Nursing Numeracy

The case for a benchmark

Edinburgh 30th March 2007
Nursing Numeracy

• ‘To be numerate means to be competent, confident, and comfortable with one’s judgements on whether to use mathematics in a particular situation and if so, what mathematics to use, how to do it, what degree of accuracy is appropriate, and what the answer means in relation to the context.’ (Coben 2000)

• The measure of numerical competence is;
  ‘..in the eye of the recipient of evidence of that competence, be it Higher Education Institutions, Regulators, Employers or Service Users.’
  (Hutton 2004)
Nursing Numeracy

• Core Skill for professional practice

• Contextual

• Practice-orientated

• Exemplars
Medication-related calculation

Most common exemplar for Nursing Numeracy

Incorrect calculation of medication dosage can result in harm to patients and to reputation of the profession.

There are no accepted national standards for teaching and/or assessment of dosage calculation skills during pre-registration nurse training.
Regulation and Numeracy: The NMC’s position

• Clear and specific focus upon ‘public protection through professional regulation’

• Use of statutory control over the approval and monitoring of nursing education to ensure appropriate professional standards
Regulation and numeracy: the NMC’s position

- Clear and specific focus upon ‘public protection through professional regulation’
- Use of statutory control over the approval and monitoring of nursing education to ensure appropriate professional standards
• Minimum entry requirements which must be met before applicants can begin their professional education

• Benchmark competencies/outcomes to be achieved at the end of the first ‘common foundation year’ and at the end of the programme (‘entry to the register’)
The Stakeholders

Educators

Students

Regulators

Employers

The Public
Recommendations from NHS Education for Scotland (2006)

1. A standardised suite of nationally recognised and validated Healthcare Numeracy provision that demonstrate sound academic progression and vocational relevance.

2. Development of national guidance and practice placement standards regarding numeracy learning

3. Closer collaboration between HE, FE and service
4. National on-line resources for learning, teaching and assessment of healthcare numeracy

5. Development of a national multi-disciplinary benchmark assessment designed to determine competence achievement at the point of registration.

6. Once developed, standard could be used as a benchmark for employment purposes
We are developing a national benchmark in numeracy for nursing

derived from research-based principles in:

- adult learning
- supported, contextualised numeracy learning for safe practice
Research-based principles of adult learning

• Learning is:
  • a purposeful, goal-directed activity
  • builds on learners’ prior knowledge and experience to shape and construct new knowledge
  • a social activity embedded in a particular culture and context
• Effective transfer of learning from one context to another requires that the learner understand not only the facts but the underlying principles, patterns and relationships acquired through the application of knowledge
Principles of adult learning, continued

- Knowing when and how to apply what has been learned (procedural knowledge) is central to expertise, and can be acquired only through practice in an authentic environment.
- Teaching involves informed interpretations of, and responses to, learners’ approaches to learning.
- Metacognitive strategies can be taught.
- Scaffolding instruction helps learners to develop their fluency, independence and range as they move from being a new learner to becoming an expert learner.
Adults’ maths life histories

- The brick wall – the point at which maths stopped making sense

- The significant other – someone perceived as a major influence on the person’s maths life history

- The door – marked ‘Mathematics’, locked or unlocked, which people have to go through to enter or get on in a chosen line of work or study

- Invisible maths – the maths someone can do, but which they may not think of as maths at all, ‘just common sense’
Teaching for numeracy

• Builds on the knowledge students bring
• Exposes and discusses common misconceptions
• Develops effective questioning
• Uses cooperative small group work
• Emphasises methods as well as answers
• Uses rich collaborative tasks
• Creates connections between mathematical topics
• Uses technology in appropriate ways
Integrating numeracy into healthcare education and training

Challenges:
- nursing lecturers may not know how to teach for numeracy
- adult numeracy tutors may not know the numeracy requirements of the healthcare context
- low base in terms of trained, experienced adult numeracy tutors

Ways forward:
- team approach - healthcare professionals and adult numeracy specialists working together on contextualised numeracy teaching and assessment
- training, CPD, teaching, learning & materials geared to healthcare professionals’ numeracy needs
Numeracy for nursing needs to be:

Robust: to cope with stress, anxiety and time pressures

Situated in the nursing/healthcare context and capable of generating:

- independence
- good judgement (e.g., on how accurate to be, when to estimate, within what tolerance and why)
Nursing knowledge includes contextualised applied maths in order to ensure safety and quality

- Drug administration
- Drug prescribing
- Fluid balance calculation
- Children’s nutritional needs
- Intravenous fluid requirements/rates
- Calculations related to weight/BMI
- Administration
- Plotting and recording data
- Understanding research and evidence
Nursing must recognise the relative importance of numeracy in the whole context of practice

When you are ill - do you need a mathematician or a nurse?
Why benchmark medicine administration?

