Research Newsletter Vol. 4 (3) September – December 2015

Lata Mangeshkar Medical Foundation's Deenanath Mangeshkar Hospital & Research Center
Erandawane, PUNE - 411 004, INDIA, Tel. 66023000 / 40151000 Email: jpmt@vsnl.com, Website: www.dmhospital.org

Hospital engineers play an important role in ensuring patient safety

Dr. Niranjan D. Khambete, Manager, Clinical Engineering, DMH&RC

Role of engineers in a hospital

In a hospital, healthcare professionals such as doctors, nurses, paramedical staff and associated supporting staff constitute the majority of the workforce, while the engineers and their supporting technical staff are in minority. Nonetheless, in today's technology intensive healthcare delivery processes, it is important to acknowledge that engineers too play an important role in providing patient care and by adopting a systematic approach towards healthcare technology management, they can help in achieving high levels of patient safety.

Role of Facilities Engineers in patient safety

In a hospital, 'Facilities Engineers' are those who manage the infrastructural facilities and can be of multiple specialties. Civil Engineers look after building maintenance and ensure supply of required quality and quantity of water. Electrical Engineers are responsible for effective and safe management of the electrical installation to achieve uninterrupted supply and appropriate distribution of electrical power. Mechanical Engineers too have an important role in satisfying the ventilation and air conditioning requirements and are also involved in supporting the medical gas infrastructure. In recent years, Computer and Information Technology Engineers have emerged as an important engineering group, who cater to the data management needs of the hospital.

The hospital being a specialised establishment for providing patient care, its infrastructure not only needs to satisfy all the statutory norms, but also needs to meet some additional specialised requirements, which can be closely linked to patient safety. Thus, by referring to international standards and various guidelines, Facilities Engineers can enhance the safety of the infrastructure and thus, help in enhancing patient safety.

Electrical Installation and patient safety

The international standard [1] and various other guidelines [2] recommend that Electrical Engineers adopt a risk management approach for enhancing the safety of the electrical installation. In this approach, clinical locations are classified into three groups based on the level of criticality of the treatment and whether any loss of power will compromise patient safety. For instance, Group 0 and Group 1 locations are low and intermediate risk areas respectively, where the contact of any medical equipment would only occur with patient's external body parts. In these two types of locations any loss of power for more than 15 seconds is not acceptable though it may not always compromise patient safety and will not endanger life. On the other hand, Group 2 locations are high risk locations where prolonged contact is needed between medical equipment and patient's internal body parts and loss of power can be life threatening. Therefore, use of Isolated Power Systems is mandatory for minimising the electric shock hazard. Furthermore, loss of power for more than 0.5 seconds cannot be tolerated and hence, use of external Uninterrupted Power Supplies or internal batteries is considered essential.

Patient safety aspects of HVAC systems and IT systems

The design and operation of Heating, Ventilation and Air Conditioning (HVAC) systems of the hospital have a direct impact on the infection control strategy of the hospital. Thus, Mechanical Engineers need to follow

standards and guidelines [3, 4], which specify limits of various parameters of the HVAC system. For example, the HVAC system of an OT should be designed to have 25 air changes with at least 4 fresh air intakes per hour. The supplied air should be filtered through 99.97% efficiency, 0.3 micron HEPA filters and the pressure inside the OT should always be maintained 25 Pa higher than all outside areas. The temperature should be controlled between 18 ^{o}C and 24 ^{o}C and relative humidity should be maintained between 40% and 60%.

The Computer and Information Technology Engineers also need to carry out thorough analysis of clinical processes and design user friendly interfaces to enable ease of usage leading to higher comfort levels and reduced human errors. These efforts would positively contribute to increasing levels of patient safety.

Role of Clinical Engineers in ensuring safety of medical equipment

'Clinical Engineers' (also known as Biomedical Engineers) are a unique group of engineering professionals who have extensive exposure to various disciplines of clinical medicine, and are involved in managing the medical equipment in hospitals throughout its life cycle. Their contribution is crucial to activities such as medical equipment selection, procurement, incoming inspection, installation, user training, periodic performance evaluation, safety testing, preventive maintenance, breakdown maintenance and safe disposal.

Each of the above activities has a closer link to patient care and hence, will also have a larger impact on patient safety. For selecting the right equipment Clinical Engineers need to ensure that they are approved by the medical device regulatory authorities. In absence of this regulatory system, such as in India, collaboration between Clinical Engineers and clinical users is needed to carefully scrutinise the equipment specifications and critically analyse the risks involved in putting non-regulated equipment into clinical use.

Once the equipment is procured and installed, it is necessary to check that the performance and safety parameters match with the specifications and that there has been no damage in transit. Before the equipment is formally introduced into clinical use, training of users on safety aspects and usage issues is an essential step because equipment failures leading to increased risk to patients can often be linked to use errors rather than technology failures.

Once the equipment is put into routine clinical use, Clinical Engineers need to carry out periodic performance checks and preventive maintenance as per the manufacturer's recommendations and safety testing as per the national and international standard [5]. Appropriate training of engineers by the manufacturers' representatives would ensure that all these activities are carried out correctly, thus resulting in the equipment remaining safe throughout its life cycle. In case of breakdown, high quality and appropriate spare parts need to be used to minimise any risk due to unexpected failure of these parts.

In summary, it is important to acknowledge that in today's technology dependant modern medical practice, engineers of various specialties play a vital role in patient care and by adopting a professional approach they can make a significant contribution towards achieving high levels of patient safety. The challenge lies in making more attempts at facilitating better interactions between the engineers and the doctors in the hospital environment, which can go a long way in increasing awareness among engineers about the criticality of clinical processes and the impact of technology on patient safety. Furthermore, it is also essential to create an atmosphere within the hospital wherein engineers will feel that they are an integral part of the clinical team.

References

[1] International Electrotechnical Commission, Geneva, 2002, IEC INTERNATIONAL STANDARD 60364-7-710 Electrical installations of buildings –Part 7-710:Requirements for special installations or locations – Medical locations

[2] Department of health, UK, 2007, Health Technical Memorandum, 06-01: Electrical services supply and distribution (Part A): Design

[3] Department of health, UK, 2007, Health Technical Memorandum 03-01: Specialised ventilation for healthcare premises (Part A): Design and validation

[4] P. N. Hoffman *et al,* 2002*,* Microbiological commissioning and monitoring of operating theatre suites A report of a working party of the Hospital Infection Society, *Journal of Hospital Infection*, vol. 52, pp 1-28

[5] Bureau of Indian Standards, New Delhi, 2007, IS/IEC 62353: Indian Standard Medical electrical equipment — recurrent test and test after repair of medical electrical equipment