Lean Management in Dentistry: Strategies for Reducing Waste and Increasing Productivity

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ABSTRACT

This study explores the application of lean management strategies in dental clinics. This qualitative study employed a descriptive-analytical approach using semi-structured interviews with 24 dental professionals from diverse countries. Participants were selected through online announcements, and data collection continued until theoretical saturation was reached. Interviews were conducted via video calls, recorded, and transcribed for analysis. Data were analyzed using thematic analysis with NVivo software, identifying key themes related to lean management in dentistry, including waste reduction, workflow optimization, and productivity enhancement. The results indicate that waste reduction strategies, such as minimizing material waste, eliminating redundant procedures, and optimizing inventory management, contribute to increased efficiency in dental clinics. Participants highlighted process optimization methods, including standardizing workflows, improving patient scheduling, and integrating automation, as crucial for reducing operational delays and enhancing service quality. Additionally, productivity enhancement was linked to effective time management, staff coordination, and performance monitoring, with digital tools and structured training programs playing a key role in facilitating lean adoption. The findings align with previous research demonstrating that lean management improves resource utilization, staff efficiency, and patient satisfaction in healthcare settings. Lean management strategies offer a structured approach to improving operational efficiency and patient care in dental clinics. By reducing waste, streamlining workflows, and enhancing staff productivity, lean methodologies contribute to cost savings, optimized resource allocation, and improved patient experiences. Successful implementation requires leadership commitment, ongoing staff training, and investment in digital technologies to sustain lean initiatives in dental practice.

Keywords: Lean management, dental efficiency, waste reduction, workflow optimization, productivity enhancement, healthcare management, process improvement.

Introduction

In the rapidly evolving field of healthcare, efficiency and patient-centered care have become focal points for improving service delivery and optimizing operational effectiveness. Dental healthcare, like other medical fields, faces growing challenges related to cost control, resource management, and service quality, necessitating innovative approaches to enhance productivity while reducing waste. Lean management, a methodology originating from manufacturing industries, has gained significant traction in healthcare settings due to its systematic approach to minimizing inefficiencies and maximizing value for patients [1-3]. As dental clinics strive to provide high-quality care while managing operational constraints, implementing lean principles can help streamline workflows, eliminate non-value-adding activities, and optimize resource utilization [4].

Lean management is based on five core principles: identifying value from the patient's perspective, mapping the value stream, creating efficient workflows, establishing a demand-driven pull system, and continuously improving processes [5]. These principles have been extensively applied in various healthcare domains, demonstrating their potential to improve

patient flow, enhance care coordination, and reduce operational bottlenecks (6). However, while lean methodologies have been successfully integrated into hospitals, emergency departments, and primary care settings, their implementation in dental healthcare remains relatively underexplored (7). Given that dental clinics must balance high patient turnover, complex treatment procedures, and stringent regulatory standards, lean management provides a structured framework to address these challenges and optimize service delivery (8).

A fundamental aspect of lean implementation in dentistry is waste reduction, which encompasses minimizing material waste, eliminating redundant procedures, and optimizing inventory management (9). Waste in dental clinics can take various forms, including excessive use of disposable materials, inefficient scheduling leading to prolonged patient wait times, and duplication of administrative processes that consume valuable time and resources (10). By identifying and addressing these inefficiencies, dental practices can not only reduce operational costs but also enhance patient satisfaction and improve overall clinic performance (11). Research has shown that healthcare facilities implementing lean strategies experience significant improvements in workflow efficiency, cost savings, and staff satisfaction, highlighting the relevance of these principles in dental healthcare (12).

One of the key strategies in lean dentistry is process optimization, which involves streamlining workflows, improving patient scheduling, and automating routine tasks to enhance operational efficiency (13). Dental clinics often struggle with delays caused by inefficient appointment management, unstructured treatment plans, and inconsistent communication between staff members (14). Implementing standardized procedures and utilizing digital tools can significantly reduce these inefficiencies, allowing clinics to handle a higher volume of patients while maintaining service quality (15). Additionally, leveraging technology, such as electronic health records (EHRs) and artificial intelligence-assisted scheduling, has been found to improve care coordination and reduce administrative burdens (16). Studies indicate that integrating automation and digital solutions in healthcare not only enhances productivity but also minimizes human errors and ensures better patient outcomes (17).

