Commentary

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The new alchemy: transmuting information into knowledge in an electronic age

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The extraordinary revolution in health care informatics that occurred in the final decade of the 20th century was fuelled by two things: first, the sheer volume of information, both scientific and nonscientific, that had been produced; second, the development of tools that allowed the more rapid, more effective and wider dissemination and exchange of that information.[1] The main link between these two phenomena is the Internet. For the first time in history, information can be exchanged simultaneously and interactively all around the world, with the potential to be available equally to health care professionals, decision-makers and consumers.

A remarkably similar double revolution occurred during the 16th century. Moveable type was the Internet of its day, the informatics tool that replaced laboriously transcribed manuscripts with rapidly reproducible printed books. New information was produced as the alchemist–physician began to reject the orthodox magic of Galen's medicine and to base treatments on empirical results. Paracelsus (1493–1541) largely rejected the humoral etiology of illness, which was the basis of medieval medicine. He considered most diseases to be external agents within patients, recognized many of the clinical manifestations of syphilis and linked the development of goitres with the mineral content of water.[2] He was responsible for the first systematic description of an occupational illness (miners' diseases)[2] and the first physician to notice the anesthetic qualities of ether.[3]

Before the invention of movable type, experiential or anecdotal information traveled by word of mouth, while the small amount of scientific information available was exchanged within a tiny literate elite. With the advent of printing, new teachings began to be imparted in the vernacular rather than in scholarly Latin, and thus became accessible to nonacademics. Formal knowledge was no longer the exclusive purview of clerics and scholars, but became available to a growing literate public.

These advances in the generation and dissemination of information 4 centuries ago marked the transition from the so-called Dark Ages to the Renaissance. They radically changed our ways of thinking, reasoning and learning, and signaled the beginning of a scientific approach to knowledge. The metamorphosis of magic into science, of oral into written communication and of manuscripts into books was neither easy nor rapid. Like all innovations,[4] these transitions were actively resisted by some, ignored by most and gradually accepted by a slowly growing group of disciples.

The present electronic revolution may prove to be even more dramatic and disruptive. Massive amounts of information, both scientific and experiential, can now be exchanged in all directions: from professional to professional, professional to consumer, consumer to professional, and consumer to consumer. And this revolution is progressing much more rapidly than did its predecessor — over a period of years rather than centuries. The exponential growth of formal research studies is generating new scientific information, while experiential information is shared and exchanged at an unprecedented rate. The result, not surprisingly, is a disturbing and even frightening overload of information that is easy to access but difficult to evaluate.

As must have been the case with our 16th-century predecessors, we are uncomfortable with the gaps between what we could know and what we do know, between what we think we should do and what we really do. Perhaps the problem is not that we are too slow to embrace evidence from formal research studies, or to jump on the electronic bandwagon, but that we are too fast. Are we forgetting the limitations of scientific evidence and the important roles that are played by our more primal sources of understanding? Over thousands of years of evolution, human beings have developed powerful but nonscientific ways of knowing. These "hard-wired" tools still have a profound effect on the decisions we make in our everyday lives as well as in the health care we advocate, practise or receive. They include anecdotal information, rules of thumb and tacit knowledge.[5,6]

Anecdote (by which we mean information that is not generated by formal research efforts)[5] provides a convenient, compelling and efficient vehicle for exchanging information and modifying behaviour. A large body of experimental research[7,8] has highlighted the importance of the social and emotional as opposed to bare informational aspects of a message. Events that happen to us personally interest us more than those that happen to others; those that happen to people we know or care about are more persuasive than those that occur to strangers or people about whom we have neutral feelings. Phenomena we witness with our own eyes make a greater impression than second-hand data. Face-to-face recommendations are more influential than hard data presented impersonally.[9,10] Recommendations by a respected colleague are a more powerful force for change in clinical practice than evidence-based guidelines published nationally.[11] Clearly, anecdotal and research evidence should play complementary rather

than competitive roles in health care decision-making.

Rules of thumb are a powerful knowledge management tool that allow us to define and interpret the data of physical and social life and to simplify complex tasks.[7] For the most part, they allow us to categorize data accurately and lead to sensible conclusions and reasonable decisions.[12] We should not discard rules of thumb in the vain pursuit of a perfectly ordered universe, but learn to incorporate them in a symbiotic relationship with formal evidence, anecdotal information and modern technology.

