecutively, with 30 patients each in the pre-lean and post-lean intervention phases conducted over 8 days each. In the pre-intervention phase, the time taken for each step of the outpatient process, including registration, billing, vital recording, and consultation, was measured using a stopwatch and recorded in minutes. Value Stream Mapping (VSM) was used to classify activities as value-adding or non-value-adding, and total outpatient waiting time was calculated accordingly. Following consultation, patient satisfaction regarding waiting time was assessed using a Tamil-language 5-point Likert scale questionnaire. In the post-intervention phase, the billing step was shifted to after consultation, and the time taken for registration, vital recording, and consultation was similarly recorded. Total outpatient waiting time and patient satisfaction scores were compared between the pre- and post-intervention phases. For patients waiting while another patient was being consulted, net waiting time was calculated by subtracting the previous patient's consultation time from the observed waiting time.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using appropriate statistical methods. Continuous variables, including outpatient waiting times, were summarized using mean, standard deviation (SD), median, and interquartile range (IQR), while patient satisfaction scores were expressed as mean $\pm$ SD. Since the pre- and post-intervention groups consisted of

different patients, they were analyzed as independent samples. Differences in outpatient waiting times between the pre- and post-lean intervention phases were assessed using Welch's independent t-test, and the Mann–Whitney U test was used as a non-parametric alternative to confirm the findings. Patient satisfaction scores, measured using a 5-point Likert scale, were primarily compared using the Mann–Whitney U test, with Welch's independent t-test performed additionally for completeness. Effect sizes were calculated using Cohen's d and Hedges' g to determine the magnitude of the intervention effect. A p-value of less than 0.05 was considered statistically significant, and 95% confidence intervals were reported where applicable.

RESULTS

Table 1. Baseline Characteristics of Study Phases

Study Phase	Sample Size (n)	Duration	Intervention
Phase 1 (Pre-Lean)	30	8 working days	Existing workflow with billing before consultation
Phase 2 (Post-Lean)	30	8 working days	Billing shifted after consultation (Lean intervention)
Total	60	16 working days	Value Stream Mapping-based process redesign

Table 1 illustrates the overall study design. A total of 60 outpatient observations were included, with equal numbers of patients in the pre-intervention and post-intervention phases.

Table 2. Comparison of Registration and Vital Measurement Times

Parameter	Pre-Lean Mean ± SD (min)	Post-Lean Mean ± SD (min)	Difference
Registration Time	3.00 ± 1.26	2.00 ± 1.26	↓ 1.00 min
Vital Recording Time	3.20 ± 1.52	2.33 ± 0.55	↓ 0.87 min

Table 2 shows that both registration and vital measurement times decreased following Lean implementation, indicating improved workflow efficiency and standardization.

Table 3. Billing Process Analysis (Pre-Lean Phase)

Parameter	Value
Mean Billing Time (min)	7.57
Standard Deviation	3.59
Minimum Time (min)	3
Maximum Time (min)	18

Table 3 demonstrates that the billing process was the major non-value-adding activity in the patient pathway. Patients spent an average of 7.57 minutes waiting in the billing section, making it the primary bottleneck identified through Value Stream Mapping.

Table 4. Total Outpatient Waiting Time Before and After Lean Intervention

Parameter	Pre-Lean	Post-Lean
Mean (min)	13.77	4.33
Standard Deviation	4.13	1.56
Median (min)	13.0	4.0
IQR	11.0–16.75	3.0–5.0
Minimum (min)	8	3
Maximum (min)	26	8
Absolute Reduction	-	9.43 min
Percentage Reduction	-	68.52%

Table 4 highlights the principal outcome of the study. Lean implementation reduced average outpatient waiting time by 9.43 minutes, representing a substantial 68.5% reduction.

Table 5. Patient Satisfaction Scores Before and After Lean Intervention

Parameter	Pre-Lean	Post-Lean
Mean Score	3.13	4.43
Standard Deviation	1.36	0.77
Median	4.0	5.0
IQR	2.25–4.0	4.0–5.0
Absolute Improvement	-	+1.30
Percentage Improvement	-	41.5%

Table 5 indicates a marked improvement in patient satisfaction following the intervention. The increase in mean satisfaction score from 3.13 to 4.43 suggests a considerably better patient experience.

