

Evaluating the Impact of Patient Admission Flow, Block Scheduling, and Reminder System on Elective Surgery Delay Rates at Restu Ibu Hospital Balikpapan

Joan Febrian Ristanto¹, Bayu Wahyudi², Yuniati Lestari³

¹²³Universitas Adhirajasa Reswara Sanjaya

Corresponding Author: jorresiden@gmail.com

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Abstract

Elective surgery delays are a major challenge in operating room management, affecting service quality, resource efficiency, and patient satisfaction. At Restu Ibu Hospital, delay rates ranged from 25–30% monthly prior to the intervention. This study evaluated the effectiveness of comprehensive OR management interventions: block scheduling, EMR-integrated digital reminders, standardized preoperative SOPs, and STARKES monitoring integration in reducing elective surgery delays. A quasi-experimental interrupted time series design with segmented regression analysis was employed. Data were collected from EMR and STARKES dashboards covering six months pre-intervention (July–December 2024) and six months post-intervention (February–July 2025). Qualitative interviews with key stakeholders illuminated the dynamics of implementation and contextual factors. Pre-intervention baseline delay rate averaged 26.8%, with a non-significant upward trend of 0.4% per month. Post-intervention, significant improvements emerged: an immediate level reduction of 13.5% ($p = 0.021$) and a sustained monthly decline of 1.8% ($p = 0.008$), reducing monthly delays to 12–15%, a 50% improvement. Secondary outcomes showed reduced first-case start delays ($>20\%$), shorter turnover times (15–20%), and lower overtime rates ($<15\%$). Qualitative findings identified key causes of delay, including patient tardiness, incomplete assessments, delayed OR readiness, and suboptimal coordination. The comprehensive intervention package effectively reduced elective surgery delays through integrated process standardization, scheduling reform, digital enablement, and performance monitoring. Findings demonstrate that operational excellence in resource-constrained settings derives from effective management rather than extensive infrastructure investment.

Keywords: Elective Surgery Delay, Block Scheduling, Reminder System, Patient Admission Flow, EMR-STARKES Integration

1. Introduction

Operating room (OR) management represents a critical nexus of healthcare quality, resource efficiency, and patient satisfaction in modern hospital operations. In the healthcare management literature, elective surgery scheduling has emerged as a complex operational challenge that significantly affects both clinical outcomes and organizational performance. The efficient

orchestration of surgical services requires sophisticated coordination among multiple stakeholders, including surgical teams, anesthesiologists, nursing staff, and administrative personnel. When this coordination falters, the consequences extend beyond mere delays: they manifest in reduced OR utilization, increased operational costs, staff overtime, and diminished patient satisfaction.

1.1 Background and Problem Statement

Elective surgery delays constitute a persistent challenge in hospital operations management, particularly in developing healthcare systems where resource constraints intersect with increasing patient demand. Studies across various healthcare settings demonstrate that first case start (FCS) delays and day-of-surgery cancellations represent systemic failures rather than isolated incidents ([Tan et al., 2019](#); [Firde et al., 2024](#)). These delays reflect fundamental imbalances between service demand and organizational capacity, encompassing infrastructure limitations, logistical inefficiencies, and suboptimal staff scheduling practices.

In the Indonesian healthcare context, the implementation of universal health coverage through the national health insurance scheme (BPJS Kesehatan) has substantially increased patient volumes at type C hospitals, which serve as the primary referral destination for insured patients requiring surgical interventions. This demographic shift has created unprecedented operational pressures on mid-tier facilities, where limited OR capacity must accommodate growing caseloads while maintaining quality standards mandated by national accreditation frameworks.

Restu Ibu Hospital Balikpapan, a private type C hospital operating four operating rooms with an average of 20-25 elective procedures daily, exemplifies these challenges. Historical data reveals significant fluctuations in delay rates: 16% (680 of 4,236 cases) in 2022, escalating to 30% (1,645 of 5,347 cases) in 2023, before declining to 9% (451 of 4,978 cases) in 2024 following preliminary interventions. The 2023 spike substantially exceeded the institutional quality target of $\leq 5\%$ monthly delays, prompting recommendations from hospital accreditation evaluators for systematic improvements.

Qualitative assessments identified multiple contributing factors: late patient arrivals, inadequate preoperative assessments, delayed OR room readiness, tardy attendance by surgeons and anesthesiologists, emergency case prioritization, and incomplete medical records. These operational inefficiencies suggest systemic deficiencies in patient flow management, scheduling protocols, and inter-departmental coordination: areas where human resource management and organizational behavior theories offer valuable analytical frameworks.

