e-IRMER - An e-Learning package for Radiation Protection training of Health Staff

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ABSTRACT

In the UK, The Ionising Radiation (Medical Exposures) Regulations 2000 (IR(ME)R) provide a framework for ensuring that medical exposures are conducted safely. Good governance would require the provision of training to any health professional who is involved in such medical exposures. One group of health professionals are those who act as a referrer for diagnostic x-ray examinations. Formerly this was the prerogative of medical doctors, but in recent years the right to request specific x-ray examinations has been devolved to other staff groups, particularly nurses. For example, nurses in Accident and Emergency Departments can be entitled by their employer to request ankle x-rays, following examination of the patient according to a strict protocol.

Good governance requires these referrers to be given information on the risks and benefits of radiation, and this has traditionally been largely organised by Medical Physicists in the form of short courses. Pressure of work has resulted in such courses being poorly attended, and modern technology gives the possibility of using computer technology. The use of the internet to provide electronic learning courses (e-learning) provides an opportunity to give staff the option to study at their own convenience, and if necessary, in short sessions.

This paper describes the Institute of Physics and Engineering in Medicine (IPEM) initiative in partnership with e-Leaning for Healthcare, to develop such a course, and gives some examples of the material produced.

KEYWORDS: IRMER, IR(ME)R, Medical Exposure, Training, e-learning.

1. Introduction

Health Services make extensive use of Ionising Radiations for both diagnosis – bone densitometry, dentistry, X-Rays, CT Imaging, Nuclear Medicine – and for treatment – radiotherapy and sealed and unsealed radioactive isotopes. A wide range of different health professions are involved in using ionising radiations, and require training to ensure that the techniques are used safely, both for staff and patients. In view of the significant risk if ionising radiation is used inappropriately, training of staff is covered internationally by safety guidance (eg ICRP, 2009; IAEA, 2011) and European Directives (Euratom, 1996), which are incorporated in UK legislation as The Ionising Radiation (Medical Exposures) Regulations 2000 (IR(ME)R, 2000). The legislation is now enforced by the UK Care Quality Commission (IR(ME)R, 2006).

IR(ME)R identifies staff who are directly or indirectly involved in the exposure of patients to ionising radiation as referrers, operators, or practitioners. Operators and practitioners require specific training, and the Regulations include a syllabus, specifying the topics which need to be studied.

Referrers are medical doctors or other state registered healthcare professionals who make the request for the diagnostic test or treatment. Traditionally, for diagnosis, this has been a medical doctor, but over the past few years this has been extended to other groups of staff who can refer for specific tests under protocols agreed with the local Radiology department. For example, nurses in Accident and Emergency Departments may be entitled to request x-rays of the ankle, following a protocol including an assessment of the patient against the Ottawa rules (Stiell *et al.*, 1992). The logic for the introduction of this methodology included the aims of reducing the time taken before patients received treatment and reducing the number of unnecessary x-rays. Allerston and Justham (2000a) confirmed that significant reductions in triage time were achieved once this was implemented, and also that nurse practitioners requested significantly fewer x-rays, with a slightly higher detection rate for fractures, although the latter was not significant (Allerston and Justham 2000b). Bachmann *et al.*, (2003) reviewed the use of the Ottawa rules, and confirmed that it had a sensitivity of almost 100%, and reduced the number of x-rays by 30-40%. This model has been introduced for other diagnostic tests, such as pre-operative chest x-rays, and sports injuries, increasing the numbers of nurse practitioners, and introducing other healthcare groups, e.g. physiotherapists, as referrers.

Whilst medical doctors receive basic training at medical school to refer patients, this is not usually the case for nurses and other healthcare professions, and they require local in-service training to take on this role. Also, depending upon the curriculum followed, the basic training received by medical doctors may not provide them with an adequate understanding of the benefit to risk involved in making requests for different types of diagnostic examinations. Freudenberg and Beyer (2011) note that several studies show that physicians are frequently poorly informed about radiation levels associated with nuclear medicine and radiological examinations, while Denman *et al*., (2004) showed that healthcare staff did not appreciate the wide range of radiation doses delivered by diagnostic examinations. Ohno and Kaori (2011) conducted a study of nurses in Japan and concluded that they felt uneasy about the use of ionising radiations for their patients, or the impact of radiation for pregnant patients, and required further training. This lack of information and understanding could lead to patients not being sent for appropriate examinations because the doctor thinks the risk is too high, or patients being sent for a high dose examination instead of a low dose examination because the doctor is unaware of the different levels of radiation involved.

