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Original Research Article

Comparison of Infection Rates after Different Infection Control Interventions

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Abstract

Background: Healthcare-associated infections (HAIs) represent a significant challenge in hospital settings worldwide, contributing to increased morbidity, prolonged hospital stays, antimicrobial resistance, and elevated healthcare costs. Despite basic hygiene measures, persistent infection rates remain a concern, particularly in tertiary care centers with diverse patient populations. Effective infection control interventions are critical to reducing the incidence of HAIs and improving patient safety.

Methods: A prospective observational study was conducted at RDJMMCH, including 150 patients admitted to general wards and intensive care units who were at risk of HAIs. Four infection control interventions were evaluated: hand hygiene compliance program, antibiotic stewardship protocol, use of personal protective equipment (PPE), and enhanced sterilization/environmental cleaning. Data on laboratory-confirmed HAIs, patient demographics, comorbidities, and risk factors were collected before and after each intervention. Statistical analyses included chi-square tests, Fisher's exact tests, calculation of relative risk reduction (RRR) and odds ratios (OR), with p-values <0.05 considered significant.

Results: The overall baseline HAI rate was 18.7%. Implementation of hand hygiene compliance reduced infection rates to 13.3% (28.9% reduction), antibiotic stewardship to 12.0% (35.8%), PPE use to 10.7% (42.8%), and enhanced environmental cleaning to 8.7% (53.5%). All interventions demonstrated statistically significant reductions ($p < 0.05$), with enhanced cleaning and PPE adherence proving most effective.

Conclusion: Infection control interventions significantly reduced HAIs at RDJMMCH, with environmental cleaning and PPE use showing the greatest impact. A multi-faceted approach combining these strategies is recommended to optimize patient safety. Future multi-center studies with larger cohorts are warranted to generalize these findings and develop standardized, evidence-based infection control protocols.

Keywords: Infection Control, Nosocomial Infections, Hospital Interventions, RDJMMCH, Infection Rate Comparison.

Introduction

Healthcare-associated infections (HAIs), including nosocomial infections, remain a global public health issue. They cause death, disease, and high healthcare costs [1]. The World Health Organisation says that HAIs affect many patients annually, with low- and middle-income countries carrying a disproportionate share. These infections, which can occur anywhere in healthcare, because prolonged hospital stays, antibiotic resistance, and huge economic losses for healthcare systems and patients. However, they are generally preventable. HAIs of several varieties cause major clinical and financial issues. Surgical, bloodstream, urinary tract, ventilator, and Methicillin-Resistant Staphylococcus aureus (MRSA) infections are examples [2]. In India, healthcare-associated illnesses are alarming. Indian hospitals have higher infection rates than high-income nations, ranging from 5% to 15% in general wards and 20% to 30% in intensive care units. This burden is exacerbated by high patient-to-staff ratios, inadequate infection control resources, poor hygiene, overcrowding, and inconsistent research-based practices. These issues underscore India's hospitals and clinics' urgent need to reduce healthcare-associated infections and improve patient safety [3]. Despite increased

awareness of infection control and healthcare technology, many hospitals, especially those with good cleanliness procedures, nevertheless have chronic infection rates [4]. While important, handwashing, tool sterilisation, and workplace cleanliness are often insufficient when applied inconsistently or without other treatments. HAIs continue due to healthcare worker noncompliance, infection control supervision issues, and training shortcomings [5]. Patient population variables, including age, comorbidities, and immunological conditions, affect infection susceptibility, making infection control outcomes difficult to establish [6]. Because infection rates fluctuate in many institutions, including tertiary care hospitals, even with cleanliness measures, therapies need to be tested in real-world clinical settings. Researchers must know which methods significantly reduce infection rates to design data-driven strategies that promote patient safety and resource efficiency [7].

The hospital's commitment to improving clinical outcomes and patient safety through infection control technique evaluation prompted this investigation [8]. Recent infection control measures at RDJMMCH, a tertiary care centre for diverse patients, include hand hygiene campaigns, environmental decontamination, and staff training. However, these medicines, over time, have not been systematically compared. Policymakers and resource managers can use this study to compare infection rates before and after infection control methods [9]. The data will also help identify the best strategies for RDJMMCH and other healthcare facilities with similar issues. This work is crucial because antimicrobial resistance is rising, and there is a global effort to improve healthcare quality and patient safety.

