

# Learning in practice

## Research in medical education: three decades of progress

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The specialty of research in medical education began just over three decades ago with a small group of clinicians and educational researchers at the medical school in Buffalo, New York. Since that time it has expanded worldwide. This paper is a personal reflection on how this research has informed our understanding of learning, teaching, and assessment in medicine.

### Measuring progress

In medicine, indicators of scientific progress might be measured by objective indicators such as death from cardiovascular disease. In education such “hard” evidence may be lacking for several reasons. Firstly, paradoxically, real differences in educational strategies may not be reflected in outcomes, such as licensing examination performance, simply because students are highly motivated and are not blinded to the intervention, so will compensate for any defects in the curriculum.<sup>1-5</sup> Secondly, a curriculum is not like a drug, which can be given at standard doses, but instead contains many components, delivered with variable quality by different teachers. Finally, the time between learning and important outcomes may be so long that the effects of the curriculum are obscured—although not always.<sup>6</sup>

### Use of evidence in educational decision making

Perhaps the most important evidence of progress in the discipline is that we are now more likely than before to demand evidence to guide educational decision making. Before 1970 important educational advances were largely adopted by persuasion and politics; since that time changes are more likely to be initiated or accompanied by evidence. Although this may sound circular, it represents tangible recognition of the contributions that research can make to the practice of education.

### Specific areas of progress

Beyond this cultural change, the following broad domains have seen real progress: basic research in the acquisition of expertise, problem based learning, advances in assessment methods, and continuing education, recertification, and relicensure.

#### Basic research in the acquisition of expertise

In the early 1970s basic research into the nature of clinical reasoning pursued the hypothesis that expert

### Summary points

Research in medical education has contributed substantially to understanding the learning process

The educational community is becoming aware of the importance of evidence in educational decision making

Areas of major development include basic research on the nature of medical expertise, problem based learning, performance assessment, and continuing education and assessment of practising physicians

clinicians were distinguished by the possession of general “clinical problem solving” skills. This was wrong; what emerged was that expertise lay predominantly in the knowledge, both formal and experiential, that the expert brought to the problem.<sup>7,8</sup>

This finding resulted in a new direction of inquiry, and a new generation of researchers attempted to uncover the ways that expert clinicians organise medical knowledge in their minds, using research strategies derived from cognitive psychology.<sup>9,10</sup> Although the fruits of these labours are not yet ripe, the research has moved from purely descriptive research to experimental studies directed at a better understanding of the process and theory based interventions that promise to improve the effectiveness of instruction.<sup>11</sup>

#### Problem based learning

Problem based learning developed at McMaster University in the late 1960s, driven by a desire to construct a medical school that was more humane than one that used the traditional, lecture based approach. Since that time an extensive body of evidence has emerged about its effectiveness.<sup>2-5,12</sup> If the evaluation is restricted to the central educational outcomes such as performance on licensing examinations, few differences are found.<sup>2,3</sup> This should not be a surprise—most students will do whatever is necessary to compensate for any perceived weakness in a curriculum.<sup>13</sup> However, in terms of the original goal of creating a humane learning environment, problem based learning is an unqualified success.<sup>3,4</sup>

### Advances in assessment methods

Arguably the most dramatic advances have occurred in approaches to assessment. Thirty years ago assessment was dominated by written tests—essays in Europe and multiple choice questions in North America. When performance assessment did occur, as in specialty certification, the traditional viva dominated. Moreover, there was a paucity of evidence about the strengths and weaknesses of various approaches.

That has all changed. In the 1970s there was a proliferation of simulation approaches to assessing higher skills like problem solving. These developments were accompanied by careful research, largely stimulated by the licensing and certification bodies in the United States. Content specificity has been a major finding of this research—the correlation of the various measures of skills across problems was typically in the range of 0.1 to 0.3,<sup>14</sup> so many samples of behaviour were necessary to obtain stable, thus reliable, measurement. It is a direct consequence of content specificity that the objective structured clinical examination,<sup>15</sup> with its multiple samples of performance, has come to dominate performance assessment and has led to an extensive literature regarding the impact of various elements such as ratings of simulated patients versus physician observers.