Traditionally in the UK, training has been provided for referrers by medical physicists, radiographers and radiologists at one or half day courses approved by an institute competent to award degrees, with staff being issued with certificates of attendance. Attendance at such courses can be difficult for a variety of reasons, including the increased work pressure on staff. However, the universal use of computers within the National Health Service (NHS) and at home, provides an opportunity for e-learning. This paper describes the development of such an e-learning package to fulfill the requirements of IR(ME)R.

2. Elements of the Teaching Package

There have been studies that demonstrate some of the elements which should be covered in referrer training. The IAEA (2012) identify that it is desirable that referrers are knowledgeable about radiation effects in regard to the various dose ranges involved in diagnostic examinations and are responsible for keeping their knowledge of radiation up to date. The primary source for the content of this training was taken from the syllabus in Schedule 2 of IR(ME)R.

Because staff may want to access e-learning for short periods of time during a quiet period at work, or at home, e-IRMER is split up into specific sessions that can be completed in less than 20 minutes by a typical learner. Some of the topic headings in Schedule 2 of IR(ME)R needed to be split, and other brief topics were merged. The development of the project took considerable time, in part due to decisions on the depth of the content. Another significant aspect was to ensure the e-learning could be undertaken in a linear fashion, so that learners would cover any prerequisite areas first, and that the initial general radiation sessions did not overlap with more specialist sections. The topics and comparison to Schedule 2 for diagnostic radiology are given in Tables 1 to 4. It should be noted that the sessions adequately cover the learning needs for referrers for diagnostic x-rays and can also act as a refresher for operators working in this field.

IR(ME)R Schedule 2 Curriculum	e-IRMER Session
	Guide to e-IRMER
	Introduction to Radiation Protection
1.1 Properties of Radiation Attenuation of ionising radiation Scattering and absorption	Properties of Ionising Radiation
1.2 Radiation Hazards and Dosimetry	
Biological effects of radiation	Biological effects of radiation
	Biological Effects of Radiation at High Doses
Risks/benefits of radiation	Risks vs Benefits of Radiation – Patients
Dose optimisation	Dose Optimisation
Absorbed dose, dose equivalent, effective dose and their units	Units and Their Use
1.3 Special Attention Areas Pregnancy and potential pregnancy Infants and children Medical and biomedical research Health screening High dose techniques	Special Circumstances

Table 1 – IRMER Training Schedule, and e-IRMER sessions to train a referrer in Diagnostic Radiology – Introduction and Fundamental Physics

IR(ME)R Schedule 2 Curriculum	e-IRMER Session
2.1 Patient Selection Justification of the individual exposure Patient identification and consent Use of existing appropriate radiological information Alternative techniques Clinical evaluation of outcome Medico-legal issues	Patient Selection
2.2 Radiation Protection General radiation protection Use of radiation protection devices - patient - personal	General Radiation Protection
Procedures for untoward incidents involving overexposure to ionising radiation	(in Equipment Testing and Faults, Section 3)

Table 2 – IRMER Training Schedule, and e-IRMER sessions to train a referrer in Diagnostic Radiology – Management and Radiation Protection of Patient

IR(ME)R Schedule 2 Curriculum	e-IRMER Session
3.1 Statutory Requirements and Non-Statutory Recommendations Regulations Local rules and procedures Individual responsibilities relating to medical exposures Responsibility for radiation safety	1. IRR99 and Other Regulations 2. IR(ME)R Regulations & staff responsibilities 3. Risks vs Benefits of Radiation- Staff
Routine inspection and testing of equipment Notification of faults and Health Department hazard warnings	Equipment Testing and Faults
Clinical audit	Clinical Audit

Table 3 – IRMER Training Schedule, and e-IRMER sessions to train a referrer in Diagnostic Radiology – Statutory Requirements and Advisory Aspects

