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Collaborative Strategies to Optimize Operating Room Turnover Time: A Systematic Review of Multidisciplinary Interventions

I Made Esa Sadana Yoga[1*], Masyitoh Basabih[1]

[1] Faculty of Public Health, Universitas Indonesia, Indonesia

Corresponding Author Email: esa.sadana.yoga@gmail.com

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ABSTRACT

Minimizing operating room turnover time (TOT) is crucial for optimizing surgical efficiency and improving clinical outcomes. Achieving this reduction heavily relies on effective multidisciplinary teamwork among surgical staff. This systematic review aims to evaluate various multidisciplinary collaboration strategies and their impact on decreasing TOT. Following the PRISMA guidelines and utilizing the JBI Critical Appraisal Checklist for quality assessment, a literature search was conducted across four databases for publications between 2015 and 2025. This yielded 16 eligible articles for analysis. The data synthesis evaluated collaboration models, intervention methods, and their specific effects on TOT. The analysis highlighted four primary strategies: (1) utilizing dedicated teams to build personnel familiarity, (2) applying structured communication during preoperative planning, (3) implementing parallel workflows for simultaneous collaboration, and (4) conducting systematic, coordination-based evaluations. These approaches were found to significantly reduce TOT. Healthcare facilities can adapt these strategies to their specific organizational contexts to enhance operational efficiency, cost-effectiveness, and patient safety. Future research should emphasize standardizing these collaborative frameworks across various hospital settings and surgical disciplines.

Key Messages:

- Multidisciplinary collaboration among teams plays a critical role in reducing operating room TOT and improving surgical efficiency.
- Four key strategies were identified to accelerate TOT processes: dedicated teams and personnel familiarity, structured preoperative communication, parallel work design, and systematic coordination-base evaluation.
- Implementing these collaborative approaches can enhance surgical workflow, operational efficiency, and patient safety in operating room settings.

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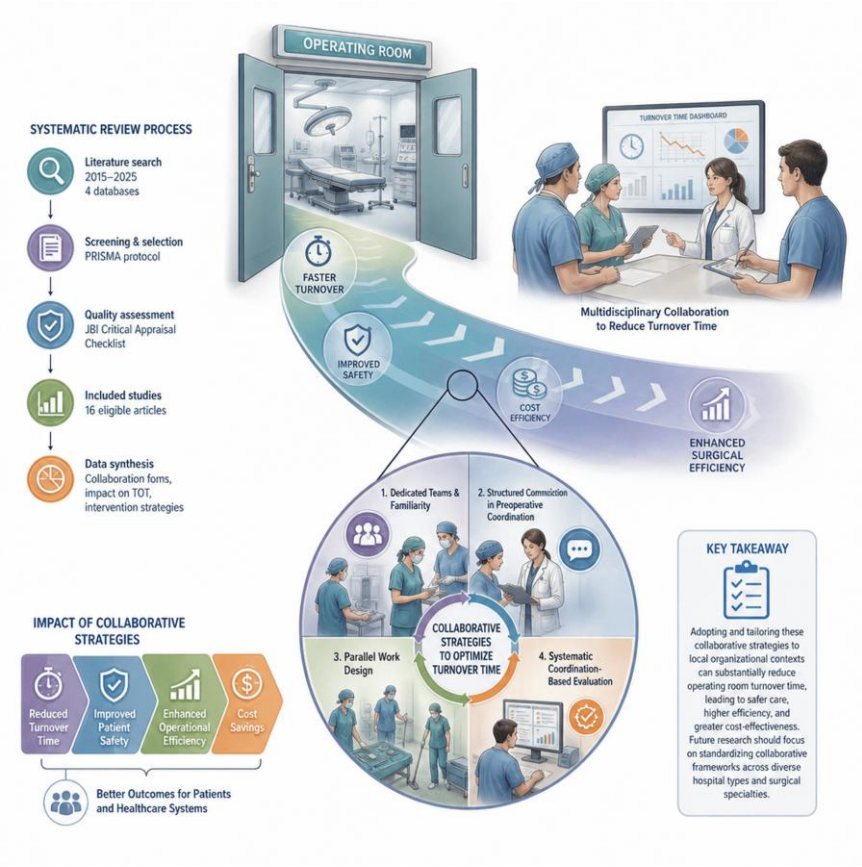
GRAPHICAL ABSTRACT



INTRODUCTION

The operating room (OR) is a strategic area for enhancing efficiency and quality, as it requires significant resource utilization. Studies show that ORs provide approximately 60-70% of a hospital's gross revenue, while also accounting for 30-50% of its operational expenses (1). Although no single indicator comprehends entirely operating room efficiency, turnover time (TOT) is regularly used as primary metric in efforts to improve operational performance and service quality (2).

