A STUDY ON INFECTION CONTROL PRACTICES IN THE OPERATIONS THEATRE AT THE HOSPITAL

Dissertation Submitted to

The IIHMR University, Jaipur

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Master of Business Administration (MBA)

in

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by

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Under the Supervision and Guidance of

Dr. Ritu Vashistha

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To Whom It May Concern

This is to certify that Ms. Surbhi Kumari, pursuing her MBA (Hospital & Healthcare Management) from IIHMR University, Jaipur has successfully completed her internship at Global Health Patliputra Private Limited (Jay Prabha Medanta Super Speciality Hospital) in the department of Medical Administration & Clinical Operations from 17th March 2025 to 17th June 2025.

We found her sincere, hardworking, and result oriented during the tenure of the internship.

We take this opportunity to wish her all the best for her future endeavours.

For, **Global Health Patliputra Private Limited.**

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CERTIFICATE

This is to certify that dissertation titled **"A Study on Infection Control Practices in the Operation Theatre" at the hospital** is a record of the research work undertaken by (Dr.Surbhi Kumari) in partial fulfilment of the requirements for the award of the degree of MBA (Hospital and Health Management from the IIHMR University, Jaipur under my guidance and supervision and his/her approach to the research study has been sincere, scientific, and analytical.

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DECLARATION BY STUDENT

I hereby declare that this dissertation titled A Study on infection control on OT in a Super speciality hospital in Patna using the Medanta SOPs, NABH audit checklist, WHO surgical guidelines Tool is the Bonafide record of my original research work. I declare that it has not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.

Surbhi

Dr.Surbhi Kumari

31/05/2025

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Abstract

Objective:

To assess current infection control practices in the operation theatre (OT), identify gaps, and recommend improvements based on established guidelines.

Methodology:

A descriptive observational study was conducted in the OT complex of a tertiary care hospital over two months. Data collection involved direct observation using structured checklists aligned with WHO and NABH standards, along with interviews of OT personnel.

Key Results:

- Hand hygiene compliance was only 65%.
- Terminal cleaning was often delayed, especially post-emergency surgeries.
- Poor adherence to OT zoning and inconsistent PPE usage were observed.
- Staff awareness of updated infection control protocols was inadequate.

Conclusion:

The study highlights significant lapses in infection control practices within the OT. Regular training, strict enforcement of SOPs, and continuous monitoring are essential to improve compliance and minimize surgical site infections. Leadership involvement and resource availability are also critical for sustaining infection control efforts.

Keywords:

Infection control, Operation theatre, Hand hygiene, OT zoning, PPE compliance, Terminal cleaning, NABH, WHO guidelines, Surgical site infection

1. Introduction

1.1. Global Burden and Impact of Healthcare-Associated Infections (HAIs) and Surgical Site Infections (SSIs)

Healthcare-associated infections (HAIs) represent a formidable global health challenge, profoundly impacting patient safety and healthcare systems worldwide. These infections are among the most frequent adverse events encountered in healthcare delivery, with an average of approximately 1 in 10 patients affected globally. This prevalence is notably exacerbated in low- and middle-income countries (LMICs) and among high-risk patient populations, such as those in intensive care units (ICUs). In LMICs, the risk of contracting HAIs can be twenty times greater than in developed nations, with infection rates potentially reaching up to 25%.

Surgical site infections (SSIs) stand out as a particularly critical concern within the broader spectrum of HAIs. They are identified as the most common complication following surgical procedures, contributing significantly to patient morbidity and mortality across the globe. SSIs pose a primary threat to surgical patients, underscoring the vital need for stringent infection prevention measures. The pervasive nature of HAIs, especially those caused by multidrug-resistant organisms, directly fuels the escalating global crisis of antimicrobial resistance (AMR). Annually, an estimated 136 million cases of healthcare-associated antibiotic-resistant infections occur worldwide. The gravity of this issue is further highlighted by the staggering statistic that over 5 million deaths globally in 2019 were associated with AMR. In Europe, the burden imposed by the six most frequent HAIs is calculated to be twice that of 32 other infectious diseases combined, in terms of disability and premature mortality, with a substantial 63.5% of antibiotic-resistant infections directly linked to healthcare settings.

The financial ramifications of HAIs and SSIs are immense, placing an enormous strain on healthcare economies. In Europe alone, approximately 9 million HAIs occur annually in acute and long-term care facilities, resulting in an estimated 25 million extra hospital days and incurring costs ranging from 13 to 24 billion euros. Similarly, in the United States, HAIs are implicated in between 44,000 and 98,000 unexpected deaths each year, with the economic cost to healthcare systems estimated to be between $17 billion and $29 billion annually. SSIs, specifically, are a leading cause of unplanned hospital readmissions and can more than double emergency room visits post-discharge.

They significantly inflate hospital costs through prolonged patient stays, increased utilization of resources such as antibiotics, additional surgeries, diagnostic tests, imaging, and wound care, alongside revenue cuts from reimbursement and potential legal disputes.

Beyond the profound financial implications, SSIs impose significant distress on patients, leading to extended recovery periods, heightened morbidity and mortality, a diminished quality of life, and often the necessity for additional surgeries or procedures. Several patient-specific factors can further impede wound healing, thereby increasing the likelihood of infection. These include advanced age, underlying comorbidities such as diabetes or obesity, smoking habits (which reduce blood flow), malnutrition (leading to deficiencies in essential nutrients), the use of certain medications (e.g., steroids, chemotherapy), and poor oxygenation of tissues.

The persistent prevalence of HAIs, as evidenced by the data, directly correlates with the rise of antibiotic resistance and imposes a substantial economic burden on healthcare systems. This suggests a self-perpetuating negative feedback loop: an increase in HAIs necessitates greater antibiotic use, which in turn accelerates the development of antimicrobial resistance. As bacteria become more resistant, infections become more challenging and expensive to treat, leading to prolonged hospital stays, increased morbidity, and higher mortality rates. This cycle further strains already limited healthcare resources. The observation that pandemic disruptions have exacerbated HAIs and AMR underscores the fragility of infection prevention and control (IPC) systems when under duress. This implies that effective infection control is not merely a clinical best practice but a fundamental strategy for preserving the efficacy of existing antibiotics, ensuring the long-term sustainability of healthcare systems, and mitigating the risk of future public health crises driven by untreatable infections. This elevates robust IPC programs to a global health security imperative.