This research has led to major advances in performance assessment—for example, the Medical Council of Canada now administers a performance examination to 1800 licensure candidates each year.<sup>16</sup> Changes in assessment methods at the school level have, however, been much slower in coming.<sup>17</sup>

#### Research foci and major findings

##### Basic research on reasoning

Generic reasoning skills are non-existent  
Knowledge (formal and experiential) is a critical determinant of reasoning

##### Problem based learning

Self directed learning does not result in lower knowledge  
Students and teachers are happier and more satisfied

##### Performance assessment

Multiple sampling strategies are crucial to reliable, valid assessment  
Performance can be assessed as well as knowledge

##### Continuing education

Improved reliable methods for performance assessment in practice  
Systematic approaches to relicensure

### Continuing education, recertification, and relicensure

While continuing education of health professionals remains dominated by the “day in medicine,” when physicians assemble and hear a full day of lectures on a particular topic from academic specialists, a substantial body of evidence has emerged pointing to the deficiencies of this approach, and, more importantly, identifying alternative methods that are effective.<sup>18</sup>

These changes have paralleled dramatic changes in the assessment of practising physicians. Society is challenging the presumed right of independent practice conferred on the physician at the time of licensure, and



Medical education, 1960s-style

the medical education community has responded by devising and implementing several defensible strategies for reassessment. One highly innovative approach is the use of unidentified standardised patients who enter physicians' practices undetected.<sup>19 20</sup> Another is the serious attempt to identify and deal with incompetent physicians through formal performance assessment both in Canada and in the United Kingdom.<sup>21 22</sup>

### The outcome of medical education

Research in medical education is no longer in its infancy (see box). While it remains multifocal, with nearly as many research methods as researchers, there

#### Additional educational resources

##### Useful websites

- Queen's University, Ontario, Canada (<http://meds.queensu.ca/medicine/pbl/pblhome.htm>)—problem based learning home page from Queen's University's School of Medicine
- Clerkship Directors in Internal Medicine Task Force Subgroup Report (<http://www.im.org/cdim/5educate/eval/clinical.html>)—evaluation of clinical competence
- National Board of Medical Examiners (<http://www.nbme.org/about/itemwriting.asp>)—constructing written test questions for the basic and clinical sciences

##### Useful publications

- Norman GR, Schmidt HG. The psychological basis of problem-based learning: a review of evidence. *Acad Med* 1992;67:557-65.
- Norman GR, van der Vleuten CPM, Newble DI. *International Handbook of Research in Medical Education*. Dordrecht: Kluwer, 2002.
- Swanson DB, Norman GR, Linn RL. Performance based assessment: lessons from the health professions. *Educ Res* 1995;24:5-11.

is a growing body of knowledge about the process and outcome of medical education.

In my view there has been insufficient attention to the interface between our understanding of clinical expertise and the application of this knowledge to improve instruction and assessment. Studies at the curriculum level of complex “treatments” like problem based learning are unlikely to reveal a deeper understanding of the interface between instruction and learning. Real improvement in education, just like real improvements in medical treatments, will only result when we combine better the understanding of basic science with the experimental interventions.

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- 1 Norman GR. Reflections on BEME. *Med Teacher* 2000;22:141-4.
- 2 Colliver J. Effectiveness of problem based learning curricula. *Acad Med* 2000;75:259-66.
- 3 Albanese MA, Mitchell S. Problem based learning: a review of literature on its outcomes and implementation issues. *Acad Med* 1993;68:52-81.
- 4 Vernon DTA, Blake RL. Does problem-based learning work? A meta-analysis of evaluative research. *Acad Med* 1993;68:550-63.
- 5 Enarson C, Cariaga-Lo L. Influence of curriculum type on student performance in the United States Medical Licensing Examination Step 1 and Step 2 exams: problem-based learning vs lecture-based curriculum. *Med Educ* 2001;35:1050-5.
- 6 Monette J, Tamblin RM, McLeod PJ, Gayton DC. Characteristics of physicians who frequently prescribe long-acting benzodiazepines for the elderly. *Eval Health Prof* 1997;20:115-30.
- 7 Elstein AS, Shulman LS, Sprafka SA. *Medical problem solving: an analysis of clinical reasoning*. Cambridge, MA: Harvard University Press, 1978.

