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Factors Associated With Radiographers' Intravenous Pharmacotherapy Theoretical Competence: A Comparative Repeated-Measures Study

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A B S T R A C T

Introduction: There are concerns that the high incidence of medicine-related adverse events is compromising patient safety. System errors and human factors, particularly inadequate knowledge of pharmacotherapy, are significant causes of medication errors. Little has been published on the continuing professional education of radiographers. We report on a study undertaken in Finland between 2012 and 2014.
Methods: In this quasi-experimental study, we explored the relationship between radiographers' backgrounds (e.g., age, clinical experience, sex) and intravenous (IV) medication theoretical competence before (n = 77) continuing pharmacotherapy education delivered with two different learning methods, 1 to 2 weeks after (n = 56) and 6 months later (n = 37).
Results: After the education programs, younger age, less clinical experience, and education in higher education institute (University of Applied Sciences) were significantly associated with performing better than average (more than median score) in the IV pharmacotherapy knowledge test. Both immediately after education and 6 months later, more participants performed better than average and passed more than 80% of correct answers limit after simulation-based than web-based education, respectively.
Discussion: Continuing IV pharmacotherapy education improved theoretical medication competence, particularly for younger and less experienced radiographers. Evidence-based continuing education for radiographers is needed to assure patient safety.

Introduction

Rapid developments in health care technology have expanded the number and scope of interventional radiology and image-guided procedures (Craciun, Mankad, & Lynch, 2015; Miller, Price, & Vosper, 2011; Niell et al., 2015; Patatas & Koukkoulli, 2009). This has increased the use of medicines in radiology departments, not only intravenous (IV) contrast agents but also IV opioids and anxiolytics to alleviate patients' experiences of pain or anxiety during their radiologic procedures (Huffman & Haas, 2014; Lundén, Lundgren, & Lepp, 2012). Globally, there is diversity in the role of radiographers in medication management, depending on country and clinical environment. In Finland, IV medicines are usually prescribed by radiologists and administered by radiographers. In addition to imaging technology, nursing care is an important component of radiographers' work (Andersson, Christensson, Jakobsson, Fridlund, & Broström, 2012; Andersson, Fridlund, Elgan, & Axelsson, 2008), and medicine management is one of their core competencies (Huffman & Haas, 2014; Royal College of Nursing, 2012); thus, radiographers'

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responsibilities include assessment of patients' needs, anxiety, and pain during procedures (American Society of Radiologic Technologist, 2016; Andersson et al., 2008).

As the use of technology and medicine in radiology departments has increased, attention has been drawn to patient safety and medication safety and the high incidence of medicine-related adverse events and errors, including occasional fatalities (Alhawassi, Krass, Bajorek, & Pont, 2014; Bouvy, De Bruin, & Koopmanschap, 2015; Harkanen et al., 2015; Keers, Williams, Cooke, & Ashcroft, 2013; Mansour, James, & Edgley, 2012). Medication error is defined as "any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient, or consumer. Such events may be related to professional practice, health care products, procedures, and systems, including prescribing, order communication, product labeling, packaging, and nomenclature, compounding, dispensing, distribution, administration, education, monitoring, and use" (National Coordinating Council for Medication Error Reporting and Prevention, 2017). Medication administration is the phase in the complex medication process or chain that is most prone to error. Despite the "5 rights" as the standard for safe medication practice (the right patient, medicine, dose, route, and timing), the most common types of errors reported are wrong dose, wrong medicine, and wrong route (Harkanen, Turunen, & Vehvilainen-Julkunen, 2016; Valentin et al., 2009). All these are included in radiographers' responsibilities when they administer IV medication. Some authors report that patients in radiology departments are at risk to harm-related to procedural complications (Craciun et al., 2015) or instability particularly during magnetic resonance imaging or computer tomography (Ott et al., 2015).