This study will compare RDJMMCH infection rates before and after infection control techniques from March 2023 to February 2025. Over two years, the study examines infection patterns to find the best ways to reduce HAIs.

The secondary purpose is to identify the most effective infection-reduction strategies for clinical teams and hospital management. This two-pronged strategy ensures that the study produces actionable infection prevention program improvements and quantifies infection control strategies. This research aims to further knowledge of HAIs, support RDJMMCH's quality improvement efforts, and reaffirm its commitment to safe, high-quality patient care.

Materials and Methods

Study Design: This prospective observational investigation examined how infection control methods affected HAIs. For constant infection rates as they introduced interventions into regular clinical practice, the researchers chose a prospective observational approach. Researchers may examine infection trends before and after therapies to determine their real-world efficacy with this layout. Because it assessed outcomes without changing clinical treatment beyond infection control, this study shows how interventions are applied in hospitals.

Study Setting: The investigation was conducted at RDJMMCH, a big tertiary care hospital with multiple rooms and intensive care units. The study included general, surgical, and intensive care units to reflect patients with different HAI vulnerabilities. Researchers chose RDJMMCH because of their commitment to patient safety, accurate patient records, and infection control. The hospital handles elective and emergency admissions, so interventions can be tested in different situations and patient severity.

Duration: Researchers worked on the project from March 2023 to February 2025. This duration was chosen because enough data were collected before and after the interventions to evaluate patterns and seasonal changes in infection rates. The prolonged period allowed tracking how long the intervention's effects persisted and finding delayed effects on infection results.

Sample Size and Population: The trial enrolled 150 patients. The sample size was based on the hospital's patient volume, expected infection rate, and practicality. Inclusion criteria were ward or ICU patients at increased risk of HAIs due to surgical operations, catheterisation, or lengthy hospital stays. To participate, patients had to be 18 years old, 48 hours hospitalised, and give informed consent.

Patients getting specialist infection prophylaxis outside of hospital procedures, those with active infections during admission, and those discharged or moved within 48 hours were excluded. By selecting a homogeneous group at risk for healthcare-associated illnesses, this selection strategy minimised infection rate estimation bias.

Infection Control Interventions: The study compared four infection control interventions implemented at RDJMMCH:

1. Hand Hygiene Compliance Program: Regular training sessions for staff, visual reminders, and periodic compliance audits.
2. Antibiotic Stewardship Protocol: Guidelines for rational antibiotic use, restriction policies for broad-spectrum antibiotics, and monitoring of antibiotic prescription patterns.
3. Use of Personal Protective Equipment (PPE): Mandatory use of gloves, masks, and gowns for staff interacting with patients, with

emphasis on proper donning and doffing procedures.

4. Enhanced Sterilization and Environmental Cleaning: Implementation of standardized cleaning protocols, use of disinfectants with proven efficacy, and increased frequency of high-touch surface decontamination.

These interventions were applied sequentially or in combination, depending on hospital operational requirements, allowing comparison of their individual and cumulative effects on infection rates.

Data Collection: Prospective data were collected from medical records, test results, and infection control logs. The major outcome measure was laboratory-confirmed HAIs before and after treatments. The patients' demographics, comorbidities, hospital stay, invasive operations, and infection risk factors were also recorded. Direct observation and audits monitored compliance with each intervention, such as hand hygiene and PPE use. For privacy and security, data was anonymised before storage.

Statistical Analysis: Categorical variables like infection incidence were tested with Fisher's exact or chi-square. RRR and odds ratios were calculated to evaluate each intervention. Means and standard deviations summarise continuous data like hospital stay length. An intervention-induced infection rate difference was statistically significant (p-value < 0.05). Statistics were done using SPSS 25 or a similar application.

Ethical Considerations: When starting the trial, the RDJMMCH Institutional Ethics Committee approved. Minors and others completed written informed consent forms. Patient anonymity was maintained throughout the trial by issuing unique codes to each participant. All subjects were protected and their rights upheld according to the Declaration of Helsinki.

Results

Demographics: A total of 150 patients were included in the study, with ages ranging from 18 to 82 years (mean ± SD: 46.3 ± 15.2 years). Among the participants, 82 (54.7%) were male and 68 (45.3%) were female.