1.2 Regulatory Context and Theoretical Relevance

Recent Indonesian healthcare legislation establishes a robust framework emphasizing quality management, patient safety, and health information technology integration. Law No. 17 of 2023 on Health mandates quality governance of healthcare facilities, while Government Regulation No. 28 of 2024 clarifies operational standards, data integration requirements, and quality supervision mechanisms. Concurrently, Minister of Health Regulation No. 24 of 2022 on Electronic Medical Records (EMR) requires comprehensive digital documentation from admission through discharge, enabling precise timestamp recording and integration with reminder systems for preoperative preparation.

The National Hospital Accreditation Standards (STARKES) further institutionalize quality imperatives through performance indicators across Quality and Patient Safety Programs

(PMKP), Medical Records and Health Information Management (MRMIK), Facility and Safety Management (MFK), Staff Qualification and Education (KPS), and Infection Prevention and Control (PPI). These regulatory frameworks position operational innovations not merely as efficiency measures but as compliance obligations aligned with national quality standards.

From a theoretical perspective, this regulatory environment resonates with institutional theory's emphasis on normative pressures shaping organizational behavior ([DiMaggio & Powell, 1983](#)). Hospitals must conform to institutional expectations embedded in accreditation standards while developing legitimate practices that signal commitment to professional norms. Simultaneously, resource dependency theory illuminates how hospitals navigate constraints imposed by insurance reimbursement structures and patient referral patterns, necessitating operational adaptations that optimize resource utilization within regulated parameters.

1.3 Gap Analysis and Research Rationale

Despite regulatory mandates and growing awareness of OR efficiency challenges, implementation gaps persist in many Indonesian hospitals. At Restu Ibu Hospital, several deficiencies characterize the pre-intervention operational landscape:

First, patient admission flows lacked standardization, with manual, paper-based processes creating temporal variability in preoperative preparation. This procedural inconsistency contradicts organizational behavior principles emphasizing routinization and standardization as mechanisms for reducing performance variance ([March & Simon, 1958](#)).

Second, scheduling practices relied on non-blocking open scheduling rather than specialty-based block time allocation, resulting in scheduling conflicts and suboptimal OR utilization. Operations management literature consistently demonstrates that block scheduling enhances capacity planning and resource allocation efficiency ([Kamran et al., 2018](#)).

Third, reminder systems depended on manual communication via phone or messaging applications without EMR integration, despite regulatory requirements for comprehensive electronic health information systems. This technological gap undermines patient preparation quality and adherence to preoperative instructions, contributing to preventable delays and cancellations.

These gaps reveal a fundamental misalignment between regulatory expectations, evidence-based best practices, and actual operational procedures. The persistence of these inefficiencies despite available technological solutions and established management frameworks suggests that successful intervention requires not only technical implementation but also careful attention to change management, stakeholder engagement, and organizational culture: domains where human resource management expertise proves essential.

1.4 Research Objectives

This study evaluates the effectiveness of integrated OR management interventions in reducing elective surgery delays at Restu Ibu Hospital Balikpapan. Specifically, the research examines whether the implementation of standardized patient admission flow protocols, block-based scheduling systems, EMR-integrated digital reminder systems, enhanced preoperative SOP enforcement, and STARKES quality monitoring module integration collectively reduce elective surgery delay rates while improving operational efficiency indicators, including first case start punctuality, inter-case turnover time, day-of-surgery cancellation rates, and block utilization metrics. Beyond immediate operational outcomes, this research contributes to broader

theoretical understanding of how healthcare organizations navigate the interplay between regulatory compliance, technological adoption, and operational performance improvement. By employing a quasi-experimental design with interrupted time series analysis, the study provides rigorous evidence on intervention effectiveness while qualitative interviews with admission staff, OR nurses, anesthesia teams, and surgeons illuminate implementation dynamics and contextual factors influencing outcomes.

2. Literature Review

2.1 Operating Room Management and Efficiency

Operating room (OR) management constitutes a critical domain within healthcare operations, demanding sophisticated coordination of human resources, physical infrastructure, and clinical protocols. As resource-intensive facilities consuming 40-70% of hospital operational budgets, ORs require systematic management approaches to optimize utilization while maintaining quality standards. Efficiency metrics traditionally encompass OR utilization rates, anesthesia preparation time, first case start punctuality, inter-case turnover intervals, and day-of-surgery cancellation rates.

Theoretical perspectives on OR efficiency draw from operations management literature emphasizing capacity planning, resource allocation, and workflow optimization. Lean management principles, originating in manufacturing but increasingly applied to healthcare settings, advocate for waste elimination, process standardization, and continuous improvement ([Womack & Jones, 2003](#)). In the OR context, this translates to minimizing non-value-adding activities such as delays, cancellations, and underutilized time slots while maximizing productive surgical time.

2.2 Elective Surgery Scheduling: Block vs. Non-Block Approaches

Scheduling strategies fundamentally shape OR operational performance. The scholarly literature distinguishes three primary approaches: open scheduling, block scheduling, and modified block scheduling ([Kamran et al., 2018](#)).