Furthermore, the data consistently points to a disproportionately higher burden of HAIs in LMICs compared to high-income countries. This disparity is explicitly linked to inadequate surgical infrastructure, human resources, equipment, insufficient monitoring of infection occurrence, and the absence of guidelines for preventative antibiotics in LMICs. This direct connection between resource limitations and increased infection rates reveals a systemic inequity in global healthcare outcomes. The global burden of HAIs and SSIs is therefore not a uniform challenge but is profoundly shaped by socio-economic factors and the availability of resources. Consequently, addressing this issue effectively requires interventions that extend beyond clinical protocols to encompass broader development efforts, including investments in healthcare infrastructure, capacity building for human resources, and ensuring equitable access to essential IPC resources and training. A "one-size-fits-all" approach to implementing international guidelines may prove insufficient without careful consideration of local contexts and resource constraints.

1.2. The Imperative of Infection Control in Operating Theatres

The operating theatre (OT) presents a uniquely high-risk environment within the healthcare continuum. Here, multiple risk factors converge, significantly elevating the potential for adverse events, with infection remaining a primary and persistent daily challenge. SSIs are recognized as a leading cause of preventable hospital mortality, directly linked to procedures performed in this critical setting.

The direct invasion of the body during surgical procedures creates an immediate pathway for bacterial entry, making SSIs a paramount concern. The consequences of these infections are severe, profoundly impacting patient recovery, leading to prolonged hospital stays, increased complications, and significant financial strain on both patients and healthcare systems. Crucially, a significant proportion of SSIs are preventable when both patients and hospital staff adhere rigorously to proper prevention practices. This inherent preventability highlights the actionable nature and immense potential impact of dedicated infection control efforts within the operating theatre.

While the operating room is clearly identified as a high-risk environment demanding meticulous infection control practices, the challenges outlined—such as staffing shortages, outdated protocols, and the rise of antimicrobial resistance—are not exclusive to the OR. Instead, they reflect broader, systemic issues prevalent across healthcare. However, due to the controlled and critical nature of surgical procedures, failures in these areas within the OR become particularly impactful and visible, often leading to severe patient outcomes. This suggests that efforts to improve infection control in the OR cannot be isolated from the overall health and resilience of a hospital's infection prevention and control program. Sustainable improvements in OR infection control necessitate addressing these underlying systemic weaknesses in healthcare infrastructure, workforce management, and the continuous adaptation of protocols to evolving threats. The OR thus serves as a crucial indicator and a testbed for the effectiveness of a hospital's broader IPC strategies.

1.3. Defining Key Infection Control Practices in the Surgical Environment

Infection control practices in the operating room encompass a comprehensive array of measures meticulously designed to maintain an aseptic environment throughout the entire surgical procedure. These foundational principles include proper scrubbing procedures for both the patient and the surgical team, adherence to specific protocols by all operating personnel during procedures, and the diligent and proper handling of surgical instruments.

The practices can be broadly categorized into several critical components:

Hand Hygiene: This is universally recognized as the single most effective measure to prevent infection transmission and serves as the cornerstone of infection prevention, significantly decreasing disease transmission and reducing infection rates. For surgical hand antisepsis, specific steps are mandated. These include the removal of all jewelry from wrists and hands, cleaning debris from underneath fingernails using a nail cleaner under running water, and the application of an antimicrobial agent (surgical hand wash or rub) for a duration of 3–5 minutes. Hands and forearms must be washed approximately 5 cm above the elbows, and it is imperative that they are allowed to dry thoroughly before donning sterile gloves. Compliance with hand hygiene by healthcare workers is a vital quality measure, and consistent monitoring to provide feedback is critical for continuous performance improvement. Perioperative nurses, in particular, play a crucial role, with proper and frequent handwashing being fundamental to their duties.

Patient Preparation: This critical phase involves patients showering or bathing their full body with an antiseptic agent, such as chlorhexidine, or plain soap, ideally at least the night before the operative day. If hair removal is deemed necessary, it should be performed immediately before surgery using clippers rather than razors, as shaving with a razor can irritate the skin and increase the risk of infection. The operative site itself must be meticulously scrubbed with an alcohol-based antiseptic, ensuring it is allowed to dry completely before the use of electrocautery. Furthermore, identifying and treating any remote infections before elective operations, and encouraging tobacco cessation for a minimum of 30 days prior to surgery, are crucial steps in minimizing infection risk.

Surgical Attire and Barrier Techniques: These measures are essential for preventing the transmission of infectious agents from personnel to the patient and vice-versa. This includes the mandatory wearing of head covers that fully cover all hair, sideburns, and necklines, ideally disposable and made of nonporous material. Masks, preferably disposable and made of synthetic fibers with filters, must be worn throughout the entire procedure, covering both the mouth and nose. Sterile gloves and surgical gowns and drapes that serve as effective barriers when wet (i.e., resist liquid penetration) are also critical components. Any scrub suits that become visibly soiled, contaminated, or penetrated by blood or other potentially infectious materials must be changed immediately.

Instrument Handling and Reprocessing: Proper handling of instruments and meticulous decontamination are vital to prevent the spread of pathogens. This multi-step process involves physical cleaning, water purification, ultrasonic cleaning, disinfection, antisepsis, and ultimately, sterilization. All surgical instruments must be sterilized strictly according to published guidelines and manufacturer's recommendations. Immediate-use steam sterilization should be reserved only for genuine emergencies when no other options are available, and never used for convenience, as an alternative to purchasing additional instrument sets, or to save time. The decontamination and reprocessing of medical devices are emphasized in WHO guidelines as crucial for preventing healthcare-associated infections.

Environmental Control and Ventilation: Maintaining an aseptic environment within the operating theatre is paramount. This includes specific requirements for operating room ventilation systems: they must maintain positive pressure (ensuring air flows from the OR to adjacent areas, minimizing inflow of contaminated air), have a minimum of 20 air changes per hour (of which at least four changes should be with fresh air), ideally incorporate high-efficiency particulate air (HEPA) filtration, and maintain strict temperature (68-75°F or 20-24°C) and humidity (20-60%) controls. Cleaning and disinfection of the inanimate environment are also critical, with floors cleaned daily or at the end of each session, horizontal surfaces and all surgical items cleaned between procedures, specific blood or body fluid spillages dealt with immediately, and walls and ceilings cleaned biannually.

Sterile and Surgical Technique: Strict adherence to the principles of sterile technique is fundamental for all invasive procedures. Surgeons are expected to employ meticulous operative techniques, which include obliterating dead spaces where possible, handling tissues gently, limiting the use of electrocautery, and removing all devitalized tissue before wound closure. If drainage is necessary, a closed suction drain should be utilized, placed in a separate incision distant from the primary operative incision, and removed as soon as clinically possible.

