Original Research

Enhancing Resurrection Practices for Unusable Surgical Inventory Items at District General Hospital, Negombo

L. I. Malalasekara[1*], W. M. U. S. Wijemanne[1]

[1]*Ministry of Health*

[*]*Correspondence: lasithaim@gmail.com*

https://doi.org/10.4038/sljhr.v4i1.77

https://orcid.org/0009-0008-0108-1603

Abstract

Background: Effective management and maintenance of surgical inventory items are vital for ensuring uninterrupted healthcare services and optimizing resource utilization in hospitals. In resource-poor settings where financial and technical constraints limit the availability of new equipment, enhancing resurrection practices plays a critical role in sustaining healthcare delivery and maximizing existing resources.

Objective: The primary aim of this study was to enhance the resurrection practices of selected surgical inventory items at District General Hospital (DGH) Negombo through tailored interventions and involvement of volunteer technical support.

Methods: This implementation science study with pre- and post-assessments conducted at DGH Negombo from August 2022 to November 2023 focused on collaborating with unit heads managing surgical inventory items and condemned items identified by the Biomedical Engineering Division. Data collection involved key informant interviews to gather qualitative insights, self-administered questionnaires distributed to unit heads for quantitative data on repair processes, and a desk review of hospital records to identify frequently malfunctioning items. Statistical analysis included content analysis for qualitative data and descriptive statistics for quantitative data, helping to prioritize items for repair based on urgency and feasibility.

Results: Pre-intervention assessments highlighted several inefficiencies including prolonged repair times, poor coordination with the Biomedical Engineering Division, and inadequate infrastructure for managing surgical inventory items. Post-intervention evaluations demonstrated marked improvements, with repair times decreasing by 32%, enhanced coordination with Biomedical Engineering units, and increased stakeholder satisfaction, as indicated by the higher SAQ scores. Additionally, 60% of condemned multipara monitors, 76% of oxygen regulators, and 78% of suction apparatus were successfully restored, underscoring significant efficiency gains in equipment availability and resource utilization.

Conclusion and Recommendations: The tailored interventions implemented during this study significantly improved efficiency and effectiveness in managing surgical inventory items at DGH Negombo, enhancing equipment availability, and achieving cost savings. Similar approaches emphasizing systematic assessments, stakeholder collaboration, and volunteer technical support are recommended for sustainable improvements in comparable healthcare settings.

Keywords: Surgical Inventory Items; Resurrection Practices; Hospital Management; Resource Utilization

Background

Effective functioning of medical equipment in hospitals is crucial for delivering high-quality patient care and maintaining operational efficiency [1]. Hospital surgical items includes a wide array of items. These surgical items are divided into two groups: surgical inventory items (e.g., multipara monitors, infusion pumps, oxygen regulators, and ICU beds) and surgical consumable items (e.g., disposable syringes, gloves, and masks).

This research project focused specifically on the management and maintenance of surgical inventory items in hospital settings. These surgical items are essential for various medical procedures and patient care. Efficient handling and timely repair of these items are imperative for maintaining uninterrupted hospital services [2].

When surgical inventory items malfunction, they are typically reported to the Biomedical Engineering Division (BME) of the Ministry of Health (MoH) for repair. BME operates through several subdivisions and district-level units and undertakes the repair and subsequent return of functional items to hospital units. Items deemed irreparable are condemned with appropriate documentation for future disposal procedures. Until then, these obsolete items were collected from wards and other places in the hospital, occupying valuable space and obstructing the smooth functioning of the institution [3].

In this context, resurrection (in some countries, this process is called refurbishment) refers to the restoration of unusable medical equipment according to defined safety and performance standards [4]. This project aims to resurrect identified surgical inventory items marked for condemnation by leveraging low-cost interventions to extend operational lifespan. Resurrection processes involve meticulous steps, such as decontamination, testing, and refurbishment [5].

The economic challenges faced by hospitals emphasize the importance of resurrection practices. With limited financial resources and rising costs of medical equipment, hospitals are compelled to explore innovative approaches to maximize the utility of existing inventory items. Resurrection not only reduces waste but also contributes to cost savings and sustainable healthcare practices [6].

Objective

This study aimed to improve the resurrection practices of selected unusable surgical inventory items at DGH Negombo by assessing existing processes, identifying deficiencies, and implementing tailored interventions. This study also aimed to evaluate the effectiveness of these interventions in enhancing equipment availability and operational efficiency.