Turnover time is defined as the interval between "wheels out" (when the previous patient exits) and "wheels in" (when the next patient enters) the operating room (3). Efficiency in this process directly affects OR utilization, service capacity, surgical scheduling continuity, and the hospital's financial outcomes (4,5). Consequently, delays in patient TOT not only contribute to surgical backlogs, but also lead to financial losses (6).

An increase in average TOT of 45-60 minutes per case can result in cost overruns of approximately US$ 1.620-2.220 per procedure (7). Conversely, reducing preparation time and TOT can lead to financial efficiencies, with potential saving exceeding US$1.76 million per operating room annually, along with increase in daily utilization from 2.8 to 4 surgical cases (8). Improved TOT efficiency also contributes to the reduction of adverse events. Surgical that begin one hour earlier than scheduled are associated with an adverse event rate of 21.6% significantly higher than the 14.4% observed in surgeries that start on time (9). This suggests that TOT is not merely about speeding up the intervals between surgeries, but about identifying the most optimal and efficient timing to maximize OR utilization.

A systematic review that analyzed 105 studies on TOT interventions categorized various modifiable factors, including anesthesia, equipment setup, room conditions, technology, and management (10). Similarly, another systematic review highlighted process optimization strategies focused on workflow efficiency and resource utilization but provided limited emphasis on interprofessional collaboration (11). While these studies offer valuable insights into technical improvements, their approaches often fall short in practical implementation. This is because technical solutions alone do not

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adequately address the complex coordination and communication required among multidisciplinary teams to execute these interventions effectively. As a result, inefficiencies in TOT processes may persist despite the optimization of individual components. Therefor, there is a growing need to move beyond a purely technical perspective and adopt a multidisciplinary and collaborative approach that integrates interprofessional coordination as a central element in optimizing OR TOT.

Collaboration is a continuous joint effort to develop a shared understanding of an issue, supported by mutually agreed representation of the problem that needs to be addressed (12). Collaboration encompasses communication, coordination, cooperation, and it also involves tools such as project and risk management that allow team member to express their creativity (13). Meanwhile, multidisciplinary collaboration refers to coordinated teamwork across various disciplines and professions within a team (14). In the operating room, this collaborative approach involves divers professionals such as surgeons, nurse, CSSD and support personnel working together to achieve the goals of improving patient safety and operational efficiency (15).

Multidisciplinary collaboration has been widely recognized as factor in reducing TOT and enhancing operational efficiency. A hospital-based study demonstrated that coordinated process redesign could reduce TOT from 42.8 ± 21.7 minutes to 26.4 ± 11.2 minutes (16). Another study reported that OR efficiency could be improved by forming consistent multidisciplinary staff teams, which helped free up to 5.500 hour per year equivalent to approximately one hour per operating room per day (17). Furthermore, a separate study highlighted that forming consistent OR team composed of the same surgeon, nurses, and anesthesia personnel for each procedure significantly contribute to a reduction in TOT (2).

Therefore, this systematic review seeks to explore how multidisciplinary approaches have been implemented in studies targeting TOT reduction, identify effective strategies for interprofessional collaboration, and assess their contributions to improved surgical workflow outcomes. The findings are expected to offer both conceptual insight and practical recommendation for developing more comprehensive and sustainable operating room efficiency strategies.

METHODS

Design

A systematic review design was used in this study. The literature search was conducted in May 2025 using articles published in international journals indexed in electronic databases such as Scopus, PubMed (MEDLINE), ScienceDirect, and ProQuest (Health Medical). The process of article selection followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (*PRISMA*) to guarantee methodological clarity (18).

Inclusion and Exclusion Criteria

The inclusion criteria were taken from the original research article discussing about the factors of multidisciplinary collaboration connected to TOT in hospital operating rooms as the setting of the study. Published in English between the year of 2015 to 2025, and accessible in open access in full-text format. Articles using review methods or classified as non-scientific publications such as books, editorials, or grey literature were excluded.

Search Strategy

Specific keywords relevant to the search topic namely operating room, multidisciplinary, turnover time, collaboration, and others along with boolean operator were combined in PICO search strategy. The process began by applying filters to the journal database, merging the search result, removing duplicates, and screening based on titles and abstracts. The JBI Critical Appraisal Checklist for Systematic Review was used as a guide to evaluate the reviewed studies quality. Full-text screening was then conducted to evaluate eligibility based on the inclusion criteria and predetermined objectives. The entire process of searching, selecting, and analyzing articles was carried out systematically and documented in a traceable manner to ensure the production of a valid and scientifically accountable literature synthesis.