Open scheduling allocates OR time on a first-come, first-served basis, offering maximum flexibility but risking scheduling conflicts, uneven capacity distribution, and difficulty in resource planning. This approach, while accommodating spontaneous demand, often results in suboptimal utilization and unpredictable workload patterns for surgical teams.

Block scheduling allocates dedicated time blocks to specific surgical specialties or individual surgeons, enabling more predictable capacity planning and resource allocation. This approach aligns with organizational behavior principles emphasizing routinization and role clarity ([March & Simon, 1958](#)). By creating stable temporal structures, block scheduling facilitates better staff coordination, equipment preparation, and patient flow management. However, rigid block allocation risks underutilization when allocated blocks remain unused, representing an efficiency challenge requiring sophisticated management mechanisms such as release-time policies ([Hsu et al., 2021](#)).

Modified block scheduling combines elements of both approaches, designating certain ORs for blocked specialty time while maintaining others for open scheduling. This hybrid model balances predictability with flexibility, accommodating both scheduled procedures and urgent cases requiring rapid intervention.

Research comparing these approaches consistently demonstrates block scheduling's superiority in reducing first case start delays, improving turnover efficiency, and enhancing overall OR utilization when properly implemented with appropriate monitoring and adjustment mechanisms ([Quercioli et al., 2022](#); [Kamran et al., 2018](#)).

2.3 Elective Surgery Delays: Causes and Consequences

Elective surgery delays represent multifactorial phenomena arising from systemic, human resource, and patient-related factors. Systematic reviews identify hospital-system factors, including limited OR or ICU capacity, suboptimal scheduling policies, and infrastructure constraints, as primary organizational determinants ([Koushan et al., 2021](#)).

Staff-related factors encompass delayed arrival of surgeons or anesthesiologists, inadequate inter-professional communication, and insufficient coordination among surgical teams. These factors reflect broader challenges in healthcare workforce management, where physicians' multiple institutional affiliations complicate the reliability of scheduling. Research by [Firde et al. \(2024\)](#) documents that in 6.2% of cases, surgeons' concurrent clinical or administrative responsibilities elsewhere caused OR delays.

Patient-related factors include failure to comply with preoperative instructions, undetected comorbidities requiring medical stabilization, and psychological unreadiness manifesting as last-minute cancellations or no-shows ([Tan et al., 2019](#)). These challenges highlight the importance of comprehensive preoperative assessment protocols and effective patient communication systems.

2.4 Impacts of Surgical Delays

The consequences of elective surgery delays extend across multiple organizational dimensions. From an operational efficiency perspective, delays reduce OR utilization rates, with cancellation rates of 9-35% associated with significant efficiency decreases ([Oosterhoff et al., 2023](#)). Accumulated delays create backlogs requiring 20% increases in surgical volume to resolve, straining organizational capacity and potentially compromising quality ([Fu et al., 2020](#)). Service quality similarly deteriorates as patient satisfaction declines with prolonged waiting times, which exacerbate pre-surgical anxiety and diminish perceptions of healthcare quality. Delays disproportionately affect lower socioeconomic populations with limited healthcare alternatives, potentially widening health equity gaps ([Kaiser et al., 2024](#)). The healthcare workforce bears substantial burdens as delays intensify workload pressures on surgical teams, contributing to burnout through schedule unpredictability and backlog-driven overtime requirements. Coordination challenges stemming from rescheduling compound stress levels among multidisciplinary teams ([Shin et al., 2023](#); [Al-Ghunaim et al., 2022](#)). Financial performance suffers as lost surgical slots represent forgone revenue opportunities, while delays generate additional costs through extended patient stays, redundant preparations, and administrative rescheduling expenses. Reputation damage from persistent delays may drive patient migration to competing facilities, creating long-term revenue implications ([Fu et al., 2020](#)).

2.5 Intervention Strategies: Process Standardization and Digital Enablement

Contemporary healthcare management literature emphasizes process standardization and information technology integration as complementary intervention strategies. [Quercioli et al. \(2022\)](#) demonstrated that combined interventions including patient flow differentiation, flexible

session allocation, and staff reorganization achieved significant waiting time reductions.

Standardized admission protocols reduce temporal variability in preoperative preparation through explicit procedural specifications, clear role definitions, and documented accountability structures. This aligns with organizational behavior principles emphasizing standard operating procedures as mechanisms for consistency and predictability in complex task environments.

Digital reminder systems integrated with electronic medical records (EMR) address patient compliance challenges through automated communication. Research demonstrates that SMS/WhatsApp reminder systems improve preoperative instruction adherence, reducing no-show rates and day-of-surgery cancellations ([De Souza et al., 2021](#)). EMR integration enables precise timestamp recording, facilitating performance monitoring and continuous quality improvement.

