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Numeracy skills of undergraduate entry level nurse, midwife and pharmacy students

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ABSTRACT

Background: The ability of healthcare professionals to perform basic numeracy and therefore dose calculations competently is without question. Research has primarily focused on nurses, and to a lesser extent doctors, ability to perform this function with findings highlighting poor aptitude. Studies involving pharmacists are few but findings are more positive than other healthcare staff.
Aims: To determine first year nursing, midwifery and pharmacy students ability to perform basic numeracy calculations.
Method: All new undergraduate entrants to nursing, midwifery and pharmacy sat a formative numeracy test within the first two weeks of their first year of study.
Results: Test results showed that pharmacy students significantly outperformed midwifery and nursing students on all questions. In turn midwifery students outperformed nurses, although this did not achieve significance. When looking at each cohorts general attitude towards mathematics, pharmacy students were more positive and confident compared to midwifery and nursing students.
Conclusion: Pharmacy students expressed greater levels of enjoyment and confidence in performing mathematics and correspondingly showed the greatest proficiency. In contrast nurse, and to a lesser extent midwifery students showed poor performance and low confidence levels.

Introduction

Patient safety is of paramount importance; however iatrogenic disease (that caused by medical intervention) remains common (Harne-Britner et al., 2006). Examples of iatrogenic disease include side-effects of medicines, harmful medicine combinations, medical negligence, medical error or misjudgement. Many are unavoidable or not predictable, yet those involving human error can be quantified and categorised. This helps to inform and shape healthcare policy with the goal of minimising risk to patients (DH, 2000; NPSA, 2009).

Exposure to unintentional harm can be experienced throughout the patient journey, from misdiagnosis to poor prescribing and from incorrect dispensing to patient non-adherence. However, one area that appears to be consistently prone to error is the ability of healthcare practitioners to perform dosage calculations correctly. Particular attention has been devoted to nurse ability to calculate doses as drug administration forms a major part of the nurses clinical role (Trim, 2004). Numerous studies, spanning many countries, over the last 20 years have called into question both student and registered nurse ability to adequately demonstrate competence in this area (Table 1).

In response to these deficiencies numerous papers reporting on how to perform calculations have been written (Chapelhow and Crouch, 2007; Dopson, 2008; Grassby, 2007a,b; Haigh, 2002; Hutton, 1998; Sandwell and Carson, 2005; Woodrow, 1998; Wright, 2004), with educators reporting various strategies to improve performance (Chapman and Halley, 2007; Elliott and Joyce, 2005; Middleton, 2008; Rainboth and DeMasi, 2006; Warburton and Khan, 2007) and professional bodies such as the Nursing and Midwifery Council setting standards for numerical proficiency (NMC, 2008).

Calculation deficiencies are not however restricted to nursing. Studies involving medical students and doctors have shown them to be far from perfect (Wheeler et al., 2004a,b, 2006; Scrimshire, 1989; Rolfe and Harper, 1995; Simpson et al., 2009) and even though pharmacists have shown good aptitude (Oldridge et al., 2004; Perlstein et al., 1979) pharmacy educators have voiced

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Table 1
Summary of nursing calculation papers.