Another critical component of lean management in dentistry is enhancing staff productivity through effective team communication, staff training, and performance monitoring (3). Dental clinics operate as multidisciplinary environments where seamless coordination among dentists, hygienists, and administrative staff is crucial for efficient service delivery (18). Poor communication and unclear role definitions often lead to operational inefficiencies, patient dissatisfaction, and increased workload for healthcare professionals (19). Implementing structured team huddles, fostering a culture of continuous feedback, and investing in ongoing staff training programs can enhance workforce efficiency and promote a patient-centered approach to care (20). Research has highlighted that well-trained and engaged employees contribute to better service quality and improved patient experiences, reinforcing the importance of effective leadership and team management in lean dentistry (1).

The impact of lean management on patient care and satisfaction is also a significant area of consideration. Studies have demonstrated that lean principles improve patient experiences by reducing wait times, enhancing the efficiency of treatment processes, and ensuring timely access to care (21). In dental settings, long wait times and appointment delays are common issues that negatively affect patient satisfaction (22, 23). By implementing lean strategies such as appointment clustering, real-time scheduling adjustments, and workflow standardization, dental clinics can create a more streamlined patient experience, leading to higher levels of satisfaction and trust in dental services (24). Additionally, integrating lean methodologies into dental education and training programs has been suggested as a means to prepare future dental professionals for efficient practice management (25).

Despite its advantages, the implementation of lean management in dentistry is not without challenges. Resistance to change, lack of leadership commitment, and inadequate training on lean methodologies have been cited as significant barriers to successful adoption (26). Many dental clinics operate within traditional practice models that prioritize volume-based care over efficiency, making the transition to a lean system complex and requiring a cultural shift (27). Additionally, the effectiveness of lean management in dental settings depends on continuous improvement efforts,

necessitating a long-term commitment to refining processes and adopting innovative strategies (23). Addressing these challenges requires strong leadership, clear communication, and a willingness to adapt to new workflows and technologies (2).

In summary, lean management presents a promising approach for enhancing efficiency, reducing waste, and improving service quality in dental clinics. By focusing on waste reduction, process optimization, and productivity enhancement, dental healthcare providers can create more streamlined and patient-centered care environments (28). The adoption of lean principles not only benefits clinic operations but also contributes to higher patient satisfaction and better treatment outcomes (29). However, successful implementation requires commitment, ongoing training, and a structured approach to overcoming resistance to change (8). This study aims to explore how lean management strategies can be effectively integrated into dental practices to address inefficiencies, optimize workflows, and enhance overall productivity.

Methods and Materials

This qualitative study employed a descriptive-analytical approach to explore the application of lean management strategies in dentistry, with a particular focus on waste reduction and productivity enhancement. The study design was based on in-depth, semi-structured interviews with dental professionals from diverse geographical backgrounds. The participants were selected through online announcements and professional networks, ensuring a broad representation of perspectives. The inclusion criteria required participants to be practicing dentists or dental clinic managers with experience in implementing or observing efficiency-related practices in dental settings. The study adhered to ethical guidelines, ensuring informed consent and confidentiality. Theoretical saturation determined the final sample size, which was reached after interviewing 24 participants.

Data collection was conducted through semi-structured interviews, which were carried out via video calls to accommodate participants from different countries. The interviews focused on identifying common inefficiencies in dental practice, exploring strategies for waste reduction, and assessing the impact of lean management techniques on productivity. An interview guide was developed based on existing literature on lean management in healthcare, ensuring that key aspects such as workflow optimization, resource allocation, and patient experience were covered. Each interview lasted between 40 and 60 minutes and was recorded with participant consent for accuracy in data transcription.

Data analysis was performed using NVivo software to facilitate the organization and coding of qualitative data. A thematic analysis approach was applied, beginning with the transcription of all interviews, followed by an iterative coding process to identify recurring themes and patterns related to lean management in dentistry. Open coding was initially employed to generate broad categories, which were then refined into axial codes to establish relationships among emerging themes. To enhance the validity of the findings, intercoder reliability was ensured by having multiple researchers review the coded data. The final themes were derived based on theoretical saturation, indicating that no new insights emerged from subsequent interviews.