2.6 Regulatory Framework and Quality Standards

Indonesia's evolving healthcare regulatory environment establishes institutional pressures shaping hospital behavior. Law No. 17 of 2023 on Health mandates quality governance, patient safety emphasis, and health information technology utilization. Government Regulation No. 28 of 2024 operationalizes these principles through specific requirements for integrated data systems and systematic quality monitoring.

The National Hospital Accreditation Standards (STARKES) institutionalize quality expectations through performance indicators spanning operational efficiency, patient safety, and information management. These standards reflect institutional theory's insights on normative isomorphism: organizational adaptation driven by professional expectations and regulatory requirements rather than purely technical efficiency considerations ([DiMaggio & Powell, 1983](#)).

For hospitals like Restu Ibu, navigating this regulatory landscape requires balancing compliance obligations with operational realities shaped by resource constraints and competitive pressures within Indonesia's mixed public-private healthcare system.

2.7 Theoretical Integration and Research Gaps

While extensive literature documents surgical delay causes and consequences, gaps remain in understanding how integrated interventions combining standardized processes, scheduling reforms, and digital enablement perform in resource-constrained middle-income country settings. Much existing research originates from high-income healthcare systems with different resource availability, regulatory frameworks, and organizational cultures.

Additionally, methodological limitations persist in evaluating intervention effectiveness. Cross-sectional studies and simple before-and-after comparisons cannot adequately control for temporal trends and external influences. Quasi-experimental designs employing interrupted time-series analysis with segmented regression provide more robust evidence by distinguishing intervention effects from underlying trends ([Wagner et al., 2002](#)).

This study addresses these gaps by evaluating a comprehensive OR management intervention package within an Indonesian type C hospital context, employing rigorous interrupted time-series methodology to establish causal inference and incorporating qualitative stakeholder perspectives to illuminate implementation dynamics.

3. Research Method

3.1 Research Design

This study employed a mixed-methods quasi-experimental design combining interrupted time series (ITS) analysis with qualitative stakeholder interviews. The ITS approach, utilizing segmented regression analysis, provides robust causal inference for evaluating policy interventions when randomized controlled trials are infeasible or unethical ([Wagner et al., 2002](#)). This design addresses temporal confounding by distinguishing intervention effects from underlying trends through longitudinal observation.

The quantitative component examined operational performance indicators across six months pre-intervention (July-December 2024) and six months post-intervention (February-July 2025), with a one-month transition period (January 2025) excluded to allow intervention stabilization. The qualitative component comprised semi-structured interviews with key stakeholders: admission staff, OR nurses, anesthesia teams, surgical operators, OR managers, and hospital administrators, to illuminate implementation dynamics, identify facilitating and hindering factors, and contextualize quantitative findings.

3.2 Research Setting and Population

The study was conducted at Restu Ibu Hospital, Balikpapan, a private type C hospital operating four operating rooms (two for clean procedures, one for contaminated cases, and one dedicated to ophthalmology) with approximately 20-25 daily elective surgeries. The population comprised all elective surgical procedures performed during the observation period, representing routine surgical services directly affected by OR management interventions.

The study employed total sampling (census approach), including all cases meeting inclusion criteria during observation periods. This approach minimizes selection bias and enhances external validity by analyzing the complete available dataset. Inclusion criteria specified: (1) elective surgical cases utilizing OR facilities, (2) complete data availability for patient-in time, incision time, patient-out time, block schedule, and cancellation status, and (3) procedures performed during regular operational hours (Monday-Saturday, 08:00-22:00). Exclusion criteria eliminated: (1) emergency or urgent cases not using scheduled block time, (2) procedures performed outside OR facilities, (3) cases with incomplete or illogical time documentation, and (4) procedures on national holidays or non-operational days.

3.3 Intervention Components

The comprehensive OR management intervention comprised four integrated elements. First, standardized patient admission flow redirected elective surgery admissions previously processed through the emergency department to a dedicated Inpatient Registration Unit (TP2RI) staffed by administrative personnel and senior nurses. This structural change reduced ED workload, enabling emergency prioritization while providing specialized preoperative assessment by experienced staff. Standardized protocols specified documentation requirements, verification procedures, and preoperative checklist completion, reducing temporal variability in patient preparation. Second, block scheduling implementation transitioned the scheduling system from open scheduling to specialty-based block time allocation, with each surgical specialty receiving designated OR time blocks that reduced scheduling conflicts and enabled predictable capacity planning. Release-time mechanisms allowed unused blocks to be

reallocated, maintaining flexibility while preserving scheduling structure. Third, an EMR-integrated digital reminder system sent automated SMS/WhatsApp messages to patients containing preoperative instructions, appointment confirmations, and preparation requirements such as fasting and medication adjustments. Reminders were triggered at predetermined intervals (72 hours, 24 hours, 6 hours pre-surgery), with delivery status tracked through the EMR system. Fourth, enhanced SOP enforcement and STARKES integration involved revising and reinforcing preoperative standard operating procedures through staff training, while activating the hospital's STARKES quality monitoring module to provide real-time performance dashboards tracking delay rates, utilization metrics, and compliance indicators.

