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Original Research Article

The heart of hospital hygiene: Exploring the central sterile supply department of a tertiary care hospital in Punjab

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Abstract

Background: Healthcare-associated infections (HAIs) continue to pose a major challenge to healthcare professionals in all healthcare settings. To combat hospital-acquired infections, hospitals need an effective method of disinfection and sterilization, which can be taken care of by the central sterile supply department (CSSD). So this study was planned to get information and a detailed picture of organization, the functioning of the CSSD department and its role in the prevention of HAIs.

Materials and Methods: This observational study was carried out in the CSSD department of a tertiary care hospital in Punjab over a period of three months. An observation checklist was used for the purpose of the study after obtaining permission from the appropriate authorities

Results: CSSD of this institution is conveniently located, offering easy access to all operating theatres and wards. Sterilization is done by steam sterilization and gas sterilization with a total of five autoclaves and one ETO machine. Physical, chemical and biological indicators are regularly used during the process of sterilization.

Conclusion: CSSD of this institution is contributing its part towards the reduction of HAIs. For effective prevention and control of HAIs, a continuous surveillance and monitoring system is imperative for determining the extent of the problem.

Keywords: CSSD, Autoclave, Sterilization, Indicators, HAIs

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1. Introduction

Hospital-acquired infections (HAIs) are those infections that patients acquire while receiving health care.[1] They are one of the most critical complications in hospitalized patients.[2] HAIs are infections where the date of the infection event occurs on or after the third calendar day of a patient's admission to an inpatient location.[3] They have tremendous implications in terms of associated mortality, morbidity, increased cost of treatment, adverse patient outcomes and social impact. According to a WHO report hospital hospital-acquired infection rates in developing countries vary from 5.7% to 19.1% (but mostly >10%).[4]

To combat these infections hospital needs effective methods of disinfection and adequate sterilization of equipment, which nowadays has been centralized into a single department called the Central Sterile Supply Department (CSSD). It is one of the important supportive services, forming the heart of hospital hygiene that ensures an infection-free atmosphere. It receives, stores, sterilizes and distributes instruments and equipment to all departments within the hospital.[5] Every step in CSSD has a direct impact on infection control, patient care and safety. Lack of quality can have dramatic consequences on the health and safety of the patients.

Therefore, the present study was planned to get information and a detailed picture of organization and functioning of the CSSD department, and its role in the prevention of HAIs.

2. Materials and Methods

This study is a descriptive cross-sectional study carried out in the CSSD department of a 1600-bedded tertiary care hospital of Punjab over a period of three months. An observation checklist based on CSSD standards as prescribed by the

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World Health Organization (WHO) was used for data collection.[6]

Prior permission was obtained from the hospital administration before conducting the study. The investigator visited the CSSD of the institution and collected data using an observation checklist regarding infrastructure, staffing patterns, items sterilized, process of sterilization, maintenance and quality control in CSSD. Confidentiality of information was maintained. Due approval was taken from Institutional Ethics Committee, vide IEC No. 2020-551.

The Data was collected, compiled and analyzed using Microsoft Excel and Statistical Package for the Social Sciences (IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.). Percentages and proportions were used to describe and compare various categorical variables.

3. Results

The present study was carried out in Central Sterile Supply Department (CSSD) of a tertiary care hospital in Punjab. The department is centrally located on the first floor of the main hospital building, which is convenient to all operation theatres and wards. It operates round the clock in three shifts (Morning, Afternoon and Night). It also operates on Sundays and holidays. Restricted access is permitted into the CSSD. Appropriate personal protective equipment (PPE) have to be worn before entering this area. It is divided into three zones i.e. soiled zone, clean zone and sterile zone.

Zoning in the CSSD	Area (Sq. ft)
Receiving area and Instruments cleaning area	27.4 ft X10 ft
OT Instrument Packing Room	15 ft X 10 ft
Procedure set Assembly and Packing room	15 ft X 10 ft
Sterilization area (Autoclave area)	31ft X 21ft
ETO Room	10 ft X10.8 ft
Sterile storage area	23.7 ft X 25.6 ft

3.1. Soiled zone or collection zone

Where soiled and used items from various departments are received and counted (especially for instruments in trays). The record of received items are maintained according to the name of the user department and date of receipt. Items are further sorted to be sent for cleaning and sterilization.

