MEDICAL EQUIPMENT MANAGEMENT: A PERSPECTIVE FROM PHILIPPINES, RWANDA, AND SYRIA

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Abstract— **Medical equipment management has long been an integral component of healthcare. For countries considered to be part of the low-middle income (LMI) bracket, challenges relating to medical equipment management influence the overall healthcare performance of an institution. The aim of this paper is to identify the similarities and differences in medical equipment management of different countries. Moreover, the challenges and efforts to address these challenges in managing medical equipment will be presented as well.**

Keywords—**medical equipment, management, medical physicists, low-middle income**

I. Introduction

Medical equipment management has long been an integral component of healthcare. This ensures that proper diagnosis, treatment, management are afforded to the patients within a safe environment of care [1,2]. Moreover, these medical devices should be properly stored and maintained to maintain a safe working environment for the benefit of the patients and staff [3]. Figure 1 shows the equipment life cycle of an equipment.

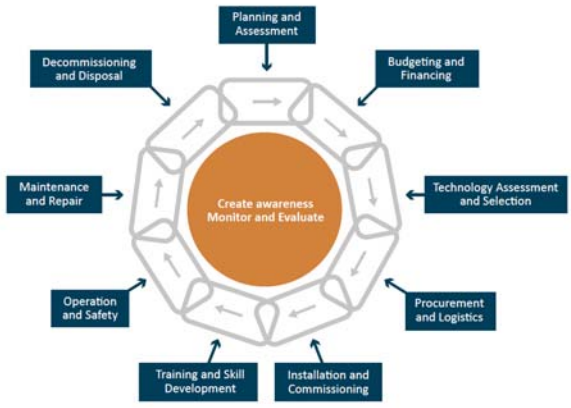

Fig. 1 Equipment Life Cycle [4]

The aim of this paper is to identify the similarities and differences when it comes to equipment management from different parts of the world. Another secondary objective is to identify the challenges being encountered by medical physicists in their respective institutions and how they are being addressed. This paper is limited to discussing challenges and experiences regarding medical equipment management from the three (3) countries: Philippines, Rwanda, and Syria.

II. Country Information

This section of the paper gives a brief background about each country that will be mentioned in this paper.

A. PHILIPPINES

The Republic of the Philippines is an archipelago of about 7,641 islands. The country has a land area of approximately 300, 000 sq. km. and a total coastline of 36, 289 km. As of December 2022, the country has a population of more than 100 million Filipinos. The recorded gross domestic product (GDP) last 2021 of the Philippines was $394.1 billion [10].

B. RWANDA

Rwanda is one of the sub-Saharan countries and part of the East African Community (EAC) of Burundi, Kenya, Uganda and Tanzania, South Sudan, and Democratic Republic of Congo (DRC). It is a small country, of just over 10,000 square miles and the country population of nearly 13 million. Rwanda is geographically bordered by the Democratic Republic of Congo, Uganda, Tanzania, and Burundi. The country elevation makes the climate much cooler and more comfortable than a typical equatorial climate. It is a well-organized and safe country with a committed Government and very low corruption rates, making Rwanda a potential regional hub for health care activities in a long-term perspective. The country has tried to stabilize its economy and it was ranked 2nd in Africa in the ease of doing business by the World Bank [5]. Finally, Rwanda is one of the few South Saharan African countries on track to achieving most of the Millennium Development Goals (MDGs), despite the large number of challenges and needs in the health care sector. Therefore, the market for doing business in the health sector is thus largely untapped, and for investors or exporters there is enormous potential.

C. SYRIA

Syrian Arab Republic, or more commonly known as Syria, is a country located in the Middle East. It has direct access to the Mediterranean. Syria has a total area of 185, 180 sq. km and a total coastline of 193 km. As of writing, Syria has a population of more than 18 million people [6].

