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A study on the development and apply a measuring tool for the measurement of the performance of medical equipment management system

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Abstract
According to the results of a recent study, hospitals can potentially minimize the number of medical equipment breakdowns or failures if they use effective, carefully planned and monitored maintenance management methods. 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: Apply, measuring, medical, management

Introduction

Due to the rapid expansion of medical technology in recent years, not only has the quality of medical care been constantly improving in all industries, but also a large number of advanced medical products have been developed, manufactured and marketed. As hospitals purchase more and more varieties of medical equipment, the maintenance and service requirements for medical equipment also increase. This is a cycle that will continue as hospitals purchase medical equipment. Knowing how to manage and maintain these medical devices with numerous brands and advanced science and technology and at the same time being able to carry out their medical care to the best of their knowledge is a very important topic for hospital service managers, as well as for technicians and technicians of maintenance and awareness. Due to the continuous expansion of medical equipment in hospitals, the speed with which equipment upgrades and upgrades are made has increased and the information needed to manage maintenance has become an increasingly complicated collection. Every year, device maintenance management and information recovery policies become more and more demanding [1].

Many scientists around the world have conducted in-depth research and discussions on medical device management in different countries. Amerieon 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.

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 [2]. 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. 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 [3]. 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 [4].

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. However, the basic criteria for efficient and effective health technology management are the same in all contexts [5]. These basic criteria include clear standards, technical guidelines and practical tools for the effective and efficient management of health technologies (David HW, 2001).

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 [6]. 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. 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 (Stiefel, 2009). 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 [7]. 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 [8].

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. Create metrics and minimal data set elements (MDS) to conduct research on the provided key performance indicators (KPIs).

Research methodology: The purpose of the research methodology section of the document is to provide a description of the methods and procedures used to achieve the objectives that have been defined for the study in question. "The objective of this research was to create and apply key performance indicators to assess the proper functioning of MEMS in public hospitals, with the ultimate goal of improving the quality of care provided to patients. Consequently, the research was developed in two well-differentiated phases: the development phase and the application phase".

"This paper provides an overview of quantitative research, which can be divided into several distinct stages and uses a variety of methods. This paper is divided into sections covering the research sample, study units, study areas, data collection techniques, the creation of research tools and instruments" and the validity and reliability of these research tools and instruments. Research. These topics are listed below. Throughout the implementation phase of the study, attempts were made to use statistically verified key performance indicators (KPIs) and MDSs (questionnaire). The methodology used throughout the data analysis and hypothesis testing process was also detailed. The last section of the paper provides a summary of everything that has been covered so far [9]. The study period is carried out between August 2019 to August 2021

Results

The data collected and analyzed in this paper were further detailed in the previous paper, according to the objectives and purposes of the "study. The first part of the study involved the development and validation of measurement tools for research, such as the definition of Key Performance Indicators (KPI), the Multidimensional Scale (MDS) and a conceptual framework, all included in the first three main objectives of I study". This part of the study was divided into two parts. The researchers then used these tools in 4 different public hospitals to assess the overall effectiveness of the MEMS system. This was the continuation of the second part of the research project. In the second phase of the project, two main objectives and two secondary objectives were added. As a result, the research project had a total of 7 objectives, each of which was examined and analyzed individually and detailed in various "sections of this paper" [10].

"As discussed in more detail in Paper the first phase of the research was carried out with the support of experts from a variety of fields and specializations". The researcher who conducted the study contacted them to request their help in validating the measurement tools. They rated the usefulness of their suggestions on a scale of one to five. After the first part of the project, consisting of reliability and validation tests, the second phase of the project consisted of testing the tools carried out on a total of 252 different devices. Each of the 4 public hospitals in the city of Chandigarh hosted part of the screening and application process that took place there [11].

Before distribution, the validity and reliability of the meter were examined through the prism of various statistical methods. The conclusions were positive. A significance level of 0.05 was used to assess the study objectives and the results were calculated taking this into account. A simple analysis of variance was performed to allow comparison of the efficiency of 4 hospitals. Pearson's correlation coefficient was useful to analyze the data collected during the process of analyzing the relationship between the different elements of the conceptual framework. The use of linear regression analysis was necessary to accomplish the task of determining the results of the secondary endpoints. In this particular scenario, the CPU value was expected against the KPI totals and health values [12].

Go alone

Under the first objective, Key Performance Indicators (KPIs) were prepared for public hospitals in the Indian setting using MEMS best practices for public hospitals in the country. As mentioned in the previous paper (Table 1), a set of thirty key performance indicators (KPIs) were provided and their reliability was assessed, as explained in more detail in the next section. Ultimately, the proposed KPIs, also known as KPIs, were only listed and selected after they were determined to meet the agreement criteria [13].