Findings

The study included 24 participants from a variety of professional and demographic backgrounds. Among them, 14 were male and 10 were female, with an average age of 42 years (ranging from 32 to 55). Professionally, the group comprised 15 dentists, 6 dental clinic managers, and 3 dental assistants. Participants were located in six different countries, including the United States, Canada, the United Kingdom, India, Australia, and South Africa. The majority of participants (17 out of 24) reported having more than 10 years of experience in their respective fields, while the remaining 7 had between 5 and 10 years of experience. This diverse demographic profile provided a broad range of insights into lean management practices in different cultural and professional contexts.

Table 1. The Results of Qualitative Analysis

Category	Subcategory	Concepts
Waste Reduction Strategies	Minimizing Material Waste	Bulk purchasing, proper storage, avoiding overuse, sustainable packaging, reusable instruments
	Reducing Redundant Procedures	Eliminating duplicate records, simplifying treatment plans, streamlining approval processes
	Optimizing Inventory Management	Real-time tracking, automated ordering, centralized supply chain, reducing expired stock
	Enhancing Digital Documentation	Cloud-based storage, digital patient records, voice-to-text documentation, AI-assisted notes
	Eco-Friendly Waste Disposal	Recycling protocols, biodegradable materials, waste segregation, energy-efficient disposal
	Reducing Chairside Time	Efficient workflow design, pre-appointment planning, optimized treatment sequences
Process Optimization	Standardizing Workflows	Standard operating procedures, task delegation, lean documentation, clinical checklists
	Efficient Patient Scheduling	Appointment clustering, reducing patient wait times, real-time scheduling adjustments
	Reducing Bottlenecks	Identifying workflow delays, optimizing task handoffs, streamlining referral systems
	Automation in Routine Tasks	AI-powered reminders, automated billing, digital diagnostics, self-check-in systems
	Improving Staff Coordination	Cross-functional training, clear role definitions, real-time staff coordination tools
Productivity Enhancement	Time Management Techniques	Task prioritization, efficient scheduling, reducing task switching, minimizing idle time
	Enhancing Team Communication	Regular team huddles, interdepartmental collaboration, feedback culture, structured meetings
	Leveraging Digital Tools	Digital task lists, cloud-based communication, remote coordination tools, AI-based scheduling
	Staff Training Programs	Continuous professional development, simulation-based training, peer mentoring, workflow drills
	Monitoring Performance Metrics	KPIs tracking, real-time dashboards, benchmarking best practices, performance analytics
	Reducing Non-Value-Adding Activities	Identifying redundant tasks, reducing paperwork, optimizing consultation time, automation
	Implementing Feedback Mechanisms	Patient satisfaction surveys, employee feedback loops, adaptive management strategies, real-time analytics

The findings of this study revealed three main themes regarding the implementation of lean management in dental practices: waste reduction strategies, process optimization, and productivity enhancement. Each theme was further divided into subthemes based on the analysis of interview data, illustrating key aspects of lean management strategies in dentistry.

One significant aspect of waste reduction strategies was minimizing material waste, where participants emphasized the importance of bulk purchasing and proper storage to reduce unnecessary expenditures. Several interviewees noted that "ordering materials in bulk helps us cut costs and reduce packaging waste." Another recurring point was reducing redundant procedures, where participants highlighted the streamlining of treatment plans and the elimination of duplicate records. One participant mentioned, "We used to have multiple patient records, which led to confusion and inefficiencies. Now, a single digital record per patient has improved our workflow." Additionally, optimizing inventory management emerged as a crucial strategy, with respondents stressing the benefits of real-time tracking and automated ordering systems. A clinic manager stated, "With an automated system, we no longer overstock materials that expire before use." Enhancing digital documentation was also recognized as a means to reduce paper waste and administrative delays. Many participants pointed to cloud-based storage as a solution, with one dentist explaining,

"Switching to digital records has not only reduced paperwork but also made patient information retrieval much faster." Furthermore, eco-friendly waste disposal was a subtheme that highlighted the adoption of biodegradable materials and recycling protocols. A participant shared, "We have replaced plastic cups and disposable trays with compostable alternatives, reducing our clinic's environmental impact." Finally, reducing chairside time was an essential component of waste reduction, where pre-appointment planning and optimized treatment sequences were implemented. "By preparing everything in advance, we can complete procedures more efficiently, benefiting both the clinic and the patient," one dentist remarked.

