

The paths from research to improved health outcomes

Evidence-based medicine aims to provide clinicians and patients with choices about the most effective care based on the best available research evidence. To patients, this is a natural expectation. To clinicians, it's a nearly impossible dream. The U.S. Institute of Medicine report "Crossing the Quality Chasm" has documented and drawn attention to the gap between what we know and what we do (1). The report identified 3 types of quality problems—overuse, underuse, and misuse. It suggested that "The burden of harm conveyed by the collective impact of all of our health care quality problems is staggering." While attention has focused on misuse (or error), a larger portion of the preventable burden is likely to be the evidence-practice gaps of underuse and overuse.

Research that should change practice is often ignored for years. For example, crystalloid (rather than colloid) for shock (2), supine position after lumbar puncture (3), bed rest for any medical condition (3), and appropriate use of anticoagulants and aspirin among patients with atrial fibrillation (4). Antman and colleagues (5) documented the substantial delays between cardiovascular trial results and textbook recommendations. However, even when best practices are well-known they are often poorly implemented: National surveys show that most cases of hypertension are undetected, untreated, or inadequately controlled (6). This has led to the current interest in knowledge translation (7).

PRACTICE FAMINE AMIDST THE EVIDENCE GLUT

What role does evidence-based medicine (8) have in bridging the research-practice gap? Surveys of clinicians suggest that a major barrier to using current research evidence is the time, effort, and skills needed to access the right information among the massive volumes of research (9). Even for a (mythical) up-to-date clinician, the problem of maintaining currency is immense. Each year, MEDLINE indexes over 560 000 new articles and Cochrane Central adds about 20 000 new randomized trials. This is about 1500 new articles and 55 new trials per day! Clinicians need clear and efficient strategies to sift, digest, and act on new research likely to benefit their patients. 2 stages can be considered: getting the evidence straight, and getting the straight evidence used (10, 11).

GETTING THE EVIDENCE STRAIGHT

While individual new research articles are peer-reviewed and published, there is little effort to set their results systematically in the context of other, similar studies (12). Ideally, clinicians could access an updated, well-conducted systematic review for all questions, or at least for all clinical research. However, only about 10% of randomized trials have currently been incorporated into Cochrane systematic reviews (13). For nontherapy questions, the situation is worse. Guidelines are not a panacea here, as they usually rely on existing reviews or, more often, ignore evidence (14) and are rarely presented in clinician-friendly formats. Hence, the Institute of Medicine report recommended that we "establish and maintain a comprehensive program aimed at making scientific evidence more useful and accessible to clinicians and patients" (1).

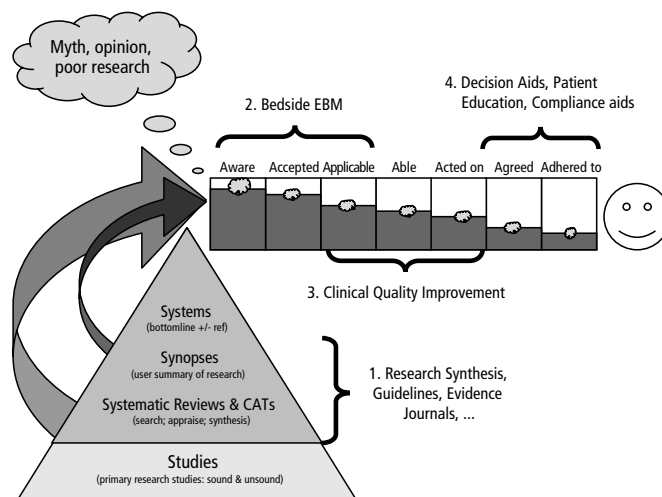
GETTING THE EVIDENCE USED

Clinicians frequently have questions about the medical care of their patients, but most go unanswered (15). Even if an "answer" is provided, it usually comes from an out-of-date textbook within the immediate clinical setting. The main predictors of the attempt to answer a question are the belief that an answer exists and the urgency of the patient's problem (16).