Antimicrobial Prophylaxis: The administration of appropriate antimicrobial prophylaxis immediately before skin incision is a key strategy in preventing SSIs. This ensures that the bactericidal concentration of the antibiotic is highest in the serum and tissues at the critical time of incision. Generally, antibiotics should be discontinued after the incision is closed in the operating room, even in the presence of a drain.

The detailed enumeration of infection control practices—ranging from hand hygiene and patient preparation to surgical attire, instrument reprocessing, environmental controls, surgical technique, and antimicrobial prophylaxis—reveals that effective infection control in the OR is not a collection of isolated steps. Instead, it functions as a highly interconnected and interdependent system. A lapse in one area, such as inadequate hand hygiene, can directly compromise the integrity and effectiveness of other critical elements, like maintaining a sterile field. The emphasis on achieving an "aseptic environment throughout the procedure" and employing "meticulous operative techniques" further underscores this systemic dependency. For infection control to be truly effective, it necessitates a holistic approach where all elements are consistently and correctly implemented. Training and monitoring programs should therefore emphasize these interdependencies, fostering a culture of collective responsibility among the surgical team rather than focusing solely on individual task completion. This inherent complexity also implies that identifying the root causes of surgical site infections may require a comprehensive investigation that traces potential failures across multiple, seemingly disparate practices.

Moreover, the extensive guidelines from organizations like WHO and CDC are presented as comprehensive and subject to regular updates. References to "evidence-based standards and guidelines" and the "rapidly evolving nature of EBP" clearly indicate that infection control is a dynamic field. Specific examples, such as the recommendation to use clippers instead of razors for hair removal or the preference for alcohol-based antiseptics, demonstrate how practices evolve directly in response to new scientific evidence. This dynamic nature mandates a commitment to continuous learning and adaptation within healthcare facilities and among personnel to remain compliant with the latest evidence-based practices. The persistence of "outdated protocols" poses a significant barrier, highlighting an urgent need for robust mechanisms for knowledge dissemination, efficient protocol updates, and ongoing staff education. This also fundamentally implies that the concept of "best practice" in infection control is not static but requires constant re-evaluation and refinement.

1.4. Challenges in Implementing Effective Infection Control

Despite the existence of comprehensive guidelines and a clear understanding of effective practices, numerous persistent obstacles hinder the optimal implementation of infection control measures in operating theatres.

One significant challenge stems from emerging pathogens and antimicrobial resistance (AMR). New germs are constantly emerging, and existing ones are developing resistance to common antibiotics, rendering infections increasingly difficult to control and treat. The Centers for Disease Control and Prevention (CDC) reports that nearly 1 in 31 hospital patients has at least one healthcare-associated infection (HAI) on any given day, and the World Health Organization (WHO) projects that resistant infections could tragically cause 10 million deaths annually by 2050. This necessitates continuous adaptation of infection prevention strategies and highlights the relentless evolutionary pressure on pathogens.

Staffing shortages and morale challenges represent another critical barrier. Insufficient staffing levels and widespread healthcare worker burnout, affecting nearly 30% of the workforce, directly compromise infection control efforts. Overwhelmed or fatigued staff may inadvertently skip crucial hygiene and safety steps, leading to higher infection rates. The stress associated with limited or poor-quality Personal Protective Equipment (PPE) can further erode morale and contribute to high staff turnover, creating a vicious cycle where shortages exacerbate burnout, which in turn lowers infection control standards.

Outdated infection prevention protocols also pose a substantial impediment. Many hospitals continue to rely on protocols that do not reflect the latest scientific and technological advancements, thereby failing to adequately account for new germs or resistant bacteria. This can lead to delays in critical information sharing, for instance, through continued reliance on paper records instead of electronic systems, and an increased propensity for errors in patient care. A particularly concerning barrier is the reported lack of a dedicated Infection Prevention Nurse in 32% of US hospitals, a role that is crucial for the continuous updating and rigorous enforcement of protocols.

Furthermore, implementation gaps and low compliance with established guidelines are widespread. Despite international consensus guidelines proposing evidence-based strategies, there are persistent challenges in the efficient and interdisciplinary implementation of these measures within the operating theatre, leading to low compliance with surgical site infection (SSI) prevention measures. Globally, only 29% of tertiary hospitals have established comprehensive IPC programs, and numerous facilities report significant deficiencies in procedural adherence, staff training, and the adequate presence of hygiene specialists.

The lack of specificity and interdisciplinary integration in existing guidelines also presents a challenge. While guidelines from organizations like WHO and CDC provide a strong foundational framework, they often lack sufficient specificity regarding the intricate interdisciplinary applications required for effective SSI prevention in complex operating room environments. The concept of "interdisciplinary" collaboration, which is crucial for coordinated efforts among surgeons, anaesthetists, technicians, and nurses, remains underexplored in the existing literature, highlighting a gap in understanding how to best foster cohesive teamwork.

Finally, the management of human error and challenges in evaluation persists. Managing human error in the perioperative period remains a major challenge, as even minor deviations from protocol can have significant consequences. Additionally, the effective evaluation of interventions is complicated by inconsistent reporting of outcome measures and considerable variability in monitoring methods across different studies and facilities. There is also a noted lack of innovation in studies, which frequently highlight "what should be done" but rarely delve into "how to implement these measures effectively," pointing to an urgent need for more actionable strategies.

The simultaneous existence of comprehensive, evidence-based guidelines from reputable organizations like WHO and CDC and the documented prevalence of issues such as low compliance, outdated protocols, and significant deficiencies in IPC programs at a global level points to a critical gap between knowledge and practice. This indicates that while the fundamental scientific understanding and recommended practices are available, their consistent and effective application in real-world clinical settings remains problematic. This suggests that the primary challenge in infection control is not a deficit in scientific understanding or guideline development, but rather the presence of deeply rooted systemic, cultural, and operational barriers to implementation. Consequently, future interventions and research should shift focus from merely developing new guidelines to understanding and overcoming these implementation hurdles, emphasizing human factors, organizational culture, resource allocation, and continuous quality improvement methodologies. The concerning statistic that 32% of US hospitals lack an Infection Prevention Nurse is a stark indicator of this critical gap in practical application.