The second major theme, process optimization, focused on improving operational efficiency in dental clinics. Standardizing workflows was a recurring subtheme, with participants advocating for the use of standard operating procedures and task delegation. A senior dentist mentioned, "Establishing clinical checklists has significantly reduced errors and improved patient outcomes." Efficient patient scheduling was also a key factor in optimizing processes, with interviewees describing strategies such as appointment clustering and real-time adjustments. One respondent explained, "By grouping similar procedures on specific days, we have managed to reduce setup and sterilization time." Another important element was reducing bottlenecks, where streamlining referral systems and optimizing task

handoffs were frequently mentioned. "Delays in lab work used to disrupt our workflow, but by coordinating better with our partners, we have cut down turnaround time," one participant shared. The introduction of automation in routine tasks further improved efficiency, with AI-powered reminders and self-check-in systems being widely adopted. "Patients can now check in via an app, reducing front desk congestion," an office manager noted. Lastly, improving staff coordination played a crucial role in enhancing operational effectiveness, with cross-functional training and clear role definitions emerging as essential components. "Since implementing a better communication system, everyone knows their responsibilities, and work runs much smoother," a clinic supervisor observed.

The third theme, productivity enhancement, encompassed various strategies aimed at improving staff and clinic performance. Time management techniques were frequently discussed, with participants emphasizing the benefits of efficient scheduling and reducing task switching. One dentist noted, "If I focus on similar procedures in a single session, I can work more efficiently and reduce mental fatigue." Enhancing team communication was another key subtheme, with regular team huddles and structured meetings being common strategies. A participant described, "Daily five-minute meetings help us address issues before they escalate." Leveraging digital tools was also mentioned as an effective way to boost productivity, with cloud-based communication and AI-based scheduling becoming increasingly prevalent. "Our team uses a shared digital planner, which has significantly improved coordination," one respondent stated. The role of staff training programs in productivity enhancement was also underscored, with continuous professional development and peer mentoring proving beneficial. "We conduct regular hands-on training sessions to ensure that all staff members are up to date with the latest techniques," a clinic owner explained. Monitoring performance metrics was another important element, where key performance indicators and real-time dashboards helped clinics measure efficiency. "Having performance data available in real-time has allowed us to make quicker, data-driven decisions," one practice manager noted. Additionally, reducing non-value-adding activities was highlighted as a method for boosting productivity, with many clinics eliminating redundant paperwork and optimizing

consultation times. "We identified a lot of unnecessary steps in patient intake and streamlined the process," a participant remarked. Finally, implementing feedback mechanisms was emphasized as a way to sustain improvements in productivity, with employee feedback loops and patient satisfaction surveys playing a significant role. "We actively use patient feedback to adjust our services and improve their experience," a dental clinic director shared.

Discussion and Conclusion

The findings of this study illustrate the significant impact of lean management principles on waste reduction, process optimization, and productivity enhancement in dental clinics. Participants consistently highlighted that minimizing material waste, reducing redundant procedures, and optimizing inventory management were key strategies for improving efficiency and cost-effectiveness. The integration of bulk purchasing, real-time tracking, and automated ordering systems allowed clinics to mitigate excessive material usage and ensure resource sustainability. These results align with previous research indicating that lean management enhances resource utilization and reduces unnecessary expenses in healthcare settings (9). Furthermore, the findings confirm that digital documentation, particularly through cloud-based patient records and AI-assisted notes, plays a crucial role in eliminating redundant paperwork and administrative inefficiencies, a trend widely supported in the literature (16).

Another key finding was the role of eco-friendly waste disposal methods, such as recycling protocols and biodegradable materials, in promoting sustainability in dental clinics. Participants emphasized that integrating environmentally friendly practices not only reduced operational waste but also improved their clinic's reputation among patients. This finding is consistent with the growing emphasis on sustainability within healthcare, as reported by Rotter et al. (2018), who found that lean implementation in hospitals resulted in lower waste production and improved environmental stewardship (4).

In terms of process optimization, this study found that standardizing workflows, improving patient scheduling, and reducing bottlenecks were vital for enhancing clinic

efficiency. Participants reported that the use of structured work protocols, real-time scheduling adjustments, and digital automation significantly reduced delays and improved overall patient flow. These results align with research conducted by Fogliatto et al. (2019), which demonstrated that lean-oriented facility design and standardized workflows in healthcare improved patient throughput and minimized wait times (14). Additionally, the use of AI-powered reminders and automated billing systems was highlighted as an effective way to streamline routine administrative tasks. The benefits of automation in healthcare, particularly in reducing human error and administrative workload, have been well documented in previous studies (17).