Methods

The project, titled "Enhancing Resurrection Practices for Surgical Inventory Items at DGH Negombo," ran from August 1, 2022, to November 15, 2023. It focused on engaging with all unit heads responsible for surgical inventory items within the hospital, and targeted unusable surgical inventory items marked for condemnation by the Biomedical Engineering (BME) Division. Items awaiting repair by the BME Division and those already condemned were excluded, as they were outside the scope of the project. The project followed a systematic, three-phase approach. Phase I: Planning involved collecting qualitative data through Key Informant Interviews (KIIs) and quantitative data via Self-Administered Questionnaires (SAQs) and desk reviews. This phase identified challenges in inventory management, categorized unusable items, and informed the design of the targeted interventions. Phase II: Execution implemented strategies, such as developing methodologies for technicians, improving processes, providing infrastructure support, involving volunteers, introducing a color-coding system, and establishing centralized coordination. Phase III: Evaluation assessed the impact of these interventions through inspections, benefits analysis, and stakeholder feedback. A project plan guided by SWOT and TWOS analyses ensured effective execution with stakeholder collaboration, detailed activity planning, and robust project management.

To evaluate the interventions, SAQs were administered to 45 unit heads to gather baseline data on the repair processes, space occupied by unusable items, and traceability. The SAQs, designed using a Likert scale, were conducted pre-intervention and repeated six months post-intervention to measure the impact. Data analysis combined qualitative insights from KIIs using NVivo with quantitative metrics from SAQs and desk reviews, and grouping responses into binary variables. These methods evaluate changes in satisfaction, space utilization, and traceability, enabling the development and validation of effective solutions to enhance inventory management and repair processes.

Results

The pre-intervention qualitative assessment, based on Key Informant Interviews (KII) with 15 participants, identified several key issues affecting the maintenance

and repair of surgical inventory items. The most significant challenge was delays in the repair process (39.7%), followed by unavailability (26.5%), and difficulty (13.2%) in obtaining spare parts. Human resource issues, including a lack of technicians and engineers (8.8%) and delays in visits by Biomedical Engineering (BME) technicians (13.2%) were also notable concerns. Infrastructure problems, such as the absence of a biomedical unit (11.8%) and inadequate reporting systems (11.8%), further hinder efficiency. Additionally, delays in reporting malfunctioning items (8.8%) and bypassing the surgical pharmacist during repair (2.9%) were highlighted. These findings underscore the need for targeted interventions to address systemic inefficiencies.

A desk review identified unusable surgical inventory items and prioritized categories based on hospital urgency, breakdown frequency, and resurrection potential. Oxygen regulators, suction apparatus, and multipara monitors (basic) were selected for intervention. Of these, 20 of 160 multipara monitors (12.5%), 33 of 78 oxygen regulators (42%), and 23 of 74 suction apparatus (31%) were marked for resurrection, highlighting significant gaps in functional inventory impacting healthcare delivery (Table 1).

Interventions for resurrection of unusable Surgical Inventory Items

Following the preintervention assessment, targeted interventions were implemented to address key issues in the maintenance and repair of surgical inventory items. These interventions focused on improving repair times, enhancing coordination, optimizing workspace allocation, and streamlining communication. Key activities included conducting public relations and communication workshops, identifying well-wishers to assist the project, and establishing a pre-condemned store. Facilities were improved for in-house workers and visiting Biomedical Engineering (BME) technicians, and job cards and forms for handling unusable items to volunteer technicians were developed. A dedicated focal point with staff was set up, complemented by a web-based platform and WhatsApp group to enhance communication and coordination among stakeholders. These measures collectively aim to improve the efficiency and sustainability of the repair and resurrection processes.

Post-intervention qualitative assessments

The post-intervention qualitative assessment, based on Key Informant Interviews (KII) with 15 participants, revealed significant improvements across several domains in the maintenance and repair of surgical inventory items. Improved repair time was the most frequently cited enhancement, accounting for 32.1% of the references, reflecting the effectiveness of interventions aimed at addressing delays. Better communication and a regular pathway of information flow were reported by 25% of the participants, indicating streamlined processes. Designated workspaces for repairs (21.4%), including separate areas for biomedical technicians, and the successful resurrection of to-be-confirmed items (21.4%) were also noted as major improvements. Enhanced coordination with the Biomedical Engineering (BME) unit (21.4%), involvement of voluntary outside technicians (10.7%), and support from the hospital committee (7.1%) further contributed to operational efficiency. Overall, these results highlight the success of targeted interventions in improving repair times, communication pathways, workspace allocation, and engagement of additional resources, leading to more effective inventory management.

