Electrical Safety in Public Healthcare Facilities and Medical Devices Management

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ABSTRACT

In hospitals, electrical hazards pose a serious risk that needs to be continuously assessed and improved. Medical surveillance systems and workplace assessments are frequently disregarded, and workers do not follow workplace instructions on safety precautions. The events are linked to a lack of understanding about the significance of electrical dangers and workplace safety and public health. Ignoring these evaluations could have negative effects on one's health, the quality of one's work, handicap, and impairment. The perspective of occupational safety and health on electrical dangers in hospital settings is described in this paper. Additional preventive actions were suggested in order to provide a list of workable and realistic actions that would create a safer and healthier workplace.

1. Introduction

One of the most significant sectors in the world is healthcare. In the hospital, technology is a major factor in providing high-quality patient care. Medical equipment is a crucial component of the modern hospital setup and is now required for practically all of its operations. All patient care procedures, including therapeutic, supportive, and diagnostic ones, depend on these pieces of medical equipment [1]. Rapid advancements in technology, especially in the previous several decades, have greatly expanded the importance of medical technology [3]. These medical equipment pieces are essential to the physical framework of every healthcare facility. The enhancement of patient health services is greatly aided by the prompt accessibility, availability, and best use of these medical devices [2].

The World Health Organisation defines medical equipment as "devices used for a specific purpose of therapy, diagnosis, and patient monitoring, as well as for rehabilitation purposes following an injury [5]." These pieces of equipment need to be maintained and repaired, user-trained, and decommissioned after a certain amount of time. However, medical equipment does not include implanted, disposable, or single-use gadgets [10]. The primary focus of hospital administration is the quality control of medical equipment in order to deliver high-quality healthcare [11]. The complete process of managing medical equipment is covered by MEMS/MEMP (Medical Equipment Management System/Plan), which starts with the procurement process and continues through installation, maintenance, utilisation, and safe decommissioning [14]. Therefore, a strong maintenance service, an effective system for gathering data and maintaining records, and established policies and procedures controlling every facet of equipment management are critical to the program's success. Additionally, it is critical that management promotes the involvement of all users—clinicians, technical staff, and nursing staff—in the decision-making process [4].

In this case, the introduction is examined in section 1 of the article while the review of NEMS detection technique is discussed in section 2. Section 3 explains the application of NEMS diagnostics system, Section 4 shows the discussed the proposed diagnostic model, and Section 5 concludes up the project.

Performance Indicators In Public Health Services

In the last few years, the term "performance" has gained widespread recognition in the global public health care industry. Even in the public sector, the performance evaluation of health services has emerged as a critical tool for improving patient care's effectiveness and quality. The phrase "performance management and measurement" in the context of healthcare services refers to a number of aspects, such as the delivery of integrated health services in accordance with public needs and

expectations, patient care services founded on evidence-based medicine and practices, and preventive medicine and health promotion. The primary evaluative criteria for accomplishing all of these patient healthcare and service goals, as illustrated in Figure 1, are performance indicators [12]. In summary, performance measurement has numerous advantages for an organisation. These include:

- a mechanism to manage and describe the processes;
- a scientific approach to setting standards in accordance with goals and objectives;
- the ability to identify and address issues early on for a continuous improvement system; and the prevalence of a reporting and documentation system of all accomplishments within the organisation.

