The doctor as an expert: apprentice, journeyman or master

A commitment to understanding and improving medical expertise is fundamental to training, practice and evaluation of doctors' performance

> "As we know, there are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns — the ones we do not know we do not know."
>
> Donald Rumsfeld

Australian medical specialist colleges are currently reviewing their continuing medical education programs in the context of the Medical Board of Australia's proposed implementation of revalidation. At the same time, there has been an expansion of the number of medical schools and consequent innovation in curricula. In this context, the role of a doctor as a medical expert has been central to influential curriculum models such as CanMEDS — a Canadian initiative to improve patient care, focusing on medical education and practice.[1] To proceed with basic and continuing medical education and revalidation without defining and understanding the development of medical expertise is to put the cart before the horse. This article aims to stimulate consideration of the characterisation of medical expertise as a core skill set of medical practice and, therefore, fundamental to teaching and assessment at all levels of medical education and practice: from the apprentice physician, through the journeyman stage and towards mastery.

The path to expertise: apprentice, journeyman or master

Whether a physician should be a medical expert seems paradoxical. However, CanMEDS, which is the most widely accepted model for medical, specialist and continuing training, has "medical expert" as integral to several core competencies.[1] The emphasis of CanMEDS has been on defining core competencies focused on measurable outcomes of medical education.[1] Measurable competency is necessary, but insufficient; a medical expert should excel.[2,3] In addition to reaching certain competencies, a physician must not only maintain but also improve their skills to meet the criteria for becoming an expert practitioner.[2,3] The concept of medical expertise requires further empirical investigation, iterative development of theoretical models, testing and validation before a comprehensive model is attained. Medical students and junior medical practitioners will not be experts, but they must develop expertise in order to be certified as medical specialists. In view of the lack of substantive knowledge of medical expertise, it is difficult to design medical training at the basic (apprentice) or certified practitioner (journeyman) level, let alone for the expert (master) level.

Defining medical expertise

At present, medical education does not appear to incorporate the burgeoning research in the fields of cognitive psychology of learning, decision making[4] and expert performance.[2,3] Researchers in medical expertise have reflected on whether it is possible for physicians to excel in all domains of medical expertise, such as diagnosis, therapeutics, communication and peer regard,[5] in addition to all other CanMEDS competencies.[1] Expertise has been defined as reproducible superior performance.[2] At a basic competency level, routine expertise may yield skilled journeyman technicians, who may attempt to adapt problems to the solutions they already know. At a master level, adaptive expertise involves flexibly adapting or developing innovative solutions to fit the problems faced.[6] In situations at the edge of their competence, adaptive experts go beyond regular competencies and display flexible, creative and innovative abilities to extend their knowledge over and above the usual applications,[6] which may be considered essential to master level adaptive medical expertise.

In more routine medical tasks, there are no major measurable differences between performance of practitioners regarded as experienced and novices.[3] Superior flexible and innovative performance indicative of expertise may only manifest in ambiguous, difficult clinical situations, which are hard to simulate and study.

Models of task-based competence such as CanMEDS may set the standard for medical training at all levels at routine expertise,[6] as opposed to assessing development of adaptive expertise and excellence.

Cognitive psychology and medical expertise

There have been advances in the cognitive psychology of learning at all levels of education. It is known that spacing,

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repetition and interleaving of different topics improves retention and the ability to use knowledge and skills.[7] These advances need to be incorporated into medical education to provide a foundation for the development of expertise.

Research in the cognitive psychology of decision making under situations of uncertainty, time constraints and complexity, has identified that processing speed may affect decision outcomes in clinical situations.[4] Fast thinking corresponds to non-analytical processing (eg, heuristic pattern recognition in routine circumstances)[8], whereas slow thinking represents more analytical processing (eg, considered reasoning in ambiguous situations).[9,10] Moreover, expertise may be manifest in whether the problem or situation is recognised as challenging, that is, knowing what is not known and when help is needed. Cognitive psychology research into self-assessment shows that medical practitioners may have major difficulties in recognising and self-assessing their own incompetence.[11] The skill of meta-cognitive self-monitoring is crucial in such self-evaluation, which involves accessing external and internal data to evaluate current performance, assessing the need for improvement and having capacity to continue doing self-appraisals as one practises.[12] However, effective self-appraisal remains difficult, and it is therefore necessary to obtain the evaluation of peers.

Expert performance studies have identified the role of deliberate practice in improving expert skills.[2,3] Nevertheless, deliberate practice may only impart routine expertise[2,13] as opposed to adaptive expertise. An element of deliberate practice seems to involve reflection to improve performance; yet capturing the core features of reflection in practice for professionals seems challenging.[14] The complexity of reflection may be due to the difficulty in rationally accessing and deconstructing routine, automated cognitions and behaviours in order to improve them.[2]

In understanding medical expertise, the use of medical informatics, decision-making tools (software and hardware), computers and related medical technology also merits further investigation.

Therefore, a modern model of medical expertise may be based on the cognitive psychology of learning, decision making, deliberate practice, self-assessment and peer appraisal, and may include both routine journeyman expertise, and additionally, master level adaptive expertise to reflect reproducible superior performance in challenging situations.

Training for medical expertise

Due to the problems identifying medical expertise, little is known about effective training for the apprentice in junior medical training. The breadth of skills and knowledge required in medical practice are difficult to encompass in a model,[5] and attempting to investigate a monolithic concept of medical expertise may prove futile. Current research focuses on more easily measurable task-related routine medical expertise, such as perceptual diagnostic reasoning (eg, interpreting electrocardiograms or mammography results)[2] and skill performance (eg, specific operative skills). To date, there has been a focus on deliberate practice of skills, based on studies of expertise in chess and sports; yet there are also indications that cognitive capacities, such as working memory and executive function, have a role in medical expertise.[9] Adaptive expertise has also been studied in the application of effortful analysis in problematic situations in surgery.[15]

We suggest a multidimensional approach to medical expertise. Basic biomedical knowledge is a foundation for both fast and slow processing. The development of this knowledge should be informed by implementing principles of the cognitive psychology of learning. In teaching clinical reasoning, there is evidence that guiding trainees to be aware of fast and slow processing may be helpful.[10] The use of analytical reasoning is significant in complex and difficult situations and trainees should be aware of the need to apply such reasoning.[15] In addition, the specific development of adaptive expertise under difficult, complex and ambiguous situations is needed.

Training in self-monitoring of performance, and peer appraisal, may contribute to the development of journeyman level and master level expertise in medicine. The types of skills, cognitive capacities and training that will develop the various domains of medical expertise merit further investigation.

Given the need for more research into medical expertise, it would be premature at this stage to seek to select students for medical school based on the limited existing knowledge.

Conclusion

Systematic research into the characterisation of medical expertise is necessary for the development of basic and continuing medical education, as well as appraisal of skill performance at all levels. Building on the foundations of the cognitive psychology of learning, decision making and expert performance, research should explore definitions of domains of medical expertise, accepted criteria of expertise (especially excellence), models of cognition and decision making in complex medical situations, and cognitive and behavioural drivers of deliberate practice, skill development and improvement. As a result of this research, the design, implementation and evaluation of training in domains of expertise will be essential.

Whether an apprentice, journeyman or master practitioner, a commitment to improving medical expertise is fundamental to training, practice and evaluation of performance.

> "One becomes a beginner after 1000 days of training and an expert after 10 000 days of practice."
>
> Masutatsu Ōyama

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