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A Case Study: The Heart of Cleanliness: Critical Analysis of Layouts, Functions and Procedures; Transforming Central Sterile Supply Departments (CSSDs) Processes in National Hospital Sri Lanka

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ABSTRACT

Introduction: The National Hospital of Sri Lanka (NHSL) established in 1864, situated in Colombo on a 32-acre block of land is the largest Teaching Hospital in Sri Lanka and the final referral centre in the country consisting of 3324 beds. There are Nine CSSDs in NHSL. The CSSDs play a vital role in ensuring the cleanliness, safety, and effectiveness of medical instruments and equipment used in patient care. The CSSD ensures the quality of medical care and controls infection. The professional, standardized, and scientific management of the CSSD is a prerequisite if a hospital is to realize sustainable development. The CSSDs are mainly responsible for the cleaning, disinfection, sterilization, distribution, recycling, and storage of clinical medical articles and equipment, and the provision of sterile articles to all hospital departments.

Objective: To analyze layouts, functions and procedures and propose recommendations to optimize CSSD processes in NHSL.

Methods: Key informant interviews (KIIs), direct observation and document reviews were carried out. Analyzed the data and evaluated against standards.

Results: The prioritized problem was the unavailability of proper and regular maintenance. The prioritized root cause was the lack of standardized maintenance procedures for CSSD in NHSL.

Conclusion: Emphasized the importance of optimizing layouts, functions, and procedures to ensure the highest standards of cleanliness, safety, and efficiency of CSSDs in NHSL.

Recommendations: Train the staff on maintenance procedures, create a maintenance schedule and maintenance of proper document activities for CSSDs in NHSL.

Keywords: CSSD, analysis, layouts, functions, optimize, sterilization

Introduction

The Central Sterile Supply Department (CSSD) is a specialized area responsible for the collection, decontamination, assembling, packing, sterilization, storing and distribution of medical devices, equipment, and consumables to patient care areas (WHO,2010). CSSD is the hospital's central nervous system where the battle against infection takes place.

Objectives of CSSDs;

- To provide supplies of sterile linen packs basins, instruments and other sterile items.
- To maintain an accurate record of the effectiveness of the cleaning, disinfecting and sterilizing process.
- To monitor and enforce control necessary to prevent cross-infection according to infection control policies.
- To review current practice for possible improvement in quality or service provided.
- To provide consulting services to other departments in all areas of sterile processing

The functions of CSSD include receiving, rinsing, cleaning, drying, checking, sterilization, labelling, storage, issuing and distribution (SLCM,2021).

The Basic layouts of CSSDs are shown below (Figure 1)

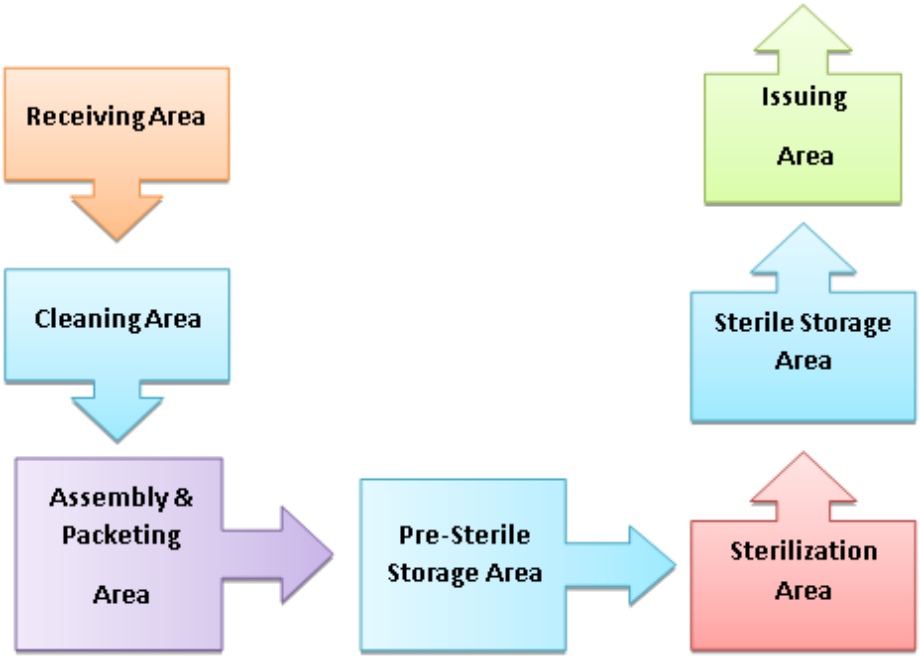

Figure 1:Basic layouts of a CSSD

General objective of the case study

- To analyze layouts, functions and procedures and propose recommendations to optimize CSSD processes in NHSL.

