

## Comparative Analysis of the Medical Equipment Management Process in Colombo Gampaha and Kaluthara Districts

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### Abstract

**Background:** Bio Medical Engineering (BME) professionals need to continuously review and improve their management strategies to keep up with enhancement in equipment technology, as well as with increasing expectations of health care organizations. In the last two decades, management strategies have evolved from the initial observation of electrical safety to flexible criteria that fit the individual institution's needs. The focus should be on the risks caused by equipment failure, rather than on equipment with highest maintenance demands.

**Objective:** To explore the Medical Equipment Management process in the Department of Health Western Province.

**Methods:** A retrospective cross-sectional study was conducted. Study period was from 1st January 2022 to 31st December 2022. Retrospective documentary data was obtained from the records maintained by the three Bio Medical Engineering offices in Colombo, Kaluthara and Gampaha. Data analysis was performed in an Excel sheet. Since the availability of a huge volume of equipment categories, researchers had to exclude some equipment such as blood pressure monitors due to time constraints.

**Results:** Lowest preventive maintenance has been performed by Kaluthara BME Unit. It is confirmed that 100% Preventive

maintenance has been performed by the local agent in Kaluthara District.

**Conclusion:** Lowest performance in preventive maintenance has been performed by Kaluthara district BME unit. But in the aspect of corrective maintenance, they expressed the highest performance. Other two districts evidence showed an average performance. It is recommended to instruct BME unit Kaluthara district to start preventive maintenance. It is recommended to use their professional judgment and experience in establishing their own maintenance strategies.

**Keywords:** Bio Medical Engineering, preventive maintenance

### Introduction

Bio Medical Engineering (BME) professionals need to continuously review and improve their management strategies to keep up with enhancements in equipment technology, as well as with increasing expectations of healthcare organizations. In the last two decades, management strategies have evolved from the initial observation of electrical safety to flexible criteria that fit the individual institution's needs. The focus should be on risks caused by equipment failure, rather than on equipment with highest maintenance demands. Furthermore, it is not enough to consider risks posed by individual pieces of equipment to individual patients. It is critical to anticipate the impact of an

equipment failure on larger groups of patients, especially when dealing with one-of-a-kind, sophisticated pieces of equipment that are required to provide timely and accurate diagnoses for immediate therapeutic decisions or surgical interventions. A strategy for incorporating multiple criteria to formulate appropriate management strategies is provided in this article.

The medical equipment management standards published by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) have been a major driving force for the practice of clinical engineering (CE) in the United States over the last 20 years. During that time, JCAHO has timely revised and improved these standards as health care and technology have evolved. In Sri Lankan context, some of those changes allow us to refocus our resources on areas with the greatest potential for improving patient care and enhancing organizational success.

The schedules could differ, taking into consideration factors such as the frequency of use and the severity of failure on patient safety. One example could be different strategies for defibrillators used in emergency departments and intensive care units vs those used in general ward areas or clinics.

A second improvement is the use of a grace period for determining when a piece of equipment should be considered overdue for a scheduled maintenance event. This flexibility provides some leeway when a scheduled maintenance activity cannot be performed at the appropriate time due to unavoidable factors, such as equipment that is in use on a patient or devices that cannot be located. In other words, a maintenance activity may be considered performed on

time even if it takes place beyond the established inspection time, as long as it is consistent with the organization's Medical Equipment Management Plan (MEMP). For example, a quarterly inspection period could have a one-month grace period, whereas an annual inspection period could have a two-month grace period.

Combined, both actions above support the primary message that each organization should analyse its equipment inventory and find the most appropriate maintenance strategies to have “effective, safe, and reliable operation”. Engineers can consider the experience acquired in their daily work, that some critical-care equipment requires little maintenance, whereas some low-risk equipment e.g. X-ray film processors need frequent attention. Preventive maintenance (PM) often does not increase reliability and may introduce failures, in industrial maintenance<sup>[1,2]</sup>.

