



Clinical Perspective

Building a Magnetic Resonance Imaging Safety Culture from the Ground Up

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ABSTRACT

Magnetic resonance imaging (MRI) uses a strong magnetic field to generate diagnostic images. This magnetic field has the potential to cause serious and even fatal injuries to patients undergoing scans and to personnel in the area. Ensuring awareness of MRI hazards and safety procedures through a formalized education and training program is integral in creating an MRI safety culture that protects patients and staff from harm. The aim of our project was to develop an accessible and interprofessional electronic e-module learning series to instill an MRI safety culture throughout the entire hospital. This is the first such program in Canada. A simplified e-search was conducted using key search terms “mri: safety, education, safety training.” Very few articles or information were found that fulfilled our needs in helping us build an MRI safety program. In concert with an e-search we reached out to similar institutions and, through informal discussions, we confirmed the lack of a formalized, transferable safety program within Canada. This led to the creation of an interprofessional working team at our institution composed of key stakeholders: educators, clinical and technical experts from radiation therapy, medical imaging, the research institute, medical radiation physics, nursing, and radiation oncology. This team collaborated on the development of three education modules tailored for specific audiences based on classification as Non-MR Personnel, Level 1 MR Personnel, or Level 2 MR Personnel as defined by the American College of Radiology guidelines. All modules were 10 to 20 minutes in length with interactive engagement activities throughout as well as a final summative evaluation to test for comprehension. Knowledge of the existence of the MRI unit is only one facet of creating an MRI safety culture. By increasing the awareness of the hazards of MRI to all personnel throughout the hospital, the risk of harm to patients and staff may be decreased.

Keywords: MRI safety; MRI hazards

RÉSUMÉ

L'imagerie par résonance magnétique (IRM) utilise un puissant champ magnétique pour produire des images diagnostiques. Ce champ magnétique a le potentiel d'infliger des blessures graves et parfois mortelles aux patients examinés et au personnel environnant. Assurer la sensibilisation aux risques de l'IRM et aux procédures de sécurité par un programme formel d'éducation et de formation constitue un aspect intégral de la création d'une culture de sécurité en IRM qui protège les patients et le personnel du danger. Notre projet visait à développer une série de modules d'apprentissage électronique accessible et interprofessionnelle afin de susciter une culture de sécurité IRM dans tout l'hôpital. Il s'agit du premier programme de ce type au Canada. Une recherche électronique simplifiée a été effectuée à l'aide des mots-clés « mri: safety, education, safety training ». Nous avons trouvé très peu d'articles ou de renseignements répondant à nos besoins pour nous aider à bâtir un programme de sécurité IRM. Dans le cadre d'une recherche électronique, nous avons communiqué avec d'autres institutions similaires et, par des discussions informelles, nous avons confirmé l'absence d'un programme de sécurité formel et transférable au Canada. C'est ce qui a conduit à la mise sur pied d'un groupe de travail interprofessionnel dans notre institution, regroupant les intervenants clés: éducateurs, experts cliniques et techniques en radiothérapie, imagerie médicale, institut de recherche, physique de la radiation médicale, soins infirmiers et radio-oncologie. L'équipe a collaboré au développement de trois modules éducatifs adaptés à des auditoires spécifiques, selon la classification suivante: personnel non-RM, personnel RM de Niveau 1 et personnel RM de Niveau 2, selon la définition établie dans les lignes directrices de l'American College of Radiology (ACR). Les modules, d'une durée de 10 à 20 minutes, comprennent des activités d'engagement interactif ainsi qu'une évaluation sommative visant à mesurer la compréhension. La connaissance de l'existence de l'appareil d'IRM n'est qu'une des facettes de la création d'une culture de sécurité IRM. En augmentant la sensibilisation face aux risques de l'IRM pour tout le personnel de l'hôpital, on pourrait diminuer le risque de dommages pour les patients et le personnel.

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Introduction

Magnetic resonance imaging (MRI) is a diagnostic tool that uses magnetism and radio waves to produce high-resolution images of structures and organs inside the body. MRI is safe but comes with great risk; not only for the patient, but also for health care professionals and any other personnel who may come in contact with the magnetic fields in or around the scanner [1, 2].