Specific objectives of the case study

- To analyze the current Layouts, Functions and Procedures of Central Sterile Supplies Departments [CSSDs] in NHSL.
- To review the utilization of resources, including staff, equipment, and supplies.
- To identify areas for improvement in instrument processing, sterilization, and distribution.
- To propose recommendations to optimize CSSD processes and improve overall performance.

Methodology

- Key Informant Interviews (KIIs) were carried out with NOICs of CSSDs and relevant stakeholders.
- Direct observation by the Principal Investigator [PI] for mapping out the CSSD layout and workflow from instrument collection to distribution and handoffs.
- Document reviews were carried out by the PI.
- Analyzed collected data and evaluated CSSD performance against established hospital standards and identified gaps, inefficiencies, and challenges in the current processes.
- Based on the findings from the analysis, practical and feasible recommendations and an action plan to optimize CSSD processes through a literature review as well as brainstorming with Senior Registrars and Registrars in Medical Administration.

There are Nine CSSDs in NHSL. They are mentioned below;

- Bandaranaike Building CSSD
- Operation Theatre ‘C’[OTC] CSSD
- Neuro Trauma Centre [NTC] CSSD
- National Epilepsy Centre CSSD
- Burn Unit or Old Accident Service CSSD

- Accident and Orthopedics Services Unit CSSD
- Cardiology Unit CSSD
- Cardiology Unit Ethylene Oxide [ETO] CSSD
- New Ambulatory Care or New OPD Clinic Building CSSD

The identified problems are listed below;

- Lack of space for some CSSD units
- Several autoclave and instrument washing machines were broken
- A Water softener system was not available
- Unavailability of proper and regular maintenance by Bio-Medical Engineering Unit (BMEU)
- Non-availability of water softeners causes CaCO3 and MgCO3 deposits on elements.
- Lack of Indicators e.g. Physical, biological, and chemical
- No basic layout was available in some CSSDs
- Lack of Human Resources (HR) to run CSSD 24/7
- Water leakages from ceilings and roofs in some CSSDs
- No regular In-Service Training Programmes (ISTPs) were available
- Changing & washing rooms were not available for HR in some CSSDs
- Absenteeism of Healthcare Assistants (HCAs)
- Some ward staff did not obey CSSD techniques.
- No proper scheduling times to receive items

Problem prioritization

Problem prioritization was conducted using the nominal group technique with 3 senior registrars and 2 registrars in medical administration, MO/Planning, 1 sister and 1 NO at CSSDs in NHSL and displayed below (Table 1).

Table 1: Priority Matrix for Problem Prioritization for Problems in CSSDs

Problems	**Number of votes received**		**Total Votes**	**Final Priority**
Problems identified regarding CSSDs in NHSL	1st Round [Six votes for each of eight members] [48 votes]	2nd Round [Five votes for each of eight members] [40 votes]		
1. Lack of space for some CSSD units	3	1	4	-
2. Several autoclave and instrument washing machines were broken	3	2	5	-
3. A Water softener system was not available	6	7	13	2
4. Unavailability of proper and regular maintenance by BMEU	10	10	20	1
5. Non-availability of water softeners causes CaCO3 and MgCO3 deposits on elements.	3	3	6	-
6. Lack of Indicators e.g. Physical, biological, and chemical	4	2	6	-
7. No basic layout is available in some CSSDs	6	4	10	3
8. Lack of HR to run CSSD 24/7	2	1	3	-

9. Water leakages from ceilings and roofs in some CSSDs	2	1	3	-
10.No regular ISTPs are available	1	1	2	-
11. Changing & washing rooms are not available for HR in some CSSDs	1	2	3	-
12. Absenteeism of HCAs	3	2	5	-
13.Some ward staff do not obey CSSD techniques.	2	2	4	-
14. No proper scheduling times to receive items	2	2	4	-