In its standards, JCAHO3 offers the choice of using risk criteria to create a limited inventory, known as the MEMP inventory. It is highly desirable to regulate unplanned services performed on all equipment. Even if it were possible, it would be a waste of limited resources to examine failure modes and effects of simple and low-risk devices such as otoscopes and other portable diagnostic tools. We believe the inclusion criteria for preventive maintenance (PM) and safety and performance inspections (SPIs) should include, in addition to risk, other criteria that reflect the requirement of the organization such as operational impact, detectability of hidden failures, equipment hazards, reliability and ready availability of spare parts. At least mission criticality should be included in the inclusion criteria, because it addresses not only the organization's desire to have efficient and profitable operations but also the fact that

failure of mission-critical equipment may put patients or the organization at risk.

To avoid ambiguity, PM will be used here solely to represent scheduled replacement of wearable parts to prevent a predictable failure. As the reliability of medical equipment has improved remarkably, the need for PM has been drastically reduced. Often there are non-serviceable period is longer than the average useful life of the equipment <sup>[6]</sup>.

### **General Objective**

To explore the Medical Equipment Management process in the department of health western province.

### **Specific objectives**

1. To compare the Preventive maintenance (PM) process in three districts.
2. To compare the Corrective maintenance (CM) process in three districts.
3. To explore the equipment downtime.

According to figure 1 it is observed that majority of corrective maintenance in all four quarters is done by the BME unit Colombo District. Very few, less than 10 in number done by the local agent.

According to table 2, and figure 2 it is observed that majority of corrective maintenance is by the divisional Bio Medical Engineering units. As a percentage it is 95.99% in Gampaha district, 95.4% and 95.37% in Colombo and Kaluthara, respectively.

According to the Table.4 it is observed Preventive maintenance in Kalutara district has been done by local agents only. But CM done by both BME and the local agents.

According to the Figure 3 and Table 5 it is observed lowest preventive maintenance has been performed by Kaluthara BME Unit. It is confirmed 100% Preventive maintenance has been performed by the local agent in Kaluthara District.

### **Discussion**

It is observed the difficulty in creating a single MEMP that fits all organizations. The MEMP that works well for an extremely busy, District General and Base hospital is likely more comprehensive than what is required for a divisional level hospital. For this reason, the discussion has been more methodological than prescriptive. Readers must use their professional judgment and experience in establishing their own maintenance strategies.

The primary goal here is to stimulate development of innovative management strategies that balance limited resources with the need to improve patient safety, clinical outcomes, patient throughput, and the organization's mission. Time gained from eliminating unproductive scheduled maintenance is better used to improve the value of the service. The staff can participate more effectively in equipment

**Table 1: Average equipment downtime, in all three districts**

District	OTH Lamp	OT Table	Anesthetic Workstation	Multi Monitor	Defibrillator
Colombo	1	1	0	11	3
Gampaha	6	5	6	13	6
Kalutara	16	6	14	10	7

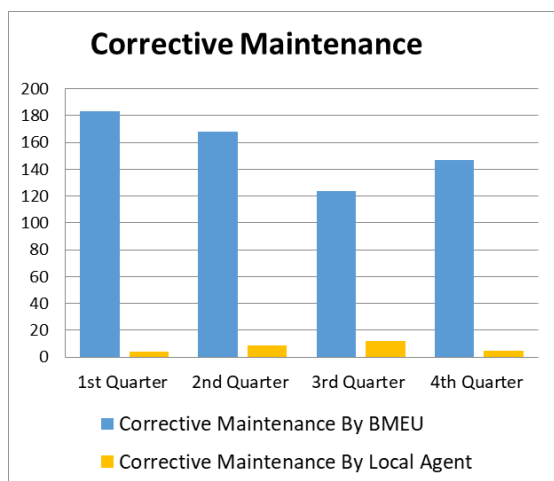


Figure 1: Quarterly Corrective Maintenance; Colombo

Table 2: Comparative Corrective

District	Corrective Maintenance		Total
	By BMEU	By Local Agent	
Colombo	622	30	652
Gampaha	311	13	324
Kaluthara	1483	72	1555