- NMC already require Universities to judge maths ability at entry and at registration (NMC, 2004)

- Current medication related error rates remain high 41,217 to July 2006 (NPSA, HCC, 2006) though at 9% consistent with historical data and no isolation of calculation error is noted! Employers are charged with reducing error rates year on year (DoH 2002)

- New nurses can expect employers to include maths assessment as part of the interview process, and within their employment.

- and perceptions of poor maths sells newspapers.......
A Third of New Nurses Fail Simple English and Maths Test….

By Celia Hall, Medical Editor

Daily Telegraph

Last Updated: BST 05/08/2006

These are the types of questions the ‘rigorously’ tested Christ Church students were having trouble with.

You start your late shift at 3 p.m. Which of the following times is the same as 8 p.m?
- a 18.00
- b 19.00
- c 20.00
- d 21.00

Ambulance staff have a holiday entitlement of 27 days per year, rising to 33 days after 10 years service. Putting the small number first, how many must you add to get the larger number?
- a 4
- b 5
- c 6
- d 7

Under the Agenda for Change, all directly employed staff of the NHS will work thirty seven and a half hours per week. One half hour is:
- a 15 minutes
- b 20 minutes
- c 30 minutes
- d 45 minutes

The price of a prescription is six hundred and fifty pence. What is the correct format for the price of a prescription in decimal nomination?
- a £6.05
- b £6.50
- c £55.0
- d £6.05

Blood can be frozen and stored for 10 years. The temperature of frozen blood must be greater than -40 degrees. Blood can be frozen at 40 degrees below zero. If frozen blood gets 40 degrees colder what is the new temperature?
- a -80 degrees
- b 0 degrees
- c 0 degrees
- d 40 degrees

One non-emergency volunteer driver carries six people in one journey. How many journeys must the driver make if he is to transport 24 patients?
- a 3
- b 4
- c 5
- d 6
Maths learning can be associated with anxiety. This is recognised to affect performance, and lead to aversion and avoidance for fear of failure. However, an ingrained ethos of healthcare is that getting it wrong is shaming… ‘first do no harm…’ and negative ‘drug error’!

Unless managed effectively, testing with the possibility of failure may add to this..... and may create a vicious circle of stressed and under-confident professionals.
Universities must prepare their students for professional practice and play a part in ensuring a level playing field – but without a benchmark there is no clear standard to be met.

Without a clearly identified benchmark, employers don’t trust enough to rely on registration proficiency and test for themselves… (without a benchmark)…

When nurses are newly qualified this is expensive repetition which risks credibility of courses and the relationship of trust between employers and educators.

Nurses who attend employment interviews find different standards, different modes of testing and different levels of expectation – This is ineffective and stands to exacerbate stress and anxiety for applicants.
Evidence-based literature in the field of nursing numeracy strongly supports a realistic approach to the teaching and learning of calculation skills, which in turn deserve to be tested in an authentic environment.

The assessment tool should determine competence in the key elements of the required competence.

There should be an element of differentiation between the requirements for each of the branches of nursing.
Good practice principles cont.

- The assessment should be consistent with the principles of adult numeracy learning teaching and assessment, having an enablement focus

- The assessment tool should provide a diagnostic element, identifying which area of competence has been achieved, and which requires further intervention

- The assessment should be able to demonstrate a clear relationship between ‘test’ achievement and performance in the practice context
Good practice principles cont.

The tool should provide:

- a unique set of questions with a consistent level of difficulty
- a structured range of complexity
- questions derived from authentic settings

- The assessment should take place within a defined framework, at points by which students can be effectively prepared, while allowing time for supportive remediation

- The assessment should be easy to administer, providing the opportunity for rapid collation of results, error determination, diagnosis and feedback
‘To hear is to forget
To see is to remember
To do is to understand’
Confucius 420BC
Proposed Exploratory Design
Features of:
NES Medication Dosage Problem-Solving Authentic Diagnostic Assessment Project

Keith W. Weeks  Diana Coburn
Mike Sabin   Carol Hall
Meriel Hutton  Norman Woolley
Overview of proposed research process

1. Definition of research problem & Aims
   • Objective of the study

2. Situation and literature Review
   • Past research and theory on practice issue

3. Design Research
   a. Research design, time frame, unit of analysis, measures
   b. Sample with rationale
   c. Design & development of instruments

4. Data collection

5. Data analysis and Evaluation
   • Data and statistical analysis

6. Recommendations/reporting
   a. Implications for practice
   b. Future research
Aims

1. To assess 3rd year nursing student’s and registered nurse’s medication dosage problem-solving skill performances within an online authentic diagnostic assessment environment

2. To evaluate the validity of outcome performances measured on an online authentic diagnostic assessment environment in predicting performance in Skills Laboratory setting medication dosage problem-solving

3. To evaluate nursing student and registered nurse perceptions of the authentic assessment environment as preparation for medication dosage problem-solving in practice settings
Sample

- 300 third year randomly selected nursing students following pre-registration adult, child, mental health & intellectual disability nurse education programmes in three HEI’s in Scotland.