Many studies have explored factors contributing to medication errors (Keers, Williams, Cooke, & Ashcroft, 2015). System errors, such as workload, shortage of staff, or inexperienced professionals and distractions are significant causes of medication errors, but more errors are due to human factors, including inadequate pharmacotherapy knowledge and performance (Harkanen et al., 2016; Keers et al., 2015). Pharmacotherapy knowledge relates to *theoretical medication competence*, supported by understanding of pharmacology and medication management (Sulosaari, Suhonen, & Leino-Kilpi, 2011). Better theoretical medication competence, clinical experience, postgraduate specialization, working in hospitals, and continuing education have been linked with fewer errors (Hsaio et al., 2010; Keijsers et al., 2015; Simonsen, Johansson, Daehlin, Osvik, & Farup, 2011). On the other hand, Sneck et al. (2016) found that younger nurses achieved better results in theoretical examinations (Sneck, Saarnio, Isola, & Boigu, 2016). In addition, several studies have reported how suboptimal theoretical medication competence has been addressed for physicians and nurses (Alshammari et al., 2015; Keijsers et al., 2015; Simonsen, Daehlin, Johansson, & Farup, 2014). However, there are some health care professionals, such as radiographers, whose pharmacotherapy knowledge is under-researched (Andersson et al., 2012; Aura, Jordan, Saano, Tossavainen, & Turunen, 2016).

Safe pharmacotherapy and medication management require medication competence and extensive knowledge (Berdot et al., 2016; Bush, Hueckel, Robinson, Seelinger, & Molloy, 2015; Sulosaari et al., 2011), and educators are challenged to support medication competence with effective learning methods (Sulosaari et al., 2015). In addition, it is important to explore the factors that support acquisition of knowledge to pharmacology (Strayer & Beitz, 2010). Because there is little research into radiographers' medication competence, we explored the factors associated with radiographers' theoretical competence or knowledge before and after education in pharmacotherapy (Figure 1).

The aim of this study was to identify factors associated with radiographers' IV pharmacotherapy theoretical competence before and after continuing IV pharmacotherapy education.

Methods

Participants

This comparative, descriptive, repeated-measures study is a part of a larger prospective two-center quasi-experimental nonequivalent comparison-group study conducted in Finland (Aura,

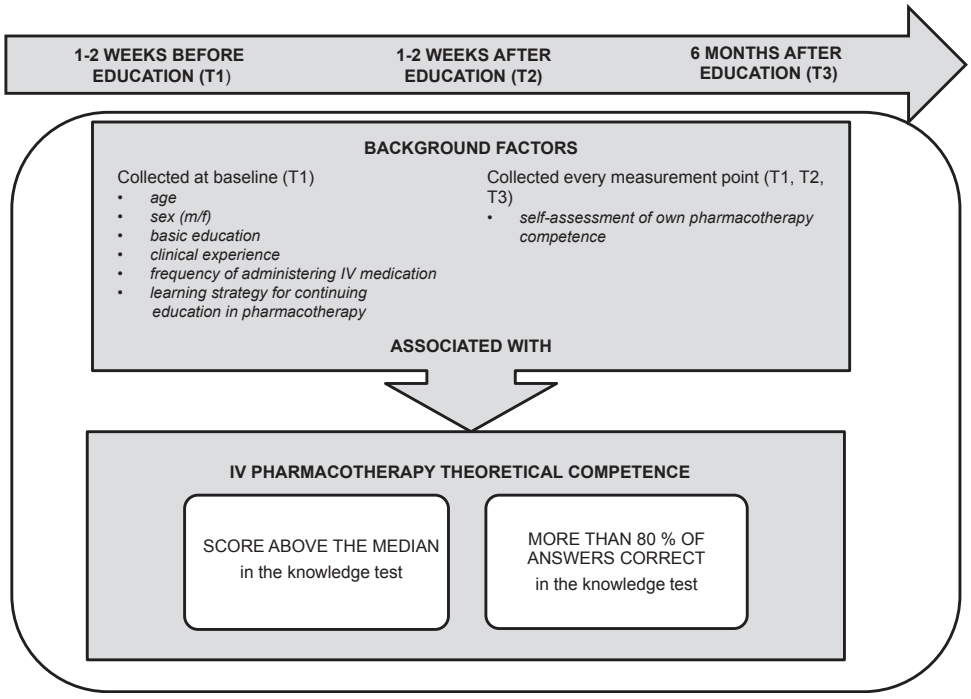

Figure 1. The research frame. IV = intravenous.