Furthermore, the presented information explicitly draws a direct causal link between staffing shortages and healthcare worker burnout and elevated infection rates. This occurs because overwhelmed or fatigued staff are more likely to overlook critical hygiene and safety protocols. This establishes that the well-being, capacity, and mental state of healthcare personnel are not merely human resources concerns but fundamental determinants of patient safety outcomes. Therefore, strategic investments in healthcare workforce retention, comprehensive programs to address burnout, ensuring adequate staffing levels, and providing high-quality personal protective equipment are not optional benefits but essential infection control strategies. A healthy, well-supported, and appropriately staffed workforce is an indispensable prerequisite for the effective and consistent implementation of infection prevention measures, directly impacting the quality and safety of patient care.

1.5. Rationale for a Retrospective Study Design

The selection of a retrospective study design for this dissertation is predicated on several distinct advantages that align well with the objectives of examining infection control practices in the operating theatre.

Firstly, retrospective studies are notably efficient and cost-effective in terms of both time and financial resources. Since the data has already been collected—often from existing hospital electrical records systems or medical records—there is no requirement for new, resource-intensive data collection, expensive laboratory equipment, or a large research team. This inherent characteristic allows for quicker completion of studies, even when the study period spans several years, as the primary work involves collation and analysis of existing information.

Secondly, this approach offers the significant benefit of leveraging existing data. It enables the utilization of pre-existing secondary research data, frequently derived from prior prospective studies or routine hospital records, which can be readily accessed for analysis. A survey even indicated that retrospective chart review conducted by medical record technicians for nosocomial infections could be as accurate and reliable for identifying basic trends as prospective review, sometimes even identifying more infections. This highlights the untapped potential of routinely collected clinical data for surveillance and improvement.

Thirdly, a retrospective approach demonstrates strong feasibility for infection control research. Given that infection control practices and outcomes (such as SSI rates) are routinely documented within hospital information systems, this design is particularly well-suited to examine historical adherence to protocols, identify trends in SSI rates over time, or analyze the impact of past interventions without interfering with ongoing clinical operations.

Fourthly, retrospective studies, particularly cohort designs, facilitate greater outcome analysis. They possess the capacity to analyze multiple outcomes simultaneously from a single identified exposure, leading to a more comprehensive understanding of complex relationships and enabling the identification of the natural history of a disease or the long-term impact of specific practices.

Finally, a key purpose of retrospective studies is their utility in informing prospective research. They can serve as an intermediate step between preliminary investigations and more robust prospective experimental designs, strengthening the assumptions and hypotheses that underpin future, more resource-intensive studies.

The inherent advantages of retrospective studies—namely, their efficiency, cost-effectiveness, and ability to leverage existing data—strongly suggest that a vast amount of valuable information pertinent to infection control is continuously generated and stored within healthcare facilities. The finding that retrospective chart reviews can be as accurate as, or even more effective than, prospective reviews for identifying nosocomial infections indicates that this routine clinical data holds significant, often untapped, potential for ongoing surveillance, trend analysis, and pinpointing areas ripe for improvement, all without the need for resource-intensive, de novo data collection. This implies that healthcare institutions should strategically invest in developing robust, easily accessible electronic health record (EHR) systems and advanced data analytics capabilities. By doing so, they can maximize the utility of their existing clinical data for continuous infection control surveillance and research. Such an approach could facilitate real-time monitoring, enable rapid identification of emerging issues or gaps in protocol adherence, and ultimately shift the paradigm of IPC from a reactive to a proactive and continuously improving system.

1.6. Aim and Objectives of the Dissertation

The overarching aim of this dissertation is to retrospectively analyze the adherence to and impact of infection control practices within the operating theatre of over a defined period, with the goal of identifying areas for improvement and informing future infection prevention strategies.

2.Literature Review

Authors	Study Location	Sample Size	Sampling Techniques	Salient Features
1.Camilla Wistrand, Karin Falk-Brynhildsen, Ann-Sofie Sundqvist	Sweden	890 OR nurses	Web-based cross-sectional survey	Nurses identified 12 key SSI prevention interventions (skin disinfection most important); noted knowledge gap on skin disinfection sterility.
2.Tesfaye Engdaw Habtie, Sefineh Fenta Feleke, Aregash Birhan Terefe, Addis Wondmagegn Alamaw, Melsew Dagne Abate	Global (Systematic Review & Meta-analysis, many studies from Ethiopia)	17 observational studies (sample sizes 30-515)	Systematic Review/Meta-analysis (PRISMA checklist)	Pooled nurses' good knowledge of SSI prevention 62% (dichotomous) or 46% (Likert); highlights poor knowledge levels and need for targeted education; training, longer service years, higher education improve knowledge.
3.Sara Khan, Humaira Saddique, Rubina Jabeen	Lahore, Pakistan	130 operating room nurses	Purposive sampling	Discrepancy between low knowledge (e.g., 60% gown sterility, 54.6% dropped sterile packages) and high practice (94% sterile

				techniques, 91% handwashing); critical need for enhanced training and continuous education.
4.*Not specified in snippet* (Study on surgical attire)	Eastern Cape, South Africa	n=85 nurses	Convenience sample, purposive allocation (quasi-experimental)	Educational intervention improved nurses' knowledge of surgical attire; identified knowledge deficiencies (gowns reuse, inadequate hair covering, improper hand hygiene) increasing SSI likelihood.
5.*Not specified in snippet* (Systematic review on SSI prevention)	Global (Systematic Review)	N/A (synthesizes multiple trials)	Systematic Review of Randomized Trials	Identified 6 evidence-backed SSI prevention strategies: avoiding razors, decolonization (intranasal antistaphylococcal agents, skin antiseptics), appropriate antibiotic prophylaxis, normothermia, chlorhexidine gluconate + alcohol

				skin prep, perioperative glucose control.
6.SR Vatavati, MS Kampli	Public health institutions throughout India	1,88,82,734 surgeries (48,51,788 major, 1,40,30,946 minor); 23,286 SSIs reported	Analysis of existing Health Management Information System (HMIS) data (census)	SSI incidence in India consistently higher (23-38% in some studies) vs. global (0.5-15%); 123 SSIs per 100,000 surgeries nationally; significant regional variations in SSI reporting (e.g., Meghalaya 923, Assam 669, vs. Kerala, Nagaland, Odisha, Rajasthan low).
7.Ambika Bhatiani, Ritika Tiwari, Mohd. Saqib Hasan, Nashra Afaq, Ajay Narang, Shahnaz Parveen, R. Sujatha, Deepika Shukla, Deepak Kumar	Tertiary Care Centre, Uttar Pradesh, India	170 patients	Cross-sectional study (inclusion: surgically treated adults >16; exclusion: repeat surgery, immunosuppressed, immunodeficient, on antibiotics, other infections)	SSI prevalence 8.2%; more common in abdominal/emergency surgeries, males (64.2%), diabetics, age >30, lengthy hospital stay; common isolates: *Klebsiella pneumoniae* (28.5%), *E. coli* (21.4%), *Pseudomonas aeruginosa* (21.4%), *S. aureus* (14.25%);