This lack of bedside use of evidence inspired the 4-step model of bedside evidence-based medicine (8, 17): Ask an answerable question; track down the best evidence; critically appraise the evidence for validity, impact, and applicability; and integrate the results with the patient's unique biology, circumstances, and values. In teaching evidence-based medicine, integration of the steps into the clinical setting and for real patient problems is crucial for changing attitudes and behavior (18). Following these steps in clinical practice is challenging, especially given the time constraints and skills needed to complete them.

THE EVIDENCE PIPELINE

What underlies substantial gaps between the best evidence and the management patients receive? Pathman and colleagues (19) described 4 stages from evidence to action: The clinician needs to be aware, then agree, then adopt, and then adhere. Their survey of physicians' use of vaccine guidelines showed a steady decline at each stage. For example, the rates with respect to vaccination for acellular pertussis were 90% aware, 67% agree, 46% adopt, and 35% adhere. This is consistent with findings from research on the diffusion of innovations (20), which generally suggests a 5-stage model of knowing, accepting, deciding, implementing, and continuing. A subsequent systematic review of barriers to the use of evidence (9) suggested that several further stages might be added. The Figure extends the awareness-to-adherence model to include these newer elements—in particular, patient involvement.



The model illustrates that even with high rates of transfer between stages, there may be little effect on patient outcomes. Thus, even 80% transfer at each of 7 stages would result in only a 21% patient use ($0.8^7 = 0.21$).

Using this model, we shall look, first, at the initial problem of getting the valid and relevant evidence into the clinical “pipelines” and how this can be improved and, second, at methods for reducing blockages at each stage.

1. AWARE

Given the information glut, it is not surprising that individual clinicians find it difficult to be aware of all relevant, valid evidence. Profitable new interventions are likely to have a substantial marketing campaign. However, for many important practice changes, such as low-cost pharmaceuticals or nonpharmaceuticals, awareness is more problematic. To ease the burden, several scanning and alert services have arisen that help clinicians become aware of important changes. For example, each issue of the *ACP Journal Club* and the *Evidence-Based* journals results from the scanning of more than 100 journals to identify new evidence that is valid and important. This process has been augmented to build a new service, *bmjupdates*⁺ (<http://bmjupdates.mcmaster.ca>), which allows practitioners to tap into just those articles that their peers rate as highly relevant and interesting for clinical practice.

2. ACCEPTED

While practitioners may have heard of the benefits of a new intervention or the harms of an old one, they may not be persuaded to change management based on this evidence. A central problem is that clinicians may be persuaded by many means other than unbiased evidence, such as marketing techniques, reciprocity (the obligation arising from “gifts”), authority, social validation (acceptance by peers), and friendship/personal relationships (21, 22). Pharmaceutical companies and others invest considerable resources in such methods. Hence, more work is needed to identify methods that can best “vaccinate” clinicians against poor evidence.

3. APPLICABLE

Even if evidence is accepted, clinicians and guidelines may not target the correct groups. For example, a review of 20 guidelines for atrial fibrillation (most of which were not evidence-based) showed that the proportion of patients recommended for warfarin varied between 13% and 100% (23). Whether there are net benefits of anticoagulation depends on balancing the risk for stroke against the risk for hemorrhage. A survey of physicians in Australia suggested good knowledge of factors that increased the hemorrhage risk, but only half correctly identified a patient with a previous stroke as being at high risk for stroke recurrence (24). Similarly, a Dutch study showed that risk factors that should predict a higher prescription rate of warfarin did not (25). Unfortunately, the relation between diagnosis and treatment is rarely 1 to 1. Clinicians must usually learn about and understand the multiple factors that go into making a good decision that balances benefits and harms (26).

4. AVAILABLE AND ABLE

To carry out an intervention requires both access and know-how. For medications, this is challenging enough—becoming familiar with dosing, contraindications, initiation, adverse effects, and monitoring. For more complex interventions, such as brief counseling or spinal manipulation, the learning curve is even steeper and hence is a greater barrier to changing practice. For many such complex interventions as smoking cessation, external cephalic version, or problem-solving therapy for depression, clinicians may require additional training before carrying these out as competently as in the trials that documented their benefits.