3.2. Clean zone

Where washing, cleaning and packaging of items is done. Items are cleaned under fresh water. Manual cleaning sinks (three in number) are present to allow for soaking, washing and rinsing of instruments. Different cleaning agents (detergents/enzymatic cleaners/disinfectants) are used in the CSSD of this institution, and all these Chemical agents used are diluted optimally as per the manufacturer's guidelines. Instruments are then packed as per pre-identified sets. Medical grade paper is used for packing instruments, both for gas and steam sterilization and later the packed items are sent to the sterilization zone.

3.3. Sterilization zone

Where the actual sterilization of packages is done either by steam sterilization (Autoclave) or gas sterilization (ETO machine). The sterilized packs are stored in storage area till their distribution. Articles are transported back to the user departments in stainless steel trolleys. Records are maintained regarding the number and type of items issued, along with the details of the receiver.

The department is designed to facilitate a unidirectional flow (from 'soiled' area to the 'clean' area) of people and supplies. Restricted access is permitted into the CSSD. Appropriate PPE have to be worn before entering this area.

Basic amenities, including drinking water, toilets, hand-washing facilities, and a changing room, are available in the department. There are a total of 36 staff members in CSSD, including the in-charge, supervisor, assistant supervisor, technicians, attendants and storekeeper. In-charge of CSSD is responsible for the overall functioning of CSSD, ensuring implementation of all infection control measures, department policies and procedures. There are three sweepers (working for 8 hours each) who undertake the housekeeping activities in the CSSD.

The floor of the CSSD department is smooth, impervious and tiled with a non-slip finish. The floor is cleaned daily in each shift by wet mopping using quaternary ammonium compound solution. Workbenches or slabs are made of stainless steel and are also cleaned daily with the same solution. Walls of CSSD are tiled up to 7 feet, and thereafter they are cemented and painted. There are no cracks or crevices present on any surfaces.

Equipment available in CSSD includes autoclaves, ETO machines, Air Pressure gun, High pressure water jet, dry oven, Rotary Sealing machine, trolleys, storage racks, work benches with stainless steel top, etc. Various articles are sterilized in the CSSD employing different sterilization techniques. Details of articles sterilized along with the method employed for sterilization is summarized as below:

CSSD of the institution follows a clean for dirty exchange system, i.e., soiled items from the user department are replaced by another set of sterilized articles. Gloves are not reprocessed, and disposable gloves are used throughout the hospital.

Introduction	Items	Method of sterilization used
1	OT linen	Washed linen is received from laundry and sterilized by steam sterilization
2	Bowls and OT sets	Steam sterilization
3	Ward articles	Steam or gas sterilization (depending upon the type of article)
4	Other item like dressing, sponges, gauze and cotton material	Steam sterilization
5	Instruments	Gas sterilization

A total of 5 autoclaves (3 single-door and 2 double-door) and one ETO machine are present in the department. Linen, dressings, drum and trays are sterilized by autoclaving. Heat sensitive articles like those made of plastic or rubber are sterilized by an ETO machine using ethylene oxide gas. Since this gas may be poisonous, utmost care and precautions are taken during the process of sterilization. High-quality operating standards are maintained as sterilized items are distributed only after the biological indicator tests negative for the growth of any microorganism. For each sterilization cycle, following things are recorded in the sterilization record register: autoclave number, the lot number for the cycle, date of the sterilization (month/day/year), specific contents of the load, exposure time, temperature and pressure set on the sterilizer, name and initials of the operator.

Physical, chemical and biological indicators are regularly employed to maintain the quality of sterilization. These are verified in the Microbiology laboratory of the institution. The results of the Bowie-dick test, Process challenge device and Biological spore test are recorded and documented in the sterilization record register, and the respective test sheets are saved.

If any sterilized pack is not utilized within the given time (6 months in case of both autoclaved and ETO sterilized packs), it is then returned to CSSD, where it undergoes the complete cycle of cleaning, disinfection and sterilization.