- 300 registered nurses practising in adult, child and mental health practice settings within three NHS Trusts in Scotland.

- These sample sizes are for illustrative purposes only and are subject to numbers of participating HEI’s & NHS Trust’s and a power calculation analysis to determine requisite sample sizes.
Table 1: Draft HEI & NHS Trust Samples

(Sample sizes subject to power calculation analysis)

<table>
<thead>
<tr>
<th>HEI Sample</th>
<th>HEI #1</th>
<th>HEI #2</th>
<th>HEI #3</th>
<th>Total</th>
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<td>Adult n = 50</td>
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<td>150</td>
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<tr>
<td>Child n = 25</td>
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<td>75</td>
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<tr>
<td>M. Health n = 25</td>
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<td>75</td>
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<tr>
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<td>n = 100</td>
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<th>NHS #1</th>
<th>NHS #2</th>
<th>NHS #3</th>
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Proposed HEI Stratified Random Sampling Frame

• It is proposed that a sample of 3rd year nursing students from HEI’s be determined via a stratified random sampling process.

• It is proposed that the random stratified sample frame will be determined by 3rd year nursing students’ branch (i.e. child, adult, mental health & intellectual disability).

• Gaining feedback from 3rd year nursing students following child, adult, mental health & intellectual disability branches is aimed at establishing their medication dosage problem solving and calculation performance; and their perceptions of how representative the medication dosage Authentic Assessment environment and dosage problems are of their branch dosage calculation requirements at point of registration.
Draft Proposal for HEI Stratified Random Sampling Frame

Assuming $n = 100$
50% random sample = 50
3rd year Adult Branch
participants per HEI

Assuming $n = 50$
50% random sample = 25
3rd year Child Branch
participants per HEI

Assuming $n = 50$
50% random sample = 25
3rd year Mental Health Branch
participants per HEI
Proposed NHS Cluster Sampling Frame

- It is proposed that a representative random sample of registered nurses from NHS Trusts be determined via a cluster sampling process.

- It is proposed that the sample frame will be determined by nurses’ grade (e.g. D, E, F etc or equivalent) & practice setting (e.g. child, mental health, adult medicine, adult surgery, A & E, etc).

- Gaining feedback from registered nurses practising in a wide range of practice settings is aimed at establishing their perceptions of how representative the medication dosage Authentic Assessment environment and dosage problems are of their practice setting medication dosage calculation requirements.
Proposed NHS Random Cluster Sampling Frame: Example provided = D Grade RN’s practising in Adult Medical practice settings of a NHS Trust

<table>
<thead>
<tr>
<th>D Grade (or equivalent) Registered Nurses Adult Medical Ward x NHS Trust #1</th>
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<tbody>
<tr>
<td><img src="image1.png" alt="Image of nurses" /></td>
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<tr>
<td><img src="image3.png" alt="Image of nurses" /></td>
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Assuming $n = 60$

10% random cluster sample =

6 D Grade (or equivalent) Registered Nurse Participants practising in Adult Medical Wards per NHS Trusts

This example is for illustrative purposes only and actual cluster sample percentage and numbers need to be determined via representative population numbers and power calculation analysis.
### Table 2: Table of Proposed Exploratory Research Activity

**Timeline:** research methods, dates and scheduled time periods to be determined following consultation with participating HEI’s & NHS Trusts

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Activity</th>
<th>Activity</th>
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<tbody>
<tr>
<td></td>
<td>Orientation to Authentic Assessment Environment</td>
<td>Diagnostic assessment of typical branch/practice setting specific medication dosage calculation skills: <em>Online environment</em></td>
<td>Analysis of Authentic Assessment outcome data</td>
<td>Diagnostic assessment of typical branch/practice setting specific medication dosage calculation skills: <em>Skills Lab setting environment</em></td>
<td>Analysis of skills lab outcome data</td>
</tr>
<tr>
<td>Process</td>
<td>4-6 week orientation period</td>
<td>50 point Authentic Assessment: <em>Typical unit dose, sub &amp; multiple unit dose, complex problems, conversion of SI units, IV infusions</em></td>
<td>Appropriate statistical analysis of student/practitioner variance in performance</td>
<td>Assessment via examiner observation of typical medication dosage calculation skills in skills laboratory environment</td>
<td>Statistical analysis of construct and predictive validity of Authentic Assessment performance outcomes in skills lab settings</td>
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Five-Dimensional Framework for Authentic Assessment