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The measurement of the performance of Medical Equipment Management System (MEMS) in public hospitals especially

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Abstract
The medical equipment needed can range from highly sophisticated life support systems in tertiary hospitals to the simplest devices needed to accurately diagnose and safely treat patients in primary care. For hospitals to achieve these goals, they must develop and implement an initiative known as a Medical Equipment Management Program (MEMP), which outlines the actions that must be taken to mitigate the risks associated with specific medical devices. Gear. Inspection and preventive maintenance are essential parts of that plan and must be regularly reviewed and updated to keep up with the rapid technological advances in medical devices and the growing expectations of healthcare organizations. According to the latest information gathered on the subject, Indian public hospitals currently do not have a comprehensive metric or "framework to assess the performance of MEMS. This study is carried out with the aim of developing a model or framework for MEMS that can serve as an integrated tool, using key performance indicators (KPIs) as the unit of measurement".

Keywords: Measurement, medical, equipment, management

Introduction
Many scientists around the world have conducted in-depth research and discussions on medical device management in different countries. Amarion and colleagues conducted qualitative research on the factors that influence the care and management of medical devices in military hospitals. His research was summarized in an article published in the journal Military Medicine. Using the framework analysis tool, he conducted a survey specifically targeting healthcare and management professionals at a hospital serving in the military. Semi-organized interviews are used to analyze the data and descriptive statistics are applied to prioritize the frequency of occurrence of the various criteria that influence the maintenance management of medical devices. Based on the results of the experiments, a significant portion of the total can be attributed to device management training. Of course, they took into account how convincing the results might be to others, but the sample size was quite small, so it was unavoidable [1]. Ms. Ulickey has studied a significant number of complex cases requiring integrated facilities management systems. In the past, networking and technical advancement of digital control systems have enabled the integration of a wide variety of control strategies. This was achieved using a number of different control schemes. These strategies apply not only to the management of building systems, but also to the management of health facilities. The development of new scientific knowledge provides a stronger mathematical foundation for the logical application of a wide range of medical technologies, paving the way for more efficient use of available resources. In the future, people should focus on learning how to properly understand this data and improving the system's ability to make informed planning decisions.
With advances in science and technology, hospitals in the United States are investing more and more time and resources in the management and maintenance of their medical equipment. According to Qiang, the availability of advanced medical technologies is one of the most important aspects of the technological infrastructure of hospitals today. Therefore, it is the responsibility of the hospital to create an effective management model, manage medical equipment to ensure it is kept in excellent working order, and ensure the safety of

hospital patients and visitors. Topics related to the maintenance and management of hospital medical devices and the development and characteristics of the maintenance management model and the current situation in Germany and abroad have been summarized with different methodologies, including literature searches, surveys, questionnaires and data analysis. some data [2]. These methods were used to collect and analyze the data. However, it did not present any evidence to support its claim that the use of modern Internet technology to build intelligent systems in medical device management is highly practical. He claimed that this was the case, but did not present any evidence to support this claim. It also did not provide any data to support its claims that the benefit had been demonstrated in specific field studies.

This research has laid the groundwork for an in-depth analysis of the integrated medical device management system that will be based on cloud computing and the Internet of Things in the future. Most of the research is based on the following parts, which serve as a basis: The first section of this article discusses the technologies and methods used in the development of the system. Some of these include cloud computing and task scheduling, IoT intelligent control system, particle swarm algorithm, and chicken swarm optimization algorithm. Other methods include cloud computing and task scheduling. Therefore, this article discusses the network architecture, software structure, development environment, database, and other components to create a complete resource management system platform. These and many other topics are covered in more detail later in this article. In summary, this research model simulates the system's impact on real-world applications, as well as a variety of potential barriers, from the perspective of acquiring and distributing medical devices, as well as the maintenance, operation, and use of medical devices [3].