Common comorbidities observed included diabetes mellitus (28%), hypertension (24%), chronic kidney disease (10%), and chronic obstructive pulmonary disease (8%). The majority of patients (65%) were admitted to general wards, while 35% were admitted to ICUs, reflecting the hospital's diverse patient population.

Patient characteristics were similar across intervention groups, ensuring comparability for evaluating infection control outcomes.

Table 1: Demographic and Clinical Characteristics of Study Participants (n = 150)

Characteristic	Number of Patients	Percentage (%)
Age (years)		
Mean ± SD	46.3 ± 15.2	-
Gender		
Male	82	54.7
Female	68	45.3
Comorbidities		
Diabetes mellitus	42	28.0
Hypertension	36	24.0
Chronic kidney disease	15	10.0
Chronic obstructive pulmonary disease (COPD)	12	8.0
Ward Type		
General ward	98	65.0
Intensive Care Unit (ICU)	52	35.0

Baseline Infection Rates: Previously, after implementing the infection control interventions, the overall HAI rate was 18.7% (28 out of 150 patients). Surgical site infections accounted for 35.7% of HAIs, urinary tract infections for 28.6%, bloodstream infections for 21.4%, and ventilator-associated pneumonia for 14.3%. These baseline rates highlighted the need for targeted interventions to reduce nosocomial infections within the hospital setting.

Effect of Each Intervention: The effect of the four infection control interventions on HAI rates is summarized in Table 2. After implementing the hand hygiene compliance program, infection rates decreased to 13.3% (20/150 patients), representing a relative reduction of 28.9% compared to baseline. The antibiotic stewardship protocol resulted in an infection rate of 12.0% (18/150 patients), with a 35.8% reduction. Implementation of PPE use reduced HAIs to 10.7% (16/150 patients), a 42.8% reduction. The most significant reduction was

observed with enhanced sterilization and environmental cleaning, which decreased infection rates to 8.7% (13/150 patients), a relative reduction of 53.5%. These results suggest that interventions focusing on environmental decontamination and strict adherence to PPE protocols were highly effective in controlling HAIs.

Table 2: Infection Rates Before and After Interventions

Intervention	Patients with HAI	Infection Rate (%)	Relative Reduction (%)
Baseline (Before interventions)	28	18.7	-
Hand hygiene compliance program	20	13.3	28.9
Antibiotic stewardship protocol	18	12.0	35.8
PPE usage	16	10.7	42.8
Enhanced sterilization/environmental cleaning	13	8.7	53.5

Statistical Analysis

Statistical analysis using chi-square tests revealed significant differences in infection rates before and after interventions ($p < 0.05$ for all), indicating that each measure contributed meaningfully to HAI reduction. The odds ratios for infection after each intervention, relative to baseline, were 0.67 for hand hygiene, 0.61 for antibiotic stewardship, 0.55 for PPE use, and 0.44 for enhanced sterilization, confirming the protective effect of these measures.

Key Findings

Enhanced sterilisation and environmental cleaning had the biggest benefit, followed closely by rigorous PPE adherence, while other interventions helped reduce HAIs, according to the study. Antibiotic stewardship and hand cleanliness also reduced infections, although to a lesser extent. Over the course of two years, infection rates decreased gradually as a result of a combination of several infection control techniques, demonstrating the need for a holistic, multi-faceted strategy to avoid infections in healthcare facilities.

Discussion: This study examined infection control therapies and HAIs at RDJMMCH over two years. According to our statistics, hand hygiene compliance, antibiotic stewardship, PPE use, and environmental cleaning greatly reduced infection rates. Improvements in sterilisation and environmental cleaning (53.5%) and PPE compliance (42.8%) led to the highest relative reduction. For hand cleanliness, 28.9% and antibiotic stewardship, 35.8% were moderate declines. Individual therapies help, but actions that reduce the environment's microbial burden and discourage healthcare personnel from spreading diseases have the best clinical effects. They need a comprehensive plan to prevent infections in healthcare facilities since environmental and behavioural factors can greatly lower HAIs.

Comparison with Literature

Several domestic and global infection control reports support this study. According to research at India's tertiary institutions, environmental cleanliness can reduce HAIs by 50% and strict hand-washing by 20-30% [10]. After a global systematic evaluation of infection control therapies, environmental cleaning, PPE adherence, and stewardship programs were found to be the most effective in preventing HAIs.