Table 6. Consultation Time Comparison

Parameter	Pre-Lean	Post-Lean
Mean (min)	12.60	11.83
Standard Deviation	4.60	0.91
Minimum (min)	4	3
Maximum (min)	23	27

Table 6 observes that consultation time remained relatively stable before and after intervention, suggesting that improvements in waiting time were achieved without reducing physician consultation duration.

Table 7. Value-Added Time Comparison

Parameter	Pre-Lean	Post-Lean
Mean (min)	18.77	16.17
Standard Deviation	4.44	5.28
Minimum (min)	9	6
Maximum (min)	27	32

Table 7 illustrates that the time spent on value-adding clinical activities remained largely preserved, while non-value-adding activities were reduced. This aligns with the fundamental objective of Lean methodology.

Table 8. Effect Size of Lean Intervention

Outcome	Statistical Test	Test Statistic	p-value	Effect Size
Waiting Time	Welch's t-test	t = 11.70	<0.001	Cohen's d = 3.02
Waiting Time	Mann-Whitney U	U = 898	<0.001	Hedges' g = 2.98
Satisfaction Score	Mann-Whitney U	U = 719	<0.001	Cohen's d = 1.18
Satisfaction Score	Welch's t-test	t = 4.56	<0.001	Hedges' g = 1.16

Table 8 confirms that the observed reductions in waiting time and improvements in patient satisfaction were statistically highly significant ($p < 0.001$) and demonstrated large effect sizes, indicating strong practical and clinical relevance.

DISCUSSION

The present study evaluated the effectiveness of a Lean methodology-based intervention using Value Stream Mapping (VSM) in a tertiary care urology outpatient department. Following implementation, the mean outpatient waiting time decreased significantly from 13.77 ± 4.13 minutes to 4.33 ± 1.56 minutes, representing a 68.5% reduction, while the mean patient satisfaction score improved from 3.13 ± 1.36 to 4.43 ± 0.77 , corresponding to a 41.5% increase. These findings demonstrate that Lean-based process redesign can substantially improve operational efficiency and patient experience in specialty outpatient services.

The findings of the present study are consistent with the principles of Lean healthcare described by Ojo et al[6] who emphasized that identifying and eliminating non-value-adding activities is central to healthcare quality improvement. Similarly, Moraros et al[5] in their systematic review concluded that Lean interventions are generally associated with improvements in workflow efficiency, process outcomes, and patient satisfaction. In the present study, Value Stream Mapping identified the billing process as the major source of delay, accounting for an average of 7.57 minutes of waiting time. By shifting this activity to the post-consultation period, a significant reduction in waiting time was achieved without requiring additional resources.

Among urology-specific studies, Skeldon et al[7] reported significant reductions in patient cycle time and time to initial assessment after implementing Lean methodology in an academic uro-oncology clinic. Likewise, White et al[8] observed a 63% reduction in initial waiting time and a 48% reduction in process rework following Lean interventions in an outpatient urology clinic. The 68.5% reduction in waiting time observed in the present study is slightly greater than that reported by White et al., indicating that targeted elimination of a major bottleneck can yield substantial improvements in patient flow. Boronat et al[9] demonstrated that Lean Healthcare implementation in a tertiary care urology department resulted in sustained improvements in efficiency indicators, quality measures, and practitioner satisfaction over a four-year period. Although their study assessed broader departmental performance, the findings support the conclusion that Lean principles can be successfully applied to urological healthcare services. Similarly, Waiman et al[10] in a systematic review of Lean Six Sigma interventions reported reductions in outpatient waiting time ranging from 5.2% to 97%, with most studies demonstrating concurrent improvements in patient satisfaction and operational efficiency. The 68.5% reduction observed in the present study falls well within this reported range.

Recent literature continues to support the effectiveness of Lean methodologies in healthcare. Talero-Sarmiento et al[11] in a comprehensive review of Lean healthcare applications, concluded that Lean interventions consistently improve operational performance, reduce process waste, and enhance patient-centred outcomes. Furthermore, Waiman et al. [10] conducted a systematic review of Lean Six Sigma interventions and reported reductions in outpatient waiting times ranging from 5.2% to 97%, with most studies demonstrating concurrent improvements in service efficiency and patient satisfaction. The 68.5% reduction achieved in the present study falls well within this reported range and compares favourably with outcomes reported from larger healthcare organizations.