The overall percentage of agreement of the experts is shown in the figure and can be seen below. The percentage of overall agreement is presented in Table 1, which also includes a summary of the results. The qualities with the highest percentage of agreement were Achievable, 93% (Relevant), 87.1% (Punctual) and Specific, while the rest of the characteristics presented the lowest percentage of agreement. Consequently, each of the characteristics showed an agreement percentage greater than 70%, which was considered the minimum necessary to demonstrate the agreement of the experts. The subjective review of the reviewers allowed to demonstrate the justification of the recommended tool, both aesthetically and in terms of content. This was achieved by evaluating the content of the tool. In addition, the experts were asked to share their views on the key insights and areas in which the recommended KPIs were ranked [14].

The calculations and reliability checks of Guttman's half and Cronbach's alpha of each key performance indicator (KPI) were performed using the statistical program SPSS version 23. The reliability of the entire instrument, which is the sum of all indicators key performance indicators (KPIs), have been tested individually in addition to the reliability of each individual KPI. To perform the Guttman split-half reliability calculation, the data set was split in half to produce two separate halves. The first section included three aspects: 1 (specific), 2 (measurable), and 3 (indicating overall quality) (attainable). The second part, like the first, consisted of three characteristics, namely qualities 3, 4 and 5 (all important). Table 3 summarizes the results of the reliability and hypothesis tests for each KPI using a Kolmogorov-Smirnov (KPI) test on one sample. The importance of each individual characteristic (SMART) of each key performance indicator (KPI) was evaluated against the hypothesis. The theory turned out to be correct [15].

Cronbach's alpha scores ranged from 0.77 to 0.98, while Guttman's split reliability of all agreed KPIs ranged from 0.78 to 0.95 on the Guttman scale.

Table 1: List of proposed KPIs

KPI #	Proposed KPI	Under the perspective
1.	MEMS Policies and Guidelines	Internal administration
2.	Responsibility	Internal administration
3.	Patient-centered approach	Service user
4.	Human Resources	Internal administration
5.	Biomedical engineering services	Service user
6.	Infrastructures and structures	Internal administration
7.	MEMS funding/grant allocation	Financially
8	Risk management	Continuous improvement
9.	Registration and documentation	Continuous improvement
10.	Preventive maintenance	Continuous improvement
11	Security practices	Service user
12	Precision and quality control	Continuous improvement
13	Formation and development	Continuous improvement
14	Corrective maintenance	Internal administration
15.	Cost-benefit analysis	Financially
16	POE and instructions for use	Internal administration
17	Usage model	Service user
18	Reliability of medical devices	Internal administration
19	Patient safety	Service user
20	Employee safety	Service user
21	Service cost report	Financially
22	User satisfaction	Service user
23	Duly updated inventory	Internal administration
24	Duty cycle (percent)	Service user
25	Availability index	Internal administration
26	Percentage of PPM compliance	Internal administration
27	TAT medical equipment repair	Service user
28	Percentage of Repairs Completed	Service user
29	Percentage of medical devices in operation	Service user
30	Percentage of medical devices in maintenance	Internal administration

Table 2: Percentage of agreement between experts

Attribute	Tall in disagreement	In disagreement	I cannot say it	To accept	Tall To accept	Percentage okay
Specific	0.0	2.1	6.9	42.9	48.1	91%
Measurable	0.0	2.5	12.3	46.9	38.3	85.2%
Realizable	0.0	1.7	12.7	46.0	39.6	85.6%
Important	0.0	1.5	5.6	41.7	51.3	93.0%
On time	0.0	1.9	11.0	52.3	34.8	87.1%