Providing fair, quality, and affordable health care requires access to an extraordinary array of resources, all of which must be carefully balanced and managed (Bastiaan LR, 1997). Tangible resources, such as capital goods and consumer goods, collectively referred to as health technology, are examples of the types of inputs that are among the most important. The medical equipment needed can range from sophisticated life support equipment in a tertiary hospital to the simple equipment needed for accurate patient diagnosis and safe treatment in a primary care clinic (Andreas L., Willi K., and Manjit K., 2000). However, the basic criteria for efficient and effective health technology management are the same in all contexts. These basic criteria include clear standards, technical guidelines and practical tools for the effective and efficient management of health technologies (David HW, 2001) [15].

Finding, purchasing, and implementing the right technology are activities that require significant effort, and the resulting decisions must be carefully considered before being made. It is necessary to maintain an adequate balance of capital and recurring expenses, as well as the ability to manage the technology throughout its life cycle, to ensure the best possible match between the provision of technology and the needs of the health system. This allows the greatest possible compatibility between the technology offered and the needs of the health system. The formalized model was developed by Bloom G. and Temple-Bird C. (1990). (Bloom G and Temple-Bird C, 1990). Developing countries are responsible for spending an estimated $5 billion annually on medical equipment. This is equivalent to approximately 7% of the total annual spending on medical devices worldwide. These expenses include consumables for medical and dental professionals, surgical instruments and X-ray equipment, diagnostic tools, and implanted items (David HW, 2001) [4]. However, advances in medical technology are a major source of pressure on developing countries. This pressure comes both from outside (in the form of technology providers and donor organizations) and from within (in the form of pressure from their populations' growing demand for health care) (Andreas L., Willi K. and Manjit K., 2000). Many developing countries are characterized by poor management of health facilities, resulting in the waste of crucial and limited resources in the health sector. This is a problem because efficient management of health facilities is essential for quality care (Bloom G. and Temple-Bird C., 1990). The study period is carried out between August 2019 to August 2021

Objective

1. Design of key performance indicators for public hospitals in India adapted to the Indian environment and based on the best practices of MEMS
2. "To assess the effectiveness of the MEMS program in participating public hospitals against selected key performance indicators (KPIs)".

Biomedical device management and maintenance program

- Until now, there is no adequate structure in the public sector for the maintenance of sanitary equipment.
- The mapping was done in 29 states under the direction of the NHSRC. 7,56,750 devices have been identified in 29,115 healthcare facilities costing approximately Rs 4,564 crore.
- Between 13% and 34% of devices were found to be malfunctioning in all states.
- Therefore, the BEMMP is related to the availability of equipment (95% in district hospitals, 90% in community health centers, and 80% in primary health centers). Guidelines and template for bidding documents were developed in 2015
- In October 2019, a technical manual was published to support the implementation in the PPP and internal modalities. Approved guidelines are published and distributed to all states/UTs.

It would be an understatement to say that the current state of medical equipment is in pretty poor shape, especially when it comes to maintenance and repair. It is quite rare for hospitals to have more than 50 or sixty percent of their equipment in good working order. According to a study compiled by the Indian government's Department of Electronics (DOE), a range of high-tech medical equipment worth a total of Rs 50 million is currently housed in government hospitals in nine different states, including Delhi. This is due to lack of funds and lack of replacement components now available. Based on the survey results, the researchers visited 132 government hospitals in nine different states, including Delhi, Madhya Pradesh, Orissa, Bihar, Punjab, Uttar Pradesh, Maharashtra, Assam, Haryana, and Tamil Nadu. According to the study, the medical electrical equipment worth Rs. 48.61 crore was out of order

for a total cost of Rs. 180.58 million rupees. Since the study did not include all hospitals except those in Punjab, the results were extrapolated to conclude that the equipment is worth at least Rs. Rs 50 crore may not be operational in those states. The only hospitals in Punjab included in the study were those in Punjab [5].

