Nurse Education in Practice 14 (2014) 491–503

Contents lists available at ScienceDirect

Nurse Education in Practice

journal homepage: www.elsevier.com/nepr

Review

Educational strategies aimed at improving student nurse's medication calculation skills: A review of the research literature

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Keywords:
Student nurse
Medication calculation
Integrative review
Educational strategies

A B S T R A C T

Medication administration is an important and essential nursing function with the potential for dangerous consequences if errors occur. Not only must nurses understand the use and outcomes of administering medications they must be able to calculate correct dosages. Medication administration and dosage calculation education occurs across the undergraduate program for student nurses. Research highlights inconsistencies in the approaches used by academics to enhance the student nurse's medication calculation abilities. The aim of this integrative review was to examine the literature available on effective education strategies for undergraduate student nurses on medication dosage calculations. A literature search of five health care databases: Sciencedirect, Cinahl, Pubmed, Proquest, Medline to identify journal articles between 1990 and 2012 was conducted. Research articles on medication calculation educational strategies were considered for inclusion in this review. The search yielded 266 papers of which 20 meet the inclusion criteria. A total of 5206 student nurse were included in the final review. The review revealed educational strategies fell into four types of strategies; traditional pedagogy, technology, psychomotor skills and blended learning. The results suggested student nurses showed some benefit from the different strategies; however more improvements could be made. More rigorous research into this area is needed.

Introduction

This paper presents an integrative review of the literature on education strategies for undergraduate student nurses. Effective mathematical skills are vital for medication calculations (Rainboth and DeMasi, 2006; Wright, 2007). However, many studies report student nurses have deficiencies in medication calculation abilities (Brown, 2002; Elliot and Joyce, 2005; Grandell-Niemi et al., 2006; Jukes and Gilchrist, 2006; O'Shea, 1999; Wright, 2005). Students are unprepared particularly in skills including fractions (Brown, 2002; Harvey et al., 2009; Wright, 2007), percentages (Wright, 2007), place values, interpreting data (Wright, 2007), Standard International units and formulae (Harvey et al., 2009). In order for student nurses to develop accurate safe administration of medications, strategies aimed at improving dosage calculations need to be implemented (Wright, 2007). The ability to perform medication calculations accurately and administer medication precisely is reinforced through many of the Australian Nursing and Midwifery Council National Competency Standards (2006) for the registered nurse (RN). The Australian Council for Safety and Quality in Health care has recommended safe administration of medications as a National Health priority area and strategies to combat issues are required (Reid-Searl et al., 2008). Research consistently highlights the need for improvements in the safe administration of medications to the patient yet there is little consistency in the approaches used by academics to enhance the student nurses understanding of medication dosage calculations (Andrew et al., 2009; Brown, 2002; Elliot and Joyce, 2005; Grandell-Niemi et al., 2006; Greenfield, 2007; Harvey et al., 2009; Kapborg and Rosander, 2001; O'Shea, 1999; Page and McKinney, 2007; Papastrat and Wallace, 2003; Rainboth and DeMasi, 2006; Wright, 2007, 2008). The aim of this review is perform an integrated review of the literature to examine the effectiveness of education strategies for undergraduate nursing students on medication dosage calculations. The aim will be achieved by way of a methodological analysis and presentation of past empirical and theoretical literature related to interventions to improve medication calculations for student nurses.

An integrative review of the literature is a nonexperimental design in which information derived from primary research is systematically considered (Gangong, 1987). Past research is summarised and overall conclusions are drawn from many different

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http://dx.doi.org/10.1016/j.nepr.2014.05.010
1471-5953/

studies that reflect the past and current state of knowledge pertaining to a particular subject (Whitmore and Knafl, 2005). The review is conducted to make a more substantial contribution to nursing literature and nursing knowledge (Beyea and Nichll, 1998). This review is conducted to make a meaningful contribution related to strategies to improve medication calculations skills for student nurses.