				superficial site most affected (57.1%).
8.Parmeshwar Kumar, Shakti Kumar Gupta, Arti Kapil, Aarti Vij, IB Singh	Operation theaters of tertiary level, referral public and private sector hospitals in Delhi, India	80 cases (1920 observations) across 6 hospitals (15 from autonomous, 13 from others)	Purposive sampling (for hospitals)	Overall hand hygiene compliance 80.5% (autonomous 89% > private 78% > public 74.5%); significant gaps in hand washing practices (e.g., after glove removal 60% overall, before catheter insertion public 71% vs. autonomous 100%); compliance with CDC Category 1A practices varied (autonomous 80%, private 67.8%, public 62%); surgical scrub compliance 85% overall with specific technique gaps (e.g., subungual cleaning, drying time)
9.Anveshi Nayan, Bhakti Sarang, Monty Khajanchi, Nobhojit Roy,	Rural and semi-urban hospitals across India	Phase I: 17 surgeons; Phase II: 5 hospitals, 287 surgeries	Phase I: Cross-sectional survey; Phase II: Prospective cohort study (consecutive patients, 30-day follow-up)	100% compliance with perioperative sterilization and mop count (reported by surgeons); prophylactic antimicrobials continued post-op in

Gnanaraj Jesudian, Nandakumar Menon, Mulki Patil, Raman Kataria, Ravikumar Manoharan, Rajesh Tongaonkar, Ya Dev, Anita Gadgil				>80% (against global guidelines); hand washing time knowledge 65%; WHO Surgical Safety Checklist used in only 35% hospitals (time/manpower constraints cited); overall SSI rate 7.0%; SSI rates 6x higher in dirty wounds; higher classes of antimicrobials prescribed for SSIs without culture-sensitivity.
10.Jain et al. (2024)	Gujarat, India	1,140 surface & 540 air samples from 6 OT	Purposive sampling of OTs	Highest microbial contamination in septic OT (air 251 CFU/m³); highlights importance of regular surveillance
11.Kelkar et al. (2013)	Pune, India	6 mask-wearing healthcare workers	Cough plate method at intervals (0–150 mins)	Cotton and disposable masks effective up to 60 mins; inefficacy beyond 2 hours
12.Mehta et al. (2021)	Bhagalpur, India	412 postoperative patient records	Random sampling	SSI rate 11.1%; lack of prophylaxis & emergency surgeries increased SSI risk by 2.6×

13.Nayan et al. (2023)	Rural India	Phase I: 50 surgeons, Phase II: 5 hospitals	Survey & observational SSI tracking	High sterilization compliance; poor antimicrobial stewardship; SSI rate 7%
14.Çelik et al. (2021)	Adana, Turkey	66 OT staff	Single-blind structured observation	Only 56% wet hands correctly; none followed complete hand scrubbing protocol
15.Birnbach et al. (2011)	Florida, USA	60 hours over 28 surgeries	Covert observational sampling	Hand hygiene compliance only 2–8%; major lapses during entry/exit
16.Megeus et al. (2015)	Sweden	Not specified; anaesthetic teams observed	Direct observational method	Identified serious breaks in aseptic technique during induction of anesthesia
17.Zhang et al. (2023)	Southwest China	65,885 post-op patients + 1,046 nurses	Electronic health record review + Survey	SSI incidence ~7%; staff had good knowledge/attitude but lacked full compliance
18.INICC Study (2003–2011)	Multiple hospitals, Turkey	21,145 hand hygiene opportunitie s	Pre-post interventional design	Compliance improved from 28.8% to 91% post intervention with bundles (education, audit)
19.Schmid et al. (2020)	Germany	1,145 observed HH events in 16 surgeries	Structured direct observation	Surgeons had lowest HH compliance (19.6%); anesthetists higher (47.9%)

3. METHODOLOGY

STUDY DESIGN: descriptive observational study.

SETTING: The study will be conducted in the operation theatres of a tertiary care hospital (JAY PRABHA MEDANTA SUPERSPECIALITY HOSPITAL PATNA)

STUDY POPULATION: OT personnel, including surgeons, anaesthetists, nursing staff, housekeeping staff, and infection control officers at Jay Prabha Medanta Patna.

Inclusion Criteria:

- OT staff working in the hospital from past one year.
- Consent to participate in the study.

Exclusion Criteria:

- Interns or rotational staff with less than 6 months of experience in OT.
- Personnel on leave or unavailable during the study period.

STUDY TOOLS:

- Observational checklists for qualitative insights.
- Standard Medanta SOPs, NABH audit checklist tools based on WHO/CDC surgical guidelines.

DURATION OF STUDY: 2 months (16^{th} April 2025 to 31^{ST} May 2025).

SAMPLE SIZE: Size = 95.

SAMPLING TECHNIQUE: Stratified random sampling ensuring proportional representation from different OT staff categories and different types of cases.

DATA COLLECTION PROCEDURE:

- Direct observation of surgical procedures using an IPC checklist.
- In-depth interviews with key informants (e.g., infection control nurse, OT supervisor).

Operational Definitions:

- **Compliance:** Adherence to established IPC guidelines during surgical procedures.
- **Surgical Site Infection (SSI):** Infections occurring within 90 days post-operation (or days for implants).
- **Aseptic Technique:** Practices used to prevent contamination during surgical procedures.
- **Hand Hygiene:** WHO's 5 moments of hand hygiene, including hand washing/sanitizing.
- **Sterilization:** The process to eliminate all forms of microbial life from surgical instruments.

DATA ANALYSIS PLAN:

Data will be analysed using SPSS Version 26.0.

- Descriptive statistics: Frequencies, percentages, means, standard deviations.
- Qualitative data will be thematically analyses.

ETHICAL CONSIDERATIONS:

- Ethical approval will be sought from the Institutional Ethics Committee.
- Informed written consent will be obtained from all participants.
- Anonymity and confidentiality will be strictly maintained.
- Data will be stored securely and used solely for academic purposes.
- Participants will have the right to withdraw at any stage without any consequence.

