Does instant access to compiled information undermine clinical cognition?

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The new forms of information that medical trainees cite in case-oriented clinical presentations should give us pause. Three to four decades ago, the only way to find relevant publications was to search many volumes of Index Medicus with awkward, stilted terms; house officers and students would cite original observations and clinical studies. Today, despite the immediate accessibility of original data from clinical trials or other original studies, they generally cite compiled electronic sources, practice guidelines, and compiled decision rules, and they rarely seek out and report original sources. As trainees rely more and more on instantly available information that has been extracted, summarised, and reorganised, they are increasingly learning the minimum they need to know when they need it—namely, the least amount of knowledge necessary for a particular task.[1] As a consequence, I am concerned that their foundation knowledge of clinical medicine will be superficial and that their clinical reasoning skills will suffer. I posit that the immediate availability of compiled and condensed information (especially in electronic form) is making young physicians unintentionally lazy, as others have noted in undergraduates.[2] These recently qualified doctors have little need to remember pathophysiological mechanisms, data origins (the source of the original data or information), study designs, or results and flaws when summaries are instantly available on hospital information systems or hand-held computers. Rapid information retrieval has great value, but we are beginning to see important unintended consequences of relying almost exclusively on such sources.

I began to wonder about an inverse correlation between electronic information access and the content of memory when my ability to recall everyday phone numbers and remember places I had recently driven had deteriorated. I do have occasional so-called senior moments, yet I am convinced that the explanation is simple—now that I regularly use a cell phone and a reliable Global Positioning system (GPS), I do not need to remember such details. There are many facts that we need not commit to memory when electronic devices can do it better, but we should not confuse mundane numbers and addresses, which we need not remember, with complex clinical information that should be committed to memory for optimum clinical problem solving. Studies[3–6] of the acquisition of expertise show that the interaction between knowledge and problem solving is crucial in this development. Current thinking in neuroscience holds that short-term, or working memory, can retain up to seven items and can manipulate only a few simultaneously.[7,8] These items are thought to be in the form of images or schemata,[9,10] created fleetingly in the brain as patterns of neural activity, and are used for reasoning and decision-making.[9] When first elaborated by a trainee, schemata are probably quite primitive, but with experience and deliberate, mindful effort, they are transformed into complex encapsulated concepts that are readily accessed by working memory, thus reducing the requirement for conscious thought when the information is needed.[4,7,8] By evolving more richly encapsulated schemata, including problem representations and sets of signs and symptoms, we develop expertise. Experts know more, remember more, perceive more, and become more effective problem-solvers than do learners.[6,11,12]

In medicine, reasoning requires an enormous knowledge of facts about health and disease, physiological linkages, and the benefits and risks of tests and treatments.[11,12] As learners gain expertise, much of this information becomes integrated into shorthand concepts, allowing them to make quick, intuitive responses rather than complete long analyses. Crucially, we need a substantial body of facts, connections, biochemical and physiological information, and strategies to engage in reasoning and decision making; yet, as one information scientist wrote,[1] we might be "mistaking acquisition of information for mastery of the knowledge from which it is derived". If throughout training the rapid and easy accessibility of compiled and condensed information eliminates substantial clinical information from memory, and if emphasis is placed on practice guidelines and compiled testing strategies, will complex integrated and encapsulated schemata that enhance thinking, develop? Will we produce a generation of physicians who are dependent on so-called quick and dirty summaries, practice guidelines, and precompiled recipes? Maybe the GPS and cell phone analogies exaggerate the concern, yet I am not the only clinical teacher to raise questions about the knowledge base and problem-solving abilities of many trainees; colleagues at Tufts University School of Medicine, Harvard Medical School, and Stanford University have voiced similar concerns.

As teachers, we are not blameless if the next generation is short-changed. We have often been concerned more about hurting feelings than about correcting errors. We have failed to be critical of trainees when they quote superficial information from uncritical electronic searches. We have settled for explanations of clinical decisions derived from practice guidelines without assessing whether trainees appreciate the quality of the evidence or understand the basis for the recommendations. We have not sent trainees back to the drawing board when they have applied pathophysiological

principles inappropriately. We have not expected trainees to understand the components of risk when they parrot severity scores of the stages of cancers, systemic lupus erythematosus, or hyperthyroidism. Nor have we expected them to understand the fundamental components of the models they have used to calculate the likelihood of an exudative pleural effusion or pulmonary embolism.[13,14] They can do better, but so can we.

In view of the novelty of rapidly available information sources, it is no surprise that we have not yet found the right balance for their use. Their influence will be profound and eventually, presumably positive. Nonetheless, experts in the application of technology are warning of the internet's unintended consequences, including a serious change in the way we concentrate, contemplate, and process information. One writer[15] explained that electronic media "supply the stuff of thought, but they also shape the process of thought". Another raised concerns that we are at risk of jeopardising mindful knowledge acquisition, reflection, and critical thinking,[16] and a third commented, "Learning just enough and learning it just in time will increasingly trump understanding a subject deeply, not just in business, but throughout society generally".[1]

I am not opposed to the use of compiled information or condensed clinical strategies, and I am not a Luddite when it comes to information retrieval. A few months ago, a student was presenting a patient with an acute coronary syndrome who also had herpes zoster in a T4–5 distribution and unexplained, intractable hiccups. I immediately retrieved my phone, searched Google Scholar, and to the amazement of the assemblage I produced a few published articles about an association between herpes zoster and intractable hiccups. As I described that experience to peers, I discovered many such examples of valuable insights gained from similar searches. We still have much to learn about the benefits and risks of such internet searches and of compiled electronic information summaries.

To develop expertise in problem solving and decision making, it is not enough to learn how to find information, we also need to remember the information and know how to use it. We must avoid producing physicians who are dependent on superficial electronic summaries, opaque formulas, and compiled expert opinion. They must be able to think for themselves.

Conflicts of interest

I declare that I have no conflicts of interest.

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