Author (year)	Country	Method	Main findings
Papers reporting on student performance			
Blais and Bath (1992)	USA	66 first year undergraduate nurses sat a 20-item calculation test	10.6% ($n = 7$) scored greater than 90%
Barrett (2007a)	UK	15-item test to 6 nursing cohorts (206 pre-test and 250 post-test) as part of a pre-test/post-test intervention strategy	Pre-test mean score was 53.3%. Post-test intervention group scores increased but not reported if significant or not
Barrett (2007b)	UK	Sub-analysis of study above to determine which calculations posed most difficulties	Questions involving decimal points and those calculations which involved more than 1 step were associated with greatest failure rates; only 25% achieved the correct answers
Elliott and Joyce (2005)	Australia	130 and 145 year 1 & year 2 nursing students sat a 20-item calculation test. Pass mark higher between yr. 1 & 2 to reflect increasing calculation difficulty. Calculators were allowed.	19.2% of year 1 students failed to achieve the pass mark (75%) and 13.1% of year 2 students failed (85% pass mark).
Gillham and Chu (1995)	USA	158 second year undergraduate nurses sat a 10-item calculation test	55% ($n = 88$) scored 100%. Twenty two students made calculations deemed to be clinically dangerous
Hutton (1998)	UK	119 first year undergraduate nurses sat a 50-item calculation test	Average test score was 51%
Jukes and Gilchrist (2006)	UK	37 second year nurses sat a 10-item calculation test	8.1% scored greater than 90%. Mean score was 5.5 out of 10
Kapborg (1995)	Sweden	Entrant nurses ($n = 997$) sat a 65-item calculation test; three experimental groups were devised based on prior educational experience	Scores ranged from 0 to 64. Mean scores were: Group one, 31.2; group two, 36.8; group three, 30.5. All three groups performed very poorly on items involving fractions and scaling
Wright (2006)	UK	71 second year undergraduate nurses sat a 30-item calculation test	Just 4.2% ($n = 3$) scored greater than 75%. Mean mark was 16.5.
Papers reporting on qualified nurse performance			
Ashby (1997)	USA	62 nurses sat a 20-item medication calculation test	43.5% ($n = 37$) scored greater than 90%. Significantly more errors were made when calculating I/V doses compared to oral, I/M or S/C drug doses
Bayne and Bindler (1988)	USA	62 qualified nurses sat a 20-item calculation test	35% ($n = 22$) scored greater than 90%
Bindler and Bayne (1991)	USA	110 qualified nurses sat a 20-item calculation test	19% ($n = 21$) scored greater than 90%
Bliss-Holtz (1994)	USA	51 nurses (23 registered and 28 graduate nurses) performed calculations with or without a calculator	72.5% of nurses attained the pass mark (85%) with calculators but this dropped to 54.9% ($n = 23$) without using calculators
Grandell Niemi et al. (2003)	Finland	Four part survey in which the last section involved a 17 calculation test. Approx 308 returns from graduating nurses	17% scored 100%. The commonest error involved placing the decimal point.
Hamner and Morgan (1999)	USA	Introduction of a dosage calculation examination for newly recruited nurses (number of questions unspecified)	Findings report on 157 'PN' and 'LPN' nurses. A pass mark of 85% had to be achieved and 95% of 'PN' nurses and 67% of 'LPN' passed on the first attempt
Santamaria et al. (1997)	Australia	220 graduate nurses sat an 11-item calculation test	42% ($n = 93$) scored 100%.
Papers reporting on both student and registered nurse performance			
Harne-Britner et al. (2006)	USA	31 student nurses and 22 practising nurses took part in a pre-test/post-test intervention study that involved a 20-item calculation test (I/V calculations)	58.4% of student nurses and 45.2% of practising nurses scored greater than 90%. Student nurse scores were: mean pre-test score 15.9 & post-test score rising to 17.4. Practising nurse scores were 15.5 and 18.6 respectively which was found to be significant (at the 0.01 level)
Kapborg (1994)	Sweden	545 practising nurses and 197 student nurses sat a 14-item calculation test	Practising nurse mean score was 9.5 compared to 9.43 for student nurses. I/V calculations proved most difficult.
McMullan (2010)	UK	229 2nd yr. Students and 44 nurses sat a 15-item numeracy and 20-item drug calculation test	55 & 92% of students & 45 & 89% of nurses failed the numeracy and calculation test respectively (pass mark of 60% for both)

concern over general mathematical ability of undergraduate students (Batchelor, 2004; Malcolm and McCoy, 2007; Taylor et al., 2004).

A good grasp of numeracy is therefore fundamental to allow healthcare professionals to translate this knowledge into the clinical context when performing mathematical function such as drug dose calculations.

Study aims

With this in mind the aim of this project was to assess numeracy skills of nursing, midwifery and pharmacy undergraduate students on entry to their respective programmes. Not only did this go towards complying with NMC requirements for midwifery and nursing applicants to demonstrate a minimum level of mathematical ability but more importantly provide each student with a benchmark of personal basic numeracy performance. Additionally, students were assessed on their level of confidence regarding various numeracy skills and their attitude towards mathematics as other authors have linked perception of mathematics to performance (Axe, 2011; Wright, 2006).

Method

All new entrants at the start of the academic year 2009/10 to midwifery ($n = 32$), nursing ($n = 176$) (on two campuses, A and B)