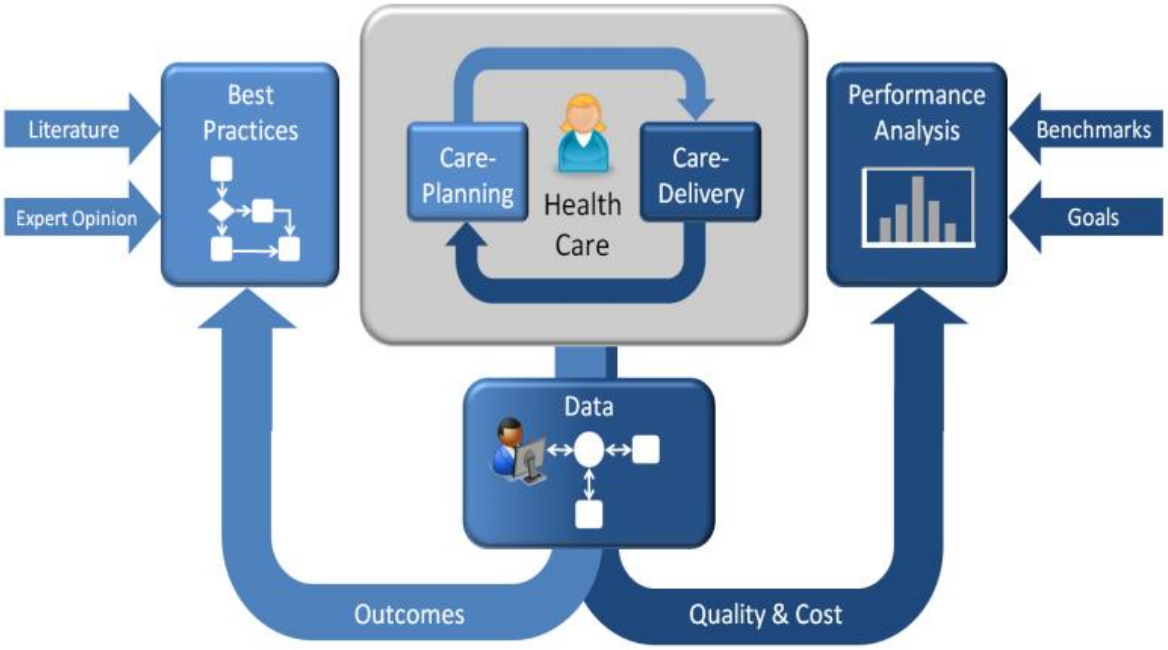

Figure 1. Performance Measurement

Medical Equipment Management System

Everything pertaining to the usage, administration, and functioning of medical equipment is included in the Medical Equipment Management System. This covers maintaining inventory and records, devising maintenance plans, handling equipment breakdowns and repairs, ensuring safety and quality control, educating users, and preserving all the information needed to create management reports and, ultimately, make decisions about future planning and enhancements. In public hospitals, significant sums of money are spent on the purchase, yearly upkeep, servicing, and repair of medical equipment [6]. Research in this area shows that mishandling these pieces of medical equipment not only causes financial crises but also fails to provide the public with the intended benefits at the same time.

Through raising quality of life, medical technology has made a patient's and his family's lives considerably easier. Patients can now get procedures with smaller incisions and shorter recovery times because to medical technology. Our monitoring and scanning technology has improved, allowing us to undertake a variety of medical operations much more comfortably [7]. Each of these contributes significantly to giving the sufferer a more fulfilling existence. For example, telemedicine services and medical equipment technologies have been integrated to enable robotic procedures nowadays. Physicians do not have to be in the operation or procedure room with the patient while the medical intervention is being performed under such a patient care system [13]. In this manner, patients may be able to receive a range of medical treatments from public health facilities in the closest area. A minimally invasive surgery can now be carried out by the surgeon with the aid of robotic surgeries.

Because of this, patients can now have surgery with fewer incisions, experience less discomfort, and recover from their procedures more quickly.

In addition to helping doctors make accurate diagnoses and promptly manage patients, medical technology also makes it possible for people to receive integrated health services. With the integration of their knowledge and services on a single platform, clinicians and healthcare practitioners from various specialisations may now treat patients effectively and at a substantially lower cost. Thus, technology facilitates the integration of systems management in a way that raises the bar for healthcare performance metrics as a whole. The hospital and clinical executives are, therefore, under pressure to obtain a return on investment when they purchase these medical technologies. The pertinent rules maintained under accounts and money must be justified. The health care organisations must implement an accountability structure in light of all these variables.