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Data Collection

A total of 167 articles were retrieved from four databases. 90 records remained after removing 27 duplicates, of which 63 passed the title and abstract screening. Following full-text evaluation, 30 articles were assessed for eligibility and appraised using The JBI Critical Appraisal Checklist. Of these, 14 articles were excluded due to lack of alignment with research objectives. Finally 16 articles were included in the synthesis (Figure. 1). The JBI appraisal result indicated that 11 studies were rated as high quality, while 5 met moderate quality criteria, indicating a generally robust evidence base for this review.

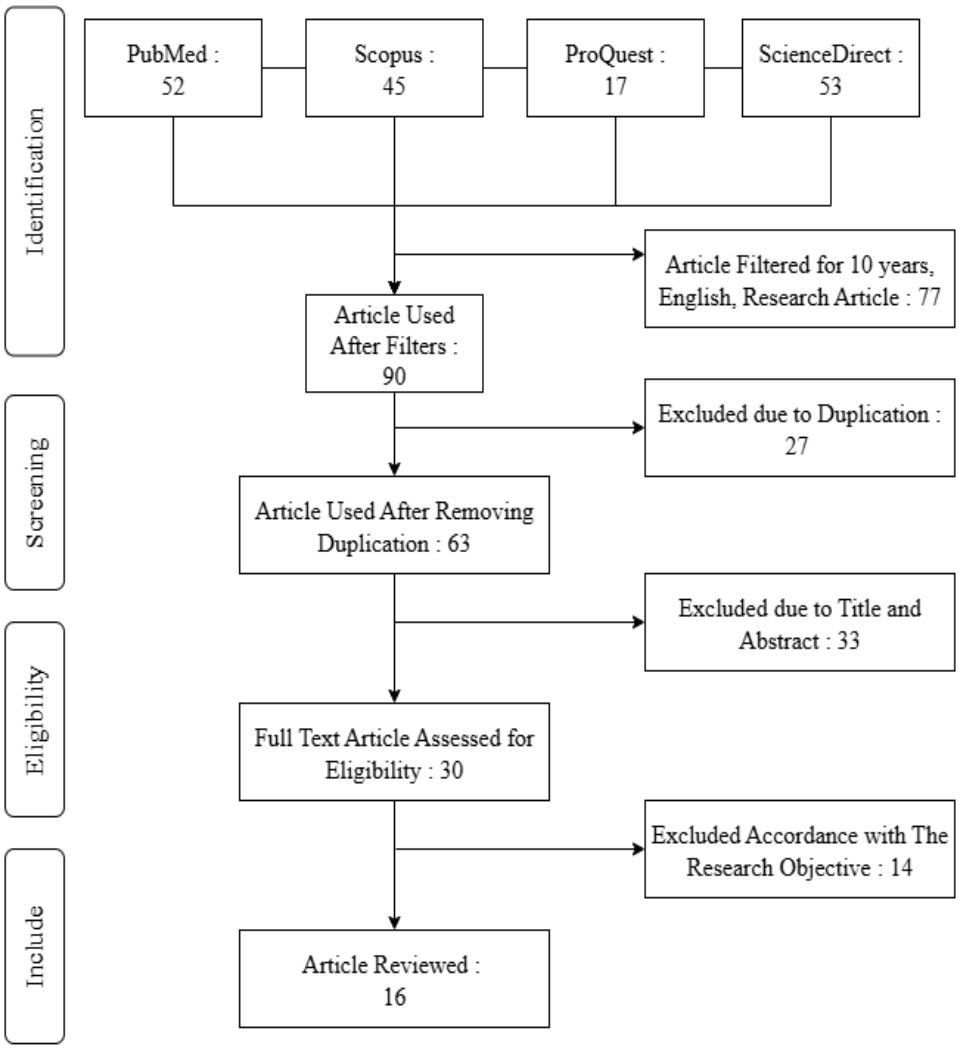

Figure. 1 PRISMA Flowchart

Relevant data were extracted based on the authors name, publication year, article title, study method, type of surgical operation, and the involved healthcare professions. To facilitate comparison across the selected articles, data synthesis focused on examining the form of multidisciplinary collaboration, the strategies employed, and their impact on OR TOT (Table 1).

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Table.1 Data Extraction Summary

