Becoming a Medical Information Master: Feeling Good About Not Knowing Everything
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The body of knowledge in medicine is growing at a phenomenal pace. Clinicians rely on many sources of medical information—journal articles and reviews, text- books, colleagues, continuing medical education con- ferences, videotapes and audiotapes, and pharmaceuti- cal representatives—although they probably have had little formal training in assessing the clinical usefulness of the information obtained from each source. Excel- lent reader guides on how to evaluate clinical trials and review articles have been published, but these tech- 
iques are time-consuming and are rarely employed by busy clinicians. In this paper, we present a "user-friendly" method of managing new information in a practical and time-efficient manner. This approach allows clini- cians to disregard most of the available medical infor- mation and focus on patient-oriented evidence that truly matters.

Key words: Information services; education; medical; models, educational. (J Fam Pract 1994; 38:505-513).

The professionally sponsored literature for medical practition- ers acts as though each practitioner in each American com- munity were supposed to be his own scholarly and scientific institute, screening, sifting, evaluating, winnowing, and transl- ating into practical terms the output of medical research that is reported on the periodical literature. This... is one aspect of the myth of the medical practitioner as a lone decision maker who makes up his own mind about things in his own office without being influenced by organized arrangements. The practitioner, of course, is quite unable to live up to this myth. We produce "scientific illiterates" who are filled like an overcrowded water with the products of science, but who are not scientific in their approach to clinical questions or new tech- nologies.

As a result of their broad focus and the continuing influx of new information, primary care clinicians find it frus-
trating and difficult to remain up to date with the current aspects of patient management. Even if they focus only on common problems, the increasing constraints of a busy practice quickly minimize any available time for this task. guilt accumulates in direct proportion to the growing stack of unopened journals.

This information management problem is particu-
larly acute when we are faced with new drugs, tech-
niques, and tests. Consider the following scenario: a 52-year-old man is in your office for his 6-month hyper-
tension check. In his hand, he carries a newspaper clipping outlining the new prostate-specific antigen (PSA) assay for the early detection of prostate cancer. He asks whether you could order the test for him, "just so that he knows." Although it is not your normal practice to use this as a screening test, the easiest answer might be to order it. The patient wants it and is willing to pay for it, so why not? The second option would be to refuse to order the test, a choice that carries the uncomfortable possibility of litigation. A third approach would be to stall.

Many sources of information are available that would answer your questions about the test. Short for time, you place a call to your urology colleague, who tells you that, based on her review of the medical literature, she recommends screening PSA for all her patients over
50. With this information, you feel much more comfortable implementing this policy into your own practice. However, on the way home you pop in the latest Audio Digest tape on cancer prevention, and the lecturer tells you that, although prostate cancer is relatively common in older men, it is frequently not found until autopsy, and very few men actually die of the disease. He therefore suggests that routine screening for prostate cancer, whether by digital prostate examination or by PSA determination, is unnecessary.

Now you have a problem. You have two conflicting sources of information, two different sets of evidence. On one hand, a urologist in your community is screening for prostate cancer. On the other hand, what is the use of identifying prostate cancer earlY if the PSA if few men die from it?

You are caught in a "specialist Ping-Pong," bouncing between different answers to the same question, not sure of "the truth." You want to know whether your patient would be better off with or without the PSA test.

In a sense, you progressed from too little information to too much in one quick step, a common dilemma among many primary care clinicians. Faced with limited time, how can we recognize "the truth" as it relates to this patient and, for that matter, all of our patients? This heightened information availability does not mean that we are more informed. Instead, we may develop a condition known as "information anxiety"—the frustration that occurs when there is a great deal of information, but we do not tell us what we need to know.

Information is not knowledge. Knowledge comes from the interpretation of information (Figure 1). While we are constantly bombarded with data and information, what we want is knowledge and wisdom, i.e., the ability to understand and apply the facts.

For example, a recent study tells us that 37 of 112 men with a PSA >4 ng/ml were subsequently found to have prostate cancer (data), leading to a positive predictive value of 3% (information). What we actually want to discern from these pieces of information is whether men are better off in some way as a result of the test (knowledge) and whether our patient will benefit if we order the test for him at this particular time (wisdom).

This progression from a lower to a higher level of information requires a good bit of thinking, sorting out the significant from the irrelevant, considering and weighing all the available evidence, and applying it to the matter at hand. This brain time is the hard part of the information game, and an aspect we often leave to others. It may be difficult to base patient management decisions on your own information processing (which may lead you to practice differently from your specialist colleagues), especially if you are uncertain of your ability to critically evaluate new information. More important, the weighing and sorting of the barrage of new information requires a lot of confidence.

