Understanding learning in the workplace for those who practise: we can't wait another 50 years

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As beautifully detailed in the paper by Billett in this issue, participation in work is one of the most common ways of acquiring competence in the professions.[1] Much of the learning in this setting occurs through the observation of role models and practice with feedback. The authors capture this wonderfully in their four key factors that contribute to learning. First, all different forms of knowledge are gained by doing. Second, the environment offers a rich set of cues about how activities are performed. Third, performing work tasks provides the opportunity for practice. Fourth, the guidance provided by co-workers (i.e. feedback) leads to learning not acquired by practice alone.

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According to the authors, there are also limitations to learning at work. A lack of access to the needed activities and a lack of guidance are unfortunately common in undergraduate and postgraduate training around the world. In addition, as a result of the hidden curriculum, what is learned is not always appropriate.

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The authors identify three areas for special emphasis over the next 50 years: (i) the 'applicability' of the current research findings, (ii) what can be learned in the workplace and how to align that with the experiences that promote it, and (iii) the importance of 'practitioner engagement'. It is this last point that I want to take up.

There is now a substantial and growing body of literature indicating that a doctor's performance declines with time since training. The seminal work in this regard is a review of the literature by Choudhry, Fletcher and Soumerai.[2] They searched all English-language publications from 1966 to 2004 and identified those that sought to account for knowledge, processes of care or outcomes of care using years in practice or age. Their review led the authors to conclude that performance declines with time since training. Specifically, doctors who had been in practice for longer possessed less knowledge, did not adhere as well to guidelines for diagnosis, screening and preventive health, did not adhere as well to guidelines for therapy, and their patients had poorer outcomes.

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In response to this work, Norman and Eva[3] acknowledged that medical knowledge and adherence to guidelines appeared to decline with time since training but they suggested that the differences in patient outcomes were relatively small. This led them to declare a paradox for which they offered two possible explanations. First, they suggested that although adherence to guidelines would be effective for a population, experienced doctors might systematically vary in serving the needs of individual patients. Consequently, they might be inappropriately penalised for this behaviour in various types of assessment. Second, they suggested that experienced clinicians rely more heavily on pattern recognition, which might compensate for declining knowledge. These explanations are buttressed by the well-documented positive relationship between experience and learning as noted in their paper.

Since the Norman and Eva publication, there has been additional research demonstrating the inverse relationship between years since training and outcomes of care.[4,5] For instance, one study found an increase in patient mortality with increased time since their attending physician graduated from medical school.[6] After controlling for a variety of hospital, doctor and patient characteristics, a study of acute myocardial infarction (AMI) and congestive heart failure (CHF) found that every additional year since a doctor's graduation was associated with a 0.58% increase in the relative mortality risk of his or her patients. Over a 30-year career, this produces a 17.4% increase in relative risk of mortality.

Even larger effects have been found for procedural skills.[7] Again after controlling for a variety of

hospital, doctor and patient characteristics, a recent study of coronary artery bypass grafts (CABG) and valve surgery found that every additional year since the operating surgeon's graduation was associated with a 0.90% increase in the relative mortality risk of his or her patients. Over a 30-year career, this produces a 27% increase in relative risk of mortality.

As these are relative risks it is important to put the numbers into some kind of context. Absolute risks would be a better measure but both studies combined the results for two conditions that have different crude mortality rates. However, earlier work looked exclusively at AMI and found a 16% increase in relative risk over a 30-year career.[8] This corresponds to an absolute increase in risk of about 1.5%. To put this in context, a large trial of the effect of aspirin given within 24 hours of the onset of AMI reduced relative risk by 23% and long-term use of beta-blockers after AMI reduced relative risks by 23%.[9,10] With this as background, the magnitude, though not the direction, of the effect of time since training over a career is roughly comparable to prescribed single interventions and therefore of considerable concern.

A straightforward explanation for these results need not refer to pattern recognition or to the assumption that assessments of knowledge and adherence to guidelines are insensitive to the needs of specific patients. In fact, as Choudhry, Fletcher and Soumerai concluded,[2] the most plausible explanation is that doctors are failing to keep up. Given the rapid advances in knowledge underlying medicine and the health professions, this is a compelling explanation and one for which there are educational interventions.

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There is preliminary evidence of the failure to keep up to date from many years ago. In response to the findings that performance in knowledge examinations declined with time since training, Day and colleagues classified the items on what was then called a recertification examination according to whether the knowledge underlying them was stable, changing or new.[11] Differences among doctors grouped according to when they finished postgraduate training were smaller for stable knowledge and larger for changing and new knowledge.

Of course, even though failure to keep up to date is the most likely explanation for the decline in performance, this does not rule out other factors that undoubtedly have an influence on some doctors. It is conceivable that cognitive decline plays a role for a few or that some assessments do not completely capture appropriate departures from standards. Further, the effects of time since training are not necessarily uniform. In the study of CABG and valve procedures described above, having an attending physician further from medical school graduation produced better patient outcomes, when the attending physician was not the same person as the operator (i.e. when there was a transfer of care). Likewise, an increase in heterogeneity with time since training might play a role.[12]

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As a next step, it would be very useful to further study the relationship between recent experience and time since training. It is conceivable that a significant amount of recent experience can make up for the declines noted with time since formal training.[12] Pending such study, however, it seems unlikely that the workplace alone, as it is currently configured, can overcome the fall-off in patient outcomes associated with time since the completion of formal training.

We cannot wait another 50 years to develop a more complete and detailed understanding of what creates and supports learning in the workplace and how to optimise it in that setting. Certainly, this will benefit the development of learning theory and our understanding of the cognitive processes that underlie it. Much more importantly, an increased understanding holds the possibility of making substantial changes in how we educate practising professionals in the workplace, which will lead to measureable improvement in the quality of care. As the well-being of patients is at stake, this should be among our top priorities for research.

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Mens sana in corpore sano: student well-being and the development of resilience

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As time goes by, increasingly one finds oneself reminiscing with like-minded doctors of a similar age. Somewhat fondly, we remember 100-hour weeks, one in two on-call rotas and shifts in the Emergency Department with nothing more to hand than the *Guide to Practical Procedures*, including helpful line-drawn diagrams should you have to drain a pericardial effusion with a lumbar puncture needle connected to a single ECG lead. Which you did have to do. 'That', we tell ourselves 'was how to become resilient', as we potter off to fill in another on-line assessment for a trainee who has never seen a pericardial effusion drained, never mind done it in the middle of the night with nothing more than a pocket handbook to help. Developing resilience? Well, maybe. Patient safety? Almost certainly compromised.

One important change in medical education over the last 50 years, reflected in the pages of this journal, has been the recognition that fatigue, stress and other mental health problems are a major cause of concern in medical education, with significant effects on the professional performance of students and doctors alike and on the safety of their patients. Where once these pages were dominated by curriculum reform, pedagogical methodologies and assessment techniques, increasingly as a community we are concerned with effective clinical supervision, team-working and professionalism, all of which have an impact on future patient care.[1–4] In this issue, Dyrbye and Shanafelt[5] provide a timely review of the literature on burnout, showing that students and doctors suffering from burnout are more likely to have poor professional behaviour, ranging from cheating and plagiarism in exams to falsifying clinical examination findings, delivering substan-

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