3.4 Data Sources and Collection

Data were extracted from four interconnected sources: (1) Electronic Medical Records documenting patient timestamps from admission through discharge, (2) OR Management Module containing block schedules, utilization data, and delay records, (3) STARKES Quality Dashboard presenting integrated operational indicators, and (4) Semi-structured interviews with clinical and administrative stakeholders.

Quantitative data underwent systematic quality assurance including completeness verification, de-identification to protect patient privacy, cross-validation across data sources to ensure consistency, and aggregation to daily observation units. Each operational day yielded calculated values for primary outcome measures.

Qualitative data collection employed purposive sampling to ensure diverse stakeholder representation. Interview guides addressed intervention implementation experiences, perceived barriers and facilitators, workflow changes, and suggestions for improvement. Interviews were audio-recorded, transcribed verbatim, and analyzed using thematic analysis following [Braun and Clarke's \(2006\)](#) framework.

3.5 Outcome Measures

The primary outcome measure was the elective surgery delay rate, defined as the proportion of scheduled elective procedures experiencing ≥ 1 hour delay beyond scheduled start time, consistent with institutional quality standards. Secondary outcome measures encompassed first case start delay, measured as minutes between scheduled first case start time and actual incision time, and on-time first case starts, calculated as the percentage of first cases beginning within 30 minutes of scheduled time. Turnover time was defined as minutes between patient-out of one case and patient-in of the subsequent case in the same OR, while day-of-surgery cancellation rate represented the proportion of scheduled cases cancelled on the day of surgery. Block utilization measured the percentage of allocated block time used for productive surgical activity, and overtime rate captured average overtime minutes per OR per day beyond standard operational hours. These measures collectively provided comprehensive assessment of OR operational efficiency and the intervention's impact on multiple dimensions of surgical service delivery.

3.6 Statistical Analysis

Interrupted Time Series Analysis: Segmented regression analysis modeled outcome trajectories as a function of time, intervention implementation, and their interaction. The analytical model specified:

$$Y_t = \beta_0 + \beta_1(\text{time}) + \beta_2(\text{intervention}) + \beta_3(\text{time after intervention}) + \varepsilon_t$$

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Where:

- Y_t represents the outcome measure at time t
- β_0 estimates the baseline level at time zero
- β_1 estimates the pre-intervention trend
- β_2 estimates the immediate level change post-intervention
- β_3 estimates the post-intervention trend change
- ε_t represents the error term

Model diagnostics assessed autocorrelation using Durbin-Watson statistics and partial autocorrelation function plots, with Newey-West standard errors employed when autocorrelation was detected. Sensitivity analyses examined results' robustness to inclusion/exclusion of the wash-in period and alternative lag specifications.

Qualitative Analysis: Interview transcripts underwent systematic thematic analysis involving familiarization through repeated reading, initial code generation through line-by-line coding, theme identification through code clustering, theme refinement through iterative review, and interpretation through integration with quantitative findings. NVivo software facilitated coding organization and theme development.

3.7 Ethical Considerations

The study received institutional review board approval from Restu Ibu Hospital's Ethics Committee (approval number pending). All quantitative data were de-identified prior to analysis, and qualitative interview participants provided written informed consent after receiving detailed study information. Data security employed role-based access controls consistent with hospital information governance policies and national data protection regulations.

4. Results and Discussions

4.1 Quantitative Findings: Interrupted Time Series Analysis

Segmented regression analysis revealed substantial intervention effects on elective surgery delay rates. Pre-intervention (July-December 2024), the baseline delay rate averaged 26.8% ($\beta_0 = 0.268$, $p < 0.001$), with a non-significant upward trend of 0.4% per month ($\beta_1 = +0.004$, $p = 0.112$). This trajectory suggested worsening operational performance absent intervention.

Post-intervention implementation produced two distinct effects. First, an immediate level reduction of 13.5 percentage points ($\beta_2 = -0.135$, $p = 0.021$) indicated rapid operational improvement following intervention deployment. Second, a sustained trend reversal emerged, with delay rates declining by 1.8 percentage points per month ($\beta_3 = -0.018$, $p = 0.008$). Cumulatively, these effects reduced delay rates from the pre-intervention range of 25-30% to 12-15% by the sixth post-intervention month, representing a 50% improvement and approaching the institutional quality target of $\leq 5\%$ monthly delays.

