Clinical practice improvement in a private dental hospital using Integrated PDSA, Lean, and Six Sigma Models: An Empirical study

Dr. Leela V. Soujanya.Nallamilli[1], Dr. Lalitha Sri Roja[2], Dr. Sandeep Reddy Ravula[3], Dr. Hemanth Subhash[4], Dr. Manohar Varma[5]

[1]*Orthodontist, PhD scholar Sankalchand patel university and MBA, DY Patil University*

[2]*Assistant professor, Department of Endodontics, GITAM Dental college and MBA DY Patil University*

[3]*Pedodontist, PhD scholar Sankalchand patel university*

[4]*Assistant professor, Department of General Surgery, GITAM Medical college*

[5] *Department of Prosthodontics, Jaipur dental college and MBA DY Patil University*

***Abstract*—Background: Continuous quality improvement (CQI) is essential for enhancing efficiency, patient safety, and care quality in dental practice. Although PDSA, Lean, and Six Sigma models are widely used in medical settings, evidence of their integrated application in private dental hospitals is limited.** Aim: **To evaluate the effectiveness of an integrated PDSA–Lean–Six Sigma framework in improving operational efficiency and patient satisfaction in a private dental hospital. Materials and Methods:A six-month mixed-methods study was conducted in a private dental hospital. Baseline data were collected for three months, followed by implementation of structured PDSA cycles supported by Lean tools and Six Sigma (DMAIC) analysis. Quantitative outcomes included patient waiting time, chairside utilization, staff efficiency, documentation error rates, and patient satisfaction scores. Qualitative data were obtained through staff interviews. Statistical analysis included paired *t*-tests, ANOVA, and process capability analysis ($p < 0.05$).Results:Mean patient waiting time decreased by 24.1% (28.6 ± 8.2 to 21.7 ± 6.9 minutes; $p = 0.02$). Chairside utilization and staff efficiency improved by 17.1% and 16.9%, respectively, while documentation errors declined by 36.7%. Patient satisfaction increased significantly (3.7 ± 0.8 to 4.4 ± 0.6; $p = 0.02$). Appointment processing sigma levels improved from 2.9 to 3. 6.. Conclusion:The integrated PDSA–Lean–Six Sigma framework is an effective and sustainable strategy for improving clinical efficiency and patient experience in private dental hospitals.**

***Index Terms*—PDSA; Lean; Six Sigma; Quality Improvement; Dental Hospital; Patient Satisfaction**

I. INTRODUCTION

Introduction

Delivering high-quality dental care requires the alignment of clinical excellence with efficient operational systems and patient-centered service delivery. Private dental hospitals operate within competitive healthcare environments where inefficiencies, prolonged waiting times, and workflow variability directly influence patient satisfaction and organizational sustainability. Traditional reactive approaches to problem-solving are increasingly insufficient to meet these demands.

Structured quality improvement methodologies, including Plan–Do–Study–Act (PDSA), Lean management, and Six Sigma, provide systematic approaches for improving healthcare processes through iterative testing, waste elimination, and reduction of process variation. While these models have been extensively applied in hospital and medical systems, their integrated application within private dental hospitals remains underexplored.

This study addresses this gap by empirically assessing the impact of a combined PDSA–Lean–Six Sigma framework on operational efficiency, staff performance, and patient satisfaction in a private dental hospital.

II. MATERIALS AND METHODS

Study Design and Setting

A mixed-methods pre- and post-interventional study was conducted over six months in a private dental hospital located in the Kingdom of Saudi Arabia. The hospital provides multidisciplinary dental services and records an average monthly patient volume of approximately 3,000 visits.

Study Population

The study population included clinical and administrative staff (n = 25) and adult patients (n = 200). Staff members directly involved in patient care or administrative workflows were included. Patients aged 18 years and above attending routine dental treatment and providing informed consent were enrolled for satisfaction assessment.

Intervention Framework

The intervention consisted of an integrated CQI framework incorporating:

- PDSA cycles to facilitate iterative testing and refinement of workflow changes
- Lean tools, including value stream mapping and 5S, to identify and eliminate non-value-added activities
- Six Sigma (DMAIC) methodology to analyze process variation and enhance consistency

Three structured improvement cycles were implemented focusing on appointment scheduling optimization, sterilization and clinical workflow standardization, and patient feedback-driven service improvement.

