POLICY STATEMENT

The Role of the Medical Physicist in Diagnostic Radiology

1. Introduction

Physicists have been closely involved with radiology since the discovery of x-rays by Roentgen in 1895. Since then a wide range of diagnostic and therapeutic applications of x-rays have been developed and supported by physicists. There are significant implications for the management of patients, the radiation dose to the population and health and safety of staff. Key areas of involvement for the medical physicist include: quality assurance, optimisation of radiation dose and image quality, monitoring of radiation doses for staff and patients, research & development and teaching. These areas are highly inter-related and should not be separated if coherent scientific support is to be provided for diagnostic x-ray services.

2. Staff in Diagnostic Radiology

Within the diagnostic radiology medical physics department, four staff groups can be identified, although in practice one individual may be appointed to act in the last three of those described below. In this document the term medical physicist is meant to refer to the combined efforts of all four of the staff groups listed.

Medical Technologist/Healthcare Science Practitioner: a science graduate who undertakes the acceptance, commissioning and routine testing of all x-ray equipment used in diagnostic radiology alongside their Clinical Scientist colleagues. Their roles often extend to the provision of additional support to the services offered by diagnostic radiology physics departments, dependent upon the department and the individual.

Clinical Scientist: A physics graduate who has undertaken a masters degree in medical physics followed by completion of the approved training scheme culminating in a successful examination for recognition as a Clinical Scientist. The term Clinical Scientist is a protected title that can only be used by someone listed on the Health and Care Professionals Council register. Clinical Scientists specialising in diagnostic radiology support the radiation legislative and research and development requirements of diagnostic radiology, working closely with the MPE and RPA.

Radiation Protection Adviser (RPA): Usually a Clinical Scientist who holds an RPA certificate from an HSE approved accreditation body. The Ionising Radiations Regulations 1999 (IRR99) require the employer to appoint an RPA to consult on meeting the requirements of IRR99. IRR99 is predominantly concerned with protection of staff and public (rather than patients).

Medical Physics Expert (MPE): A Clinical Scientist with at least 6 years experience in the field. The Ionising Radiation (Medical Exposure) Regulations 2000 (IRMER 2000) require that a facility undertaking medical exposures must appoint a MPE. They should be available for consultation on all matters concerning diagnostic and interventional radiology patient exposures.
All staff in Diagnostic Radiology work alongside relevant professionals, i.e. radiologists, radiographers, interventionalists, other equipment users and hospital management. They also liaise with external representatives including equipment manufacturers and service engineers.

3. **Scientific services**

A quality system should encompass all aspects of x-ray work and the physicist should be intimately involved in those areas which ensure that suitable x-ray systems are purchased and that their performance matches specified criteria for reliability, image quality and safety. The areas in which the physicist is involved may be considered under the following three categories.

3.1 Quality management

A MPE must be involved in the management of equipment replacement and the procurement process. They will advise on performance characteristics of imaging systems, the suitability of equipment for the proposed clinical application, the choice of equipment and ensuring that the dose to the patient is minimised in the most cost effective manner.

Following installation of new x-ray equipment, commissioning and acceptance testing must be performed prior to it being brought into clinical use. Acceptance tests confirm that a system conforms to specification, whilst commissioning tests a range of parameters to produce baseline measurements against which subsequent tests can be compared during the lifetime of the equipment. At this stage and throughout the lifetime of the equipment a MPE should be involved to provide advice on optimisation of radiation dose and image quality.

Regular monitoring of equipment performance is necessary to ensure effective operation, image quality and radiation safety. IPEM report 91, 'Recommended Standards for the Routine Performance Testing of Diagnostic X-Ray Imaging Systems' defines the scope of these performance checks which are undertaken in conjunction with other professionals, notably radiographers. Medical physicists are available for advice about how to perform local quality assurance (QA) tests and for discussion about unexpected results.

Typically equipment testing will be performed by a combination of Clinical Scientists and medical technologists, with some oversight from the RPA and/or MPE (or direct involvement where appropriate). Results of tests are used to inform clinical staff and service engineers of any performance related issues that require corrective maintenance or investigation. Equipment performance testing can also inform decisions concerning equipment replacement.

3.2 Safety

3.2.1 Patient safety

The estimation of radiation doses to patients from x-ray imaging procedures is varied in its complexity. MPEs will use their expertise to calculate or measure dose for different types x-ray imaging. Dose values are used by radiologists to support decision making when selecting the best type of imaging examination for a patient. MPEs will also provide information on radiation risk related to those imaging examinations.