Maintenance of medical equipment in nursing hospital in India

The practice of keeping machines in a condition where they can continue to function as intended, or repairing them so that they can be reused, is called "maintenance." The main objective of maintenance is to improve the availability of production facilities, the secondary objectives are to increase safety and efficiency while reducing costs. The term "medical technology" refers to the many devices used by hospitals and other medical facilities for diagnosis, treatment, monitoring, rehabilitation, and other types of care and treatment. Medical technology management is an essential part of health service delivery. In order to offer patients high-quality treatment, comprehensive medical device management is essential [6]. To effectively manage the technology, it is essential to create a medical device maintenance plan that takes into account both its functionality and its possible malfunction. 4 Any business that relies heavily on its resources to generate revenue should prioritize building and maintaining a successful maintenance department as one of its top priorities. But even if the technology is state of the art at the time of purchase, within 6-7 years of installation it inevitably risks becoming obsolete. Medical equipment represents approximately 40-50% of the total costs in a tertiary hospital. Maintenance costs represent between 40% and 50% of the total operating budget of companies that rely heavily on their fixed resources. If people have access to new technologies in the field of maintenance, they will be able to drastically reduce this amount. As a result, maintenance costs could become a company's main source of controllable expenses. It is imperative that healthcare organizations explore possible ways to reduce costs and improve the financial management of their operating expenses. According to research by the National Center for Health Systems Resources, the medical device failure rate can be as high as 60% in some parts of the world, with an average medical device failure rate even in areas with a Moderate presence of medical device industry (eg USA). This is true even though maintaining health technology has a positive impact on the overall safety and efficacy of medical treatments. It also has the additional consequence of increasing the demand for medical care, an effect that cannot be ignored. The availability of services based on the needs of patients is an essential part of the proper functioning of health technologies. The purchase of medical equipment represents the largest investment of any company involved in the health sector. Ensuring the reliability of critical equipment and performing its routine maintenance is essential to ensure patient and user safety and increase service availability [7].

The task of determining the most efficient approach to medical device maintenance is challenging. The full extent of the difficulty lies in the desire to reduce capital costs while improving equipment performance and the need to reduce equipment maintenance costs by extending residual equipment life.

Additionally, despite increasingly stringent regulatory requirements, healthcare facilities have retained limited flexibility in the strategic direction of their maintenance strategy. This is despite the fact that regulatory requirements are becoming more stringent the most important actions that occur during the life of a medical device, the most important of which is the maintenance process, which is still considered the "daily bread" of clinical engineering work. The main goal of the maintenance process is to ensure that the device is usable, always available, and safe to use. The first challenge clinical departments face is determining which preventive maintenance plan to use for each piece of equipment. In the prioritization methods used to make maintenance decisions, the most critical factors to be considered most often are the fitness of the resource for the organization's purpose, patient safety, and the intrinsic maintenance requirements of the resource. The implementation of the chosen strategy requires the allocation of human, material, financial and documentary resources, all specified through the use of multidimensional models. The successful implementation of the chosen strategy requires [8].

Furthermore, the clinically intensive maintenance of resources, long considered a necessary evil, is now recognized as a crucial role contributing to the creation of added value. This recognition came from the fact that this role had previously been underestimated. Performance measurement is just as important in the maintenance function of healthcare organizations as it is in other types of manufacturing organizations (Kumar *et al*., 2013). In fact, well-designed KPIs have the potential to help with a variety of activities, including evaluating variances between maintenance plans and activities, executing improvement initiatives, and a variety of other activities. In this context, the objective of our research is to develop a conceptual framework to analyze the variables that lead to operational difficulties in medical devices and to evaluate the process of continuity of care. In addition, one of our goals is to determine the effectiveness of health care. With this in mind, the main objective is to determine how value can be generated by monitoring clinical maintenance performance in the context of the health sector [9].

Healthcare in India

In India, there are two distinct sectors that make up the healthcare industry: the government sector and the commercial sector. Consumers do not have to pay for primary and tertiary level of care, which is the provision of public sector health services that covers all levels, from primary to tertiary. Curative and preventive health care, from elementary to tertiary level, is provided by the state sector at the national level at no cost to the user. These services are financed and managed by the public sector (which represents approximately 18% of total health spending and 0.9% of GDP). The private sector, on the other hand, is the industry leader when it comes to individual care through outpatient services. Furthermore, the private sector is responsible for approximately 82% of total health spending and 4.2% of total GDP. Based on national health care consumption rates, private health services are largely focused on providing basic health care and are mostly privately funded. As a result, these services can impose disproportionate costs on the poor and working poor. Public sector health management can be divided into three distinct

areas. Maintaining a healthy population is the main task of the state. Second, the center is responsible for providing health care in areas of the union that do not have their own legislature. It is also responsible for developing and monitoring national rules and regulations, being the liaison between states and funding agencies, and promoting a variety of programs implemented by US state governments. These responsibilities fall within the National Institute of Standards and Technology (NIST). In addition, the programmers on the concurrent list share responsibility for their work with the federal and state governments [10].