IR(ME)R Schedule 2 Curriculum	e-IRMER Session
4.1 General	
Fundamentals of radiological anatomy Fundamentals of radiological techniques	Radiological Anatomy and Technique
Production of X-rays	Production of X-rays
Equipment selection and use	Equipment selection and use
Factors affecting radiation dose	Factors affecting radiation dose
Dosimetry	
Quality assurance and quality control	Quality Assurance
4.2 Specialised Techniques	
Image intensification/fluoroscopy	Image intensification and fluoroscopy; Optimisation in fluoroscopy
Digital Fluoroscopy	
Interventional procedures	
Vascular imaging	
Computed Tomography Scanning	(included in Equipment selection and use)
4.3 Fundamentals of Image Acquisition etc.	
Image quality v. radiation dose	(included in Factors affecting radiation dose)
Conventional film processing	Conventional film processing
Additional image formats, acquisition, storage and display	Obtaining the image
4.4 Contrast Media	
Non-ionic and ionic	(included briefly in session on radiological anatomy and technique)
Use and preparation	
Contra-indications to the use of contrast media	
Use of automatic injection devices	

Table 4 – IRMER Training Schedule, and e-IRMER sessions to train a referrer in Diagnostic Radiology – Diagnostic Radiology

Each session was developed by individual authors, initially in Microsoft PowerPoint, and reviewed by one of the authors of this paper. An example is shown in Figure 1.

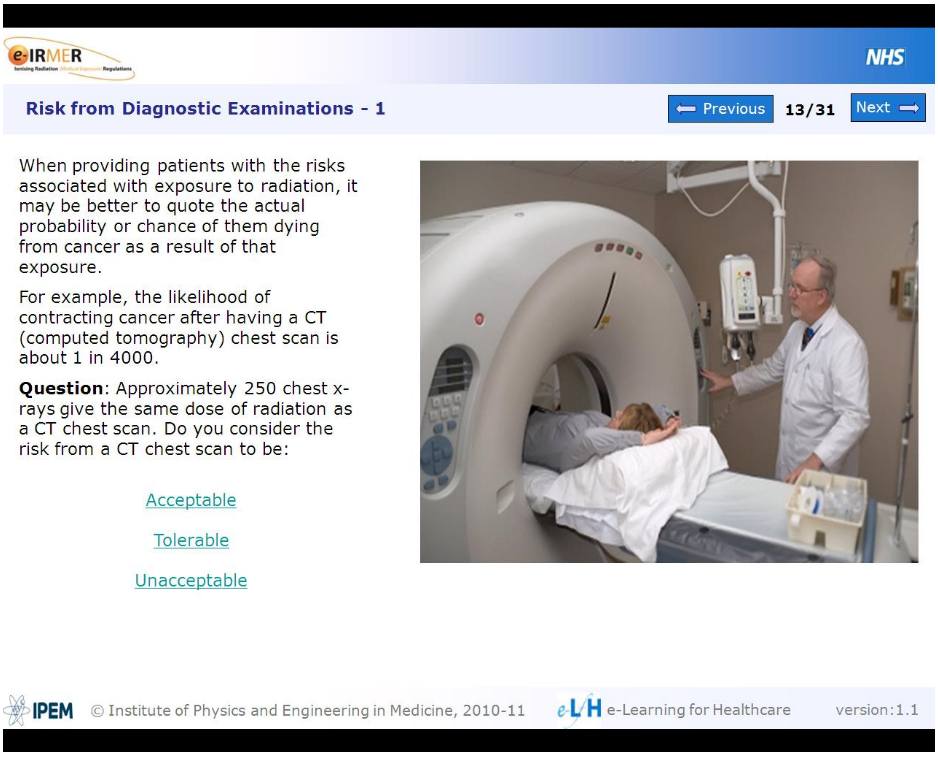

Figure 1- Example of a slide from one of the sessions

Each session includes one or more knowledge check slide at stages through the session, and has a number of self-assessment questions at the end of the session, to test the knowledge gained by the learner. An example is shown in Figure 2. The session concludes with an option to print a certificate to confirm completion of the session.

