

Improving Student and Clinical Outcomes in Math, Dosage Calculations and Medication Safety Using Interactive Online Software Program

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Education has been cited as an example of a key intervention that can support health care professionals in primary care in reducing medication errors and improving patient safety. (WHO, 2016)

Medication Errors

The administration of medication forms the backbone of treatment in the overwhelming majority of patients who are admitted to hospitals.

Unsafe medication practices and medication errors are a leading cause of injury and avoidable harm in health care systems across the world. The global cost associated with medication errors has been estimated at \$42 billion annually (WHO, 2022). Medication errors can occur due to systemic issues and/or human factors such as fatigue, poor environmental conditions or staff shortages which affect ordering, prescribing, transcribing, dispensing, preparation, administration and monitoring practices. These errors can result in severe harm, disability and even death (WHO, 2022). Medication errors cause at least one death every day and injure approximately 1.3 million people annually in the U.S. alone (WHO, 2017), but all medication errors are potentially avoidable. Preventing errors and the harm that results require putting systems and procedures in place to ensure the right patient receives the right medication at the right dose via the right route at the right time (WHO, 2017).

In 2017, the World Health Organization (WHO) launched the third Global Patient Safety Challenge with the theme of medication without harm. It aimed to reduce severe and avoidable medication-related harm by 50% over a five-year period (WHO, 2017).

Minimizing Medication Errors

Reducing medication errors and improving medication safety requires a systems approach. Education has been cited as an example of a key intervention that can support health care professionals in primary care in reducing medication errors and improving patient safety (WHO, 2016).

In 2023, a study conducted by Silvestre and Spector, which included more than 200 participating prelicensure nursing programs and collected 1,042 errors and near misses, found that collecting data on nursing students' errors and near misses can help nursing programs identify system issues, promote transparency and make quality improvements. The majority of the medication errors submitted as part of this study were due to wrong dose, which can be associated with problems with calculations. Mathematical skill and proficiency are prerequisites to accurate medication calculation, as the preparation of some medications may require several sequential and complex calculations (Roughead et al., 2013).



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Software-assisted Medication Administration to Improve Student Outcomes and Confidence

An Australian-based university, University of Wollongong (UOW), conducted a research study using an online software program, which was designed by clinicians for clinicians and nursing students. This software provides users with a two-dimensional simulated clinical environment to practice and develop medication administration skills in a highly interactive and realistic manner. Users can interact with medication administration records (MARs), virtual syringes, vials, ampules, IV tubing, etc. during simulated clinical scenarios and cases. Users can also complete summative assessments and receive certificates along with continuing education credits once they have demonstrated mastery.

The software platform allows users to review and assess their knowledge in math and basic numeracy, dosage calculations, and the rights of medication administration. In math and basic numeracy, users are provided learning resources and practice sessions involving conversions, fractions, ratios, percentages and decimals. Users can practice using dosage calculation scenarios involving a variety of medication preparations such as tablets/capsules, oral liquids, injections (e.g., IV, IM, SC), infusions (e.g., mL/hour, drops/minute, mcg/kg/min), weight-based dosages (e.g., pediatric dosing), reconstituted medications and inhalers. Many of the case studies are based on actual medication errors that have been observed in clinical practice. They have a focus on the broader scope of medication errors such as omissions, non-therapeutic doses, contraindications, allergies, documentation and reporting. These clinical case studies are an excellent resource that assist in developing critical thinking skills and clinical judgment.



The University of Wollongong piloted the software program in two final year nursing courses, which are taught concurrently, with 421 nursing students. All students took a 10-question numeracy exam with a first-time pass rate of 92% (Roughead et al., 2016). Only one student failed, underwent remediation, and was supported through the academic consideration process. In previous years at this institution, the first-time pass rate for a similar 10-question exam was 60% (average across years).

A total of 201 students (47.7% response rate) participated in the evaluation survey that evaluated satisfaction, learning experience, confidence, interest and engagement, and other parameters. More than 93% of respondents Agreed or Strongly Agreed that the software program helped improve understanding of both numeracy in general, medication

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calculation and medication administration. More than 90% Agreed or Strongly Agreed that the online modules were engaging, accurately measured what they were learning, and 88.6% found the modules to be authentic and similar to the real world. More than 88% of respondents Agreed or Strongly Agreed that the modules stimulated critical thinking, stimulated their interest in medication administration, were easy to navigate, suited their learning style, and enabled them to create a customized learner pathway using the activities and program sections. Respondents Strongly Agreed (41.3%) or Agreed (49.8%) that they felt more prepared for workplace experience through engaging in the software program and over 94% felt more confident about medication administration (Roughead, 2016).

Medication administration errors are a recognized patient safety issue with an associated cost burden to the health care system. Nursing education programs have a responsibility to ensure that student nurses entering the clinical environment are provided with the best possible resources and education to administer medications safely. The interactive software program discussed in this article provides students with a customized approach to learning medication calculation and administration and provides foundational knowledge of applied numeracy skills. ♦

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