III. Existing Practice About Medical Equipment Management

The access and effective management of healthcare technologies leads to improved quality of healthcare provision to most of the population worldwide. However, there is still a remarkable imbalance in medical technology management across different region of the world, specifically between high resources and low resources countries.

During the 90s, the situation of medical equipment management in Rwanda generally was not effectively done in the proper way. During this time, the large fraction of medical equipment in the country was donated or funded by international donors or foreign governments. Most of these devices were poorly maintained, under-utilized, and or out of service due to various reasons such as inaccessibility to spare parts, accessories, and consumables, and lack of trained professionals able to execute the needed repairs or maintenance, mainly biomedical engineers or technicians [7,8].

In the step afterwards to overcome all these, the government of Rwanda established different plans and policies for sustainable medical equipment management and support. One of those was the establishment of medical technology and infrastructure division which provides efficient management and coordination of healthcare equipment and infrastructure in all public healthcare facilities in the country.

In the Philippines, health facilities can be classified as government hospitals, private hospitals, or primary health care facilities. Hospitals are usually classified based on the ownership of that facility. It could either be a public or private hospital. About 40% of the hospitals are classified as public while the remaining 60% are considered as private institutions. Clearly, the private institutions outnumber the government hospitals in the country [9].

The acquisition of new equipment begins by planning and assessing the needs of the hospitals and their patients. It also considers the appropriateness of the equipment to be acquired to its environment, the equipment users and the allocated budget and financing. The budget and financing portion takes into consideration the estimated purchase cost and the estimated “cost of ownership”.

In Syria, the procurement process for private hospitals begins and is directly monitored and processed by the hospital management. The medical physicist is responsible for making the trend book, and the final decision is made by the hospital manager. The maintenance contract (if applicable) is yearly reviewed and revisited and directly made with the company leadership. Public hospitals, on the other hand, the procurement process is applied through the ministry belongs to (ministry of health or ministry of higher education and scientific research), and the scientific committee, consists of a medical doctor, medical physicist, and medical engineer, is established to review the trend book which is written by the medical physicist. This is carefully reviewed together with the offers to ensure that the scientific requirements are fulfilled [10].

In addition, the administrative committee is established to study the offer from a financial point of view. Both committees may contain medical physicists and radiation oncologists. It is a tender based, meaning that it needs to announce a tender and make a tender book and apply through the Purchasing Department in the hospital and make an announcement for the tender for the first and second time and receive the proposals to be opened from a tender opening committee.

A. PLANNING, TECHNICAL SPECIFICATION, INSTALLATION, AND COMMISSIONING OF MEDICAL EQUIPMENT

In Rwanda, the planning of new medical equipment, and associated activities such as budgeting and financing, procurement and tendering are done by the selected team that include the available involved professionals at the healthcare institution level: oncologists, radiologists, and management team (for radiological equipment). Sometimes, the foreigner experts in the fields like consultant medical physicists are invited to help the hospital. However, medical physicists were not available in the country until just a year ago (2021), so the healthcare institution historically used to seek experts abroad to assist in the planning and specification of the new equipment, and in the procedures of acceptance and commissioning.

After the equipment installation, the equipment vendor organizes the onsite training of the respective professionals who will regularly work with the equipment during the patient diagnosis and/or treatment. These onsite training help the involved professionals to understand the functionality of the equipment, its safe and effective usage.

In the Philippines, the participation of medical physicists in identifying the technical specifications of an equipment is not always guaranteed. For one, there are a lot of healthcare facilities who do not have an in-house medical physicist. As a result, they would often rely on the expertise of

consultants and the vendor. This is due to the fact that until now, the number of medical physicists is still far from sufficient as compared to the number of healthcare facilities [11].