Despite these difficulties, it is possible to take an active and confident approach in order to gain mastery of the information deluge, and, in so doing, to provide the best care for your patients. This paper addresses three issues of importance to clinicians desiring to improve their skills at keeping up with new information: (1) the medical information jungle and why most of the literature is incidental medical chatter that can be harmful; (2) a method of evaluating the usefulness of new information; and (3) a simple but effective approach that will allow clinicians to become medical information masters.

The Information Jungle

The statistics are astonishing. The National Library of Medicine's database, MEDLINE, contains 6 million references from 4000 journals. About 400,000 new entries are added each year. The current MEDLINE lists 17,304 articles on "prostate neoplasms," 231 of which deal specifically with some aspect of PSA. To keep ahead of the torrent of information by reading everything of possible importance to medicine, one would need to read 6000 articles each day.8

In addition, family physicians receive many unsolicited medical magazines (the so-called throwaways). At

Figure 1. Progression from data to wisdom, using prostate-specific antigen (PSA) screening as an example (see text for explanation).
least eight newsletters are marketed to family physicians, and several computer programs are available that provide summaries of current articles. The New England Journal of Medicine has its own television show. Local newspaper reporters have read the Journal of the American Medical Association before you have, and your patients are bringing in articles hot off the press. There are literally thousands of local, regional, and national meetings at which information is communicated. To top it all off, as you are reading this article, there is probably a pharmaceutical representative sitting patiently in your waiting room.

As we watch this flood of information go by, it is difficult to identify which information, knowledge, and wisdom we really need and then to incorporate the appropriate elements into practice. Although some clinicians may feel comfortable with their ability to process new information, many do not.

A number of studies have shown that there is an unacceptable lag time between publication of credible science that should change medical practice and its actual adoption by practitioners. For example, Fineberg identified 28 papers that evaluated the effect of various "landmark" trials on medical practice. Only 2 of the 28 papers found that the landmark trials had an immediate (i.e., within 1 to 2 years) effect on medical practice.

On the surface, the solution seems easy: find a way to get the information out, and people will change their ways of doing things. However, even with appropriate information, clinicians are reluctant to change their management behavior. Looking at the treatment of hypertension, Evans and colleagues found that the strongest predictor of the clinician's knowledge of hypertension was the clinician's year of graduation. Many of the practitioners in this study showed no evidence of new learning despite their continuing medical information activities, journal subscriptions, or exposure to pharmaceutical representatives.

Two additional problems remain. The first is that the knowledge needed to make a decision often does not exist. We will not know, for example, for the next 20 years or so whether patients will really be better off because of PSA screening. Instead, we must settle for intermediate outcomes that we hope represent the actual desired outcome.

The second problem with information management is that once we are aware of knowledge, we are hesitant to put it into practice. Researchers of information diffusion in medicine have found that innovations in medical practice are widely adopted in a medical community only after they are first adopted by an "opinion leader," an influential member who is trusted by others in the community.

Information scientists have found that physicians obtain information from many sources and place greater credibility on some sources than on others. No matter where or from whom the information is obtained, though, for the most part, its roots can be traced to one source: medical journals.

Medical Chatter and Gossip

Journals are the major source of new medical information and function to serve the needs of both researchers and practitioners. However, the approach to this information by the members of these two groups is quite different. When researchers evaluate articles in their area of expertise, they are usually familiar with all of the research that has been published previously. Practitioners may not be as well versed in the knowledge of previous publications, and thus, in a sense, are picking up in the middle of a conversation. The situation is similar to sitting on a bench in the middle of a mall and listening to the bits and pieces of conversation as people walk by you. Reading a journal article is like hearing these conversations—you are getting only one piece of the entire conversation. In the case of medical journals, although you may be familiar with the topic, in most instances you have not heard the whole "conversation" that preceded the article at hand.

For example, a recent abstracting service summarized an article comparing the effectiveness of the administration of a beta-agonist by means of a nebulizer vs a metered-dose inhaler (with a spacer). The researchers found that administration by nebulizer was more effective. These results contrast with many other previously published studies that showed the two methods of administration to be equivalent. Readers of this abstract who are unaware of the previous "conversation" may be misled.

Much of what is written in journals can be considered "medical chatter" among groups of researchers with the clinician listening in. Just as bits and pieces of chatter overheard in a mall can be dangerous if taken out of context (Bill did what with whom?), medical chatter can be misapplied to clinical situations, and, in the process, become just as potentially dangerous and inappropriate as gossip.