Problem Analysis

The prioritized problem was the unavailability of proper and regular maintenance by BMEU. The Root-cause analysis was carried out by literature exploration, KIIs with relevant stakeholders at NHSL and brainstorming sessions with 3 senior registrars and 2 registrars in medical administration, Medical Officer (MO)/Planning, 1 sister and 1 Nursing Officer (NO) at CSSDs in NHSL. It is illustrated below (Figure 2)

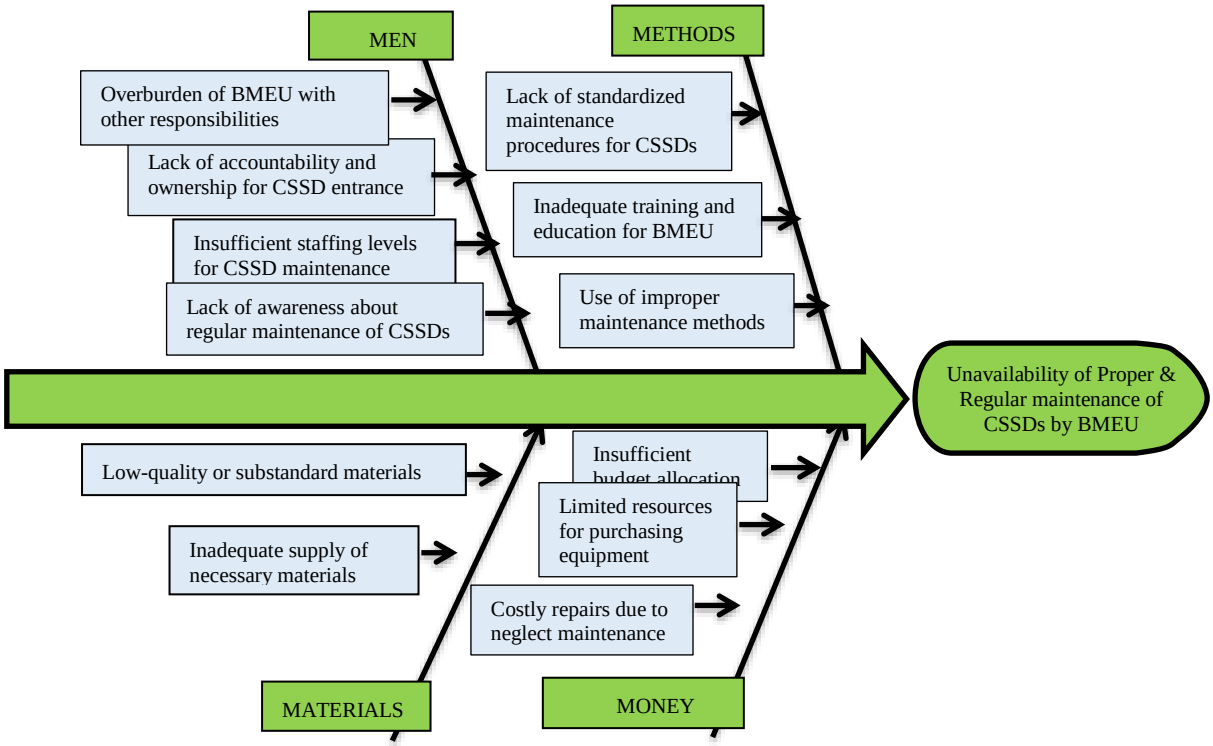

Figure 2: Ishikawa chart-Root cause analysis for Unavailability of Proper & Regular maintenance of CSSDs by BMEU

These root causes were prioritized considering followings and illustrated below (Table2);

- The feasibility to address - technical, administrative, financial, and practical.
- The impact of the root cause.
- The time factor to introduce interventions.