4. RESULTS

1. TYPES OF CLEANING PROCEDURES INSIDE THE OT

Table 4.1- Types of cleaning

TYPE OF CLEANING (16th April to 31st may)			
	YES	NO	PERCENTAGE
Mopping	95	0	100%
Dusting	43	52	45%

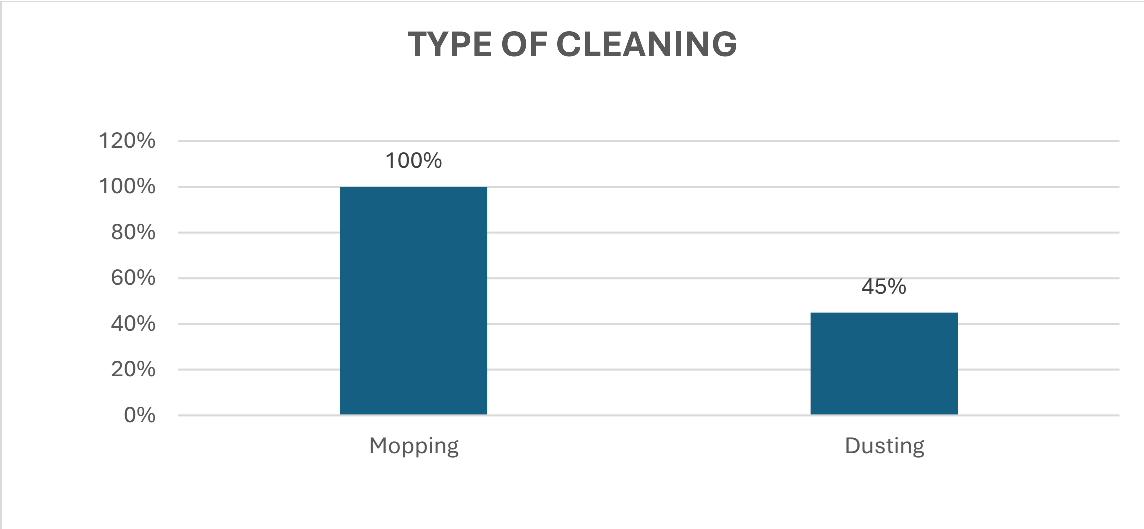

Figure 4.1- Types of Cleaning(16th April to 31st May)

Mopping was performed in 100% of observed instances. Dusting was performed in 45% of observed instances.

2. SURFACES CLEANED AFTER SURGERIES.

Table 4.2- Surfaces cleaned after surgeries.

SURFACES CLEANED					
	YES	NO			
OT TABLE	95	0	100%		
FLOOR	95	0	100%		
LIGHTS	33	62	35%		

EQUIPMENTS	73	22	77%		
DUSTBIN	95	0	100%		
TROLLEY	58	37	61%		

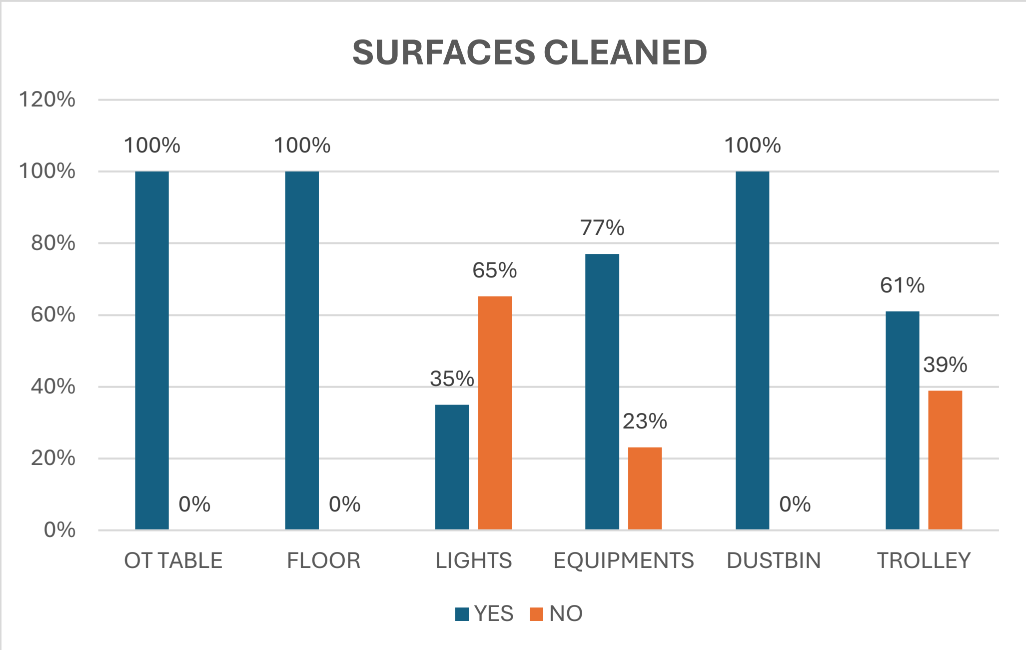

Figure 4.2- Surfaces cleaned in OT.

The OT table, floor, and dustbin were cleaned in 100% of observations. Equipment was cleaned in 77% of observations. Lights were cleaned in 35% of observations. Trolleys were cleaned in 61% of observations.

3. TOTAL CLEANING TIME AFTER EACH SURGERY.

Table 4.3- Total cleaning time after each surgery.

TOTAL CLEANING TIME (mins)	
AVERAGE	00:21
MAX	00:44
MIN	00:07

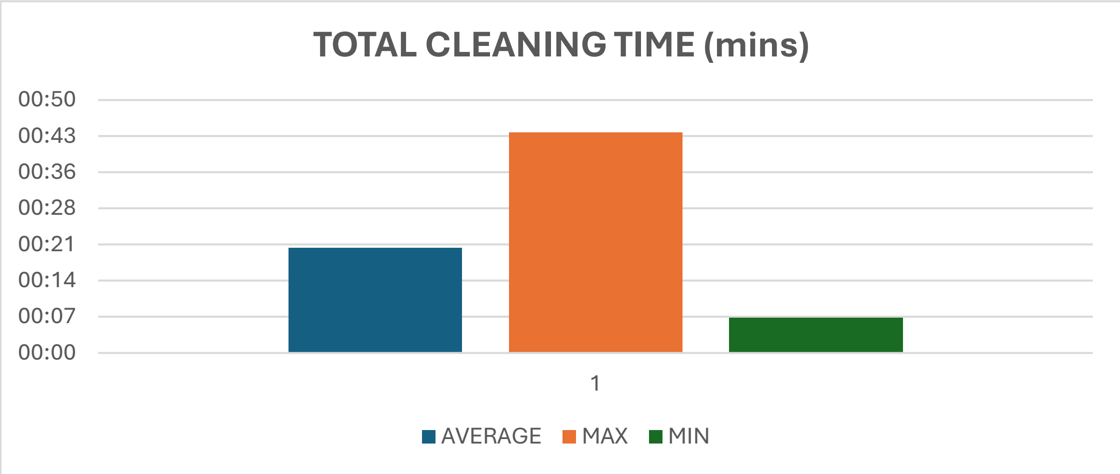

Figure 4.3- total cleaning time(mins)

The average total cleaning time observed was 21 minutes. The maximum cleaning time recorded was 43 minutes, and the minimum cleaning time was 7 minutes.