Author (Year), Article Title	Method, Type of Surgery & Involved Professions	Form of Multidisciplinary Collaboration	Intervention Strategy Employed	Impact on TOT
Catelyn A. Woelfle et al. (2024), Scheduling and Vendor Consistency Improves Turnover Time in Total Joint Arthroplasty (19).	A retrospective study of 444 cases involving total hip arthroplasty (THA) and total knee arthroplasty (TKA). The team consisted of orthopedic surgeons, scrub nurses, circulating nurses, and implant vendors.	Collaboration in scheduling surgeries and preparing instruments is key. Vendors are directly involved to ensure the instrument sets are complete, so the nursing team doesn't have to adjust a new setup.	The intervention involves scheduling with consistent vendors and types of operations. The same vendor is used in a single operation session to reduce instrument adaptation time and speed up preparation.	TOT decreased by 5.50 minutes (from 43.20 minutes to 38.20 minutes). The team's consistent collaboration with the vendor contributed significantly to this efficiency.
Griffin Rechter et al. (2022), Implementation of a Pre-Operative Huddle at a Level One Trauma Center (20).	An implementation study at a trauma center covering various types of trauma surgeries. The team included surgeons, anesthesiologists, nurses, scrub techs, as well as patients and their families.	Collaboration also takes the form of a preoperative huddle—a brief meeting involving all professionals and the patient to align understanding about the surgical plan, risks, and logistical readiness.	The intervention includes using a standard huddle checklist before each operation to verify instrument readiness, role assignments, and confirm the operation plan.	Although TOT didn't change significantly, the operation start times became more punctual and team communication improved.
Stephen R. Marrone (2018), Perioperative Accountable Care Teams: Improving Surgical Team Efficiency and Work Satisfaction Through Interprofessional Collaboration (21).	A quality improvement project at an academic hospital focusing on orthopedic, cardiothoracic, and neurological surgeries. The team was composed of surgeons, anesthesiologists, nurses, and technicians.	Accountable Care Teams (ACT) create interprofessional teams that share joint responsibility for the perioperative process, with communication and decision-making done together.	It also involves interprofessional training, pre-operation briefings, and workflow improvements to enhance coordination and speed up preparation.	TOT dropped significantly, approaching the 30-minute benchmark, which also boosted team satisfaction.
Nicole H. Goldhaber et al. (2023), Surgical Pit Crew: Initiative to Optimise Measurement and Accountability for Operating Room Turnover Time (22).	A quality study at an academic medical center with 51 multispecialty operating rooms. The team includes surgeons, anesthesiologists, nurses, EVS staff, and technicians.	Collaboration is carried out using a "pit crew" model that divides the turnover phases (cleaning, setup, room readiness) with clear responsibilities assigned to each profession.	The intervention involves segmenting the turnover phase in the EHR using real-time buttons for "clean-up start," "set-up start," and "room ready." Each team is monitored and evaluated.	The cleaning time (EVS) decreased by 5 minutes (from over 15 to under 10 minutes). Overall TOT improvements have been modest, but team accountability has increased.
Mirjam Amati et al. (2022), Reducing Changeover Time Between Surgeries Through	Action research on gynecological and general surgeries at a tertiary hospital.	Collaboration is built through cross-professional workshops to analyze	The intervention applies Lean Thinking and SMED (Single-Minute Exchange of Die)	TOT decreased by 25% equivalent to an average reduction of 17 minutes for

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Author (Year), Article Title	Method, Type of Surgery & Involved Professions	Form of Multidisciplinary Collaboration	Intervention Strategy Employed	Impact on TOT
Lean Thinking: An Action Research Project (23).	The team consists of doctors, anesthesiologists, nurses, housekeeping, and operating theater management.	workflows, identify inefficiencies, and agree on improvement steps together.	principles through Gemba Walks, process mapping, and root cause analysis to reduce time wastage.	gynecological surgery and 15 minutes for general surgery, with no additional costs or new infrastructure needed.
Tara N. Cohen et al. (2022), The Application of Human Factors Engineering to Reduce Operating Room Turnover in Robotic Surgery (24).	A quasi-experimental (pre-post) study on 40 robotic surgery turnovers (thoracic, bariatric, urology). The team consisted of robotic surgeons, anesthesiologists, nurses, EVS, and robotic technicians.	Multidisciplinary collaboration with simultaneous role division for cleaning, organizing robotic instruments, and transferring patients.	The interventions using Human Factors Engineering & the SEIPS Model include developing a real-time dashboard, standardizing cleaning procedures, and optimizing role allocation for each profession.	TOT decreased by 26 minutes ($p < 0.001$), and the number of major delays dropped by over 50%.
Robert J. Cerfolio et al. (2019), Improving Operating Room Turnover Time in a New York City Academic Hospital via Lean (25).	Lean methodology was applied in an academic hospital (bariatric surgery, hernia). The team included surgeons, anesthesiologists, CRNAs, nurses, housekeeping, and sterilization technicians.	Collaboration through the Performance Improvement Team (PIT Crew), where each profession maps out their workflow to transform it into parallel processes.	Lean & PIT Crew-based interventions involve value stream mapping, eliminating 10% of non-value steps, and policy changes where anesthesiologists and nurses prepare the next patient while the current operation is ongoing.	TOT went down from 37 minutes to 14 minutes, with an ROI of $19,500 per day.
Gaur. Khushboo (2019), Systematic and Quantitative Assessment and Application of FMEA and Lean Six Sigma for Reducing Non-Productive Time in Operation Theatre of a Tertiary Care Hospital in a Metropolis (26).	A quality study was conducted at a tertiary hospital with multiple specialties. The team comprised surgeons, anesthesiologists, nurses, and OR management.	Collaboration in the Voice of Customer (VoC) to identify failure modes using FMEA. The team analyzes every delay point in the operating theater flow.	Interventions using Lean Six Sigma (DMAIC) and FMEA focus on improving the pre-anesthesia clinic workflow, optimizing surgery schedules, and implementing day care surgery to reduce Non-Productive Time (NPT).	NPT decreased from 51 minutes to 30 minutes, boosting turnover efficiency.
J Minjy Kang et al. (2018), Improved Utilization of Operating Room Time for Trainee Cataract Surgery in	The prospective intervention involved 270 cataract surgeries performed by residents. The team included residents, anesthesiologists, nurses,	Collaboration through interdisciplinary meetings (nurses, anesthesiologists, pharmacists) to agree on timelines and task distribution.	Group goals and performance feedback intervention: a whiteboard in the operating room displaying target achievements, mass medication delivery by the	TOT decreased from 19 minutes to 18 minutes, and total case time dropped from 55 to 46 minutes.