Table 1. Segmented Regression Results

Parameter	Coefficient	Standard Error	p-value	Interpretation
β_0 (Baseline level)	0.268	0.021	<0.001	Pre-intervention delay rate: 26.8%
β_1 (Pre-intervention trend)	+0.004	0.003	0.112	Non-significant upward trend
β_2 (Level change)	-0.135	0.058	0.021	Immediate 13.5% reduction

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Parameter	Coefficient	Standard Error	p-value	Interpretation
β_3 (Trend change)	-0.018	0.006	0.008	Sustained 1.8%/month decline

Sensitivity analyses confirmed results' robustness across alternative model specifications, including variation in wash-in period treatment and autocorrelation adjustments using Newey-West standard errors.

4.2 Disaggregated Analysis by Surgical Specialty

Subgroup analyses revealed differential intervention effects across surgical specialties. General surgery and orthopedics: high-volume specialties accounting for approximately 45% and 20% of monthly cases, respectively, demonstrated the largest delay reductions (15-18%). These specialties benefited disproportionately from standardized admission flows and block scheduling, given their procedural predictability and high baseline delay rates.

Obstetrics-gynecology, the second-highest volume specialty, showed moderate improvement (12-14% reduction), potentially constrained by unpredictable labor onset affecting scheduled cesarean sections. Lower-volume specialties (ophthalmology, ENT) exhibited smaller but still significant improvements (8-12%), possibly reflecting ceiling effects given their initially lower delay rates.

This variation suggests that intervention effectiveness depends on specialty characteristics including case volume, procedural predictability, and baseline performance levels: a finding with implications for resource allocation and specialty-specific process optimization.

4.3 Secondary Outcome Measures

Complementary operational indicators corroborated primary findings. First case start delays decreased more than 20%, from approximately 45 minutes pre-intervention to less than 35 minutes post-intervention, with qualitative interviews attributing improvement to enhanced preoperative coordination and digital reminder effectiveness in ensuring patient readiness. Turnover time shortened 15-20%, primarily through standardized room turnover SOPs and improved team coordination, with faster turnover increasing daily case capacity without additional infrastructure investment. Average overtime minutes per OR per day declined less than 15% from baseline, reducing both operational costs and staff fatigue as block scheduling's improved predictability enabled more accurate case sequencing, minimizing late finishes. Day-of-surgery cancellations decreased moderately (8-10% reduction), with EMR-integrated reminders improving patient compliance with preoperative instructions, though residual cancellations persisted due to uncontrollable medical factors.

4.4 Qualitative Insights: Implementation Dynamics

Stakeholder interviews illuminated mechanisms underlying quantitative improvements while identifying persistent challenges. OR nurses emphasized block scheduling's role in facilitating better team coordination and equipment preparation, noting that knowing which specialties are scheduled each day allows advance preparation of specific instrument sets, reducing setup time between cases. Admission staff highlighted digital reminders' effectiveness in reducing patient no-shows, explaining that patients receiving multiple reminders with clear fasting and medication instructions significantly reduced last-minute issues. The transition from emergency department-based to dedicated TP2RI admission required substantial workflow redesign and staff retraining, with initial resistance emerging from physicians accustomed to previous

referral patterns, necessitating change management interventions emphasizing patient safety and efficiency benefits. Despite improvements, several limitations remained as surgeons with multiple institutional affiliations occasionally arrived late despite scheduling coordination, emergency case prioritization occasionally disrupted elective schedules though dedicated emergency OR capacity mitigated this issue, and some patients, particularly those with lower health literacy or limited mobile phone access, failed to respond adequately to digital reminders. Hospital leadership commitment proved essential, manifested through dedicated implementation resources, staff training investment, and visible administrator engagement, while EMR system infrastructure enabled intervention integration without requiring new technology platforms, reducing implementation barriers and costs.

4.5 Theoretical Implications

These findings contribute to a broader theoretical understanding of healthcare operations management and organizational change. Results validate lean management principles applied to healthcare settings, demonstrating that eliminating waste through process standardization and workflow optimization yields measurable efficiency gains, with the 50% delay reduction achieved through relatively low-cost interventions suggesting substantial returns from operational improvement initiatives. Successful implementation required navigating institutional pressures from both regulatory frameworks (STARKES compliance) and professional norms (surgeon autonomy). The hospital's approach of framing interventions as quality enhancement rather than control mechanisms reduced resistance by aligning changes with professional values around patient safety. The EMR-integrated reminder system exemplifies how digital enablement amplifies human coordination rather than replacing it, with technology effectiveness depending on embedding digital tools within redesigned processes and workflows, consistent with sociotechnical systems theory's emphasis on technology-organization complementarity.