4. SURGICAL HAND WASH TIMING.

Table 4.4- Surgical hand wash timing

	SURGEON	**SCRUB NURSE**
AVERAGE	**00:03**	**00:04**
MAX	**00:08**	**00:09**
MIN	**00:01**	**00:02**

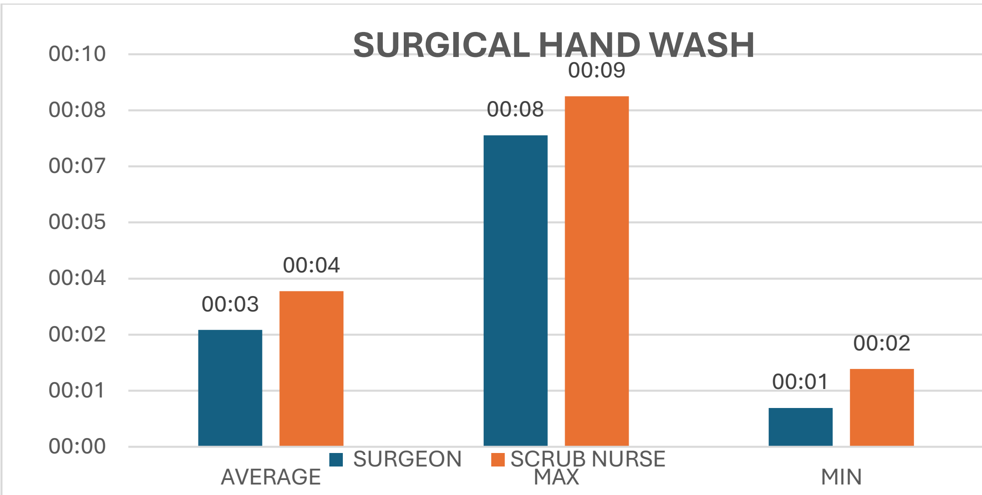

Figure 4.4- Surgical hand wash timing.

For surgeons, the average hand wash time was 2 minutes. The maximum hand wash time for surgeons was 8 minutes, and the minimum was 1 minute.

5. **<u>PPE method.</u>**

Table 4.5- PPE method.

	PPE (sample 50) of surgeons & scrub nurses			
	GOWN	MASK	HEAD CAP	GLOVES
PROPER	49	46	50	50
NOT PROPER	**1**	**4**	**0**	**0**

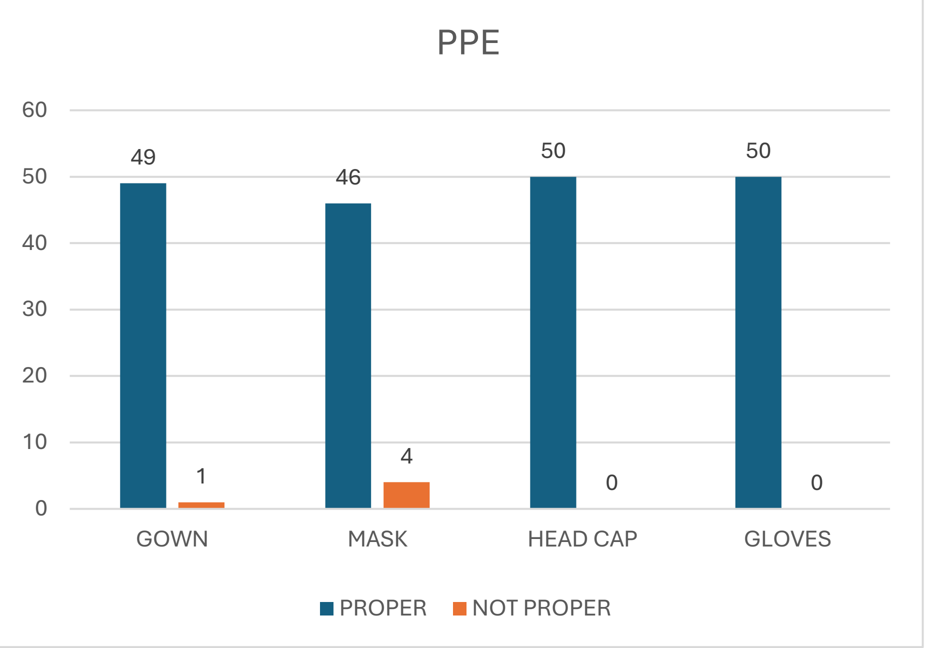

Figure 4.5- PPE method.

Gowns were worn properly in 49 out of 50 observations. Masks were worn properly in 46 out of 50 observations. Head caps and gloves were worn properly in all 50 observations.

6. **<u>TOTAL TIME BETWEEN THE SURGERIES (mins)</u>**

Table 4.6- Total time between the surgeries (mins)

Total time between Sx (mins)	
AVERAGE	00:45
MAX	03:15
MIN	00:15

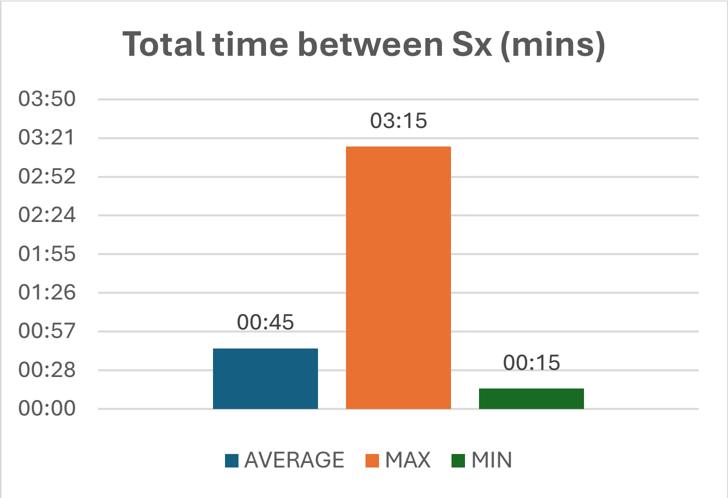

Figure 4.6- Total time between Surgeries (mins).