Public health goals and strategies are developed through a consultative process involving all levels of government and all stakeholders. This process is overseen by the Central Council on Health and Family Welfare (CCHFW), which acts as a facilitator. Between the early 1950s and early 1980s there was a sharp increase in the number of health care facilities and personnel in India. Furthermore, the number of licensed physicians per 10,000 population fell from a high of 4 per 10,000 in 1981 to three per 10,000 due to rapid population growth in the late 1980s. This was due to the fact that there were fewer people in India. In 1991 there were about 10 beds for every 10,000 people in the United States. Recent forecasts assume that about 15,000 physicians will graduate each year beginning in 2005. It is estimated that about 250,000 dentists are employed within the national network of 242 accredited institutions. Primary health centers, often referred to as PHCs, are an essential part of the health infrastructure in rural areas. According to official data, in 1991 there were approximately 22,400 primary health care facilities, 11,200 hospitals and 27,400 pharmacies in India.

According to the United Nations, these facilities are part of a multi-tiered health care system that directs the most seriously ill patients to hospitals in metropolitan areas in an attempt to provide routine health care to areas of the population. An important part of the needs of primary health care centers and subcenters are attended by paramedics who have received special training. In 1991 there were a total of 811,000 available beds in hospitals and other medical facilities in the United States. The socioeconomic conditions of the communities where the hospitals were located had a significant impact on their geographic distribution. Based on the results of a private survey of the total number of hospitals in India conducted in the early 1990s, Indian official data was more reliable than the survey results, which indicated that the country had 7,300 hospitals in 1992. About 4,000 of these properties were owned by federal, state or local governments and each of these levels of government was responsible for their maintenance. Another 2,000 hospitals, many of which were very small institutions, were owned and maintained by charitable foundations, and received some government support. Some of these hospitals were also located in rural areas [11].

The remaining 1,300 hospitals, most of which were fairly modest establishments, were owned and operated by private establishments. In the early 1990s, the use of advanced medical equipment, often imported from Western countries, was mostly limited to urban and metropolitan areas. In fact, this technology had to be imported. Until 1992, most of the country's 1,300 private hospitals lacked modern medical equipment, while about 12% had advanced technologies to diagnose and treat major diseases, including cancer. In the 1990s in India, the rapid expansion of the private medical sector, coupled with the growth of the country's middle class, led to the conception of a new concept in the nation: the opening of hospitals and other health facilities: care specially designed. Facilities for profit. In the 1970s, the number of hospitals and other public health facilities increased from 725 to more than 163,000. Health services are difficult to manage due to understaffing, financial constraints, lack of accountability for quality care, incompetent team management, and inefficient logistics management. The private sector is in10sifying its efforts to meet the growing demand for health services. According to the results of several studies, clients, regardless of their socioeconomic level, prefer to buy health services from the private sector [12].

Medical device handling problems

It is well known in the world of health that one of the most important elements of the infrastructure in the provision of services are the various medical devices. It should also be noted that medical devices, along with drugs and many other devices, have played a crucial role in the tremendous advances in health care in the last hundred years. When it comes to designing, building, and maintaining a facility, equipment is often overlooked, but it's certainly essential.

This is especially true for less developed countries where the economic situation is already precarious. Based on the results of studies conducted by the World Health Organization (WHO) and other international organizations, it is estimated that between 25% and 50% of all health care devices in developing countries cannot be used for various reasons. This seriously hampers efforts to improve the provision of health services to the citizens of these countries. While some unused equipment was donated, most was acquired through loans from bilateral and multilateral organizations, which would require significant sacrifices on the part of the recipients. In addition, some of the material was offered free of charge. If lack of money is one of the main causes of device downtime, especially when it comes to managing recurring expenses, there are other considerations to take into account as well. The findings of international experts indicate that the most important underlying factor is inadequate management of the problem. According to the results, this is the case [13].

