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Improving the Availability and Functional Status of Medical Equipment through a Clinical Audit Cycle: A Quality Improvement Study at Base Hospital Akkaraipattu, Sri Lanka

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ABSTRACT

Improving the Availability and Functional Status of Medical Equipment through a Clinical Audit Cycle: A Quality Improvement Study at a Secondary Care Hospital in Sri Lanka. Background Medical equipment is essential for effective healthcare delivery; however, in low- and middle-income countries, inadequate maintenance systems and weak governance often result in high rates of non-functional equipment. Clinical audit is a recognised quality improvement approach that can identify system gaps and drive measurable improvements. Objective: To assess and improve the availability and functional status of medical equipment through a structured clinical audit cycle. Methods: A full clinical audit cycle was conducted over six months (October 2025–March 2026) at a secondary care hospital in Sri Lanka. The audit included baseline assessment, gap analysis, implementation of targeted interventions, and re-audit. Data were collected using a structured checklist through direct observation, inventory review, and staff interviews. Key indicators included equipment functionality, preventive maintenance, maintenance documentation, and calibration status. Interventions included the introduction of repair tracking systems, preventive maintenance schedules, equipment logbooks, calibration programs, and staff training. Data were analysed using descriptive statistics. Results: A total of 660 medical equipment items were assessed. At baseline, only 61.7% were fully functional, while preventive maintenance (15.6%), maintenance documentation (17.0%), and calibration (4.3%) were markedly deficient. Following interventions, functionality improved to 91.8% (absolute increase: +30.1%), exceeding the ≥90% standard. Preventive maintenance increased to 92.4% (+76.8%), maintenance documentation to 94.5% (+77.5%), and calibration to 73.6% (+69.3%). The proportion of non-functional equipment decreased from 32.5% to 5.5%, with substantial reductions in repair delays. Conclusion: Structured, low-cost interventions implemented through a clinical audit cycle significantly improved medical equipment functionality and management. Clinical audit is an effective strategy for strengthening health technology management systems in resource-limited settings.

Keywords: *Clinical Audit, Medical Equipment, Quality Improvement, Health Technology Management, Sri Lanka.*

INTRODUCTION

Medical equipment is essential for diagnosis, treatment, and monitoring of patients, forming a core component of modern healthcare systems (World Health Organization, 2017). Effective management across the equipment lifecycle—including procurement, maintenance, and disposal—is critical to ensure optimal functionality and patient safety (Temple-Bird, 2015). Despite this, healthcare facilities in low- and middle-income countries frequently experience challenges related to equipment management. Studies suggest that up to one-third of hospital equipment may be non-functional due to inadequate maintenance systems, lack of spare parts, and insufficient technical capacity (Zamzam et al., 2021). In Sri Lanka, similar challenges have been identified, particularly in relation to weak governance, lack of structured maintenance systems, and inadequate documentation practices. These factors contribute to inefficient utilization of healthcare resources and compromised service delivery. Clinical audit is a well-established quality improvement tool that enables systematic evaluation of healthcare practices against predefined standards and facilitates targeted interventions (Azzolini et al., 2019). By completing the audit cycle—including re-evaluation after intervention—healthcare institutions can demonstrate measurable improvements. This study was conducted to assess and improve the availability and functional status of medical equipment at Base Hospital Akkaraipattu through a full clinical audit cycle.

METHODS

Study Design

A clinical audit with a full audit cycle was conducted, consisting of:

i. Baseline assessment
ii. Gap analysis
iii. Implementation of interventions
iv. Re-audit

Study Setting

Base Hospital Akkaraipattu, a secondary care hospital in Eastern Province, Sri Lanka.

Study Duration

six months: From October 2025 to March 2026

i. 2 weeks: Baseline audit
ii. 5 months: Intervention implementation
iii. 2 weeks: Re-audit

Audit Standards

i. ≥90% equipment should be functional
ii. Preventive maintenance should be available for all equipment
iii. Maintenance records should be documented
iv. Calibration should be performed for critical equipment
v. Trained operators should be available

Data Collection

Data were collected using:

i. Structured audit checklist
ii. Direct observation
iii. Equipment inventory review
iv. Staff interviews

Variables included:

i. Equipment Availability
ii. Functional status
iii. Maintenance practices
iv. Calibration status
v. Staff training

Data Analysis

Data were analyzed using descriptive statistics. Frequencies and percentages were calculated for all indicators. Baseline and re-audit findings were compared to assess improvement.