Results of pre- and post-intervention quantitative assessment

Table 2 highlights that there was a positive change in all three domains with the interventions made for the unusable inventory items at the DGH Negombo.

Discussion

This health system research project at the DGH Negombo focused on resurrecting unusable surgical inventory items aligned with global efforts to extend the life cycle of medical equipment. At the same time, the sustainable development of new healthcare facilities and procurement of new equipment have become increasingly difficult, and the increased lifespan of existing facilities has received greater attention in recent years due to the global economic crisis [7]. Similar initiatives conducted worldwide emphasize the positive impacts of equipment resurrection on efficiency, environmental outcomes, and facility sustainability [8]. This study targeted complex surgical equipment, including basic multipara monitors, oxygen regulators, and suction apparatus, reflecting international trends in medical equipment resurrection practices.

In Sri Lanka, compared to countries such as India and Malaysia, the resurrection of biomedical equipment is still at an early stage. Sri Lanka faces challenges in managing unusable medical equipment, predominantly condemning and decommissioning items, unlike its neighbors, who have developed formal resurrection processes and even export resurrected equipment [7]. The financial benefits associated with resurrected equipment play a significant role in compelling hospitals, including large institutions, to adopt this practice, thereby highlighting its integration into the global healthcare economy.

The demand for resurrected medical equipment is increasing in India. As service providers focus on Indian rural markets coupled with cost sensitivity and poor purchasing power, the demand for resurrected medical equipment is expected to increase [9].

A study conducted in Latin America also showed that there is a dire shortage of qualified people to work with medical technical equipment maintenance as a cause for poor maintenance practice [10].

The interventions implemented in this project focused on surgical inventory items aimed at addressing the critical issues identified during pre-intervention assessments. Key challenges include spare part shortages, technician deficiencies, and inadequate infrastructure for equipment resurrection. The project introduced systematic interventions, such as engaging skilled volunteers and facilities and implementing guidelines and procedures for repair and resurrection activities. A study conducted in Sri Lanka also indicated that skill training is vital for the maintenance and repair of inventory items [11].

Post-intervention evaluations revealed substantial improvements in the repair and resurrection of surgical inventory items. Notable enhancements were observed in the satisfaction levels of unit heads, space utilization, and equipment traceability. Space occupied by unusable items was relieved, and unit heads got the chance to use it for other purposes, including patient care. The successful resurrection of basic multipara monitors, oxygen regulators, and suction apparatus demonstrated the feasibility and benefits of equipment resurrection in resource-limited settings. A study conducted in Sri Lanka also indicated that skill training is vital for the maintenance and repair of inventory items [12]. For example, in this study, 60% of basic multipara monitors, 76% of oxygen regulators, and 78% of suction apparatuses were successfully resurrected, contributing to increased equipment availability and cost savings. These findings highlight the potential of equipment resurrection to support efficient patient care delivery within the hospital, especially in settings where new equipment procurement may be challenging.

Despite these accomplishments, this study has some limitations that must be acknowledged. The selection of a limited number of inventory items owing to time and resource constraints restricts the generalizability of the findings to other types of equipment or healthcare settings. Challenges related to external repairs and volunteer availability also affected the scope and scale of the project, potentially influencing the overall effectiveness and sustainability of the implemented interventions. Future research in this area should address these limitations to provide broader insights into the feasibility and impact of equipment resurrection practices in healthcare facilities.

Conclusion

The project at DGH Negombo successfully enhanced the resurrection practices for surgical inventory items, aiming to extend the lifespan of critical equipment, such as multipara monitors, oxygen regulators, and suction apparatus. Systematic assessments identified gaps in technical skills and coordination that were addressed through targeted interventions, including training and improved collaboration with the Biomedical Engineering Division. These measures streamlined the repair processes, improved resource utilization, and achieved significant cost savings. Sustained efforts, supported by hospital authorities, the Biomedical Engineering Division, and external stakeholders, are essential to maintain and expand these improvements, ensuring long-term success in inventory management and patient care optimization.