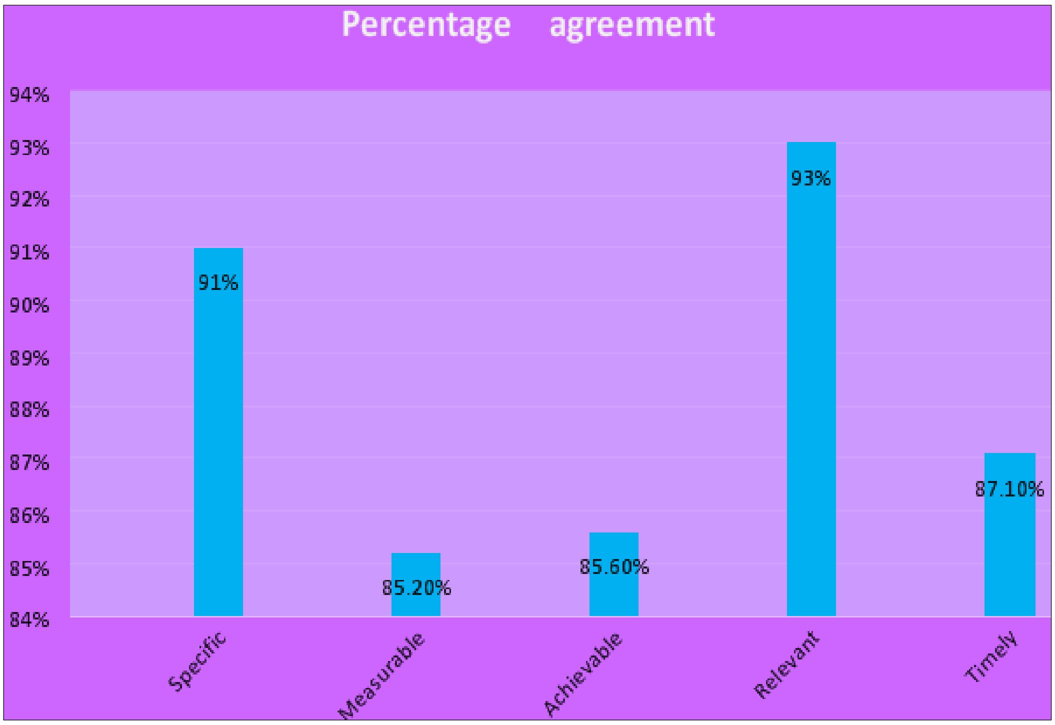

Fig 1: Overall percentage of agreement among the experts

All discussed and decided KPIs had the same values of 0.87 and 0.85 respectively, and therefore the overall scale for all KPIs was considered reasonable. After completing a single Kolmogorov-Smirnov sample for hypothesis testing purposes, the "p" value was found to be less than 0.05, indicating that the null hypothesis was invalid, untested (Fig. 2). This showed that it is statistically significant to maintain the five distinct properties, namely specificity, measurability, feasibility, relevance, and timeliness, as important components of all selected KPIs. Specificity refers to the degree to which an indicator can be measured. Measurability refers to the degree of feasibility of an indicator (KPI).

Statistics were used to examine the overall percent agreement, reliability, and importance of each feature. The results showed that there was nothing wrong with any of the factors. In the end, a set of 28 key performance indicators (KPIs) were selected from a set of 30 recommended KPIs based on their ability to meet the statistical test criteria. This selection was made from the group of suggested KPIs. According to table 4.3, two key performance indicators, KPI no. 15 (cost-benefit analysis) and KPI no. 17 (usage model) were removed from the final collection of KPIs because they did not meet minimum standards for reliability or hypothesis testing. These two KPIs have been removed from the final collection of KPIs.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of attribute 1 is normal with mean 4 and standard deviation 0.500.	One-Sample Kolmogorov-Smirnov Test	.000[1]	Reject the null hypothesis.
2	The distribution of attribute 2 is normal with mean 4 and standard deviation 0.750.	One-Sample Kolmogorov-Smirnov Test	.018[1]	Reject the null hypothesis.
3	The distribution of attribute 3 is normal with mean 4 and standard deviation 0.500.	One-Sample Kolmogorov-Smirnov Test	.000[1]	Reject the null hypothesis.
4	The distribution of attribute 4 is normal with mean 4 and standard deviation 0.516.	One-Sample Kolmogorov-Smirnov Test	.000[1]	Reject the null hypothesis.
5	The distribution of attribute 5 is normal with mean 4 and standard deviation 0.574.	One-Sample Kolmogorov-Smirnov Test	.000[1]	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

[1] Lilliefors Corrected

Fig 2: "Statistical significance of the SMART criteria"

Second objective

"The second main objective was to create the components and parameters of the minimum data sets (MDS)" that should be used to analyze the KPIs to be reported (KPIs). Developed by the researchers themselves in the form of a structured questionnaire, it was used to conduct research and analysis on a variety of MEMS properties. The final selection of the proposed MDS was made after ex Tensive analysis and review, including input collected from various industry experts. After determining the percentage of experts sharing the same opinion, a final list of MDSs corresponding to each KPI was created, which is presented in Table 2.

Conclusion

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 project was started with the intention of producing an integrated tool for MEMS in the form of a model or framework using Key Performance Indicators (KPIs) as the unit of measurement. The research led to the development of a set of thirty key performance indicators (KPIs), one hundred and 10 MDS components, and a conceptual framework for evaluating the effectiveness of MEMS. The reliability and validity of the research approach in question has also been proven through statistical analysis, which has been agreed by all industry experts as the best set of key performance indicators (KPIs). The results of this medical device management study showed that hospitals do not have a comprehensive and codified medical device management strategy in place, resulting in waste of material and equipment capital for the organization. This was determined based on research conducted as part of this medical device stewardship study. When there is no planning and control system for the inventory, purchase and maintenance of medical equipment, a series of challenges arise. These challenges include the accumulation and depreciation of equipment and the inability to provide these facilities when they are needed in critical circumstances. It is recommended to plan for replacement of key equipment components in emergency scenarios, e.g. B. when the equipment suddenly fails. These plans must take into account the type of equipment, the replacement cost and the importance of the equipment. Protocols exist to verify the safety of medical devices before they are used by the patient, as part of a preventive maintenance program, and after frequent and major repairs. All of these protocols help the hospital prepare and maintain the proper medical equipment. In this scenario, we will have more resilient companies with a higher threshold to face the unexpected.

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