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Author (Year), Article Title	Method, Type of Surgery & Involved Professions	Form of Multidisciplinary Collaboration	Intervention Strategy Employed	Impact on TOT
a Public Hospital Setting (27).	housekeeping, and pharmacy staff.		pharmacy, and two nurses preparing the next patient.	
Brian J. Linder et al. (2023), Effect of Surgical Care Team Consistency During Urologic Procedures on Surgical Efficiency and Perioperative Outcomes (28).	The retrospective study covered 11,213 urological surgeries (prostatectomy, nephrectomy, cystectomy). The team consisted of urological surgeons, anesthesiologists, circulating nurses, and CST (Certified Surgical Technologists).	Collaboration in the form of stable teams (high-consistency teams): the same CST and nurses accompany several consecutive cases.	Team Consistency Model: comparing the performance of fixed teams with rotating teams using multivariate analysis on operation duration and turnover time (TOT).	TOT went down by 7.2 minutes ($p < 0.001$) in the consistent team; 30-day readmission rates also decreased (4.70% vs. 5.80%).
Ryo Mizumoto et al. (2016), A Surgeon-Led Model to Improve Operating Theatre Change-Over Time and Overall Efficiency: A Randomised Controlled Trial (29).	RCT on 1,265 surgeries (laparoscopy, hernia, colorectal). The team consisted of surgical consultants, anesthesiologists, scrub nurses, and sterile technicians.	The collaboration is directly led by the surgical consultant, who manages the preparation of the next patient and coordinates all teams.	Surgeon-led Changeover Model: communication begins 20 minutes before closure, patient and equipment preparation are done simultaneously in the holding bay, and registrars prepare the surgical notes.	TOT decreased by 58% (12.10 minutes vs. 17.90 minutes).
Edward P. Tagge et al. (2017), Improving Operating Room Efficiency in an Academic Children's Hospital Using Lean Six Sigma Methodology (30).	Lean Six Sigma QI in a pediatric hospital with 612 multi-specialty surgeries. The team included pediatric surgeons, anesthesiologists, nurses, and management.	Collaboration takes place through the Steering Committee and Core Team (surgery, anesthesia, nursing, finance) to organize the perioperative workflow.	DMAIC and Pareto-based interventions are used to identify non-value steps, introduce parallel processing, and monitor daily performance.	TOT dropped from 41 to 32 minutes ($p < 0.0001$).
Christopher H. Stucky et al. (2022), Military Surgical Team Performance: The Impact of Familiarity, Team Size, and Nurse Anesthesia Students (31).	Retrospective study of 751 military orthopedic surgeries. The team was made up of orthopedic surgeons, anesthesiologists, nurses, and SRNAs.	Collaboration is based on the team's familiarity level and team size, where smaller and more consistent teams are more efficient.	Team Familiarity Score: analyzing the impact of SRNAs and small teams on turnover time (TOT), as well as optimizing role allocation.	Team familiarity reduced TOT by 7.84% and SRNA presence reduced expected TOT by 21%. However, the absolute reduction in minutes was not specified in the article.
Yann B. Ferrand et al. (2024), Separate Rooms for Patient Induction, Case Set-up and Breakdown:	Case study in a children's hospital; pediatric, orthopedic, and ENT surgeries. The team	The anesthesia team, scrub nurses, and technicians work simultaneously in separate rooms (induction and breakdown rooms).	Parallel processing with separate rooms: the next patient is induced outside the OR while nurses	TOT significantly decreased, allowing for one additional operation per day without extra staff. However, the