A critical aspect of process optimization identified in this study was the importance of improving staff coordination through cross-functional training, role clarity, and coordination tools. Participants emphasized that when all staff members had clearly defined responsibilities and access to efficient communication platforms, clinics operated more smoothly. These findings support previous research by Antierens et al. (2019), who highlighted that strong interdepartmental collaboration and lean training programs contributed to improved workflow efficiency and staff satisfaction (20). Similarly, Aij and Rapsaniotis (2017) underscored that successful lean leadership requires fostering a collaborative and team-oriented culture, a perspective that aligns with the results of this study (1).

The study also found that productivity enhancement in dental clinics was strongly linked to effective time management, staff training programs, and monitoring performance metrics. Participants noted that task prioritization, structured meetings, and real-time dashboards were critical tools for maintaining operational efficiency. These results corroborate findings from Kaltenbrunner et al. (2019), who reported that primary care facilities implementing lean strategies saw improvements in workload distribution and service delivery times (21). Furthermore, research by Dunsford and Reimer (2017) emphasizes that structured team huddles and performance tracking contribute to continuous process improvement, supporting the findings of this study (15).

Another important finding was the role of staff training and professional development programs in sustaining lean management practices. Participants

emphasized that peer mentoring, workflow drills, and simulation-based training were essential for fostering a lean culture in their clinics. These findings align with previous studies highlighting that ongoing education and hands-on training improve lean adoption rates and overall efficiency in healthcare settings (3). Additionally, research by Gupta et al. (2017) has demonstrated that well-trained staff exhibit greater adaptability to process changes and lean methodologies, further validating the necessity of continuous education in lean dentistry (19).

The results of this study align with previous literature on lean healthcare, reinforcing the effectiveness of lean strategies in improving operational efficiency. Research by Naidoo (2021) emphasized that lean principles reduce operational bottlenecks, enhance service quality, and promote financial sustainability in healthcare institutions, which is consistent with this study's findings on process standardization, automation, and performance monitoring (7). Furthermore, Arcidiacono et al. (2017) found that hospitals implementing workflow optimization and patient flow management strategies experienced fewer service disruptions and higher patient throughput, mirroring the reported benefits of efficient scheduling and workflow streamlining in dental clinics (24).

Another key alignment with existing literature is the role of lean management in improving patient satisfaction. Poksińska et al. (2016) found that reducing appointment wait times and simplifying administrative processes enhanced patient experiences in primary care facilities, a finding that is consistent with this study's results on real-time scheduling and minimizing chairside time (11). Similarly, Robinson et al. (2016) demonstrated that dental school clinics adopting lean methodologies improved patient engagement and service delivery, further supporting the notion that lean dentistry contributes to better patient-centered care (22).

Additionally, this study's findings on automation and digitalization resonate with previous research highlighting the benefits of technology integration in lean healthcare. Research by Conners et al. (2021) found that AI-assisted diagnostics, self-check-in systems, and automated billing improved service accuracy and reduced administrative burdens in radiology clinics (26), paralleling this study's findings on the advantages of digital tools in dental clinic efficiency. Likewise, studies by Wataha et al. (2016) emphasized the importance of

integrating lean methodologies into dental education and training (25), which supports the recommendation for continuous professional development and simulation-based training programs identified in this study.

Overall, the findings of this study contribute to the growing body of evidence supporting the application of lean management principles in healthcare. They provide further empirical validation for the benefits of waste reduction, workflow optimization, and productivity enhancement in dental clinics, demonstrating how these strategies can lead to more efficient and patient-centered service delivery.

Despite the valuable insights provided by this study, several limitations must be acknowledged. First, the study relied solely on qualitative data from semi-structured interviews, which, while rich in detail, may be subject to participant biases and self-reported perceptions. Additionally, the sample size was limited to 24 participants, which, although sufficient for achieving theoretical saturation, may not fully represent the broader landscape of lean management practices in dentistry. Furthermore, the study primarily included participants from developed healthcare systems, which may limit the generalizability of findings to resource-limited settings where lean implementation faces different structural challenges. Future research incorporating mixed-method approaches, larger sample sizes, and diverse healthcare environments would help address these limitations.

