1. Introduction

The primary role of the medical physicist or clinical engineer in the use and investigation of electromagnetic fields (EMFs) is to provide advice to the hospital management on any application affecting patient safety. However, there will also be some responsibility in advising employers how these modalities may affect staff and the local population.

Electromagnetic fields cover all areas of non-ionising radiation from mains frequencies, through the use of surgical and physiotherapy diathermy to the problems encountered at higher frequencies with mobile communication devices and wireless local area networks (LANs). Guidance has been produced by IPEM on the measurement and use of these fields.

This guidance document relates to the general measurement of EMFs. It does not cover MRI where much more comprehensive tests and expertise are required.

2. Scientific contribution

The use of EMFs in the medical environment has increased significantly in the last decade. EMFs are used in medical equipment for diagnostic and therapeutic purposes. The advent of wireless technologies for networked communications and information systems as well as the universal use of mobile telephones by staff, patients and visitors require hospital Trusts to have a detailed knowledge of the electromagnetic environment in which their business operates. IPEM has produced guidance on this subject and this document provides a comprehensive reference list for further scientific reading.

Although there is a significant body of scientific information relating to the use of these technologies, each hospital will have a unique set of criteria in which their staff and medical equipment are expected to work. Medical physicists and clinical engineers have a central role in the design and measurement of medical systems to ensure that they are fit for purpose in the individual environment.

The Health and Safety at Work Act lays particular responsibility on Trusts to ensure that their working environments are safe. Scientific departments will undertake
routine surveys of the electromagnetic environment to ensure that the Trust meets all of its legal commitments, both in terms of medical equipment safety and accuracy and the human exposure of their staff, patients and visitors. The impending European Union Physical Agents Directive on electromagnetic fields will strengthen current legislation regarding the exposure of staff.

Medical physicists and clinical engineers will have expert knowledge in the use of electromagnetic fields in hospitals. EMFs in equipment have the potential to interfere or be interfered with by other equipment. This whole area of scientific endeavour is still in an embryonic stage and hospital based staff are in a unique position to evaluate the issues and applications of these technologies. Staff will be expected to disseminate their knowledge through publication in scientific journals and presentations at conferences. In a rapidly changing and financially challenged world, it is important for patient safety and the general patient experience that knowledge gained in one environment is rapidly disseminated to others so that patient safety is maintained at all times.

The medical physicist or clinical engineer will have access to a range of electromagnetic field measurement devices in order to conduct their research. As a minimum these should be a field survey meter and spectrum analyser.

3. Educational role

Many departments use EMFs in routine clinical practice. Short-wave physiotherapy and surgical diathermy (electrosurgery) are high powered sources of electromagnetic fields. Many diagnostic tests are highly susceptible to interference effects from EMFs. Medical physicists and clinical engineers are involved with the education and training of staff in the use of these technologies and the mitigation of any issues surrounding their use. Staff will be expected to teach either on formal courses at undergraduate or postgraduate levels. A typical example would be in advising on the use of surgical diathermy with a patient who has a cardiac pacemaker and needs resection of a tumour in the breast. Advice to the cardiologist, surgeon and anaesthetist will ensure a safe procedure for the patient.

Specialist lectures at universities are necessary to enable healthcare professionals to be aware of where issues may arise and techniques that they might use to ensure safety and accuracy of patient treatment.

4. Managerial role

With the increasing use of EMFs in the hospital, medical physicists and clinical engineers will be expected to write policies and procedures related to the clinical use of EMFs so that patient care is conducted in an optimal manner. They will advise Trust Health and Safety Committees on the issues surrounding the use and application of these technologies. They will investigate incidents, or potential incidents due to interference caused by EMFs and advise on their elimination. They will ensure that adverse incidents arising from interference are reported to an appropriate body such as the Medicines and Healthcare products Regulatory Agency (MHRA).
All new medical equipment has the potential to be subjected to interference from EMF sources. The relevant international standard – BS EN 60601-1-2:2007 states that the responsibility for ensuring that no issues arise is a joint one between manufacturers and the user. It is important that users of equipment are made aware of any manufacturer’s warnings regarding the potential for a device to create or suffer from interference. The medical physicist or clinical engineer will provide to management the necessary expertise to ensure that patient safety is not compromised. They will also advise on occupational exposure issues as indicated below.

Experts should advise on implications for electromagnetic interference owing to in-house maintenance or modification of equipment. For example, alterations to a metal case can degrade the shielding effectiveness of a piece of equipment.

All medical devices have the potential to generate or be susceptible to electromagnetic fields. The medical physics or clinical engineering expert should be asked to advise on any new building developments where medical devices will be used. Trusts should ensure that the siting of any new development will not cause electromagnetic compatibility issues which can be costly to rectify.

5. Human exposure advice

There is significant concern amongst the population about the effects of electromagnetic fields on the human body. In general this relates to mobile phones and their base stations, although there are many other sources within a hospital. Trusts will wish to assure their staff, patients and visitors, as well as local residents, that there are no issues with these devices or installations. The medical physicist or clinical engineer may not be an expert on the biological effects of many of these electromagnetic fields, but they will have specialist knowledge which can be used to assist the Trust in reassuring any enquirer of the safety of their systems.

The local specialist should be able to demonstrate the safety of anyone who is on, or lives near to their site by measurement of the relevant field strength. They should compare these measurements to national and international standards to demonstrate a safe working and living environment. They will conduct surveys of the hospital site to ensure that electromagnetic fields in any area are within the limits of EU regulation.

The local specialist should be consulted before the installation of any mobile phone base stations on the hospital site. They will then liaise with the base station supplier and ensure that the Trust is not placed at risk of litigation.

6. Electromagnetic interference investigation

Electromagnetic interference with medical equipment is not a new issue. Mains electricity has been a source of concern for many years and the local medical physicist or clinical engineer will be familiar with these problems. The advent of new wireless technologies has increased the likelihood of interference causing problems. Some medical devices have the potential to disrupt wireless communication systems, such as wireless LANs.
The local expert will conduct surveys of the hospital site to establish a baseline of electromagnetic fields and identify any potential sources of interference. They will be knowledgeable about the limits of immunity relevant to particular types of medical equipment and identify any areas of concern.

With the increasing use of wireless networking for both medical and administrative data communications, the local expert will advise Information Technology Departments on the potential for interference to cause loss of packet data and slow or corrupt communications systems. They will devise strategies to minimise these risks and identify solutions when problems arise.

The medical physicist or clinical engineer will advise management, as mentioned above, on the compatibility of any selection of medical devices and their use in the hospital. They will ensure that the Trust maximises the financial benefit of purchasing new medical devices by ensuring that they are fit to be used in the location that the Trust desires. There will be some types of equipment that cannot be used in areas where particularly sensitive diagnostic equipment is used. For instance, problems can occur when operating theatres, physiotherapy departments and departments undertaking sensitive physiological measurements are placed in close proximity. However electromagnetic field strengths tend to fall rapidly with distance so physical separation is often an effective solution.

7. Conclusions

Electromagnetic fields are a growing issue within healthcare establishments. Hospitals need to be aware of, and deal with the various issues that surround new technologies introduced for patient care and that are present as part of the modern technological environment in which they operate. The medical physics and clinical engineering team provides the level of expertise that management requires to ensure that patients are treated in a safe and efficient manner. The local experts will have a role in scientific investigation and education.

References


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