5. ACTED ON

Even when we know and accept what to do, we often forget or neglect to do it. Habits do not change easily, despite our best intentions. Omissions are particularly easy for preventive procedures, as they are often not the pressing focus of a consultation. Not surprisingly, rates of appropriate preventive procedures are frequently low. A simple reminder is often sufficient for such simple omissions of interventions that we believe in and can do. A review of 16 randomized trials of reminders for preventive procedures showed substantial increase in adherence for most but not all areas (27). Similar but less dramatic results have been shown for reminders in some areas of medication management (28).

6. AGREED TO

When we have remembered to suggest an applicable treatment, the above steps may begin all over again for the patient. For the patient to agree, they must be aware of the options, accept that the management recommended is appropriate, and be able to undertake it. This may involve a complex mixture of the patient’s values and beliefs, which thus need to be explored. To assist communication and understanding, patient decision aids have been developed. While such aids can reduce patients’ decisional conflict with their final choice, it is less clear whether aided decisions result in better patient outcomes (29).

7. ADHERED TO

Patients must also contend with competing claims and advice, adverse effects or fear thereof, and sometimes lack of ability to pay for tests and treatments. If resources to inform prescribers of current best evidence are inadequate, they are woefully more so for patients, despite such pioneering efforts as DipEx (www.dipex.org). Even when patients accept the benefits of therapy and wish to comply, they may not. We may all agree to exercise more, eat less, or stop smoking, but too few do. Even for medications, dosing frequency, pill size, and simple forgetfulness can all cause problems. Typical adherence rates for medications are < 50%. Improving adherence to short courses of treatment is relatively easy, but enhancing adherence with long-term regimens is more difficult. Helpful elements include information about the regimen, counseling about the importance of adherence and how to organize medication taking, reminders, rewards and recognition for the patient’s efforts in following the regimen, and enlisting social support from family and friends (30).

CONCLUSIONS

Even when most clinicians are aware of evidence, there may be little effect on quality of care without further attention to the other stages. However, we would see the initial awareness (and discrimination) of high-quality research as the first large hurdle. While bedside evidence-based medicine has focused on clinicians becoming aware of and accepting the best-quality research, it is clearly important but insufficient. Not all clinicians will have or use the skills of bedside evidence-based medicine (31), and even the well skilled will not implement intended changes fully. Hence, evidence-based medicine should not just be concerned with clinical content but also with the processes of changing care and systems of care.