Table 2: Priority matrix for root cause prioritization for unavailability of proper & regular maintenance of CSSDs by BMEU

Root Causes	**Number of votes received**		**Total Votes**	**Final Priority**
Root causes for unavailability of proper & regular maintenance of CSSDs	1st Round [Six votes for each of eight members] [48 votes]	2nd Round [Five votes for each of eight members][40votes]		
1. Lack of standardized maintenance procedures for CSSDs	14	12	26	1
2. Lack of awareness about regular maintenance of CSSDs	10	8	18	2
3. Inadequate training and education for BMEU	4	1	5	-
4. Use of improper maintenance methods	3	2	5	-
5. Insufficient budget allocation	2	1	3	-
6. Limited resources for purchasing necessary equipment	1	1	2	-
7. Costly repairs due to neglect maintenance	1	2	3	-
8. Overburden of BMEU with other responsibilities	5	5	10	3
9. Inadequate staffing levels for CSSD maintenance tasks	2	1	3	-
10. Inadequate supplies of necessary materials.	4	3	7	-
11. Low-quality or substandard materials	1	2	3	-
12. Lack of accountability and ownership for CSSD maintenance	1	2	3	-

According to the number of votes received by each root cause, they are arranged in descending order. Next, using Microsoft Office 365 Excel, a Pareto chart was created (Figure 3).

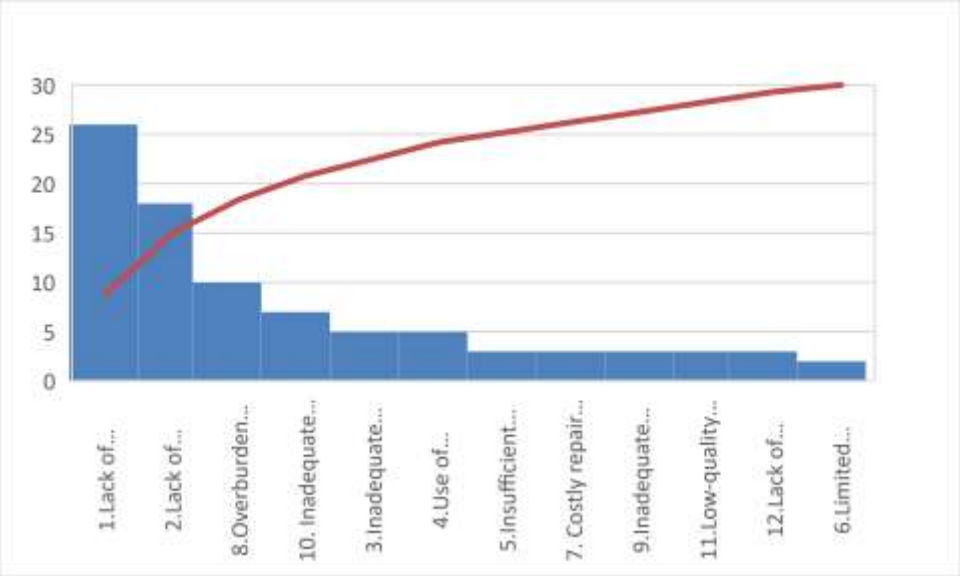

Figure 3 :pareto chart for root cause analysis for unavailability of proper & regular maintenance of CSSDs

Proposals

Solutions for the vital root causes were identified through a literature search (Mechanized Laundry,2022) and brainstorming sessions. According to the Pareto analysis following are the vital few root causes;

1. Lack of standardized maintenance procedures for CSSDs
2. Lack of awareness about regular maintenance of CSSDs.

The lack of standardized maintenance procedures for Central Sterile Supply Departments (CSSDs) in NHSL could be addressed by implementing the following proposals:

1) Develop comprehensive maintenance protocols: Establish clear and standardized maintenance procedures for all CSSD equipment, including sterilizers, washers, and other critical instruments. These protocols should outline routine maintenance tasks, frequency, and responsibilities for each task (Hu *et al*.,2024).

2) Train staff on maintenance procedures: Provide adequate training to CSSD personnel on the proper maintenance procedures for different equipment. This includes training on inspection, cleaning, lubrication, calibration, and any other necessary tasks. Regular refresher training should be conducted to ensure adherence to the procedures (Wang *et al*.,2018).

3) Create a maintenance schedule: Implement a regular maintenance schedule for CSSD equipment, considering manufacturer recommendations and industry standards. Schedule routine inspections, cleaning, calibration, and preventive maintenance tasks to minimize breakdowns and ensure optimal performance (Ministry of Health,2019).