Recommendations

Tailored interventions that focus on resurrecting unusable surgical inventory items through systematic assessments, stakeholder collaboration, and

engagement with volunteer technical support are highly recommended for similar healthcare settings. To further strengthen these practices at the DGH Negombo, hospital management should prioritize expanding efforts with cost-effective solutions and robust monitoring mechanisms. Improved coordination with the Biomedical Engineering Division, including the potential establishment of an on-site branch unit, can expedite urgent repair and streamline processes. Additionally, actively engaging skilled volunteers to support maintenance and optimization efforts will ensure sustained improvement. These measures collectively enhance operational efficiency and contribute to improved patient care outcomes

Table 1: Number and percentage of resurrected selected inventory items

Name of the unusable item groups	Number of items marked for condemning	Number of items resurrected	Percentage resurrected
Multipara monitors (Basic)	20	12	60%
Oxygen regulators	33	25	76%
Suction apparatus	23	18	78%

Table 2: Mean score of statements of the satisfaction, space and traceability in the pre- & post- intervention period

Serial No:	Domain	Pre (n =38)			Post (n=38)			Sig.
		Mean	SD	Interpretation mean score	Mean	SD	Interpretation mean score	Paired-test, p
1	Satisfaction	2.38	0.56	Average	3.87	0.31	High	15.75, p<0.001
2	Space	3.91	0.85	High	2.41	0.54	Average	9.37, p<0.001
3	Traceability	3.22	0.58	Average	4.03	0.46	High	7.83, p<0.001

Author declaration

Author contributions: Both authors contributed to conceptualizing, designing, carrying out the study, and writing the manuscript. Both authors read and approved the final manuscript

Conflicts of interest: The authors declare no conflicts of interest concerning the research, authorship, and/or publication of this article

Ethics approval and consent to participate: Ethical approval was obtained from the Ethics Review Committee of the PGIM, Colombo.

Funding: This study did not receive grants from any funding agencies in the public, commercial, or not-for-profit sector

References

[1]. Mutia DM, Kihiu J, Maranga SM. Maintenance management of medical equipment in hospitals. Ind Eng Lett. 2012;2(3):9–19.

[2]. Jamshidi A, Rahimi SA, Ait-Kadi D, Ruiz A. A comprehensive fuzzy risk-based maintenance framework for prioritization of medical devices. Appl Soft Comput. 2015;32:322–34. doi: https://doi.org/10.1016/j.asoc.2015.03.054.

[3]. Koggalage PD, De Alwis S. A project to improve management of biomedical equipment in selected units of District General Hospital, Gampaha, Sri Lanka. Int J Res Found Hosp Health Adm. 2019;7(2):67–74. doi:10.5005/jp-journals-10035-1109

[4]. Medical Device Authority. Medical Device Authority Ministry of Health Malaysia Medical Device Guidance Document: Good Refurbishment Practice of Medical Device (GRPMD). Cyberjaya, Selangor, Malaysia: Ministry of Health Malaysia; 2016. p. 1–16.

[5]. World Health Organization. Decommissioning Medical Devices [Internet]. Geneva, Switzerland: WHO, Department of Medicines and Health Products; 2019 [cited 2022 Sep 17]. p. 1–52. Available from: https://www.who.int/publications/i/item/9789241517041.

[6]. Klein A. Hospitals save money, but safety is questioned. Wash Post. 2005 Dec 11;A1, A6, A7.

[7]. Sheth A, et al. Reviewing the sustainability of existing healthcare facilities. In: Association of Researchers in Construction Management, ARCOM 2008 - Proceedings of the 24th Annual Conference. 2008;2:1193–202.

[8]. Kapoor P, Harrington C, Church C, Gale T, Tan P, Abou-Zaki A. Guide to sustaining existing tower blocks in the UK. Comfort Energy Use Build. 2006;27–30.

[9]. Dasanayaka S. Performance of healthcare equipment in the public sector hospitals in the eye of good governance: a case study based on the Sri Lankan public sector hospitals [Internet]. 2001 [cited 2022 Oct 27]; p. 1–25. Available from: http://www.napsipag.org/PDF/SARATH_DASANAYKA.pdf.

[10]. Refurbished medical equipment: challenges and opportunities [Internet]. GreenBook; 2015 [cited 2022 Oct 27]. Available from: https://www.greenbook.org/marketing-research/refurbished-medical-equipment-challenges-opportunities-40073.

[11]. Maxwell RJ. Resource constraints and the quality of care. Lancet. 1985;326(8461):936–9. doi: 10.1016/S0140-6736(85)90862-1.

[12]. Dharmaratne GSK, Jayawardana AKL, Gunatunga MW. Integrated logistic support and equipment availability in government hospitals of a developing country. Sri Lankan J Manag. 2010;15(2, 3 & 4):79–102.