e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(4); 991-994

Original Research Article

Central Sterile Supply Department as the Backbone of Hospital Infection Prevention and Control: A Descriptive Observational Study of Organization, Workflow, and Turnaround Time Analysis in a Tertiary Care Hospital

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Received: 01-01-2026 / Revised: 15-02-2026 / Accepted: 21-03-2026

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Conflict of interest: Nil

Abstract

Healthcare-associated infections (HAIs) remain a major challenge to patient safety, quality of care, and healthcare economics worldwide. Despite advances in antimicrobial therapy and infection prevention strategies, HAIs continue to contribute significantly to morbidity, mortality, prolonged hospital stay, and increased healthcare costs. A strong infection prevention and control (IPC) program is therefore essential for all healthcare facilities. Among the various components of IPC, the Central Sterile Supply Department (CSSD) plays a pivotal yet often under-recognized role. The CSSD is responsible for the complete reprocessing cycle of reusable medical devices, including collection, decontamination, cleaning, disinfection, inspection, packing, sterilization, storage, and distribution. A descriptive observational study was conducted from September 2025 to December 2025 in a tertiary care hospital in Ahmedabad. Assessment was carried out using structured observational checklists based on WHO, NABH, and AAMI guidelines. CSSD demonstrated structured workflow and adherence to sterilization protocols. Cleaning and packing stages contributed significantly to turnaround time delays. The Central Sterile Supply Department is a critical component of infection prevention and control. Strengthening organization, workflow efficiency, and turnaround time is essential for improving patient safety.

Keywords: Central Sterile Supply Department, Infection Control, Surgical Site Infection, Sterilization, Healthcare Associated Infections.

DOI: 10.25258/ijcpr.18.4.157

Introduction

Healthcare-associated infections (HAIs) remain a major challenge to patient safety, quality of care, and healthcare economics worldwide. Despite advances in antimicrobial therapy and infection prevention strategies, HAIs continue to contribute significantly to morbidity, mortality, prolonged hospital stay, and increased healthcare costs. A strong infection prevention and control (IPC) program is therefore essential for all healthcare facilities [1,2]. Among the various components of IPC, the Central Sterile Supply Department (CSSD) plays a pivotal yet often under-recognized role. The CSSD is responsible for the complete reprocessing cycle of reusable medical devices, including collection, decontamination, cleaning, disinfection, inspection, packing, sterilization, storage, and distribution. Any breach in this cycle can directly compromise instrument sterility and patient safety [3,4].

International organizations such as WHO, AAMI, and IAHCSMM recognize CSSD as a cornerstone of hospital IPC programs [1,3,5]. Several outbreak investigations have demonstrated that lapses in CSSD practices are associated with surgical site infections and multidrug-resistant organism transmission [6,7]. Conversely, an efficiently organized CSSD with standardized workflows and optimal turnaround time supports safe surgical care and antimicrobial stewardship [8,9]..

Aims and Objectives

Aim: To evaluate the role of the Central Sterile Supply Department in infection prevention and control through assessment of its organization, workflow, and turnaround time.

Objectives

- To assess the organizational structure and physical layout of the CSSD

- To evaluate operational workflow and zoning practices
- To analyze turnaround time and identify process bottlenecks
- To assess the impact of CSSD functioning on infection prevention
- To highlight consequences of breaches in CSSD practices

Role of CSSD in Infection Prevention and Control: The CSSD contributes to infection prevention by breaking the chain of infection through effective cleaning, disinfection, and sterilization of reusable medical devices. Properly reprocessed instruments are essential to prevent direct and indirect transmission of pathogens. [10]

Availability of sterile surgical instruments is a prerequisite for safe operative care, and compromised sterilization has been identified as a major contributor to SSI outbreaks. [6] CSSD also plays a key role in limiting cross-transmission of MDROs such as carbapenem-resistant Enterobacterales, Acinetobacter baumannii, and Pseudomonas aeruginosa. [12]

By preventing infections, CSSD indirectly supports antimicrobial stewardship by reducing unnecessary antimicrobial exposure and resistance development. Standardization, documentation, and traceability within CSSD further enable effective monitoring and recall in the event of sterilization failure. [9,13]

Materials and Methods

A descriptive observational study was conducted from September 2025 to December 2025 in the CSSD of a tertiary care hospital in Ahmedabad. Assessment was carried out using a structured observational checklist based on WHO IPC guidelines, NABH standards, and AAMI ST79 recommendations [1,3,4].

Physical layout, zoning, workflow, staffing, equipment, quality assurance practices, and turnaround time were evaluated.

Role of CSSD in Infection Prevention and Control: The CSSD contributes to infection prevention by breaking the chain of infection through effective cleaning, disinfection, and sterilization of reusable medical devices. Properly reprocessed instruments are essential to prevent direct and indirect transmission of pathogens [10].

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Consequences of Breaches in CSSD Practices: Breaches at any stage of CSSD functioning can lead to increased HAIs, SSI outbreaks, transmission of MDROs, and interruption of surgical services [14,15] The consequences of CSSD process breaches are summarized in Table 1.