B. EQUIPMENT MAINTENANCE AND REPAIRS

For the three (3) countries in this study, a contract with the appropriate vendor is, more often than not, secured by the hospital management as a form of assurance that should their equipment breakdown, support will be readily available. However, these contracts are usually costly and should also be considered during the planning stage under the "cost of ownership". Generally, the healthcare institutions take the responsibility of their equipment maintenance and repair. For oncology equipment, regular QC and QA are done by the physicists or therapy technologists with the supervision of physicist. However, there are QC/QA procedures in diagnostic radiology departments that are not properly implemented. This requires urgent attention for the proper functionality of the available diagnostic department equipment (x-ray machine, CT, and MRI) country. Historically, the absence of medical physicists, and specifically physicists working in diagnostic radiology triggered this issue. Currently, physicists who specialised in diagnostic radiology are available, and the establishment of a medical physics society can help address all these challenges.

Medical equipment repair maintenance is in accordance with the vendor and hospital agreement. Both parties agree on a service contract which is renewed yearly. Currently, some vendors have the local service company with a local biomedical trained engineer which deals with the equipment regular service, and the vendor intervenes when the machine requires a serious repair like tube replacement, etc. however, there is still a challenge in availability of spare parts which causes the equipment long breakdown period.

IV. Challenges Encountered About Medical Equipment Management

The following are the similar challenges being experienced, in general, by the three (3) countries mentioned in this study:

I. Large critical and non-critical equipment not functioning.
II. Management do not consult medical physicists in terms of technical specifications that may help them save money.
III. Poor cost-cost benefit analysis of management in terms of purchasing equipment (i.e focus on the cost of equipment but not the "cost of ownership").
IV. Costly contracts after the warranty period ends which small hospitals may not be able to afford.
V. High attrition rate of technologists and medical physicists to look for greener pasture
VI. Lack of local experts and in-house medical physicists
VII. Lack of qualified manpower and dependence of foreign expertise to install and maintain medical device
VIII. No infrastructure to organize the workshop
IX. Proper tools (i.e phantoms) are not available for technical staff
X. No specific policy, strategy, and planning for medical equipment management at hospital/clinic level

V. EFFORTS BEING DONE TO ADDRESS THESE CHALLENGES

Listed in this section are the similar efforts being done by each country in order to address these challenges surrounding the medical equipment management umbrella of a hospital:

I. Stronger support from the regulatory bodies in terms of human resource staffing for medical physicists.
II. Support and promote biomedical engineering training in higher learning institutions
III. Inspire biomedical innovations among students and researchers through the establishment of competitions and awards
IV. Use public procurement contracts as a tool for technological learning and commercialization.
V. Creation of a network of centers of excellence in biomedical sciences and engineering
VI. Different policies and guidelines for medical technologies management and maintenance have been developed
VII. Establishment of web-based system "Medical Equipment Maintenance Management System" for inventory, preventive and curative maintenance management and spare parts procurement

VI. Conclusions

Medical equipment, without a doubt, is a crucial part of our healthcare system. Moreover, managing medical equipment should be a priority for all hospitals. The process in which we acquire them, maintain them, and use them should be carefully planned by the management and their technical staff. This is where the role and expertise of a medical physicist come in. For the three (3) countries represented by the three (3) authors, the practice in managing equipment has similarities and differences as well.

The patients and health care providers and environment must be protected for any unnecessary or potential harm associated with the improper functionality of the hospital equipment. To achieve this, there should be a proper hospital equipment management system in every hospital irrespective of size and location of the hospital.

The healthcare technology management policies and QA/QC procedures should always be implemented at hospital/clinic level to ensure that hospital equipment and other systems used in healthcare are safe, operational and a proper maintenance of the equipment to meet the mission and vision of the healthcare institution. The role of medical physicists in the management of medical equipment should be recognized at the hospital/clinic level and during tendering for the new equipment, the responsible team should include the QC tools/materials in the entire budget.

Without a doubt, the role of medical physicists is crucial in ensuring that the medical equipment management is given urgent attention. Another issue that the authors realized is the lack of formal educational institutions and training opportunities for medical physicists in the graduate level as well as a clinical residency training program. Both of which are integral in honing clinically qualified medical physicists in different fields.

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