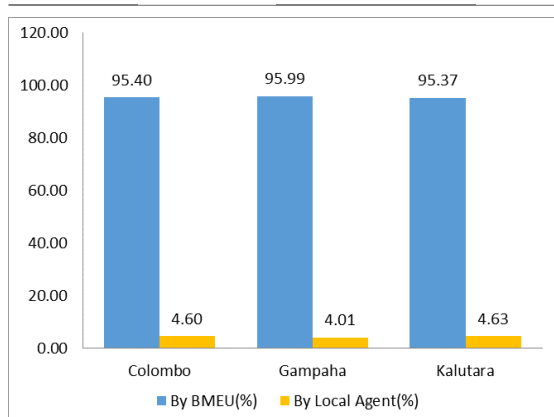


Figure 2: Comparative analysis of the status of corrective maintenance in three districts

planning and acquisition projects to ensure the selection of better engineered and more appropriate equipment, and potentially reduce medical errors. Staff can be more involved in the education and training of clinical staff, thus helping to decrease the number of equipment abuse. Finally, the BME staff may be able to increase repair capability, thus reducing equipment

Table 3: Medical Equipment Maintenance, Colombo District BME

Time Period	Preventive maintenance		Corrective Maintenance	
	By BMEU	By Local Agent	By BMEU	By Local Agent
1st Quarter	20	2	183	4
2nd Quarter	22	2	168	9
3rd Quarter	19	2	124	12
4th Quarter	21	2	147	5
Total	82	8	622	30

downtime and costs to the organization related to vendor service and required rental of supplemental equipment.

Perhaps the most important benefit of this new approach is a shift from concentrating

Table 4: Medical Equipment maintenance: Kaluthara District unit

Time Period	Preventive maintenance		Corrective Maintenance	
	By BMEU	By Local Agent	By BMEU	By Local Agent
1st Quarter		14	370	18
2nd Quarter		10	263	26
3rd Quarter		3	462	12
4th Quarter		9	388	16
Total	-	36.00	1,483.00	72.00

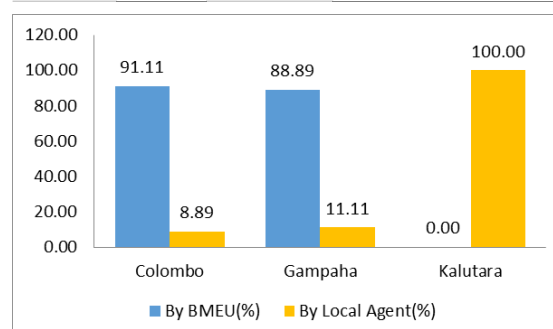


Figure 3: Comparative Preventive maintenance in all three districts Colombo

exclusively on medical equipment as the source of patient safety risk to a balanced evaluation of the contribution to risk by the equipment and by the user. BME professionals will be able to shift some of their attention from equipment itself to supporting the users. This shift in focus will help health care organizations meet their commitments to achieving the goals.

## Conclusion and recommendations

Lowest performance in preventive maintenance has been performed by

**Table 4: Preventive maintenance;  
District level**

Time Period	Preventive maintenance		
	By BMEU	By Local Agent	Total
Colombo	82	8	<b>90</b>
Gampaha	48	6	<b>54</b>
Kalutara	0	36	<b>36</b>

Kaluthara district BME unit. But in the aspect of corrective maintenance they expressed the highest performance. Other two district evidence with average performance. It is recommended to instruct BME unit Kaluthara district to start preventive maintenance. It is recommended to use their professional judgment and experience in establishing their own maintenance strategies.

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