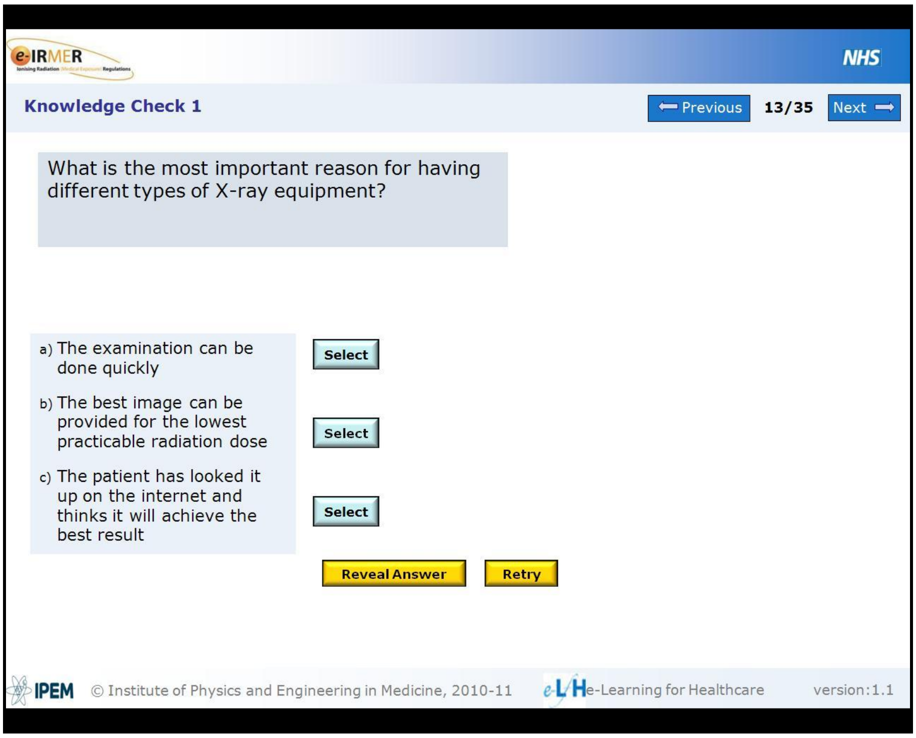

Figure 2 – Example of knowledge check question

The sessions were then reviewed and converted into suitable format for learners to access via a dedicated website hosted by e-Learning for Healthcare (e-LfH). www.e-lfh.org.uk. A screenshot of a page in one of the sessions hosted by e-LfH is shown in figure 3.

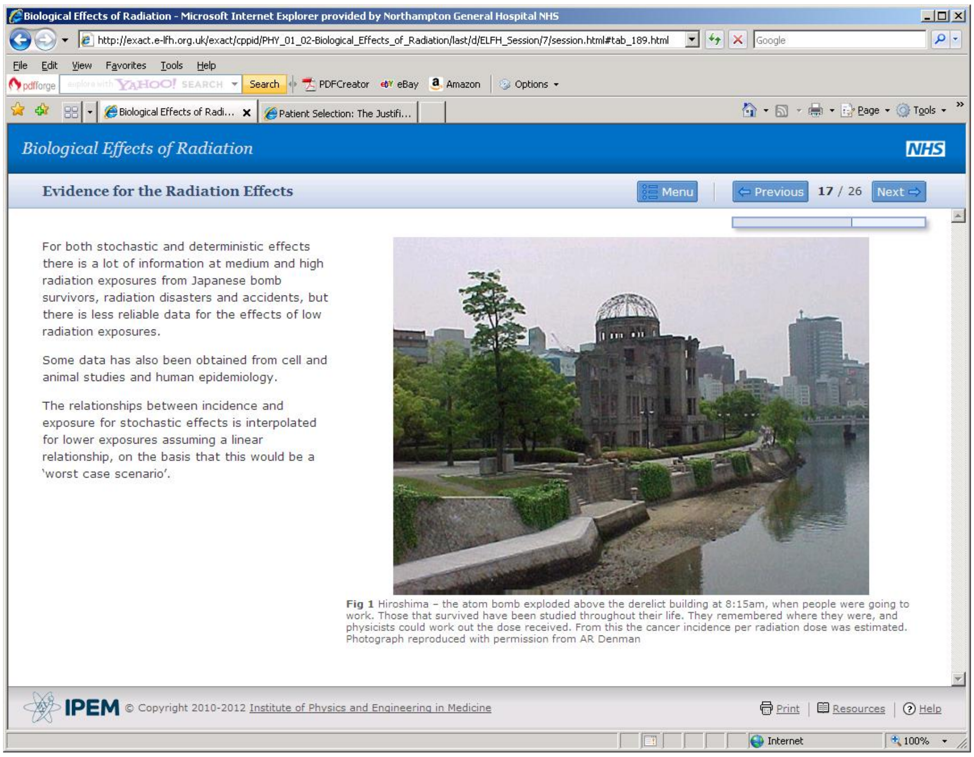

Figure 3 - Screenshot taken from a session built by e-LfH

An example of a knowledge check on e-LfH is shown in the screenshot in figure 4.