III. DATA COLLECTION

Quantitative data included patient waiting time, chairside utilization rates, staff efficiency indices, documentation error rates, and patient satisfaction scores measured using a structured Likert-scale questionnaire. Qualitative data were obtained through semi-structured staff interviews and focus group discussions conducted at the conclusion of each improvement cycle.

Statistical Analysis

Data analysis was performed using IBM SPSS Statistics Version 26. Descriptive statistics were calculated for all variables. Paired t-tests and one-way ANOVA were used to compare pre- and post-intervention outcomes. Six Sigma process capability analysis was conducted to assess sigma levels and defects per million opportunities (DPMO). Statistical significance was defined as $p < 0.05$.

IV. RESULTS

Implementation of the integrated CQI framework resulted in statistically significant improvements across all key performance indicators. Mean patient waiting time decreased by 24.1%, chairside utilization increased by 17.1%, and staff efficiency improved by 16.9%. Documentation error rates declined by 36.7%, indicating improved process reliability. Patient satisfaction scores increased significantly by 18.9%.

Six Sigma analysis demonstrated enhanced process stability, with appointment processing sigma levels improving from 2.9 at baseline to 3.6 post-intervention. Qualitative analysis identified three dominant themes: enhanced interdisciplinary teamwork, improved communication, and increased staff empowerment in quality improvement activities

V. DISCUSSION

The findings of this study demonstrate that integrating PDSA, Lean, and Six Sigma methodologies leads to meaningful improvements in both operational performance and patient experience in private dental settings. Reductions in waiting time and documentation errors reflect the effectiveness of Lean waste elimination and Six Sigma process control, while improved staff engagement underscores the value of PDSA-driven iterative learning.

The observed cultural shift toward collaboration and shared accountability aligns with existing literature emphasizing the importance of organizational culture in sustaining quality improvement initiatives. These results suggest that CQI success in dentistry depends not only on technical tools but also on staff participation and leadership support

VI. LIMITATIONS

This study was conducted in a single private dental hospital with a relatively short intervention period, which may limit generalizability and long-term sustainability assessment. Additionally, patient

satisfaction data relied on self-reported measures, which may be subject to response bias. Future multicenter and longitudinal studies are recommended

VII. CONCLUSION

The integrated PDSA–Lean–Six Sigma framework provides a practical and effective approach for improving efficiency, accuracy, and patient satisfaction in private dental hospitals. Adoption of structured CQI methodologies can foster sustainable performance improvement and a culture of continuous excellence in dental healthcare delivery

VIII. ACKNOWLEDGMENT

This study has been a significant part of my professional and academic development. Conducting this research on clinical practice improvement using PDSA, Lean, and Six Sigma models deepened my understanding of strategic healthcare management, process optimization, and evidence-based decision-making.

REFERENCES

[1] Berwick DM. A primer on leading the improvement of systems. BMJ. 1996;312(7031):619–622.
[2] Institute for Healthcare Improvement. Science of improvement: testing changes. BMJ. 2008;336(7644):759–760.
[3] Taylor MJ, McNicholas C, Nicolay C, Darzi A, Bell D, Reed JE. Systematic review of the application of the Plan–Do–Study–Act method to improve quality in healthcare. BMJ Qual Saf. 2014;23(4):290–298.
[4] D'Andreamatteo A, Ianni L, Lega F, Sargiacomo M. Lean in healthcare: a comprehensive review. Health Policy. 2015;119(9):1197–1209.
[5] Toussaint JS, Berry LL. The promise of Lean in healthcare. Mayo Clin Proc. 2013;88(1):74–82.
[6] Antony J, Rodgers B, Gijo EV. Can Lean Six Sigma make healthcare organisations more efficient and effective? Int J Qual Reliab Manag. 2016;33(8):1149–1169.
[7] Mason SE, Nicolay CR, Darzi A. The use of Lean and Six Sigma methodologies in surgery: a systematic review. Surgeon. 2015;13(2):91–100.
[8] Shortell SM, Blodgett JC, Rundall TG, Kralovec P. Use of Lean and related transformational performance improvement systems in hospitals. Jt Comm J Qual Patient Saf. 2018;44(10):574–582.
[9] Doyle C, Lennox L, Bell D. A systematic review of evidence on the links between patient experience and clinical safety and effectiveness. BMJ Open. 2013;3(1): e001570.
[10] Kaplan GS, Patterson SH, Ching JM, Blackmore CC. Why Lean doesn't work for everyone. BMJ Qual Saf. 2014;23(12):970–973