Intervention and Implementation

Following the baseline audit and identification of key gaps, targeted interventions were implemented over a one-month period.

Implementation Process

Interventions were initiated immediately after completion of the baseline audit and continued over four weeks. Standardized tools including repair registers, maintenance checklists, logbooks, and calibration registers were introduced across all clinical units. Orientation sessions were conducted for staff to ensure proper understanding and use of these tools.

Team and Responsibilities

The implementation was coordinated by the principal investigator in collaboration with hospital administration. Unit-level responsibility was assigned to nursing officers and unit in-charges. A focal person was designated in each unit to maintain records, monitor equipment status, and report faults. Coordination with technical personnel was established for repair and calibration activities.

Monitoring and Evaluation

Implementation was monitored through weekly monitoring and evolution meeting and regular supervision and review of registers and logbooks. Key indicators such as functionality, maintenance compliance, and calibration status were tracked. Feedback was provided to units regularly to ensure adherence and address challenges. This continuous monitoring ensured effective implementation and sustainability of interventions.

RESULTS (BASELINE AUDIT)

1. Overall Equipment Status

A total of **660 equipment items** were assessed.

Status	Number	Percentage
Fully functional	407	61.7%
Non-functional	215	32.5%
Not in use	51	7.7%

2. Key Performance Indicators

Indicator	Value	Standard	Interpretation
Availability	100%	≥90%	Good
Functionality	61.7%	≥90%	Poor
Preventive maintenance	15.6%	100%	Poor
Maintenance records	17%	100%	Poor
Calibration	4.3%	≥90%	Very poor (critical)

3. **Reasons for non-functionality**

Cause	Frequency
Awaiting repair	155
Accessories missing	28
Mechanical failure	10
Spare parts unavailable	9

4. **Equipment Downtime**

- 117 equipment: 1–6 months
- 93 equipment: >6 months

Indicates **major delays in repair system**

Gap Analysis

The audit identified several critical gaps:

i. **Weak Maintenance System:** Preventive maintenance was extremely low (15.6%) and Lack of maintenance records observed.
ii. **Inefficient Repair System:** Majority of failures was due to "awaiting repair" and Prolonged downtime (>6 months)
iii. **Critical Calibration Deficiency:** Only 4.3% found calibrated Up to Date, resulted in Major patient safety concern
iv. **Accessories and Resource Management Issues:** Missing accessories causing avoidable downtime

Interventions

Based on identified gaps, the following interventions were implemented:

Equipment Repair Tracking System: Introduction of repair register and Monitoring of repair timelines

Table 1: Equipment Repair Tracking Register

Equipment ID	Equipment Name	Unit	Date Fault Reported	Fault Description	Reported By	Date Sent	Repair Agency	Date Repaired	Status	Remarks

Preventive Maintenance Program: Monthly maintenance checklist introduced and responsibility Assigned at unit level

Table 2: Preventive Maintenance Checklist

Equipment Name	ID	Checked	Condition	Cleaning Done	Issues	Action	Checked By	Date

Calibration Program: In Coordination with technical services Prioritization and calibration of critical equipment started

Table 3: **Calibration Register**

Equipment Name	ID	Unit	Last Calibration	Next Due	Agency	Status	Remarks

Equipment Logbook System: Maintenance and usage documentation

Table 4: Equipment Logbook (Usage Record+ Maintenance)

Date	Type (Use/Maintenance)	Used/Done By	Purpose/Issue	Action Taken	Remarks	Signature

Staff Awareness and Training: Staff training on reporting faults and equipment use introduced

Table 5: Staff Awareness and Training

Date	Training Topic or Awareness program	Trainer	Department	Trainee/ participant Staff Name	Designation	Signature

Accessories Management System: Checklist introduced to ensure availability of components

Table 6: Accessories Checklist

Equipment Name	ID	Required Items	Available	Missing	Action	Checked By	Date

Re-Audit Plan

The same audit checklist will be used after five months to reassess Functional status, Maintenance practices and Repair efficiency