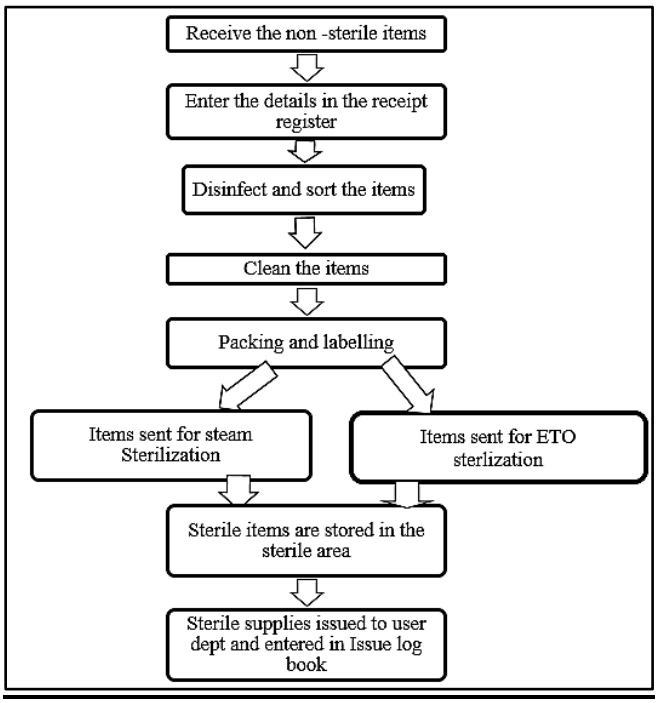
CSSD of the institution has its own set of Standard Operating Procedures (SOPs) and operates accordingly in case of sterilization failure or failure of Biological Indicator. In this process, the items of the said load are recalled from the concerned departments immediately for re-autoclaving. The information is also provided to the infection control nurse by the sister-in-charge to monitor the patient's condition and follow up. The next load is sterilized only when all the tests are passed.

All equipment used in the department are calibrated at periodic intervals. Single door autoclave machines are under Annual Maintenance Contract (AMC), while Double door autoclaves are under Comprehensive Maintenance Contract (CMC). The ETO machine is also under CMC.

Biomedical waste generated during the process of cleaning, packing and sterilization is disposed of according to current biomedical waste management guidelines. Different colour-coded bins are available in CSSD.

Periodic internal audits and monitoring is performed by the in-charge and supervisor of CSSD. Yearly financial audits are also undertaken by the accounts department to assess the utilization of the budget. Regular external audits are also undertaken by the hospital infection control team for overall quality improvement.

3.4. Process flow of CSSD



4. Discussion

Recent advances in surgical techniques and the responsibility for the control of infections have placed the CSSD (Central Sterile Supply Department) in a prominent position within the hospital. The CSSD of the institution has been performing its role in sterilization and disinfection of medical equipment and thus reducing the chances of nosocomial infections. Basu et.al. Conducted a study regarding the operation of CSSD in a 167-bed oncology centre in the eastern part of India and documented the importance of CSSD in the control of nosocomial infections.[7]

According to WHO,[6] there is no strict regulations or criteria regarding space measurements. The space estimate might be based on some or all of the following:

1. Size of the institution
2. Average number and type of surgical procedures per day
3. Number of beds relying on the supply from CSSD

This CSSD currently reviewed fulfilled the criterion for the physical infrastructure of CSSD. There is clear demarcation of zones in CSSD (i.e. soiled, clean and sterile zones) to ensure one-way movement of staff and devices from contaminated to clean areas.

According to WHO guidelines for CSSD, there is a major restriction on timings for receipt and issue of items in CSSD because departments like OT, ICU, Emergency, etc. are exempted from time dimensions since it is difficult to restrict their activity within specific time limit due to the emergency nature of care provided by them.[6] This is similarly followed in the CSSD of this tertiary care institution. It operates for 24 hours in three shifts (Morning, Afternoon and Night).

According to World Health Organization, the structure and number of staff vary greatly and as yet, there are no clear published guidelines on how to calculate the staffing ratio. The minimum requirement is at least one supervisor each for the dirty area and clean area, but more may be necessary in a larger CSSD.[6] In the CSSD of this tertiary care institution, there are two supervisors, i.e. Senior Supervisor and an assistant supervisor, but there is no division of their job profile according to the zones of CSSD. There are a total of 36 staff members in the CSSD of this institution.