Electrical Safety For Public Health

Originally, the purpose of isolated power systems was to lower the possibility of fire and explosion during surgical procedures involving flammable anaesthetics. These systems had less chance of electrical arcing to ground, which may have served as an ignition source, because the power conductors were electrically insulated from the ground. Operating rooms were equipped with conductive flooring, explosion-proof outlets and receptacles, improved grounding, and isolated electricity to reduce the risk associated with the use of flammable anaesthetics [8]. Nonetheless, American healthcare facilities no longer employ flammable anaesthetics. These days, it is necessary to have prior knowledge of the standards that set the requirements for the diagnosis and evaluation of an electrical installation in order to interact with any electrical system. This information is intended to identify hazardous situations, deterioration of the physical environment, abuse, and other circumstances that raise the likelihood of harm to people and their property. Since humans have been using electricity, there have been hazards such as electric shock and arc hazards, thus it is vital to be informed of current electrical safety standards. Having said that, a lack of knowledge regarding electrical safety has led to a rise in the amount of fatalities, severe injuries, burns, and property losses [9]. Currently lacking knowledge about electrical hazards, this can be remedied by addressing the first two stages of the conscious competence learning model: Both conscious and unconscious incompetence.

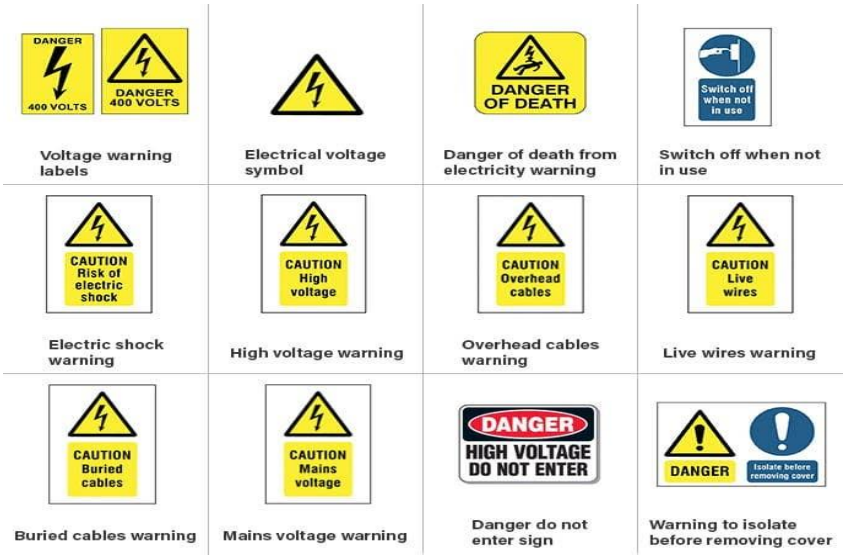

Figure 2. Electrical safety on sites

The most well-known electrical hazard, and the basis for the majority of safety regulations, is electric shock. In every situation, the impact of electric current on the body is different. Even in cases where shock current does not reach a critical organ, the effects of electric shock range, also referred to as the current that flows through the body, can result in internal burns that cause severe injury or death (5

amperes or more); because these burns are internal and third-degree burns, they can cause delayed death [15].

2. Results and discussion

Isolating the energy source and using up any remaining energy is the greatest preventive measure for any work or place where there is exposure to an active energy source. Protection systems are those that keep out of direct and indirect contact. These are the protection categories:

- Complete protection: Designed to prevent any form of contact with energised parts, the active parts should, for instance, be fully covered with an insulating cover that can tolerate external impacts. Fixed, secure, and sturdy barriers and enclosures that offer enough quality to guarantee the necessary protection standards must be a part of the protection.
- Partial protective measures: Enclosures and barriers must be erected as impediments in order to prevent unintentional contact with energised parts.
- Extra precautionary measures: High-sensitivity differential switches are designed to safeguard users from harm should they come into touch with an active area.
- Dielectric helmets, dielectric gloves, dielectric shoes, and dielectric personal protection equipment.

A differential switch's drawback is that it only activates when an electric shock is about to happen rather than acting in a preventative manner. Lastly, one efficient way to keep an electrically safe environment is to keep a safe approach distance from exposed conductors or areas of energised electrical circuits.

3. Conclusion and future scope

In hospitals, electrical hazards pose a serious risk that needs to be continuously assessed and improved. Therefore, it happens frequently that medical surveillance systems and workplace assessments are disregarded, and workers disregard instructions to follow safety precautions. This is ascribed to a lack of understanding of workplace safety and health and an underestimation of its significance. Ignoring these evaluations could have negative effects on one's health, the quality of one's work, handicap, and impairment. Hospitals should use workplace assessments to enhance each employee's general health, as this will boost productivity and improve the standard of care provided. Consequently, the above-mentioned ideas are realistic and doable, and putting them into practice should lead to a safer and healthier work environment.