More recently, Wang et al[12] reported in a systematic review of Lean implementation in hospitals that waiting-time reductions generally ranged from approximately 53.8% to 60% following Lean interventions. The greater reduction observed in the present study may be attributable to the clear identification and removal of a single high-impact non-value-adding activity through Value Stream Mapping. This finding highlights the effectiveness of focused, low-cost interventions in improving healthcare delivery.

The improvement in patient satisfaction observed in the present study is also consistent with the findings of Rotter et al[1] whose Cochrane review demonstrated that Lean management strategies can positively influence patient outcomes and healthcare delivery processes. The large effect sizes observed for both waiting time reduction (Cohen's $d = 3.02$) and patient satisfaction improvement (Cohen's $d = 1.18$) indicate that the intervention was not only statistically significant but also operationally meaningful.

Limitations

This study had certain limitations. It was conducted over a short duration of four weeks with a relatively small sample size of 60 patients, which may limit the generalizability of the findings. Patient satisfaction was assessed immediately after consultation, introducing the possibility of response bias, as ratings may have been influenced by both waiting time and the quality of the consultation. Operational changes implemented during the Lean intervention phase, particularly the deferred payment process, required close administrative monitoring and may have influenced workflow outcomes. Additionally, because different patient groups were evaluated before and after the intervention, only an independent t-test could be performed, limiting the ability to assess paired individual-level changes.

CONCLUSION

The implementation of Lean methodology in the Urology Outpatient Department resulted in a significant reduction in patient waiting time and a marked improvement in patient satisfaction, demonstrating its effectiveness in optimizing outpatient workflow and enhancing service quality. By systematically identifying and eliminating non-value-added activities, Lean interventions promoted a more patient-centred approach to care delivery. These findings support the adoption of Lean principles in other outpatient settings to improve operational efficiency and patient experience, while emphasizing the importance of sustained leadership support and staff engagement for long-term success.

REFERENCES

1. Rotter T, Plishka CT, Adegboyega L, et al. Lean management in health care: effects on patient outcomes, professional practice, and healthcare systems. *Cochrane Database Syst Rev* 2017;11:CD012831.
2. Shook J, Marchwinski C. Lean enterprise institute I. lean lexicon: a graphical glossary for lean thinkers. Lean Enterprise Institute Inc 2014.
3. Breyfogle FW. Lean tools that improve processes: an overview. *BPTrends* 2007.
4. Womack JP, Jones DT. Lean thinking-banish waste and create wealth in your corporation. *Journal of the Operational Research Society* 1997;48(11):1148

5. Moraros J, Lemstra M, Nwankwo C. Lean interventions in healthcare: do they actually work? A systematic literature review. *Int J Qual Health Care* 2016;28(2):150-65.
6. Ojo B, Feldman R, Rampersad S. Lean methodology in quality improvement. *Pediatr Anaesth* 2022;32(11):1209-15.
7. Skeldon SC, Simmons A, Hersey K, et al. Lean methodology improves efficiency in outpatient academic uro-oncology clinics. *Urology* 2014;83(5):992-8.
8. White H, Bowling C, Harris AM. Use of Lean Methodologies in Outpatient Urology Clinic. *Urology Practice* 2021;8(6):649-56.
9. Boronat F, Budia A, Broseta E, et al. Application of Lean Healthcare methodology in a urology department of a tertiary hospital as a tool for improving efficiency. *Actas Urol Esp* 2018;42(1):42-8.
10. Waiman E, Achadi A, Agustina R. Reducing hospital outpatient waiting time using lean six sigma: a systematic review. *Indonesian Journal of Health Administration* 2023;11(1):154-66.
11. Talero-Sarmiento LH, Escobar-Rodríguez LY, Gomez-Avila FL, et al. A literature review on lean healthcare: implementation strategies, challenges, and future research directions. *Cogent Engineering* 2024;11(1):2411857.
12. Wang J, Lv H, Chen M, et al. A systematic review of Lean implementation in hospitals: Impact on efficiency, quality, cost, and satisfaction. *International Journal of Health Policy and Management* 2025;14:8974.