More precisely, the most important obstacle is the lack of clearly defined standards and procedures for the design, purchase, use and maintenance of medical devices. Once the equipment has been integrated into the organization (or health system), it is the responsibility of the organization (or health system) to manage the equipment throughout its life cycle. The activation of a medical device, as well as its installation, acceptance and approval tests, clinical use, preventive and corrective maintenance, and definitive dismantling due to economic necessity or obsolescence are part of the life cycle of a medical device. Other core tasks, including but not limited to technology assessment, usage standards, quality assurance and improvement, safety and risk management, facility and utility management, and customer relations management with manufacturers and third parties should be considered part of the life cycle. One of the most basic mistakes made by the vast majority of management programmers is the lack of feedback, good or, more critically, bad experiences from each block to the previous blocks, to the block that started. all. This is one of the biggest mistakes made by the vast majority of business

programmers. Therefore, it is extremely important to understand the life stages of devices, beginning with the identification of a need and continuing through research and development, production, sale, and use by healthcare facilities. So it is important to have this understanding. The history of the medical device business is covered in the next paper.

Medical device management

The provision of health services is greatly facilitated by the use of various medical devices. This offering includes simple and basic devices, such as the sphygmomanometer, as well as more complex and bulky devices, such as magnetic resonance imaging (MRI) scanners. This ranking is the result of differences in the technologies used and the purposes they should serve. Therefore, there is a great need for healthcare organizations to effectively manage their resources to keep their expenses under control while maintaining the highest possible level of quality in healthcare delivery. The management of medical devices (MEM) is carried out within the available resources, such as human, material, structural and organizational resources, as well as financial. It is a process that helps hospitals develop, monitor and manage their equipment to promote the safe, efficient and profitable use and maintenance of their facilities. Specifically, it does so by helping hospitals achieve their goals of safe, efficient, and profitable operations and maintenance. To ensure that an appropriate medical device is used in accordance with the manufacturer's instructions, maintained in a safe and reliable condition, and properly disposed of at the end of its useful life, MEMs must be established and periodically reviewed by responsible organizations [14].

A hospital approach known as the Medical Equipment Management Program (MEMP) aims to ensure the safe and reliable operation of medical equipment while promoting the most efficient use of equipment. This program describes the procedures and guidelines to follow in the management of operations involving medical equipment, from the selection and acquisition of the equipment to its dismantling. The MEMP ensures that medical devices can provide reliable and accurate information to healthcare professionals, that they function safely for patients, and that they reach their full potential (University of Michigan Hospitals, 2010). - Comprehensive research of the life cycle of medical devices to ensure efficient maintenance of these products. Management failures at any stage of the life cycle, but particularly in the early stages, are likely to lead to bigger problems in later stages. For example, when equipment maintainability is considered during the acquisition phase of the process, it is possible to reduce the number of problems that can arise during the equipment maintenance phase.

Conclusion

It was found that the medical device quality management strategy based on key performance indicators (KPI) could be used to hire medical device management plan in public hospitals should be approved in an integrated and comprehensive manner, provided that it is based on a conceptual framework with 4 domains of input, process, output and result. On this point, too, all parties agreed. More importantly, the feedback they provided on the Likert scale for the data items validated the concept that the MDS for MEMS serves as a decision support system for healthcare managers. This gives healthcare executives the opportunity to assess and make the right decisions to improve management effectiveness. During the development of this study, a series of statistical analyzes were performed to evaluate the performance of MEMS in 4 different public hospitals. Hypothesis tests have also shown that managers and employees can always improve their performance by following corporate best practices. The conceptual framework had 4 distinct domains, each related to the other domains. The level of correlation between the 4 different domains of the MEMS framework ranged from very significant to quite significant. Poor performance in one domain has a ripple effect, causing the overall performance of all other domains to decline as well. The results of the linear regression model showed that there was a relationship between the total values of the KPIs and the coefficients of use of the examined medical devices, which could be considered statistically significant.

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