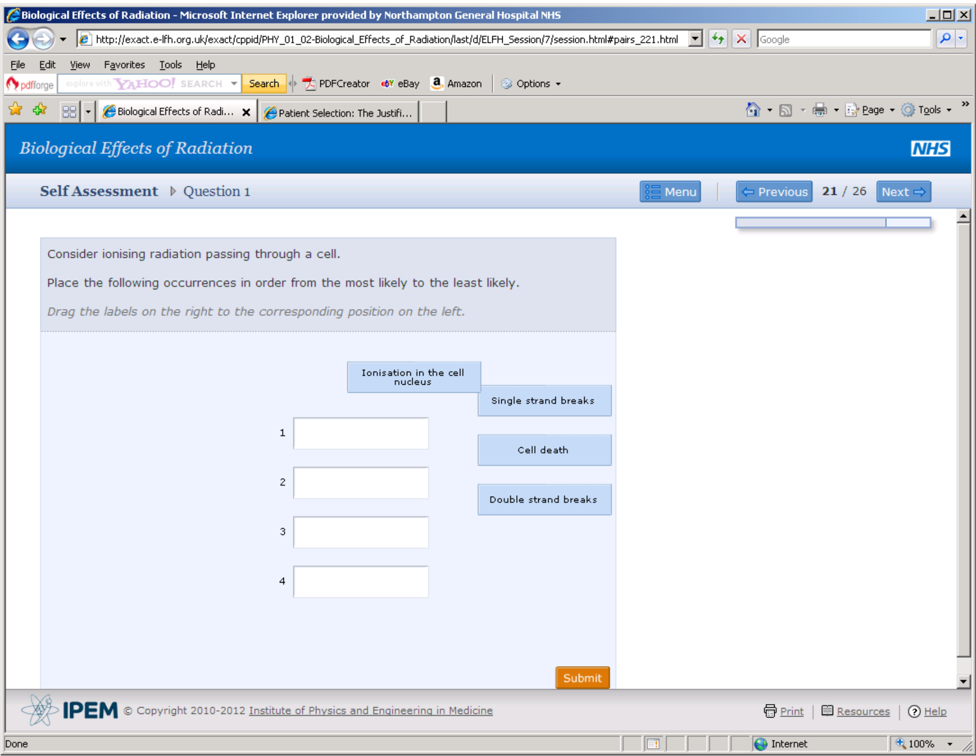

Figure 4 – Example of knowledge check question built by e-LfH

3. Discussion

The development of this training package was based on the twin premises that e-learning would provide a convenient way for staff to gain knowledge about radiation safety, and that healthcare staff are now sufficiently used to this type of learning to benefit from it. Certainly, Wilkinson *et al.,* (2009) in their review note that there is a continuing expansion of web-based learning at all levels, combined with the mobility of the healthcare workforce and the need for this workforce to have flexible modes of continuing education, and that, in the UK, there is an expectation that healthcare professionals are, at the point of registration, computer and information literate. Wahl and Latayan (2011), in the USA, also note the move to evidence-based practice and economic cutbacks as drivers for e-learning, while our own experience running face-to-face half-day courses on radiation safety is that nursing staff find it difficult to have time away from the ward or clinic to attend even necessary and legally-specified study.

While Wilkinson *et al.,* (2009) note that there is no universal assessment of attitudes and experience of nursing students using e-learning, which may be influenced by demographics, Autti *et al.,* (2007) indicate that a computer-based radiation safety course for medical doctors in Finland was well received by the learners. Pinto *et al.,* (2008) discuss a number of the technical issues to be overcome in establishing a national e-learning scheme leading to a formal qualification for clinical radiologists, noting that the advances in computer technology and the more widespread use of computers improve the quality and experience of e-learning – and in particular the display of digital x-ray images – and the reduction in costs. Finally, they conclude that "those who do not keep up with technological progress eventually become marginalised. Therefore this development should be followed and interpreted rationally, reasonably trying to derive the greatest advantages for our profession."

4. Conclusion

A radiation safety e-learning package has been developed for UK healthcare staff, which aims to comply with the requirements of IR(ME)R. It is hoped that this will appeal to staff and ensure there is a greater uptake of training, and subsequently improvements in radiation safety for both patients and healthcare staff.

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