It is a key requirement of the IRMER regulations that doses to patients be kept as low as reasonably practicable (ALARP). The MPE assisted by Clinical Scientist colleagues has an important role in achieving this goal. The MPE has a detailed understanding of the complex effect that the wide range of user controllable imaging parameters will have on radiation dose and image quality. The MPE will be directly involved in discussions on optimisation. The role of the MPE is particularly important when new types of imaging modalities are introduced which use x-rays. For example PET CT in nuclear medicine or x-ray imaging in support of radiotherapy. MPEs who understand the x-ray imaging processes can support the clinical and scientific teams to ensure high quality imaging techniques are safely bought in to clinical use.
It is a requirement of IRMER that departments undertake audit of the radiation dose levels received by patients. The MPE and Clinical Scientist will often oversee this work, supporting clinical staff to produce local diagnostic reference levels (LDRL) and compare these to relevant National and International equivalents. This is one means through which areas that require optimisation are highlighted; the MPE can then advise on how best to proceed.

3.2.2 The safety of staff and members of the public

The design and mode of operation of x-ray equipment, the nature of the examination and the techniques used all determine the magnitude of the doses to both staff and public and require protective measures as required by IRR99. The RPA (or Clinical Scientist on behalf of the RPA) is involved with:

a) design and layout of x-ray rooms;
b) designation of radiation controlled areas and classified workers;
c) establishment of good working practices;
d) formulation of local rules and systems of work;
e) calibration of radiation measuring equipment;
f) investigation and reporting of radiation incidents,
g) provision of a personal dosimetry service.

h) consultation with government agencies regarding draft legislation and national standards.
i) liaison with government inspectors to meet statutory obligations.

3.3 Service design and development

The senior Clinical Scientist is well placed to support the development of Radiology services, providing expertise in areas such as technical performance of imaging equipment, the requirements of the radiation regulations and IT systems which support imaging. Recent national examples include provision of advice to support role development of radiography staff to enable the introduction of Assistant Practitioners as operators of x-ray imaging equipment; support for the wholesale upgrading of imaging departments from film-based imaging to digital imaging; the introduction of managed equipment services to facilitate imaging equipment replacement and maintenance; changes to hospital or regional wide PACs systems for x-ray image storage.

4. Research and Innovation

Medical physicists are employed in the National Health Service, universities and in the private sector. They provide scientific support to x-ray services in a broad range of departments from the small District General Hospital to the academic Department of Radiology in a large teaching hospital. Relevant research and development comes out of a good understanding of the basic science behind the routine aspects of scientific work and the needs of clinical colleagues. Physicists continually seek to improve existing techniques and develop new methods. Applied research and development includes physics-based research, feasibility projects and pre-protocol work. Physicists participate in multidisciplinary teams in the development and assessment of clinical techniques and studies. Physicists’ training in experimental design techniques and scientific evaluation methods contribute to Health Technology Assessment and evidence-based medicine. The scientific and technical background of medical physicists along with knowledge of clinical practice often lead to research and development collaboration with industry and other outside bodies. A broad range of
applied research and development activities forms an integral part of the scientific support of x-ray services.

4.1 Research Ethics
Many research studies across a wide range of medical disciplines require the use of medical radiation exposures to track the effectiveness of treatments. All such studies are required under IRMER to commission a suitably qualified MPE to report on the radiation doses involved in the study, as part of the ethical approval process.

5. Education and training
The medical physicist provides teaching and instruction for a wide range of staff including:

a) undergraduate medical students and post graduate medical staff
b) radiologists undertaking the examination for Fellowship of the Royal College of Radiologists;
c) radiographers undertaking studies for degree courses in Radiography;
d) medical physics staff undertaking STP, PTP, or other work based training schemes
e) other Health Service staff, usually in aspects of radiation protection;

6. Scientific leadership
Medical physicists (the MPE and the RPA) have an important role to play on hospital groups which support organisational governance and health and safety. These groups are often called the radiation safety committee or medical radiation group. The physicist can advise senior management on whether the organisation is compliant with radiation regulations and what future actions are needed for continued compliance. They are skilled at interpreting regulations and national policies/directives and applying them to local situations. Their role at an organisational level is also essential when considering new radiology facilities, x-ray equipment replacement programmes and maintenance policies. They should be involved in or consulted when organisational polices regarding safe use of radiation are developed. Medical physicists will often take a role of directly liaising with government inspectors. This may be during inspections, communicating regarding incidents, or seeking clarification regarding policy, where it may benefit the individual Trust.

References/bibliography
The Ionising Radiation (Medical Exposure) Regulations 2000 (S.I 2000/1059)
The Ionising Radiations Regulations 1999 (S.I 1999/3232)
Drafted by: Diagnostic Radiology Special Interest Group

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