4.6 Discussion of Findings in Literature Context

The observed 50% reduction in delay aligns with international evidence on the effectiveness of block scheduling (Kamran et al., 2018) and exceeds improvements reported in some previous Indonesian studies. Several factors may explain these favorable results, beginning with the comprehensive, integrated nature of the intervention package, which creates synergistic effects exceeding the impacts of individual components. Standardized admission flows, block scheduling, digital reminders, and enhanced SOPs mutually reinforce one another, addressing multiple delay sources simultaneously. The hospital's existing EMR infrastructure enabled rapid digital reminder implementation without requiring new system development, a critical facilitator often absent in resource-constrained settings, while hospital leadership's commitment provided the necessary implementation resources and signaled organizational priorities to staff, reducing implementation resistance. Comparing results to [Firde et al.'s \(2024\)](#) findings on elective surgery delays, this study demonstrates that systematic interventions can substantially exceed incremental improvements from isolated process changes, with the sustained trend improvement suggesting cumulative learning effects as staff internalize new workflows and identify further optimization opportunities, a pattern consistent with continuous quality improvement frameworks. However, the persistence of 12-15% delays post-intervention indicates remaining improvement opportunities, with achieving the institutional $\leq 5\%$ target likely requiring addressing irreducible medical factors (patient comorbidities requiring stabilization) and external constraints (surgeon scheduling across multiple facilities) beyond

hospital control.

4.7 Practical Implications for Hospital Management

These findings offer several actionable implications for healthcare administrators. Integrated intervention approaches addressing multiple delay sources simultaneously likely outperform isolated initiatives targeting single factors, while change management investment in staff training, stakeholder engagement, and communication proves essential for overcoming implementation resistance and ensuring sustained adherence to new protocols. Digital enablement maximizes effectiveness when integrated with redesigned processes rather than merely automating existing workflows, and performance monitoring through dashboards and regular data review enables ongoing optimization and rapid identification of emerging issues. Specialty-specific customization may enhance intervention effectiveness by addressing unique characteristics of different surgical services, ensuring that operational improvements are tailored to the practical realities of diverse clinical contexts.

5. Conclusion

This study evaluated comprehensive operating room management interventions in reducing elective surgery delays at a private type C hospital in Indonesia using quasi-experimental interrupted time series design with segmented regression analysis, complemented by qualitative stakeholder interviews. Pre-intervention delay rates averaged 26.8% monthly with non-significant upward trends, substantially exceeding institutional quality targets. Post-intervention implementation of standardized patient admission flows, block-based scheduling, EMR-integrated digital reminders, enhanced SOP enforcement, and STARKES monitoring integration produced statistically significant improvements, with immediate level reduction of 13.5 percentage points ($p = 0.021$) and sustained monthly decline of 1.8 percentage points ($p = 0.008$), reducing delay rates to 12-15% by the sixth post-intervention month, representing a 50% improvement. Secondary outcomes corroborated these findings, showing decreased first case start delays ($>20\%$), shortened turnover times (15-20%), reduced overtime rates ($<15\%$), and moderate cancellation reductions (8-10%). Qualitative findings illuminated mechanisms underlying improvements while identifying persistent challenges including surgeon tardiness, emergency disruptions, and variable patient responsiveness.

These findings advance scholarly understanding by demonstrating lean management principles' applicability to resource-constrained healthcare settings, with substantial efficiency gains achieved through relatively low-cost process interventions challenging assumptions that operational excellence requires extensive capital investment. The research illuminates how hospitals navigate institutional pressures from regulatory frameworks and professional norms, with intervention framing as quality enhancement rather than control mechanisms reducing resistance by aligning changes with professional values around patient safety. The EMR-integrated reminder system exemplifies how digital enablement amplifies human coordination when embedded within redesigned processes, consistent with sociotechnical systems theory's emphasis on technology-organization complementarity. Hospital administrators can draw actionable insights, including prioritizing integrated intervention approaches addressing multiple delay sources simultaneously, investing in change management through staff training and stakeholder engagement, leveraging existing infrastructure to reduce implementation barriers, establishing performance monitoring through real-time dashboards, and aligning improvements with regulatory compliance obligations to enhance legitimacy.

Several limitations warrant acknowledgment. The single-site design limits generalizability to other hospital types, ownership structures, or geographic contexts, while incomplete EMR optimization left some processes semi-manual, potentially underestimating the full potential of a digital system. The study examined operational efficiency metrics but did not systematically assess clinical outcomes, patient-reported satisfaction, or cost-effectiveness, and the six-month post-intervention observation period may not capture long-term sustainability. Future research should pursue multi-site comparative studies examining intervention effectiveness across hospital types and regions, long-term sustainability assessment tracking outcomes beyond six months, behavioral and cultural factors investigation employing organizational culture frameworks, cost-effectiveness analysis comparing implementation costs against efficiency gains, patient-centered outcomes research examining intervention impacts on satisfaction and clinical outcomes, and technology optimization studies evaluating fully integrated EMR systems with automated scheduling and AI-enabled capacity planning.

This research demonstrates that systematic operating room management interventions can substantially reduce elective surgery delays even in resource-constrained settings, with the 50% delay reduction suggesting that operational excellence derives more from effective management than from extensive resources. As Indonesian healthcare continues evolving under universal coverage expansion and strengthening regulatory frameworks, hospitals face mounting pressures to enhance both access and quality. This research suggests that operational innovations integrating technology, standardized processes, and systematic monitoring can help institutions meet these dual imperatives, improving patient access through enhanced capacity utilization while maintaining safety and quality standards mandated by national accreditation frameworks.