Reference

[1] Chobanov, Veselin. "Electrical Infrastrucure in Hospitals risks and opportunity for quality healthcare." In *2021 3rd International Congress on Human-Computer Interaction, Optimization and Robotic Applications (HORA)*, pp. 1-5. IEEE, 2021.

[2] Dela Cruz, Ramiro Z., and Ruth A. Ortega-Dela Cruz. "Facilities technology management framework for public health-care institutions in a developing country." *Journal of Facilities Management* 20, no. 5 (2022): 609-628.

[3] S. Neelima, Manoj Govindaraj, Dr.K. Subramani, Ahmed ALkhayyat, & Dr. Chippy Mohan. (2024). Factors Influencing Data Utilization and Performance of Health Management Information Systems: A Case Study. Indian Journal of Information Sources and Services, 14(2), 146–152. https://doi.org/10.51983/ijiss-2024.14.2.21

[4] Corciovă, Călin, Robert Fuior, Doru Andriţoi, and Cătălina Luca. "Assessment of medical equipment maintenance management." In *Operations Management and Management Science*. IntechOpen, 2022.

[5] Stephen, K. V. K., Mathivanan, V., Manalang, A. R., Udinookkaran, P., De Vera, R. P. N., Shaikh, M. T., & Al-Harthy, F. R. A. (2023). IOT-Based Generic Health Monitoring with Cardiac Classification Using Edge Computing. Journal of Internet Services and Information Security, 13(2), 128-145.

[6] Elahi, Bijan. *Safety risk management for medical devices*. Academic Press, 2021.

[7] Malathi, K., Shruthi, S.N., Madhumitha, N., Sreelakshmi, S., Sathya, U., & Sangeetha, P.M. (2024). Medical Data Integration and Interoperability through Remote Monitoring of Healthcare Devices. Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications (JoWUA), 15(2), 60-72. https://doi.org/10.58346/JOWUA.2024.I2.005

[8] Hossain, Md Anwar, Mohiuddin Ahmad, Md Rafiqul Islam, and Yadin David. "Evaluation of performance outcomes of medical equipment technology management and patient safety: skilled clinical engineer's approach." *Global Clinical Engineering Journal* 1, no. 2 (2019): 4-16.

[9] Zamzam, Aizat Hilmi, Ahmad Khairi Abdul Wahab, Muhammad Mokhzaini Azizan, Suresh Chandra Satapathy, Khin Wee Lai, and Khairunnisa Hasikin. "A systematic review of medical equipment reliability assessment in improving the quality of healthcare services." *Frontiers in Public Health* 9 (2021): 753951.

[10] Allin Geo A.V., et.al An Sofm classifier for improved convergence for detection of picks syndrome using wavelet transforms, World Applied Sciences Journal, V-29, I-14, PP:57-61, 2014.

[11] Clemente, Fabrizio, Giuliana Faiella, Gennaro Rutoli, Paolo Bifulco, Maria Romano, and Mario Cesarelli. "Critical failures in the use of home ventilation medical equipment." *Heliyon* 5, no. 12 (2019).

[12] Abd Rahman, Noorul Husna, Muhammad Hazim Mohamad Zaki, Khairunnisa Hasikin, Nasrul Anuar Abd Razak, Ayman Khaleel Ibrahim, and Khin Wee Lai. "Predicting medical device failure: a promise to reduce healthcare facilities cost through smart healthcare management." *PeerJ Computer Science* 9 (2023): e1279.

[13] VON MORGEN, E. D. O. A. R. D. O. "Analysis of a hospital clinical engineering service and development of e-learning tools for electrical safety of medical devices." (2019).

[14] Kutlu, Y., & Camgözlü, Y. (2021). Detection of coronavirus disease (COVID-19) from X-ray images using deep convolutional neural networks. Natural and Engineering Sciences, 6(1), 60-74.

[15] Sesotyo, Priyo Adi, and Taufiq Dwi Cahyono. "Electrical Safety Improvement in Ngaliyan Public Health Facility on Semarang City." In *2023 International Conference on Technology, Engineering, and Computing Applications (ICTECA)*, pp. 1-6. IEEE, 2023.