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Author (Year), Article Title	Method, Type of Surgery & Involved Professions	Form of Multidisciplinary Collaboration	Intervention Strategy Employed	Impact on TOT
Innovative Operating Room Turnover Through Quality Management (32).	included anesthesiologists, scrub nurses, and technicians.		prepare instruments in another OR.	absolute reduction in minutes was not specified in the article.
Eddie Y. Lo et al. (2021), Operating Room Efficiency and Cost Reduction in Shoulder Arthroplasty: Advantage of a Dedicated Operating Room Team (33).	Comparative retrospective study of 348 shoulder arthroplasty surgeries. The team consisted of surgeons, anesthesiologists, scrub nurses, and sterile technicians.	A dedicated OR team (orthopedic surgery, anesthesia, scrub nurses, circulating nurses, scrub tech) operates with a fixed communication pattern.	Dedicated team with a 2-room system: one OR is used for surgery while the other is set up in parallel by the same team.	TOT went down by 26 minutes (14 vs. 40 minutes); total OR time reduced by 74 minutes; costs dropped by $360 per case.
Garreth S.Turnbull et al. (2018), Trauma Theatre Productivity – Does the Individual Surgeon, Anaesthetist or Consultant Presence Matter? (34).	Retrospective study: 2,787 orthopedic trauma procedures. Doctors and nurses.	Trauma team collaboration (surgery, anesthesia, nursing) with direct supervision by consultants.	Consultant-led model: consultants manage scheduling, setup, and case priorities, especially for complex trauma surgery lists.	TOT significantly decreased for cases with consultant presence (>50% of the list), particulary in complex trauma lists. However, the absolute reduction in minutes was not specified in the article.

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RESULT

The systematic extraction of data from the reviewed literature highlights four primary multidisciplinary collaboration strategies utilized to optimize operating room turnover time (TOT). First, the implementation of dedicated teams and interprofessional familiarity proved highly effective; maintaining consistent surgical teams, sometimes extending to scheduling consistent external vendors, significantly minimized instrument adaptation time and decreased TOT by 5.5 to 26 minutes per case. Second, structured communication during pre-operative coordination emerged as a vital intervention. Approaches such as standardized pre-operative huddles, perioperative accountable care teams (PACT), and surgeon-led pre-closure briefings fostered a shared mental model across professions. These systematic communication protocols successfully verified logistical readiness, improved team punctuality, and enhanced overall work satisfaction without compromising clinical outcomes.

Furthermore, the findings underscore the substantial impact of simultaneous collaboration through parallel work designs. By shifting from sequential processes to concurrent task execution—often facilitated by "pit crew" models or the utilization of separate rooms for patient induction and case breakdown—multidisciplinary teams successfully mitigated turnover bottlenecks and increased daily surgical capacity. Finally, systematic collaboration-based evaluations incorporating Lean Six Sigma methodologies, Failure Mode and Effects Analysis (FMEA), and Human Factors Engineering were pivotal in driving continuous improvements. These data-driven interventions, which included value stream mapping, the elimination of non-value-added steps, and the integration of real-time performance dashboards, enabled systematic workflow redesigns. Consequently, these rigorous analytical frameworks yielded profound efficiency gains, reaching up to a 58% reduction in TOT across various clinical and academic settings.

DISCUSSION

Implementation of Dedicated Teams and Interprofessional Familiarity

The team remains consistent in the operating room setup, referring to a stable surgical team composition over time, with interprofessional members working together repeatedly. This pattern fosters interprofessional familiarity, meaning team members understand each other's roles, work rhythms, and preferences. A multidisciplinary, team-based collaboration with consistent personnel helps speed up turnover processes. Studies show that when personnel such as surgeons, instrument nurses, anesthesiologists, and room technicians are consistently retained, there is a significant reduction in turnover time (TOT) by 7 to 26 minutes per case, a decrease in total operation time by up to 74 minutes, and a reduction in 30-day readmission rates (28,31,33). Adaptive ability without needing an initial orientation phase was also demonstrated regularly by the same team, resulting into briefings shorter and procedures more efficient. In addition, TOT is further decreased when consistency extends to external parties like instrument vendors, who actively adjust equipment setup and procurement needs, thereby cutting preparation time for the hospital's internal team (19). This effective coming from eness stems are not only coming from role repetition but also from developing and task familiarity among team members and a shared mental model, allowing intuitive coordination without explicit communication, especially for routine and repetitive procedures (28,31,33).