Future research should explore the long-term impact of lean management on dental clinic performance and patient satisfaction using quantitative methodologies such as time-series analysis and performance benchmarking. Additionally, comparative studies across different healthcare systems could provide deeper insights into how cultural and regulatory differences influence lean adoption in dentistry. Future investigations should also focus on the cost-effectiveness of lean implementation, examining whether the financial benefits of efficiency improvements outweigh the initial investment in lean training and digital infrastructure. Moreover, studies assessing the psychological impact of lean management on staff well-being could provide valuable insights into how workload optimization influences job satisfaction and burnout rates in dental professionals.

To successfully implement lean management in dental clinics, practitioners should prioritize staff training and continuous professional development to ensure smooth adoption of lean methodologies. Clinics should invest in digital tools such as automated scheduling systems, AI-assisted diagnostics, and cloud-based documentation to optimize workflow efficiency. Leadership commitment is crucial in fostering a lean culture, requiring clinic managers to engage in regular performance monitoring, feedback mechanisms, and structured team coordination meetings. Additionally, dental clinics should develop waste reduction initiatives, including material optimization strategies and sustainable disposal practices, to enhance cost-efficiency and environmental responsibility. Finally, adopting patient-centered scheduling approaches and lean workflow designs can significantly improve service delivery, reduce wait times, and enhance overall patient experiences.

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Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

References

1. Aij KH, Rapsaniotis S. Leadership Requirements for Lean Versus Servant Leadership in Health Care: A Systematic Review of the Literature. Journal of Healthcare Leadership. 2017;Volume 9:1-14. doi: 10.2147/jhl.s120166.

2. Aij KH, Teunissen M. Lean Leadership Attributes: A Systematic Review of the Literature. Journal of Health Organization and Management. 2017;31(7/8):713-29. doi: 10.1108/jhom-12-2016-0245.

3. Aij KH, Veth ME. Leadership Requirements for Successful Implementation of Lean Management in Health Care: A Systematic Review of the Literature. 2017. doi: 10.5772/65653.

4. Rotter T, Plishka C, Lawal A, Harrison E, Sari N, Goodridge D, et al. What Is Lean Management in Health Care? Development of an Operational Definition for a Cochrane Systematic Review. Evaluation & the Health Professions. 2018;42(3):366-90. doi: 10.1177/0163278718756992.

5. Tretiak VP. Implementing Lean Management Principles to Optimize Healthcare Facility Operations. Economy and Society. 2024(62). doi: 10.32782/2524-0072/2024-62-84.

6. Smith IM. Operationalising the Lean Principles in Maternity Service Design Using 3P Methodology. BMJ Quality Improvement Reports. 2016;5(1):u208920.w5761. doi: 10.1136/bmjquality.u208920.w5761.

7. Naidoo L. Critical Success Factors and Practical Considerations for Lean Readiness and Implementation in Health-Care: A Literature Review. Journal of Contemporary Management. 2021;18(1):407-32. doi: 10.35683/jcm21031.111.

8. Alshehri A, Lichy J. The Impact of Statistical Thinking on Operational Performance and Managerial Decision-Making in Private Dental Service Organizations in the Southern Region of Saudi Arabia: An Empirical Investigation. Saudi Journal of Health Systems Research. 2024:145-54. doi: 10.1159/000540370.

9. Almutairi A, Salonitis K, Al-Ashaab A. Assessing the Leanness of a Supply Chain Using Multi-Grade Fuzzy Logic: A Health-Care Case Study. International Journal of Lean Six Sigma. 2019;10(1):81-105. doi: 10.1108/ijlss-03-2018-0027.

10. Bhaladhare R, Rishipathak P. Optimizing Quality of Hospital Services and Inpatient Satisfaction Through Lean Principles. International Journal of Statistics in Medical Research. 2024;13:450-5. doi: 10.6000/1929-6029.2024.13.39.

11. Poksińska B, Fiałkowska-Filipek M, Engström J. Does Lean Healthcare Improve Patient Satisfaction? A Mixed-Method Investigation Into Primary Care. BMJ Quality & Safety. 2016;26(2):95-103. doi: 10.1136/bmjqs-2015-004290.

12. Hihnala S, Kettunen L, Suhonen M, Tiirinki H. The Finnish Healthcare Services Lean Management. Leadership in Health Services. 2017;31(1):17-32. doi: 10.1108/lhs-03-2017-0020.

