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Transfer of learning: Radiographers' perceptions of simulation-based educational intervention

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A B S T R A C T

Aim: The aims of this qualitative descriptive study were to 1) explore and define radiographers' competence in intravenous pharmacotherapy before and after a simulation-based education, 2) examine radiographer's perceptions of transfer of learning into clinical practice.
Method: Sixteen diagnostic radiographers in one hospitals' Clinical Radiology Unit were individually interviewed before a multidisciplinary simulation-based pharmacotherapy education intervention in 2012 and fourteen were re-interviewed after the intervention 6–7 months later. Data were analyzed using qualitative content analysis.
Results: Before education the participants reported uncertain competence in pain management during imaging procedures and acute situations. These weak competence areas identified were strengthened and self-confidence grew. The intervention improved the domains of pharmacotherapy-related patient safety; teamwork development and communication skills. In addition, the radiographers indicated that the iv. pharmacotherapy knowledge from simulation learning was transferred to routine work.
Conclusion: The results of this study suggest simulation-based education is suitable for radiographers' pharmacotherapy learning. Adequate pain measurement and management are essential during invasive procedures and these skills can be realistically learned in simulations and transferred to clinical practice.

Introduction

Minimisation of medication-related adverse events is essential for patient safety,[1,2] especially in radiological procedures which have evolved rapidly over recent years[3] and often involve ‘high-alert’ medications such as intravenous (iv.) contrast agents, vasopressors, sedatives and analgesics.[4–8] In some radiological procedures, such as biopsy or drain insertion, adequate analgesia and sedation are essential to reduce patient discomfort from pain, while examinations such as computed tomography (CT) or magnetic resonance imaging (MRI) can induce significant anxieties in patients, and require sedatives for effective management.[9–11] Both pain and anxiety during radiological procedures may lead to patient dissatisfaction and physiological and psychological problems, such as panic.[10–13] Therefore, adequate analgesia and sedation are essential. Education is key to safe medication management and effective pain management. Professionals' lack of knowledge and inadequate pain management skills lead to ineffective pain management.[12,13] Also, since sedatives and analgesics increase the risks of emesis and respiratory and cardiovascular problems, it is crucial that professionals in radiology departments receive effective education and training not only in medicines' management but also monitoring.[10,14–16] Furthermore, although severe contrast reactions due to low- or iso-osmolar ionated iv. contrast agents are uncommon (incidence 2–4/10,000, depending on setting), effective education for recognition and treatment of these potentially life-threatening adverse reactions is essential.[5,17,18]

As administration of medicines during radiological procedures is increasing, it is appropriate that medicines' management skills should be developed.[19] Radiographers' roles in medication management vary with country and working environment. For

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example, in the USA, "radiographers prepare, administer and document activities related to medications in accordance with state and federal regulations or lawful institutional policy."[20] In the UK, radiographers may supply and/or administer medicines using patient specific directions (PSDs) or patient group directions (PGDs) and can train to become supplementary non-medical prescribers. NHS England is currently consulting on proposals to allow four allied health professions (including radiographers) to be able to independently prescribe and administer medicines, as appropriate for their patients.[21]

To ensure patient safety, radiographers require appropriate education delivered contextually, according to experiential and adult learning theories.[22,23] Based on the work of Dewey, Lewin, Piaget and subsequently Kolb,[24] experiential learning is defined as "the process whereby knowledge is created through the transformation of experience" (p. 41). Kolb's learning cycle combines concrete experience, reflective observation, abstract conceptualization and active experimentation as abilities for effective learning. Adult educational theories such as Simons's Transfer of Learning Theory,[25] suggest that adults are more motivated to learn facts relevant and applicable to real-life situations.[22] However, as possible risks to patients during 'bedside' learning and practice of techniques are increasingly unacceptable[26] the inclusion of simulation-based learning, (which includes all aspects of Kolb's cycle) as educational tools is increasing to facilitate application of theory to clinical practice.[22,27,28] According to Gaba,[29] simulation can be defined as a "technique – not a technology – to replace or amplify real experiences with guided experiences that evoke or replicate substantial aspects of the real world in a fully interactive manner" (p. i2). The degree of reality replication, i.e. fidelity, varies from low (e.g. part task trainers) to full-scale medium, and high fidelity, including computerized full-body mannequins (patient simulators) with vital functions and responses to learners' actions.[30,31] In health care professionals' education, simulations can be arranged in real clinical practice using the same equipment and training with the same teams as in actual patient care.[32,33]

Research on simulation-based learning has increased in recent years,[30,34,35] and evaluations suggest that it is an effective learning method for health care students and professionals to transfer knowledge and skills from the classroom to the clinical environment.[30,36–38] High fidelity simulation has therefore been integrated into different fields of medicine and nursing education, and more recently into radiology.[39,40] However, we did not identify studies of simulation-based learning in continuing pharmacotherapy education of radiographers.[41]

This study aimed to: 1) explore and define radiographers' competence in intravenous pharmacotherapy before and after a simulation-based education intervention (SBEI), 2) examine radiographers' perceptions of transfer of learning into clinical practice.