In the context of hospital implementation, this can be begun with scheduling fixed teams based on daily or weekly blocks, for instance, team A is for Monday to Wednesday and team B is for Thursday to Saturday, set based on the surgical workload. This approach is commonly to be easy to be applied in military hospitals or hospitals with stable elective surgery schedules, where there is no disruption from rotation dynamics or staff shortages affect the assigned teams (30,31,33). Besides, teaching hospitals or general hospitals with many rotating resident staff and nurses encounter challenges in maintaining team consistency (27,28). This is also stated by findings from other articles highlighting that team continuity in general hospitals is often difficult to implement due to temporary contracts, fluctuating schedules, and personnel rotations across units (35). Therefore, before adopting a fixed team model in hospitals, it is important to assess and compare the effectiveness of fixed teams in different types of hospitals with

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varying flexibility of organizational, or to formulate an adaptive rotation system while retaining some continuity among team members.

Structured Communication in Pre-operative Coordination

Structured communication is a form of interprofessional communication that is systematically organized to assure crucial information is delivered on time and can be appropriately acted upon. In the context of pre-operative coordination, this communication occurs before surgery, helping to decrease turnover time (TOT). Interventions such as pre-operative huddles and the perioperative accountable care team (PACT) underscore the value of organized, team-based communication by means of systematic briefings conducted before surgery.. In practice, hospitals may schedule a 5–10 minute huddle session before the first surgery of the day, chaired by the circulating nurse or operating room coordinator, using a checklist format that covers room, team readiness, and equipment preparation, and patient identity confirmation (20,21,24). Additional interventions, such as setting time targets and providing visual feedback to resident teams, have been shown to enhance schedule adherence and speed up transitions between cases (27). Furthermore, coordination effectiveness increases when these briefing activities are led or directly controlled by senior surgeons or consultants, especially in complex surgical scheduling, through structured clinical leadership communication methods (29,34). Their role as directors and clinical decision-makers enables earlier detection of complex cases that need prioritization and allows rapid response coordination to operational issues before surgery starts. In implementation, hospitals can assign a "pre-op coordinator" role to senior doctors or nurses to bridge communication between medical teams and operational management, ensuring challenges can be addressed promptly (20,21).

However, not all studies standardize the form or frequency of the preoperative communication needed, making it difficult to apply across institutions. This variation is confirmed by external studies that found the implementation of huddles in different hospitals varies in content structure, team composition, and timing, so there is no agreed-upon best practice yet (36). Additionally, most studies do not deeply explore the influence of organizational culture on the success of this communication. Factors such as professional hierarchy, resistance to openness between professions, and high workloads can hinder effective two-way communication. Other studies also emphasize that when institutions develop a more inclusive safety culture, scores for safety perception and interprofessional communication significantly improve, positively impacting surgical outcomes (37).

In academic hospital settings, where team composition frequently changes due to rotating staff and trainees, maintaining team familiarity becomes particularly challenging. In such contexts, structured communication plays a critical compensatory role by ensuring continuity of information, clarity of roles, and alignment of tasks among team members, even when prior working relationships are limited. By fostering a shared mental model and reducing miscommunication, structured communication can mitigate the negative impact of reduced team familiarity and support consistent team performance in dynamic clinical environment (28,31,33). Therefore, if hospitals want to develop this preoperative strategy, it is advisable to create communication protocols that are not only structured but also adaptive to the social and cultural context of the hospital. Implementing tools like preoperative briefing checklists, expanded team time-outs, and interdisciplinary case reviews can be viable solutions, provided that training and reinforcement of a collaborative culture also proceed in parallel (26).

Simultaneous Collaboration with Parallel Work Design

Simultaneous collaboration describes a work approach that emphasizes executing tasks in parallel across professions rather than sequentially, aiming to decrease waiting time during turnover. Many hospitals still depend on a sequential workflow for operating room turnover, where one stage waits for the previous stage to finish, such as organizing instruments, cleaning the room, and preparing the patient. The results of this approach are bottlenecks and prolongs turnover time. Some studies have imposed simultaneous task division among professions using models like the pit crew, where turnover phases like instrument setup, cleaning, and patient transfer are carried out concurrently by different teams (22,23,32). The use of two separate rooms for induction and setup also enables teams to prepare patients and

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instruments in parallel (32,33). The adoption that can be taken by the hospitals is by developing SOPs for task segmentation and training personnel on role clarity and cross-function awareness to accelerate the transition (25,32). Such models can speed up turnover flow, with reported reductions in turnover time of up to 25–30% from previous baseline times (22,23,32). The task standardization and clear role definitions among team members can be the factors of the success of parallel work. For instance, positioning staff based on the movement path of instruments and patients, grouping instruments in ready-to-use tray sets, and using visual aids (real-time dashboards, whiteboards) all support consistent and fast turnover execution (24,26,33).