13. Kartika N, Widayanti P. Lean Healthcare Analysis at Airlangga Health Service Center. Se Asian Bus Rev. 2024;2(1):59-66. doi: 10.20473/sabr.v2i1.55029.

14. Fogliatto FS, Tortorella GL, Anzanello MJ, Tonetto LM. Lean-Oriented Layout Design of a Health Care Facility. Quality Management in Health Care. 2019;28(1):25-32. doi: 10.1097/qmh.0000000000000193.

15. Dunsford J, Reimer LE. Relationship-Centered Health Care as a Lean Intervention. International Journal for Quality in Health Care. 2017;29(8):1020-4. doi: 10.1093/intqhc/mzx156.

16. Deranek K, Kramer SL, Siegel SC. Technology-Dependent Pedagogical Process Redesign: Leveraging Lean Methods. International Journal of Quality & Reliability Management. 2021;38(8):1816-32. doi: 10.1108/ijqrm-04-2020-0107.

17. Lin C, Nguyen TM, McGrath R, Patterson A, Hall MT. Dental Health Services Victoria Value-based Health Care Principles for Oral Health Models of Care. Journal of Public Health Dentistry. 2023;83(3):325-8. doi: 10.1111/jphd.12581.

18. Bryne E, Hean S, Evensen KB, Bull VH. Seeing the Person Before the Teeth: A Realist Evaluation of a Dental Anxiety Service in Norway. European Journal of Oral Sciences. 2022;130(3). doi: 10.1111/eos.12860.

19. Gupta A, Misra SM, Garcia C, Ugalde M. Utilizing Lean Principles to Improve Immunization Administration Efficiency in a Pediatric Mobile Clinic Program. Pediatric Quality and Safety. 2017;2(5):e037. doi: 10.1097/pq9.0000000000000037.

20. Antierens A, Beeckman D, Verhaeghe S, Hecke AV. Wanted in Health Care: Lean Experts With a Broad Perspective. Journal of Nursing Management. 2019;27(6):1332-6. doi: 10.1111/jonm.12784.

21. Kaltenbrunner M, Mathiassen SE, Bengtsson L, Engström M. Lean Maturity and Quality in Primary Care. Journal of Health Organization and Management. 2019;33(2):141-54. doi: 10.1108/jhom-04-2018-0118.

22. Robinson FG, Cunningham LL, Turner S, Lindroth J, Ray DS, Khan T, et al. Improving a Dental School's Clinic Operations Using Lean Process Improvement. Journal of Dental Education. 2016;80(10):1170-9. doi: 10.1002/j.0022-0337.2016.80.10.tb06199.x.

23. Robinson FG, Fischbach H, Salisbury JR, Stefanik D, Kearney RC, Fields HW. Clinical Integration in a Dental School Clinic Through an Enhanced Patient Intake Process. Journal of Dental Education. 2019;83(9):1030-8. doi: 10.21815/jde.019.105.

24. Arcidiacono G, Matt DT, Rauch E. Axiomatic Design of a Framework for the Comprehensive Optimization of Patient Flows in Hospitals. Journal of Healthcare Engineering. 2017;2017:1-9. doi: 10.1155/2017/2309265.

25. Wataha JC, Mouradian WE, Slayton RL, Sorensen JA, Berg J. Modern Management Principles Come to the Dental School. Journal of Dental Education. 2016;80(4):393-402. doi: 10.1002/j.0022-0337.2016.80.4.tb06096.x.

26. Conners AL, Clark SE, Brandt KR, Hunt KN, Chida L, Tibor LC, et al. Leveling the Workload for Radiologists in Diagnostic Mammography: Application of Lean Principles and Heijunka. Journal of Breast Imaging. 2021;4(1):61-9. doi: 10.1093/jbi/wbab090.

27. Reijula J, Nevala N, Lahtinen M, Ruohomäki V, Reijula K. Lean Design Improves Both Health-Care Facilities and Processes: A Literature Review. Intelligent Buildings International. 2014;6(3):170-85. doi: 10.1080/17508975.2014.901904.

28. Yaduvanshi D, Sharma A. Lean Six Sigma in Health Operations. Journal of Health Management. 2017;19(2):203-13. doi: 10.1177/0972063417699665.

29. Vakhnenko OM, Kovalenko I. Перспективи Та Шляхи Розвитку Доступної Стоматології В Україні. Oral and General Health. 2022;2(3):28-31. doi: 10.22141/ogh.2.3.2021.240726.