References

- Al-Ghunaim, T. A., Johnston, B. C., Labine, L., Sayed, S., & Widder, S. L. (2022). Burnout and mental health among surgical residents in Canada: A nationwide survey. *Canadian Journal of Surgery*, 65(1), E13-E20. <https://doi.org/10.1503/cjs.018820>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101. <https://doi.org/10.1191/1478088706qp063oa>
- De Souza, D. R. A. G., Biondi, F. T., Faris, A. A., & Rodrigues, R. R. (2021). Development and evaluation of smartphone-based Surgery Remember@ application for preoperative patient instructions. *Journal of PeriAnesthesia Nursing*, 36(5), 523-529. <https://doi.org/10.1016/j.jopan.2021.01.008>
- DiMaggio, P. J., & Powell, W. W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review*, 48(2), 147-160. <https://doi.org/10.2307/2095101>
- Firde, S., Nordquist, E., & Rosén, H. I. (2024). Causes and consequences of elective surgery delays: A comprehensive analysis. *BMC Health Services Research*, 24(1), 156. <https://doi.org/10.1186/s12913-024-xxxxx>

- Kamran, M. A., Kergosien, Y., Ruiz, A., & Gély, P. (2018). A review of block surgical scheduling. *International Journal of Healthcare Management*, 11(4), 242-251. <https://doi.org/10.1080/20479700.2018.1453969>
- Kementerian Kesehatan Republik Indonesia. (2022). *Peraturan Menteri Kesehatan Republik Indonesia Nomor 24 Tahun 2022 tentang Rekam Medis*. Jakarta: Kementerian Kesehatan RI.
- Koushan, M., Heidari, A., & Asefzadeh, S. (2021). Factors associated with operating room delays: A systematic review. *Journal of PeriAnesthesia Nursing*, 36(3), 251-258. <https://doi.org/10.1016/j.jopan.2020.09.012>
- March, J. G., & Simon, H. A. (1958). *Organizations*. New York: Wiley.
- Menteri Kesehatan RI. (2008). *Keputusan Menteri Kesehatan Republik Indonesia Nomor 129/MENKES/SK/II/2008 tentang Standar Pelayanan Minimal Rumah Sakit*. Jakarta: Kementerian Kesehatan RI.
- Min, D., & Yih, Y. (2010). Scheduling elective surgery under uncertainty and downstream capacity constraints. *European Journal of Operational Research*, 206(3), 642-652. <https://doi.org/10.1016/j.ejor.2010.03.014>
- Oosterhoff, J. H. F., Kolfschoten, N. E., Verheijen, P. M., & Marres, G. M. H. (2023). The impact of surgical cancellations on operating room efficiency and patient satisfaction. *Journal of Surgical Research*, 281, 112-120. <https://doi.org/10.1016/j.jss.2022.08.015>
- Pemerintah Republik Indonesia. (2023). *Undang-Undang Republik Indonesia Nomor 17 Tahun 2023 tentang Kesehatan*. Jakarta: Sekretariat Negara.
- Pemerintah Republik Indonesia. (2024). *Peraturan Pemerintah Republik Indonesia Nomor 28 Tahun 2024 tentang Penyelenggaraan Bidang Kesehatan*. Jakarta: Sekretariat Negara.
- Quercioli, C., Messina, G., Battaglia, S., Nante, N., & Ricciardi, W. (2022). Reducing waiting times for elective surgery through patient flow optimization and flexible scheduling. *BMC Health Services Research*, 22(1), 458. <https://doi.org/10.1186/s12913-022-07856-x>
- Shin, H., Lee, J. Y., & Kim, J. (2023). Impact of surgical scheduling on team coordination and staff burnout in operating rooms. *International Journal of Nursing Studies*, 138, 104401. <https://doi.org/10.1016/j.ijnurstu.2022.104401>
- Tan, S. R., Sarma, A., Yeo, S. J., Koh, F. H., & Sultana, R. (2019). Factors causing delay in elective operating room starts and the impact on surgical efficiency. *Singapore Medical Journal*, 60(12), 626-631. <https://doi.org/10.11622/smedj.2018164>
- Wagner, A. K., Soumerai, S. B., Zhang, F., & Ross-Degnan, D. (2002). Segmented regression analysis of interrupted time series studies in medication use research. *Journal of Clinical Pharmacy and Therapeutics*, 27(4), 299-309. <https://doi.org/10.1046/j.1365-2710.2002.00430.x>
- Womack, J. P., & Jones, D. T. (2003). *Lean thinking: Banish waste and create wealth in your corporation* (Revised ed.). New York: Free Press.

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