The average time between surgeries was 45 minutes. The maximum observed time between surgeries was 3 hours and 15 minutes, while the minimum time was 15 minutes.

5.Discussion

This study, based on a sample size of 95 observations (or N=50 for PPE), provides insights into infection control practices within the operation theatre, particularly concerning cleaning protocols and hand hygiene adherence.

Inter-surgical Turnaround Time and Cleaning: The average time between surgeries was 45 minutes, with a significant maximum of 3 hours and 15 minutes. The average total cleaning time was 21 minutes, which falls within the stipulated SOP range of 20-30 minutes. However, the observed minimum cleaning time of 7 minutes indicates instances where cleaning was significantly shorter than the recommended duration, while the maximum of 43 minutes suggests potential inefficiencies or more extensive cleaning needs in specific cases. The variability in cleaning time, ranging from 7 to 43 minutes, indicates inconsistency in adherence to the SOP's expected time frame for inter-surgical cleaning.

Cleaning Methods and Surface Coverage: Mopping was consistently performed (100%), which is a fundamental component of environmental cleaning. However, dusting was only carried out in 45% of observations. This disparity suggests a potential oversight in addressing airborne particulate matter and settled dust, which can harbor microorganisms. Regarding surface cleaning, while critical surfaces like the OT table, floor, and dustbin were always cleaned (100%), there were notable deficiencies in cleaning other surfaces. Equipment was cleaned in 77% of cases, trolleys in 61%, and lights in only 35%. These findings indicate a significant gap in comprehensive environmental cleaning, as all surfaces within the OT environment can serve as reservoirs for pathogens, contributing to surgical site infections (SSIs) if not adequately disinfected. Current guidelines emphasize thorough cleaning of all high-touch surfaces and equipment after each procedure to minimize microbial load (CDC, 2003; WHO, 2016). The observed gaps pose a direct risk to patient safety.

Personal Protective Equipment (PPE) Adherence: Adherence to proper PPE usage was generally high. Head caps and gloves were worn properly in all 50 observations. Gowns were properly worn in 49 out of 50 instances, and masks in 46 out of 50. This indicates a strong level of compliance with PPE protocols among the observed staff. Proper PPE use is critical in preventing the transmission of microorganisms from healthcare personnel to patients and vice versa (Siegel et al., 2007). The minimal instances of improper mask and gown usage, though few, still highlight areas for reinforcement.

Surgical Hand Wash Duration: The observed hand wash times for both surgeons and scrub nurses fall below the recommended minimum of 5 minutes as per SOP. The average hand wash time for surgeons was 2 minutes, and for scrub nurses, it was 4 minutes. Even the maximum observed times (8 minutes for surgeons, 9 minutes for scrub nurses) are not consistently high, and the minimum times were significantly short (1 minute for surgeons, 2 minutes for scrub nurses). Surgical hand antisepsis is a cornerstone of infection prevention in the operating theatre, and inadequate duration compromises its effectiveness, potentially leading to bacterial transfer to the surgical site (Guideline for Hand Hygiene in Health-Care Settings, 2002; WHO Guidelines on Hand Hygiene in Health Care, 2009). This consistent deviation from the SOP is a critical finding that needs immediate attention.

Recommendations:

1. **Reinforce Cleaning Protocols:**
   - **Comprehensive Surface Cleaning:** Implement and strictly enforce a checklist-based system for cleaning *all* surfaces in the OT, including lights, equipment, and trolleys, after every surgery. This checklist should be visibly displayed and routinely audited. Refer to CDC guidelines for environmental infection control in healthcare facilities (CDC, 2003).
   - **Integrate Dusting:** Mandate and monitor the regular dusting of all surfaces in the OT as part of the inter-surgical cleaning process. This could be integrated into the comprehensive cleaning checklist.
   - **Time Management for Cleaning:** Investigate the reasons for extremely short (e.g., 7 minutes) and exceptionally long (e.g., 43 minutes) cleaning times. This might involve assessing staff workload, availability of cleaning supplies, and complexity of cases. Provide training on efficient and thorough cleaning techniques to ensure adherence to the 20-30 minute SOP.
2. **Optimize Surgical Hand Hygiene:**
   - **Awareness and Training:** Conduct mandatory, recurring training sessions for all surgical staff (surgeons and scrub nurses) emphasizing

the critical importance of the 5-minute minimum hand wash duration. Use visual aids and demonstrations.

    - **Auditing and Feedback:** Implement a system for regular, discreet auditing of hand wash times. Provide direct and constructive feedback to individuals or teams falling short of the SOP.
    - **Reinforce Visual Cues:** Place timers or visual prompts near surgical sinks to remind staff of the required duration.
    - **Leadership Role Modeling:** Encourage surgical leadership to visibly adhere to the 5-minute hand wash duration, setting a positive example for junior staff.

3. **Continuous Monitoring and Feedback Systems:**
    - Establish a robust system for continuous monitoring of infection control practices, including cleaning times, surface cleaning adherence, and hand hygiene duration. This could involve direct observation, video auditing (with ethical considerations), and feedback mechanisms.
    - Regularly review audit findings with OT staff to identify trends, address deficiencies, and celebrate successes. Foster a culture of accountability and continuous improvement. (WHO, 2009, Guidelines on Hand Hygiene in Health Care; WHO, 2016, Global Guidelines for the Prevention of Surgical Site Infection).

These recommendations are feasible as they focus on procedural reinforcement, targeted training, and consistent monitoring, which are implementable within existing healthcare facility frameworks.

6.Conclusion

This retrospective study reveals critical areas for improvement in infection control practices within the operation theatre, particularly concerning the duration of surgical hand washing and the comprehensiveness of environmental cleaning. While PPE adherence is commendable, the consistent failure to meet the 5-minute minimum for surgical hand antisepsis and the significant gaps in dusting and cleaning specific surfaces like lights, equipment, and trolleys, pose substantial risks for healthcare-associated infections. Adherence to established SOPs for cleaning time also shows variability. Addressing these discrepancies through targeted training, continuous monitoring, and reinforcement of established guidelines is paramount to enhancing patient safety and reducing the burden of surgical site infections.

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