*Paul Glasziou, MBBS, PhD
University of Oxford
Oxford, England, UK*

*Brian Haynes, MD, PhD
McMaster University
Hamilton, Ontario, Canada*

References

- Institute of Medicine Committee on Quality of Health Care in America. Crossing the Quality Chasm: A New Health System for the 21st Century. Washington, DC: National Academy Press; 2001.
- Cook DJ, Guyatt GH. Review: albumin administration is not associated with excess mortality in acutely ill patients. *ACP J Club*. 2002 Jan-Feb;136:2.
- Allen C, Glasziou P, Del Mar C. Bed rest: a potentially harmful treatment needing more careful evaluation. *Lancet*. 1999;354:1229-33.
- Brass LM, Krumholz HM, Scinto JD, Mathur D, Radford M. Warfarin use following ischemic stroke among Medicare patients with atrial fibrillation. *Arch Intern Med*. 1998;158:2093-100.
- Antman EM, Lau J, Kupelnick B, Mosteller F, Chalmers TC. A comparison of results of meta-analyses of randomized control trials and recommendations of clinical experts. Treatments for myocardial infarction. *JAMA*. 1992;268:240-8.
- Hajjar I, Kotchen TA. Trends in prevalence, awareness, treatment, and control of hypertension in the United States, 1988-2000. *JAMA*. 2003;290:199-206.
- Davis D, Evans M, Jadad A, et al. The case for knowledge translation: shortening the journey from evidence to effect. *BMJ*. 2003;327:33-5.
- Sackett DL, Straus SE, Richardson WS, Rosenberg W, Haynes RB. Evidence-Based Medicine: How to Practise and Teach EBM, 2d ed. Edinburgh: Churchill Livingstone; 2000.
- Cabana MD, Rand CS, Powe NR, et al. Why don't physicians follow clinical practice guidelines? A framework for improvement. *JAMA*. 1999;282:1458-65.
- Haynes RB, Sackett DL, Gray JA, Cook DL, Guyatt GH. Transferring evidence from research into practice: 2. Getting the evidence straight. *ACP J Club*. 1997 Jan-Feb;126:A14-6.
- Muir Gray JA, Haynes RB, Sackett DL, Cook DJ, Guyatt GH. Transferring evidence from research into practice: 3. Developing evidence-based clinical policy. *ACP J Club*. 1997 Mar-Apr;126:A14-6.
- Clarke M, Alderson P, Chalmers I. Discussion sections in reports of controlled trials published in general medical journals. *JAMA*. 2002;287:2799-801.
- Mallett S, Clarke M. How many Cochrane reviews are needed to cover existing evidence on the effects of health care interventions? *ACP J Club*. 2003 Jul-Aug;139:A11.
- Shaneyfelt TM, Mayo-Smith MF, Rothwangl J. Are guidelines following guidelines? The methodological quality of clinical practice guidelines in the peer-reviewed medical literature. *JAMA*. 1999;281:1900-5.
- Dawes M, Sampson U. Knowledge management in clinical practice: a systematic review of information seeking behavior in physicians. *Int J Med Inform*. 2003;71:9-15.
- Gorman PN, Helfand M. Information seeking in primary care: how physicians choose which clinical questions to pursue and which to leave unanswered. *Med Decis Making*. 1995;15:113-9.
- Sackett DL, Straus SE. Finding and applying evidence during clinical rounds: the "evidence cart". *JAMA*. 1998;280:1336-8.
- Coomarasamy A, Khan KS. What is the evidence that postgraduate teaching in evidence based medicine changes anything? A systematic review. *BMJ*. 2004;329:1017.
- Pathman DE, Konrad TR, Freed GL, Freeman VA, Koch GG. The awareness-to-adherence model of the steps to clinical guideline compliance. The case of pediatric vaccine recommendations. *Med Care*. 1996;34:873-89.
- Rogers EM. Diffusion of Innovations, 5th ed. New York: Free Press; 2003.
- Cialdini RB. Influence: The Psychology of Persuasion. New York: Quill; 1998.
- Roughead EE, Harvey KJ, Gilbert AL. Commercial detailing techniques used by pharmaceutical representatives to influence prescribing. *Aust N Z J Med*. 1998;28:306-10.
- Thomson R, McElroy H, Sudlow M. Guidelines on anticoagulant treatment in atrial fibrillation in Great Britain: variation in content and implications for treatment. *BMJ*. 1998;316:509-13.
- Peterson GM, Boom K, Jackson SL, Vial JH. Doctors' beliefs on the use of antithrombotic therapy in atrial fibrillation: identifying barriers to stroke prevention. *Intern Med J*. 2002;32:15-23.
- Rutten FH, Hak E, Stalman WA, Verheij TJ, Hoes AW. Is treatment of atrial fibrillation in primary care based on thromboembolic risk assessment? *Fam Pract*. 2003;20:16-21.
- Hunink M, Glasziou P, Siegel J, et al. Decision Making in Health and Medicine: Integrating Evidence and Values. Cambridge: Cambridge University Press; 2001.
- Shea S, DuMouchel W, Bahamonde L. A meta-analysis of 16 randomized controlled trials to evaluate computer-based clinical reminder systems for preventive care in the ambulatory setting. *J Am Med Inform Assoc*. 1996;3:399-409.
- Bennett JW, Glasziou PP. Computerised reminders and feedback in medication management: a systematic review of randomised controlled trials. *Med J Aust*. 2003;178:217-22.
- O'Connor AM, Stacey D, Entwistle V, et al. Decision aids for people facing health treatment or screening decisions. *Cochrane Database Syst Rev*. 2003;(2):CD001431.
- Haynes RB, McDonald H, Garg AX, Montague P. Interventions for helping patients to follow prescriptions for medications. *Cochrane Database Syst Rev*. 2002;(2):CD000011.
- Straus SE, Green ML, Bell DS, et al. Evaluating the teaching of evidence based medicine: conceptual framework. *BMJ*. 2004;329:1029-32.

Acknowledgments: The authors thank Iain Chalmers and Sharon Straus for helpful comments.