The implementation of parallel work design also presents an inherent trade-off between efficiency and human factors. While simultaneous task execution reduces idle time and accelerates TOT, it simultaneously increases coordination demand and cognitive load among team members. In high-preasure environment like OR, this increased workload may contribute to stress, fatigue, and potential burnout among nurses and technicians (38). Furthermore, communication interruptions and inconsistencies in handover process may exacerbate cognitive burden and reduce overall efficiency if not adequately managed (39,40). However, it is not always sufficient to address the complexity and operational dynamics across various hospitals by implementing the parallel design. As such, the development of a hybrid parallel-modern approach is recommended by some studies. Hospitals have the potential not only to depend on simultaneous task distribution but also to improve it with automatic notifications, digital dashboards, and interactive visual boards to watch the progress and team movements. External research demonstrates that integrating digital communication protocols and visual management tools can enhance intra-operation team coordination, lessen role ambiguity, and accelerate decision-making during turnover cycles in the operating room (41,42). Hospitals can leverage this strategy by complementing their existing parallel design, as understanding that efficiency is not achieved by simultaneous workflows alone, but also requires sustained communication and data-driven reporting systems. An integrated turnover dashboard could also be started to build within their Hospital Information System (HIS) and conducting interprofessional briefing training equipped with visual indicators of turnover waiting times. These steps allow a gradual but measurable transition toward a hybrid parallel-modern model (41,42).

Systematic Collaboration-based Evaluation

Systematic evaluation in the context of decreasing TOT refers to using data-driven approaches and cross-professional collaborative analysis to identify challenges and design structured workflow improvements, such as, FMEA, Lean Six Sigma and Human Factors Engineering. In hospital practice, Lean and FMEA approaches can be applied by forming dedicated quality improvement teams for the operating room, involving nurses, surgeons, and logistics staff. This team can implement root cause analyses of turnover delays using methods like Voice of Customer or Cause-Effect Diagrams and then create cycle-based recommendations. For instance, the team could establish standard times and additional procedures to accelerate instrument disinfection or patient transfer if they encounter delays in cleaning phase (26,30). Beyond Lean methods, Human Factors and the SEIPS model (Systems Engineering Initiative for Patient Safety) are used to create ergonomic workflows and enhance team efficiency by redesigning operating rooms based on workload (24). For instance, studies on robotic surgery have shown that implementing a real-time dashboard, role allocation based on workload analysis, and standardizing room cleaning steps can reduce TOT by up to 26 minutes and cut major surgery delays by over 50% (24). Some hospitals have even utilized the development of these real-time visual dashboards to allocate staff based on workload, ensure equipment readiness without verbal instructions, and reduce reliance on any single profession (23,24,26,30).

Although various systematic evaluation approaches have proven effective in reducing turnover time (TOT), there is still a gap in the standardization of evaluation frameworks that can be applied across institutions. Additionally, the integration of evaluation results into internal quality systems and the inclusion of patient safety indicators in turnover audits are rarely addressed in existing studies. However, according to research on patient safety measurement frameworks, the use of standardized safety indicators (structure-process-outcome) can help hospitals systematically track and address potential risks

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when integrated into the hospital's internal quality system alongside cross-unit operational monitoring (43). These approaches can be implemented gradually to hospitals with high procedure volumes or limited human resources, starting with mapping the main bottlenecks, auditing current turnover processes, and redesigning work procedures using Lean tools (5W1H, spaghetti diagram, SIPOC). By strengthening the Quality Committee's role, hospitals can integrate this systematic evaluation into their regular agenda, assuring that the efficiency gains are not incidental but sustainable across units, shifts, and types of operations (23,24,26,30).

CONCLUSION

This systematic review shows that hospitals with stable surgical schedules may benefit more from dedicated teams, while academic hospitals with high staff rotation should prioritize structured communication to maintain coordination despite limited team familiarity. Parallel work design can improve efficiency in high-volume settings but requires careful workload management to prevent staff burnout. In addition, systematic evaluation through data-driven approaches is essential to sustain improvements over time. Therefore, hospitals may adopt these strategies while considering their operational conditions and specific institutional contexts. Although these four approaches have shown effectiveness in various contexts, the results should not be applied broadly to all types of hospitals and surgical procedures, as disparities in organizational settings, team dynamics, and leadership support were not thoroughly explored in this study.

The restriction included the heterogeneity of intervention designs, inconsistency of reported outcomes, and limits in the literature search process such as only using open-access article. These factors may limit the breadth and depth of the analysis. Future research is therefore recommended to further investigate the impact of multidisciplinary collaboration across different types of hospitals and surgical procedures, utilizing more diverse databases and broader search strategies to enhance the sustainability and contextual relevance of TOT improvement initiatives.

DECLARATION OF THE USE OF AI

The authors declare that no artificial intelligence (AI), AI-assisted technologies, or large language models (LLMs) were used in the conception of the study, data analysis, or the drafting, writing, and editing of this manuscript. The only exception is the graphical abstract, which was created using the design platform Illustrae (https://illustrae.co/). The authors take full responsibility for the content and accuracy of the graphical abstract and the entire manuscript.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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