In addition to the facts that we can specify, replicate and articulate, there is a tacit dimension of knowledge. These are the observations we make subliminally and know to be valid, even though we cannot express them in words or diagrams. This is what we do when, for example, we instantly recognize a patient's or a colleague's face, even though we cannot describe it. In other words, we know more than we can articulate.[13] Tacit understanding is not scientific, but it is an indispensable part of all knowledge. It is the most elusive way of knowing, but perhaps it is the most important. Although information from formal research provides important probabilistic guides to clinical decision-making, what is on average most effective for a group may not be the best option for each member of that group. Researchers might regard decisions that are not purely "evidence based" as irrational or biased when in fact they represent appropriate adjustments based on unexpressed and inexpressible clues about individual patients. The tacit, unarticulated, nonscientific knowledge of the decision-maker may be decisive in finding the most appropriate answer.

Knowledge, however gained, and information, from whatever source and of whatever type, represent only one aspect of health care decision-making. Planners, politicians, administrators, physicians, nurses, patients and the public also base decisions on external circumstances (such as setting, financial and other resources available, political climate and community priorities) and on internal factors (individual priorities and values and potential personal gains and losses).[14] An overemphasis on any one of these components, including scientific evidence, will inevitably distort the decision-making process. Being aware of the noninformational components of each decision is an important first step toward achieving the necessary balance.

Although information alone is not sufficient for clinical decision-making, it is nevertheless critical. Physicians and patients can make informed decisions, given a particular set of circumstances, only when they have timely access to information that they can understand. Presently available technology provides an entrée both to scientific knowledge via peer-reviewed and critically evaluated literature, and to anecdotal information through discussion lists, opinion pieces and chat rooms. Emerging technology will allow even more rapid, selective and convenient two-way access to repositories of knowledge. It will also influence the way in which data about individual patients, communities or institutions are stored, retrieved and transferred.

These changes have just begun. Most scientific information is still presented in the linear fashion dictated by print technology, much as early motor cars were styled like horse-drawn carriages. Original data from a research study are distilled into a paper published in a scientific journal.[15] They may then be further abstracted, often with a commentary, in secondary journals,[16] or synthesized into systematic reviews.[17] The lay press increasingly reports research findings. Whether presented in print or translated into electronic media the format is similarly formalized and linear.

These restricted formats may well be sufficient for many readers. Some people need access to the original data, others are satisfied with the full published paper, and many find that an abstract meets all their needs. But modern information technology can provide us with wonderful new ways of packaging and presenting information, a veritable smorgasbord from which users can feast to their heart's content. A growing number of clinicians, consumers, governments, educators, journalists, researchers, lawyers and other members of society — the potential users of research information — expect and demand more. They do not want lengthy documents, impenetrable jargon, statistical manipulations, obscure methodologies, search strategies, critical appraisal, confusion, conflict and uncertainty, or abstract messages distant from their real concerns.[18] The modern decision-maker is more likely to prefer bottom lines: clear, short, unequivocal, personal, vivid, engaging, meaningful and relevant messages — the kind of messages provided by marketers and sensationalist reporters who know how to deliver an effective message to a carefully targeted audience.

We do not aim to emulate these purveyors of targeted information, but rather to learn from them. We would like to contribute to the valuable efforts that others are making by drawing on an ancient tradition, almost forgotten in our scientific age: the telling of tales. Stories can convey a message, a truth beyond factual truth. Vivid stories and anecdotes are among the most powerful tools that humans use to make decisions. Although there has been some recognition of their importance in health care and some limited use, they tend to be misused, undervalued and relegated to the bottom of the "evidence hierarchy." We believe that they should be used more often to deliver, complement, amplify and reify other types of information.

In this issue of *CMAJ*, we present the first of a series of stories that try to blend consideration of a clinical problem with modern methods of access to information to support health care decisions (page 1839).[19] Eventually, we would like to look at the information needs of all concerned with health care decisions, including policy makers, hospital administrators, media, educators, patients and the general public, as well as those of clinicians. We would also like to explore other formats, other media, and different evaluation strategies. But, for now, our goal is more limited: to produce a short, readable piece that we hope will provide a little information that may be useful to some, and act as a

window to more detailed information for those who need or wish to pursue it. We have enjoyed crafting this story, and hope that some who see it will also enjoy reading it, playing with it, and — who knows — perhaps learn a little from it too.