Methods

Participants and setting

A descriptive qualitative study was conducted in Finland, in one tertiary hospital's Clinical Radiology Unit (CRU). In the CRU, most radiographers work in three shifts around the clock and in specialist areas: CT (computed tomography), MRI (magnetic resonance imaging), ultrasound, interventional radiology and angiography, emergency radiography, paediatric radiography and mammography. The radiographers administer iv. medicine according to radiologists prescriptions but are responsible for correct medication, route, dosage and formulation. In addition, radiographers have important roles in assessing patients' needs, anxiety and pain during procedures. To ensure radiographers' competence in pharmacotherapy, in Finland, the National Safe Pharmacotherapy Guideline for the provision of pharmacotherapy in public and private social and health care units has been developed. It requires that the competence in pharmacotherapy of heath care professionals (e.g. radiographers) is confirmed regularly every 2–5 years.[42] Mandatory eLearning courses are developed to be suitable for all health care professionals and therefore include basics of pharmacotherapy and intravenous medication; the content is not profession specific.[43] However, due to increased workflow and more complex patients in the CRU more specific continuing education for radiographers was needed.

A simulation-based pharmacotherapy education intervention was developed and implemented for a multidisciplinary group of qualified CRU radiologists ($n = 20$) and diagnostic radiographers ($n = 65$) in November–December 2012. 20 of the 65 radiographer participants were selected by random purposeful sampling[44] using Research Randomizer[45] random number generator and invited to individual interviews. Sixteen participants agreed to take part in the interviews before the SBEI and fourteen were reinterviewed after SBEI; two participants dropped out because they were on leave. The interviews produced rich data and the collected data achieved saturation; the information started to be repetitive and no new information emerged. The sixteen participants were 25–63 years old (mean 41.5 years, standard deviation [SD] 10.3 years) and had 2–40 years radiography experience (mean 14.3 years, SD 9.4 years). Two of the 16 participants were male (13%). Age and radiography experience did not differ between the interviewed participants and the target group of 65 radiographers (age: 25–63 years, mean 43.2 years, SD 10.6 years, Student t test $P = 0.561$. Experience: 0–40 years, mean 15.9 years, SD 10.7 years, Student t test $P = 0.586$), but there were fewer men (13% vs. 32%). Similarity in demographics reduces the threat of volunteer bias.[46]

Description of the intervention

The SBEI consisted of one 2.5 h pre-simulation lecture for radiographers. The lecture included iv. medicine related patient safety and monitoring and introduced simulation learning methods. Full-scale in situ simulations with a patient simulator (mannequin) were held at CRU in small groups, lasting 4 h. Each group comprised 1 radiologist and 3 radiographers. The instructors facilitating the simulations were two clinical teachers, one anaesthetist and one anaesthetic nurse, all educated as simulation instructors.

Every simulation had two scenarios: Simulation 1 – administration of analgesics and/or sedatives during ultrasound-guided biopsy and Simulation 2 – treatment of severe anaphylaxis after contrast agent administration. The patient in Simulation 1 was a 75-year man, with a history of mild hypertension. The patient felt anxious, especially regarding possible pain. To relieve his anxiety he was prescribed and administered iv. fentanyl and midazolam after which he started to desaturate (oxygen saturation fell from 99% to 89%) and his respiratory rate decreased from 14 to 8/min. The patient in Simulation 2 was a 45-year woman, with a history of allergy to eggs and bees, managed by pen-injected adrenaline as required. When the contrast agent (iodixanol 270 mg/ml) was administered, the patient had a severe reaction (chest tightness, hoarseness and sensation of choking, ending up soon to collapse), assumed to be an anaphylactic response.

Simulations followed a common structure; introduction, briefing, action and debriefing.[47] In the introduction and briefing, the participants were told the learning outcomes of the scenario, which included understanding the importance of monitoring vital signs; evaluating changes in vital signs; knowing the effects, clinically relevant adverse reactions and interactions of commonly