Literature review

For the purpose of this review we have defined medication error as "a preventable event that may cause or lead to inappropriate medication use" (Department of Health (DoH), 2004, para. 1). The ability to calculate and understand the administration of medications underpins the safe practice for RNs (Elliot and Joyce, 2005; Greenfield, 2007; Harne-Britner et al., 2006; Pentin and Smith, 2006; Sung et al., 2008). The RN must not only understand all aspects of medication administration they must, more specifically ensure correct medication calculations and dosage for the safety of patients (Andrew et al., 2009; Nursing and Midwifery Board of Australia, 2006; Rainboth and DeMasi, 2006; Wright, 2005). Mathematical skills are imperative for nurses in calculating medication dosages, liquid solutions, strengths, as well as intake and output computations (Kapborg and Rosander, 2001)). Previous studies investigating the numeracy skills of undergraduate nurses have identified serious deficiencies with 8.1–10.6% able to obtain 90% pass mark (Blais and Bath, 1992; Jukes and Gilchrist, 2006) and 55% able to obtain 100% (Gillham and Chu, 1995). Poor drug calculation skills can result in incorrect medication administration to the patient (Harne-Britner et al., 2006; Kapborg and Rosander, 2001; Wright, 2005). Some studies have suggested between 7.5% and 27% of all adverse events are due to drug errors (Berga Culleré et al., 2009; Fahimi et al., 2008; Fanikos et al., 2007; Gurwitz et al., 2005; Manias, 2007; Røykenes and Larsen, 2010; Runciman et al., 2003). In Australia reported medication errors due to wrong medication dosages range from 1% (Coombes et al., 2001; Runciman et al., 2003) to 20% of errors (Dawson et al., 1993; Eastwood et al., 2009). Improper dose or quantity errors occurred for 17% of administration errors made by student nurses in the USA (Wolf et al., 2006). No studies were detected that reported the incidence of medication calculation errors by student nurses in Australia. Inaccurate drug calculations can lead to drug errors and potential harm to patients (Department of Health, 2000; O'Shea, 1999; Wolf et al., 2006). Any medication error is unacceptable.

Methods

Inclusion and exclusion criteria

In order to complete a critical integrative review, articles were considered for inclusion if they met the following criteria;

- Related to student nurse or nursing student
- Related to medication or drug calculation or dosage or numeracy
- Published between 1990 and 2012
- Hypothesis tested
- Included educational strategies and
- Written in English

Exclusion criteria were as follows:

- Not abstract and
- Not repeated

Search for relevant studies

An extensive and systematic literature search using the documented criteria was undertaken. The studies in this analysis were retrieved through an electronic search of five health care databases (Cummulative Index to Nursing and Allied Health Literature, Medline, Pubmed, Proquest and Sciencedirect). Search words used were: 'nurse', 'student', 'medication', 'drug', 'calculation', 'dosage', 'education' and 'numeracy'. Article abstracts were reviewed to establish relevance and were suitable full text articles were retrieved for closer examination of the inclusion and exclusion criteria. These studies were examined under the following headings: interventions, aim, research design, instruments, results or findings, discussion, limitations, implications for the future and conclusions.

Findings

Initially 17 004 articles were retrieved from the search of these databases, of these 266 were relevant to this review. There were 246 studies excluded on the basis of the inclusion criteria (see Fig. 1). Twenty met the inclusion criteria which focused on medication calculation interventions for student nurses and were included in this review (see Table 1) (Adams and Duffield, 1991; Costello, 2011; Coyne et al., 2013; Craig and Seller, 1995; Dilles et al., 2011; Glaister, 2007; Greenfield, 2007; Greenfield et al., 2006; Harne-Britner et al., 2006; Jackson and De Carlo, 2011; Kohtz and Gowda, 2010; Koohestani and Baghcheghi, 2010; McMullan et al., 2011; Pierce et al., 2008; Rainboth and DeMasi, 2006; Rice and Bell, 2005; Unver et al., 2013; Wright, 2007, 2008, 2012).

Findings and discussion

Sample sites and size of studies

Of the 20 studies, sixteen were conducted at single site (Adams and Duffield, 1991; Coyne et al., 2013; Craig and Seller, 1995; Glaister, 2007; Greenfield, 2007; Greenfield et al., 2006; Jackson and De Carlo, 2011; Kohtz and Gowda, 2010; Koohestani and Baghcheghi, 2010; Pierce et al., 2008; Rainboth and DeMasi,

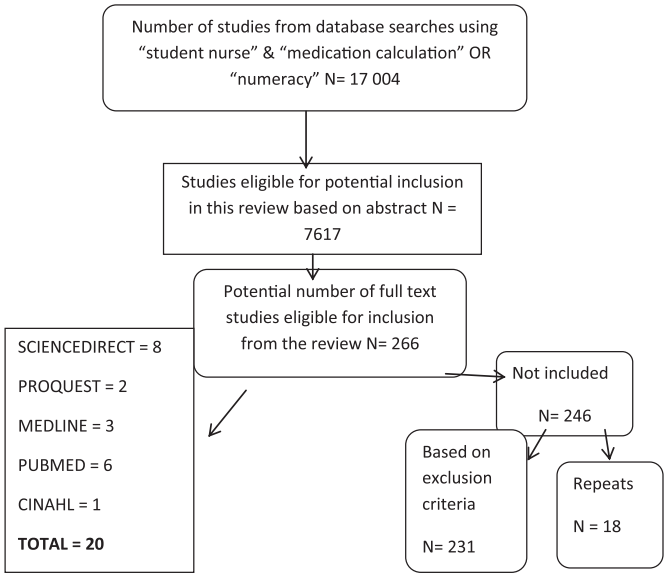

Fig. 1. Overall summation of articles retrieved for review.