In 2001, a 6-year-old boy was killed while undergoing an MRI scan when a nurse, overhearing a request for oxygen, brought an oxygen tank into the scanner room. The tank became a deadly projectile and fractured the child's skull. This tragic incident and other adverse events highlighted a need for a formal MRI safety review [3]. Within the United States, an expert panel was formed to review these events and develop safety guidelines. The resulting American College of Radiology's (ACR) White Paper on MRI Safety is used globally as a template for MRI departments in the development of their own safety policies and procedures [1].

Despite the implementation of safety policies and procedures, adverse events around the world, often devastating in nature, continue to occur at a disturbing rate [3]. Although our institution has had no fatalities, we have experienced near-misses, as no doubt all MRI departments have. One such event occurred in the spring of 2015 when a commercial floor buffer was taken by accident into an MRI suite. The buffer flew through the air and smashed into the MRI scanner. Fortunately no one was injured in this event, but there was a large cost incurred to the department and increased wait times for patients because the scanner was out of commission for several weeks. MRI incidents such as these continue to take place and highlight the need to address MRI safety issues.

With the advent of high-field MRI scanners specially designed for modern radiotherapy planning and simulation (also known as an MRI simulator), an increasing number of oncology centers are integrating MRI into their radiotherapy workflow. The implementation of an MR simulator into our radiation therapy department exposed a gap in the MRI safety program. This was the impetus that led to development of the MRI safety modules at our hospital. There was no formalized safety education program that had the ability to target a large audience with a diverse skill set, wide variability in knowledge, and need of access to the MRI suite. The location of this new MRI suite within the radiation therapy department did not fit the standard MRI department design or structure. It was, therefore, essential to ensure that all staff within the center, from administrative and support staff to leadership, received MRI safety awareness training. With this most recent acquisition in the department and the near-miss involving the floor buffer, we realized we needed to come together hospital-wide to create an MRI safety culture that included every employee if we wanted to achieve our goal of keeping patients and staff safe. Our institution has more than 10,000 employees, and there are currently 10 MR units spread across the campus in different departments. Therefore, it was imperative to

develop an MRI safety program that extended across the entire institution.

Module Development

An interprofessional team of key stakeholders that included experts from medical imaging, radiation therapy, radiation oncology, nursing, e-technology staff, research, and medical physics collaborated in developing an interactive e-learning series on MRI safety. It was essential to have diverse representation from all departments to ensure that the training content would meet everyone's needs and was inclusive of all learners including custodial staff, security, and allied health professionals. The team developed the framework for each of the three e-modules in alignment with the ACR guidelines. Two key stakeholders from medical imaging and radiation therapy completed the core content. Permission was obtained from Applied Radiology—Continuing Education Centre to embed videos illustrating various aspects of MRI safety into the modules. These videos were created by Dr. Frank Shellock (PhD, FACR, FISMRM, FACC, FACSM), a global expert and educator in MRI safety, who has authored numerous publications including the annual Reference Manual for Magnetic Resonance Safety, Implants, and Devices. The building of the modules included design, layout, video development, and voice-over script. Collaboration with e-technology facilitated the final versions based on our developed content, scripts, and vision. The e-modules were piloted for content and clarity with the interprofessional team as well as senior leadership in radiation therapy. Final revisions were completed before the formal launch in August 2016. The entire process took just more than 1 year to complete.

MRI Safety e-Module Description

The education series was divided into three e-learning modules: MRI Basic Safety, Level 1 MRI Safety, and Level 2 MRI Safety (Figures 1 and 2). Briefly, the MRI Basic Safety module is a 10-minute unit that covers important points such as signage, zones, magnet locations within the hospital, and key hazards associated with the magnet. The goal of this module is to develop a basic awareness of the risks and hazards associated with MRI. This module is intended for all non-MR personnel—those who do not work in or near the MRI environment.

The Level 1 MRI Safety module is intended to educate staff who regularly, or on occasion, work within Zone III (Appendix). This is a 20-minute interactive unit with focused messaging on patient and staff screening, signage, and important MRI safety information that includes the missile effect and the implications of a quench.

The target audience for the third module, Level 2 MRI Safety is staff (primarily MRI technologists and radiologists) working in Zones III and IV (Appendix). Building on Level 1 information, this is a 20-minute interactive module that contains higher level information regarding MRI safety.

All e-modules are housed inside the learning management system within the hospital's intranet. The modules can be

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