- 8 Barrows HS, Norman GR, Neufeld VR, Feightner JW. The clinical reasoning process of randomly selected physicians in general medical practice. *Clin Invest Med* 1982;5:49-56.
- 9 Evans D, Patel VL, eds. *Cognitive science in medicine*. Cambridge, MA: MIT Press, 1989.
- 10 Schmidt HG, Norman GR, Boshuizen HPA. A cognitive perspective on medical expertise: theory and implications. *Acad Med* 1990;65:611-21.
- 11 Norman GR, Brooks LR, Colle CL, Hatala RM. The benefit of diagnostic hypotheses in clinical reasoning: experimental study of an instructional intervention for forward and backward reasoning. *Cogn Instruct* 2000;17:433-48.
- 12 Norman GR, Schmidt HG. Effectiveness of problem based learning: theory, practice and paper darts. *Med Educ* 2000;34:721-8.
- 13 Ten Cate O. What happens to the student? The neglected variable in educational outcome research. *Adv Health Sci Educ* 2001;6:81-8.
- 14 Van der Vleuten CPM, Swanson DB. Assessment of clinical skills with standardized patients: the state of the art. *Teach Lrn Med* 1990;2:58-76.
- 15 Harden RG, Gleeson P. Assessment of clinical competence using an objective structured clinical examination. *Med Educ* 1979;13:41-54.
- 16 Reznick RK, Blackmore D, Dauphinee WD, Rothman AI, Smees S. Large-scale high-stakes testing with an OSCE: report from the Medical Council of Canada. *Acad Med* 1996;71:19-21S.
- 17 Fowell SL, Bligh J. Assessment of undergraduate medical education in the UK: time to ditch motherhood and apple pie. *Med Educ* 2001;35:1006-7.
- 18 Oxman AD, Thomson MA, Davis DA, Haynes RB. No magic bullets: a systematic review of 102 trials of interventions to improve professional practice. *CMAJ* 1995;15:1423-31.
- 19 Woodward CA, McConvey GA, Neufeld V, Norman GR, Walsh A. Measurement of physician performance by standardized patients. Refining techniques for undetected entry in physicians' offices. *Med Care* 1985;23:1019-27.
- 20 Rethans JJ, Sturmans F, Drop R, van der Vleuten C. Assessment of the performance of general practitioners by the use of standardized (simulated) patients. *Br J Gen Pract* 1991;41:97-9.
- 21 Page GG, Bates J, Dyer SM, Vincent DR, Bordage G, Jacques A, et al. Physician-assessment and physician-enhancement programs in Canada. *CMAJ* 1995;15:1723-8.
- 22 Jolly B, McAvoy P, Southgate L. GMC's proposals for revalidation. Effective revalidation system looks at how doctors practise and quality of patients' experience. *BMJ* 2001;322:358-9.

## Living with Parkinson's disease—a child's perspective

I was 10 years old when my mother came back from a large London teaching hospital having been given the diagnosis of young onset Parkinson's disease. She was 46 years of age. She had made the diagnosis herself before this appointment. She was first told it by medical students when, during a consultant led teaching session, she had been asked to walk across the front of a lecture theatre to show the characteristic gait. She was humiliated, and I was angry. That was when I decided to become a doctor myself.

Fortunately, young onset Parkinson's disease is not common. Most people are aware of the devastating symptoms—the tremor, the poverty of movement, the falls, and the terrible side effects of the drugs—but a child sees not only the slow, relentless progression of symptoms but also the loss of the mother that he or she knows.

The effects of this on a child are both practical and emotional. Many patients with Parkinson's disease prefer to withdraw from society. For me, it was the end of family activities: we no longer undertook our regular Sunday bicycle rides, meals out became an impossibility because of the practical difficulties of eating, and family holidays ended. Our family photograph album, which had been religiously updated and annotated, stopped abruptly. My attempts to learn how to sew and knit had to continue without help. Home visits by friends became difficult and strained. Physical gestures and, in particular, cuddles ceased.

Worst of all, however, were the emotional effects of this terrible illness. The frequent falls and difficulty getting up meant that I would often return from school to find my mother on the floor, where she may have been for some hours. She would never complain about her condition, and somehow that made me feel

worse. How can an adolescent who is trying to break away from her parents do so with a mother who is physically deteriorating? Would teenage rebellion make her worse? Certainly, argument would increase the tremor. My achievements would be one of the few things that would continue to give her pleasure in life. However, she was undemanding of me, and again somehow that made it worse. How could I talk about my own problems and difficulties? I was concerned about the effect on my father, a sociable man whose life had also been changed by this cruel illness.

I was an only child, and that must have increased my sense of responsibility. It certainly increased my sense of isolation. I fulfilled my intention to become a doctor, driven by my family circumstances. That drive seems to continue after family members are long since dead.

All this happened to me some time ago, and I would hope that now medical teams have a better understanding of the difficulties encountered by patients with Parkinson's disease and their families, but I wonder.

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We welcome articles of up to 600 words on topics such as *A memorable patient, A paper that changed my practice, My most unfortunate mistake*, or any other piece conveying instruction, pathos, or humour. If possible the article should be supplied on a disk. Permission is needed from the patient or a relative if an identifiable patient is referred to. We also welcome contributions for “Endpieces,” consisting of quotations of up to 80 words (but most are considerably shorter) from any source, ancient or modern, which have appealed to the reader.