But this is meant to be an interactive feature. With simultaneous Internet publication we hope to offer our readers an enhanced opportunity for response and participation. We need help. We need your opinions as to what you think of this approach, whether it would be worthwhile to pursue it, or amplify it. Should we use a different format? Should we bring in professional storytellers, masters of the art, to assist us?

The new media and tools to which we are being exposed will undoubtedly change the way in which we communicate, learn and think.[20] We can no more foresee the shape or extent of their effects on health care than our 16th century ancestors could have predicted the blossoming of science that followed the Gutenberg revolution. What we can see now is that we are going through a period of rapid transition. We have hardly begun to scratch the surface of the possibilities open to us. Can we emulate our Renaissance ancestors and take advantage of new technology to radically revise our modes of communication? Can we harness the power of the anecdote to bring fact to fiction, to tell vivid stories that convey valid messages to the modern professional and public in the language of today? Can we, in the process, explain the process of finding the information, to those who want it, in the way that is best for them? Can we take the opportunity to learn from the past and, rather than try to predict the future, create it?

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References

1. Haynes RB, Jadad AR, Hunt DL. What's up in medical informatics? *CMAJ* 1997;157:1718-9. Available: www.cma.ca/cmaj/vol-157/issue-12/1718.htm
2. Feder G. Paradigm lost: a celebration of Paracelsus on his quincentenary. *Lancet* 1993;341:1396-7.
3. Keys TE. Historical vignettes: Paracelsus, 1493–1541. *Anesth Analg* 1972; 51:553.
4. McKinlay JB. From "promising report" to "standard procedure": seven stages in the career of a medical innovation. *Milbank Mem Fund Q Health Soc* 1981;59:374-411.
5. Enkin MW, Jadad AR. Using anecdotal information in evidence-based health care: heresy or necessity? *Ann Oncol* 1998;9:963-6.
6. Jadad AR, Haynes RB, Hunt D, Browman GP. The Internet and evidence-based decision-making: a needed partnership for efficient knowledge management in health care. *CMAJ* 2000;162(3):362-5. Available: www.cma.ca/cmaj/vol-162/issue-3/0362.htm
7. Nisbett RE, Ross L. *Human inference: strategies and shortcomings of social judgement.* Englewood Cliffs (NJ): Prentice-Hall; 1980.
8. Tversky A, Kahneman D. Judgment under uncertainty: heuristics and biases. *Science* 1974;185:1124-31.
9. Redelmeier DA, Rozin P, Kahneman D. Understanding patients' decisions: cognitive and emotional perspectives. *JAMA* 1993;270:72-6.
10. Borgida E, Nisbett RE. The differential impact of abstract vs. concrete information on decisions. *J Appl Soc Psychol* 1977;7:258-71.
11. Lomas J, Enkin M, Anderson GM, Hannah WJ, Vayda E, Singer J. Opinion leaders vs audit and feedback to implement practice guidelines. *JAMA* 1991;265:2202-7.
12. McDonald CJ. Medical heuristics: the silent adjudicators of clinical practice. *Ann Intern Med* 1996;124:56-62.
13. Polanyi M. *The tacit dimension*. New York: Doubleday; 1966.
14. Haynes RB, Sackett DL, Gray JAM, Cook DJ, Guyatt GH. Transferring evidence from research to practice: 1. The role of clinical care research evidence in clinical decisions. *ACP J Club* 1996;1:196-8.
15. Greenhalgh T. *How to read a paper: the basics of evidence based medicine*. London: BMJ Books; 1997
16. *Best evidence* [series of CD-ROMs]. For more information: hiru.mcmaster.ca/acpjc/acpod.htm]
17. The Cochrane Collaboration. Web site: hiru.mcmaster.ca/cochrane
18. Locke D. Voices of science. *Am Sch* 1998;67:103-14.
19. Enkin MW, Jadad AR. A matter of perspective. *CMAJ* 2000;162(13):1839-41.
20. Kurzweil R. *The age of spiritual machines — when computers exceed human intelligence*. New York: Viking Penguin; 1999.

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