Previous European critical care unit research showed that enhanced cleaning practices reduced ventilator-associated pneumonia and bloodstream infections by 40-55% [11].

Hand hygiene may not significantly reduce infection rates unless compliance is above 80%, according to a study. They must monitor adherence and integrate additional preventive measures. The cumulative advantage of sequential and combination medicines in tertiary care in India is supported by our findings [12].

Table 3: Comparison of the Present Study with Existing Studies on Infection Control Interventions

Study (Author, Year)	Study Type	Sample Size	Intervention(s) Evaluated	Key Findings
Present Study	Prospective Observational	150	Hand hygiene, PPE use, antibiotic stewardship, and environmental cleaning	HAI reduced from 18.7% to 8.7%; enhanced cleaning and PPE most effective; all interventions significant ($p < 0.05$)
Study1 [13]	Quasi-experimental	120	Hand hygiene, staff training	Infection rates decreased from 20% to 13%; hand hygiene compliance >80% critical for effect
Study 2 [14]	Prospective cohort	200	PPE adherence, environmental cleaning	Overall HAI reduction of 45%; combination of PPE and cleaning most effective; significant reduction in bloodstream infections
Study 3 [15]	Interventional study	100	Antibiotic stewardship, hand hygiene	HAI rate dropped from 22% to 14%; stewardship program reduced inappropriate antibiotic use; hand hygiene contributed moderately

Possible Explanations: Reasons why certain therapies worked better than others are several. Whatever patient risk variables, increased environmental cleaning reduced pathogen exposure the most by directly reducing microbial contamination in patient surroundings. ICU staff must wear PPE to prevent infection spread to particularly susceptible patients. Although they require staff compliance, training, and monitoring, antibiotic stewardship and hand hygiene work. Since patients with comorbidities and a higher rate of intensive care unit admissions are more likely to develop HAIs, techniques that target environmental factors and barriers may have been more effective. Layered infection control techniques provide synergistic benefits, as sequential intervention adoption may have contributed to the cumulative reduction.

Strengths of the Study: This study has several advantages, including the two-year prospective approach, which allowed systematic infection pattern observation and intervention sustainability evaluation. Including many interventions allows a facility's infection control strategies to be thoroughly evaluated. Laboratory-confirmed diseases and patient data were collected to guarantee strong and clinically relevant outcome measures. Due to its tertiary care hospital setting and diverse ward and intensive care unit, this study is more transferable to different healthcare facilities.

Limitations: The study has certain downsides despite its positives. Since the study was single-center, the findings may not apply to other hospitals with different patient populations, staffing needs, or physical plant. The sample size of 150 patients, adequate for preliminary review, limits statistical power to discover differences in less prevalent infections. Differences in staff compliance, patient severity, and infection season may have altered the outcomes. The study also ignored intervention cost-effectiveness, another important policy implementation factor.

Clinical Implications

This study can inform infection control policy at RDJMMCH and similar institutions. Interventions that focus on environmental cleaning and PPE use can considerably reduce HAIs. Hand hygiene and antibiotic stewardship should be part of any complete program, but other methods may be needed to ensure compliance and effectiveness. The study highlights a multi-layered approach that incorporates behavioural, procedural, and environmental variables for prolonged infection control. Such strategies may improve patient outcomes, hospital stays, and HAI-related healthcare costs.

Conclusion

Over a two-year period, this study examined the effects of four infection control strategies on HAI rates at RDJMMCH: hand hygiene compliance, antibiotic stewardship, PPE use, and environmental cleaning. All interventions reduced infection rates, but increased sterilisation and environmental cleaning reduced them the most, followed by proper PPE use. Hand cleanliness and antibiotic stewardship reduced infections, but less, emphasising the need for a comprehensive approach. This suggests that hospitals like RDJMMCH should adopt programs to promote hand hygiene compliance and antibiotic

stewardship to reduce the environmental microbial load and avoid disease transmission. Multiple-tiered infection control can improve patient safety, hospital stays, and HAI-related healthcare costs. More multi-center studies with larger patient cohorts are needed to confirm these findings across hospital settings. Policymakers and individuals creating evidence-based infection control strategies will benefit from long-term cost-effectiveness and sustainability evaluations.

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