

cisely and to use medical terms to show that they understand how the patient's words translate into accepted medical equivalents and how they are linking the case to their formal knowledge. But we should not be so puritanical as to assume that one kind of formal knowledge — be it reasoning scheme, illness script, or semantic qualifier — can claim supremacy. Several paths may lead to the same destination.

Third, expertise in medicine, as in any craft, derives from both formal and experiential knowledge. The process of pattern recognition, so characteristic of an expert's approach, is a product of extensive experience with patients overlaid on a formal knowledge structure. It takes both kinds of knowledge to achieve success, and both are used by experts. For this reason, clinical teachers should abandon the mythical ideal of the clinician as an objective, impassive observer and instead should encourage learners at all levels to use their experience to guide their search. Explicitly encouraging students to use both analytical rule knowledge and experiential knowledge has been shown to be an effective pedagogic strategy.⁶ Put simply, there is no substitute for experience, even the limited experience of novice clinicians.

I think we have tended to discount the experiential component of clinical expertise, dismissing it as mere pattern recognition and disparaging experts who are guided by experience instead of the latest evidence-based systematic review. Our current understanding of medical expertise

suggests that this bias is misguided; a critical element of becoming an expert is accruing the vast experience that enables experts to recognize patterns effortlessly most of the time — and to recognize, as well, when the signs and symptoms do not fit a pattern at all. If we do little more than legitimize experiential knowledge and encourage teachers to emphasize and explain its importance to their students, instead of insisting that students gather endless lists of signs and symptoms in a mindless “complete history and physical,” this seemingly small step forward will be an important accomplishment in medical education.

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1. Bowen JL. Educational strategies to promote clinical diagnostic reasoning. *N Engl J Med* 2006;355:2217-25.
2. Norman G. Research in clinical reasoning: past history and current trends. *Med Educ* 2005;39:418-27.
3. Elstein AS, Shulman LS, Sprafka SA. *Medical problem solving: an analysis of clinical reasoning*. Cambridge, MA: Harvard University Press, 1978.
4. Hassebrock F, Johnson PE, Bullemer P, et al. When less is more: representation and selective memory in expert problem-solving. *Am J Psychol* 1993;106:155-89.
5. Hatala RM, Norman GR, Brooks LR. Influence of a single example upon subsequent electrocardiogram interpretation. *Teach Learn Med* 1999;11:110-7.
6. Ark TK, Brooks LR, Eva KW. Giving learners the best of both worlds: do clinical teachers need to guard against teaching pattern recognition to novices? *Acad Med* 2006;81:405-9.

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Research Replication

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In January 2006, we published an article by Mangano and colleagues¹ that reported the results of an observational study of antifibrinolytic agents to control bleeding in cardiac surgery. The data suggested that patients treated with aprotinin, as compared with no antifibrinolytic agent, aminocaproic acid, or tranexamic acid, had higher risks of a number of adverse events, including cardiovascular events (myocardial infarction, heart failure, and stroke) and renal failure requiring dialysis. The study data were from a prospective registry funded by the Ischemia Research and Education Foundation. As detailed by Hiatt in a

Perspective article in this issue of the *Journal*, the Food and Drug Administration (FDA),² on the basis of the Mangano article and other data, called a meeting of the Cardiovascular and Renal Drugs Advisory Committee in September to discuss the matter. Dr. Mangano was asked to provide his study data so that the FDA could conduct an independent analysis. In a letter to the editor in this issue of the *Journal*,³ Dr. Mangano reports that he initially placed restrictions on the FDA's access to his data. However, he reports that more than five months ago he offered the FDA unrestricted access to the data, but the offer was not accept-

ed. As noted in a response from the FDA,⁴ the agency is now eager to move forward with replication of the Mangano analysis.

It is not clear why the matter of data reanalysis was not resolved before the advisory committee met in September. If the data reanalysis had been completed and had confirmed the risks associated with the use of aprotinin, the action of the committee, which concluded that no labeling change was necessary, might have been different. Regardless of the reasons for the delay, the Mangano data and data from a study commissioned by Bayer that were not provided to the advisory committee before its September meeting should

be reviewed and the committee reconvened as soon as possible. The goal should be to get a clear picture of potential adverse drug events of aprotinin from the available data. With this information, a course that puts patient safety at the forefront can be charted. The sooner this happens, the better.

1. Mangano DT, Tudor IC, Dietzel C. The risk associated with aprotinin in cardiac surgery. *N Engl J Med* 2006;354:353-65.
2. Hiatt WR. Observational studies of drug safety — aprotinin and the absence of transparency. *N Engl J Med* 2006;355:2171-3.
3. Mangano DT. Judging the safety of aprotinin. *N Engl J Med* 2006;355:2261-2.
4. Rieves RD, Weiss KD. Judging the safety of aprotinin. *N Engl J Med* 2006;355:2262.

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