4) Document maintenance activities: Maintain detailed records of all maintenance activities performed on CSSD equipment. This includes documenting dates, tasks performed, personnel involved, and any observations or findings. These records can help track maintenance history, identify trends, and plan future maintenance needs.

5) Engage equipment manufacturers: Collaborate with equipment manufacturers to obtain their recommendations for maintenance procedures and schedules. They can provide valuable insights and guidance based on their expertise and knowledge of the equipment. Stay updated on any product recalls, safety alerts, or new maintenance guidelines issued by the manufacturers (Weiqin *et al.*,2022).

6) Implement quality control measures: Develop quality control measures to ensure that maintenance procedures are followed consistently and effectively. This may involve regular audits, equipment performance monitoring, and periodic validation or calibration of equipment. Use indicators such as biological and chemical indicators to validate the effectiveness of sterilization processes.

7) Continuous improvement and feedback: Establish a feedback mechanism to encourage staff to report equipment issues, suggest improvements to maintenance procedures, or share best practices. Encourage an open culture where staff feel comfortable discussing maintenance challenges and proposing solutions.

8) Regulatory compliance: Stay informed about relevant regulations and standards governing CSSD maintenance, such as those set by healthcare authorities or accrediting bodies. Ensure that maintenance procedures align with these requirements and regularly update them as needed.

9) Collaboration and knowledge sharing: Foster collaboration among CSSD teams within and across hospitals. Share experiences, lessons learned, and best practices to improve maintenance procedures collectively. Participate in professional forums, conferences, or workshops focused on CSSD maintenance to gain insights and stay updated on industry trends.

10) Utilize technology and automation: Explore the use of technology and automation to streamline maintenance processes. This can include implementing computerized maintenance management systems (CMMS) to schedule and track maintenance activities, leveraging remote monitoring or sensor-based technologies for equipment performance monitoring, and utilizing smart devices or applications to access maintenance procedures and manuals (Joseph *et al*.,2021).

Conclusion

This critical analysis emphasized the importance of optimizing layouts, functions, and procedures within CSSDs in NHSL to ensure the highest standards of cleanliness, safety, and efficiency in NHSL. The prioritized problem was the Unavailability of Proper & Regular maintenance of CSSDs by BMEU and the prioritized root cause was the lack of standardized maintenance procedures for CSSDs in NHSL.

Recommendations

1. Train the staff on maintenance procedures

Facilitates suitable training to CSSD personnel on the proper maintenance procedures for different equipment. This includes training on inspection, cleaning, lubrication, calibration, and any other necessary tasks. Consistent revision exercises should be steered to ensure adherence to the procedures.

2. Create a maintenance schedule

Implement a systematic maintenance schedule for CSSD equipment, considering manufacturer recommendations and industry standards. Schedule routine inspections, cleaning, calibration, and preventive maintenance tasks to minimize breakdowns and warrant maximum performance.

3. Document maintenance activities

Maintain detailed records of all maintenance activities performed on CSSD equipment. This includes documenting dates, tasks performed, personnel involved, and any observations or findings. These records can help track maintenance history, identify trends, and plan future maintenance needs.

Implementation

Implementation of the aforementioned recommendations could be done with the following strategies which are illustrated below (Table 3).

Table 3:Implementation-strategy, activities and responsibility

Strategy	Activities	Responsibility
1.	I. Training Needs Assessment [TNA]	DDG
Train staff on maintenance procedures	II. Training Sessions	ET&RUnit of MoH
	Training on inspection, cleaning, lubrication, calibration, and any other necessary tasks.	Director/BMEU
	II. Evaluation by Kirkpatrick's tool	Microbiologists.
		MOIC-QMU
2.	I. Equipment Inventory	DDG
Create a maintenance schedule	II. Determine Maintenance Requirements	Director/BMEU
	III. Establish Priority Levels & Define Maintenance Intervals	Microbiologists
	IV.Allocate resources	Unit Heads
	V. Monitoring and Evaluation	
3.	I. Standardized Documentation Formats	DDG
Document maintenance activities	II. Record Maintenance Activities	Microbiologists
	III. Document Repairs and Replacements	Unit Heads
	IV. Monitoring and Evaluation	

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