Table 1: CSSD Process Breaches and Infection Control Consequences

CSSD Stage	Type of Breach	Potential Consequences
Cleaning	Inadequate removal of organic matter	Sterilization failure, SSI outbreaks
Packing	Incorrect material or technique	Recontamination
Sterilization	Inadequate parameters	Survival of microorganisms
Storage	Poor environmental control	Post-sterilization Contamination
Distribution	Break in aseptic handling	Transmission of pathogens

Organization and Functioning of CSSD: For optimal functioning, CSSD should be centrally located with minimal external traffic and adequate space[3]. Proper zoning and unidirectional workflow are essential to prevent cross-contamination [4,5].

Monitoring of Sterilization Processes: Monitoring includes mechanical, chemical, and biological indicators [3,4,8,10].

- **Mechanical monitoring** ensures achievement of critical sterilization parameters.
- **Chemical monitoring** verifies exposure to sterilizing conditions.
- **Biological monitoring** using bacterial spores remains the gold standard for assessing sterilization efficacy.

Turnaround Time (TAT) Analysis: Turnaround time was defined as the duration from receipt of used instruments to dispatch of sterile instruments to user departments.

TAT data were analyzed to identify delays and workflow bottlenecks that may compromise infection prevention. [9,16]

The turnaround time analysis is presented in Table 2.

Table 2: Analysis of Turnaround Time (TAT)

Process Step	Mean Time (min)	Range (min)	Observed Bottlenecks
Receiving & Segregation	15	10–25	Peak-hour workload
Cleaning & washing	45	30–75	Staff shortage, manual cleaning
Drying	20	15–35	Limited drying capacity
Packing & Labeling	30	20–55	Complex instrument sets
Sterilization Cycle	60	50–75	Batch processing
Cooling & Storage	25	15–40	Space constraints
Total TAT	**195**	**160–305**	Cleaning & packing phases

Cleaning and packing stages contributed disproportionately to TAT variability. The unidirectional workflow of CSSD is illustrated in Figure 1.

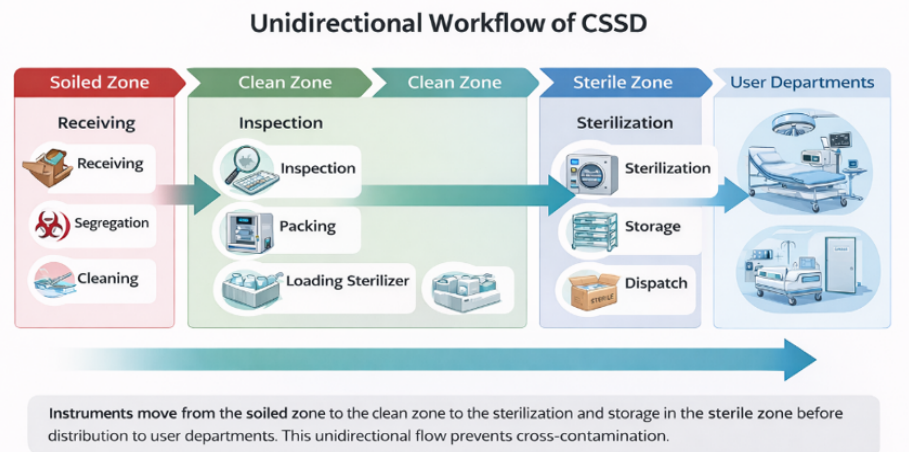

Figure 1: Unidirectional workflow from soiled to sterile zone preventing cross-contamination.

Outbreaks Linked to CSSD Failures: Evidence from published literature demonstrates that inadequate cleaning of complex instruments, breaches in zoning, reuse of damaged packaging materials, and failures in ethylene oxide sterilization and aeration have resulted in SSI clusters, MDRO transmission, and large-scale recall events.

In such outbreaks, residual organic matter interfered with sterilization efficacy, contaminated instruments served as vectors for transmission, and lack of traceability delayed corrective actions.

These findings emphasize that effective sterilization is dependent on robust CSSD processes, positioning CSSD as a critical determinant of hospital-wide infection control outcomes. [6,7,8]

Result and Discussion

The CSSD operates 24 hours a day, ensuring uninterrupted support to clinical services.

The department follows unidirectional workflow and zoning principles, consistent with international recommendations. [3,5] Routine environmental cleaning, biomedical waste management, equipment maintenance, and quality control practices were observed.

Daily Bowie–Dick testing, routine chemical indicators, and periodic biological indicator testing using Bacillus atrophaeus and Geobacillus stearothermophilus were performed, aligning with best practices. [3,8] However, staffing limitations and infrastructure constraints affected cleaning and packing phases, contributing to prolonged TAT and potential infection risk. [1,6,7]Regular internal audits, periodic external audits, continuous staff training, and well-defined recall procedures are essential to sustain sterility assurance levels and prevent infection outbreaks. [4,1]

Conclusion

The Central Sterile Supply Department is the backbone of hospital infection prevention and control, directly influencing patient safety, clinical outcomes, and institutional credibility. Breaches in CSSD practices can lead to infection outbreaks, operational disruptions, and reputational damage. Strengthening CSSD organization, workflow efficiency, and turnaround time, along with increasing awareness among healthcare professionals and administrators, is essential for delivering safe and high-quality healthcare [1,3,15].

Acknowledgements: We acknowledge the support of hospital administration and CSSD staff.

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