Cleaning is the most complex and important step in the processing of medical devices because if a device is not clean, it cannot be disinfected or sterilized.[8] In CSSD of this tertiary care institution, cleaning and decontamination are performed daily by the housekeeping staff. The CSSD of this institution uses different cleaning agents like manual plus multi-enzyme cleaner, Quaternary Ammonium compound solution and sometimes Acidic detergents for intensive cleaning of surgical instruments. To achieve effective cleaning, they are prepared at a concentration as recommended by the manufacturer/supplier.

The main equipment item in the CSSD is the autoclave.[9] At least one additional autoclave other than the main one should be provided to cater for failure or extra workload. Autoclaves must function according to the manufacturer's instructions, be regularly cleaned, and quality checks must be performed.[9] In the CSSD of this institution, five functional autoclaves (3 single door and 2 double door) are available for sterilization of articles, which is a sufficient number. Autoclaves function according to SOPs of CSSD, regularly cleaned and quality checks of sterilized items are undertaken regularly.

Shetty reported that steam sterilization (autoclave) was the only sterilization method practised in the selected hospital of Mangalore. Physical, chemical and biological indicators were regularly being used.[10] CSSD of this tertiary care institution not only practices steam sterilization but also gas sterilization (ETO) and has a total of 5 autoclaves and one ETO machine. Utmost care is taken to maintain high-quality standards in the CSSD of the institution.

Danko et.al. in their study in the USA reported that Bowie-Dick testing was reported to be performed by 99.1% and 97.2% of facilities, at least daily, after repairs and after shutdowns, respectively.[11] In the CSSD of this institution Bowie Dick Test is done daily in empty steam sterilizer at the beginning of operations as per the ideal requirement. Another test, named Process challenge device (PCD), is also used in the CSSD of this institution to monitor vacuum level and air leak detection. It is also performed daily.

All the personnel in CSSD must wear PPE at the time of operations, especially since ethylene oxide is a poisonous gas. Staff must be educated regarding the role of PPE in the prevention of occupational hazards. Precautions against ethylene oxide gas leak are taken by following a strict protocol of uninterrupted completion of the whole sterilization cycle, followed by the release of gas exhausts by chimney at the end.[9] In the CSSD of this institution, there is strict monitoring of sterilization standards by ETO machine, which is evident from the fact that the sterilized packs are issued/distributed only when the biological indicator tests negative for the presence of any microorganism.

Sterilized articles are stored in racks in the sterile store of CSSD, where proper records are maintained. However, it was observed that at the time of distribution of sterilized articles, CSSD staff only wore gloves and masks among the PPE. There is a need to emphasize the role of PPEs in hospital infection control and for own safety of the staff. Supervisors must also inspect the staff regarding the use of PPEs so as to ensure a healthy workforce and enhance the quality of operations of CSSD**.** Lin et. al. from China reported that staff who had more occupational safety knowledge were less prone to needle stick injuries. These findings highlight the need to wear PPE in CSSD.[12]

CSSD of the institution has its own set of SOPs and follows the recall procedure as mentioned in the SOPs. The items of the concerned load, where there is a failure of the indicator, are recalled from the concerned departments immediately for re-autoclaving. A study conducted by Shriyan et. al. (2015) on the "efficiency of CSSD at a health care centre" in Mangalore reported one instance where there was a recall of sets, which was observed due to a change in colour of the biological indicator by the CSSD personnel. It was reported to the Hospital Infection Control team, and the sets were withdrawn. Hence, good infection control protocol and policies in place result in effective handling of a recall process.[13]

Of the many causes of higher prevalence of HAIs in low-and middle-income countries (LMICs), the important ones are the lack of financial resources, workforce and policies for infection control, poor hygiene and sanitation, limitations in sterilization/disinfection and aseptic practices, and limited access to microbiology services in many hospitals.[14-16] Therefore, the CSSD of this institution is contributing its part towards the reduction of HAIs.

5. Conclusion

CSSD of the institution is centrally located, which is convenient to all operation theatres and wards. It is an independent department with facilities to receive, clean, pack, disinfect, sterilize, store and distribute instruments and equipment to all departments within the hospital. There is a clear demarcation of zones in CSSD (i.e. soiled, clean and sterile zones) to ensure one-way movement of staff and devices from contaminated to clean areas. CSSD of this institution is contributing its part towards the reduction of HAIs. For effective prevention and control of HAIs, a continuous surveillance and monitoring system is imperative for determining the extent of the problem.

6. Source of Funding

None.

7. Conflict of Interest

None.

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