Expected Improvement

Indicator	Baseline	Target
Functionality	61.7%	≥80%
Maintenance records	17%	≥80%
Calibration	4.3%	≥50%
Awaiting repair	155	↓50%

Re-Audit Results

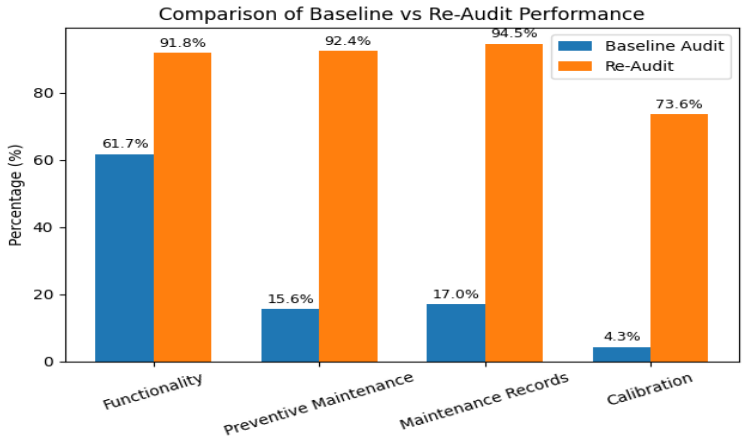
A total of 660 medical equipment items were assessed during both the baseline audit and re-audit.

The proportion of fully functional equipment increased markedly from 407 (61.7%) to 606 (91.8%), representing a 48.9% improvement. Concurrently, non-functional equipment decreased from 215 (32.6%) to 36 (5.5%), reflecting an 83.3% reduction.
Significant improvements were also observed in equipment management practices. Availability of logbooks increased from 231 (35.0%) to 660 (100%). Maintenance record documentation improved from 112 (17.0%) to 624 (94.5%), while preventive maintenance scheduling increased from 103 (15.6%) to 610 (92.4%).
Notably, equipment calibration showed the most substantial improvement, rising from 22 (3.3%) to 486 (73.6%).

Table: Comparison of Key Equipment Management Indicators Before and After the Clinical Audit

Indicator	Baseline (%)	Re-audit (%)	Absolute Improvement	Standard	Interpretation
Functionality	61.7	91.8	+30.1	≥90	Achieved
Preventive maintenance	15.6	92.4	+76.8	100	Near achieved
Maintenance records	17.0	94.5	+77.5	100	Near achieved
Calibration	4.3	73.6	+69.3	≥90	Improved but suboptimal

Figure: Comparison of baseline and re-audit performance of key medical equipment management indicators.



DISCUSSION

This study demonstrated substantial improvements in medical equipment functionality and management following the implementation of structured audit-based interventions. At baseline, although equipment availability was adequate, functionality was significantly compromised, with only 61.7% of equipment operational. This finding is consistent with previous studies conducted in low-resource settings, where ineffective maintenance systems and weak governance structures contribute to high rates of non-functional equipment. The most critical gap identified was the absence of structured maintenance and repair systems. The majority of non-functional equipment was awaiting repair, indicating that inefficiencies in repair processes, rather than lack of resources, were the primary contributors to equipment downtime. Following intervention, there was a marked improvement in all key indicators. The proportion of functional equipment increased to 91.8%, exceeding recommended standards. Preventive maintenance and documentation improved significantly, reflecting enhanced accountability and systematic monitoring. The improvement in calibration practices, although substantial, indicates that further strengthening is required to achieve optimal compliance. Calibration remains a critical component of quality assurance and patient safety, particularly for diagnostic and critical care equipment. These findings highlight the effectiveness of low-cost, system-level interventions in improving healthcare delivery in resource-limited settings. The results are consistent with global evidence demonstrating that structured maintenance systems, documentation, and staff training can significantly enhance equipment performance.

CONCLUSION

Clinical audit cycles are effective tools for improving medical equipment management. This audit identified critical gaps in the management of medical equipment, particularly in maintenance, repair systems, and calibration practices. Strengthening maintenance systems through Implementation of structured interventions and accountability mechanisms can significantly enhance healthcare service delivery.

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