Some readers may argue that it is useful to read the medical chatter to identify future trends in medical practice, but consider some of the gossip derived from the medical literature that was initially applied to clinical practice and later rejected: drug therapy for asymptomatic ventricular arrhythmias; mammatory artery ligation for coronary artery disease; the Sippy diet or ice water lavage for peptic ulcer; fluoride and saccharin as causes of cancer; the use of clonidine as an aid to smoking cessation;
and caffeine as a cause of pancreatic cancer. In all these instances, clinical practice was changed based on preliminary evidence that subsequently was not substantiated by clinical evaluation.

**Sources of Medical Information**

Some readers will point to these examples and exclaim, "That's why I don't read journals!" Medical journals are the primary means used to communicate new information, but unfortunately, not necessarily knowledge. In all these examples, the facts known to date were laid out on the table for all to see, but it was left up to each reader to interpret.

Although the facts are important, knowledge is what we would rather have, i.e., what do these facts mean? The extraction of knowledge from information is an awesome task for which few clinicians are adequately prepared. Most clinicians, as a result, turn to other sources to find knowledge.21-27 Textbooks, colleagues, newsletters, review articles, unsolicited journals, pharmaceutical representatives, and specialists are extensively used by clinicians as a means of keeping up and obtaining answers to clinical questions.

The benefit of these sources is apparent: they are quick and easy to use, and the knowledge gained is often relevant. However, each source has limitations. For example, textbooks can be out of date. Colleagues may be no better informed than you, yet feel pressured to give you an answer; or they may be unknowingly biased by their own self-interest.28 Abstracting services may give a rapid synopsis of an article but may fail to put the new information in context with the old. The biases of pharmaceutical representatives have already been noted.29

Some authors have suggested that clinicians must critically evaluate new information for themselves.30 Excellent reader guides on the evaluation of clinical trials have been published.31-40 These techniques, however, are time-consuming, oriented primarily to the critique of original research, and rarely employed by the busy clinician.16,43 How do we find some middle ground, some compromise between relying on other sources to do it for us and converting information into knowledge ourselves? A "user-friendly" approach to managing new information in a practical and time-efficient manner is necessary for this purpose.

**Determining the Usefulness of Medical Information**

When we pick up a journal, attend a conference, or call a colleague, our goal is to spend the least amount of time and energy finding the best information. The ultimate in useful information must have three attributes: it must be relevant to everyday practice, it must be correct, and it must require little work to obtain.42 These three factors can be conceptually related in the following manner:

\[
\text{Usefulness of medical information} = \frac{\text{relevance} \times \text{validity}}{\text{work}}
\]

The relevance aspect of this equation stars with the concept of "applicability to practice" but then goes much further. In the blizzard of information swirling around us, it is easy to lose sight of our primary destination—how to help our patients live long, functional, satisfying, pain- and symptom-free lives. We have an incredible amount of information at our disposal: etiology, prevalence, pathophysiology, pharmacology. The problem is that little of the available information tells us how to accomplish our primary goal.

What we are looking for is patient-oriented evidence. This type of evidence evaluates the effectiveness of interventions that patients care about and that we, as clinicians, care about for our patients. It is not enough simply to find patient-oriented evidence, for what we are truly seeking is patient-oriented evidence that matters (POEM). Examples of POEM come from studies that evaluate outcomes that matter to our patients. For example, an article about the PSA assay may report the sensitivity, specificity, and predictive value for identifying men with prostate cancer. The results may tell us how good the test is at correctly identifying men with an early stage of the disease, but this is just an intermediate outcome. It does not tell us what we want to know: whether the patient will be better off as a result of identifying the cancer earlier. A randomized trial evaluating the overall effect of this early detection on the mortality of prostate cancer would provide this information. A randomized trial demonstrating that men who underwent a screening PSA test enjoyed an improved quality and length of life would be an even better measure. A study of this sort would be a POEM.

POEMs are rare and scattered among the huge number of articles that can be labeled as disease-oriented evidence (DOE). Examples of DOE consist of information aimed at increasing our understanding of disease, that is, the etiology, prevalence, pathophysiology, pharmacology, prognosis, and so on. These studies are abolutely crucial to medicine, for without them, we would not have POEMs. We must understand how a disease "works" before we can diagnose, treat, or prevent it with any certainty.

Until recently, though, DOE were the only infor-
Figure 2. Examples of hypothetical disease-oriented evidence (DOE) and patient-oriented evidence that matters (POEM) studies. (Note that not all these POEM trials have been performed.) CV denotes cardiovascular; PSA, prostate-specific antigen; PVC, premature ventricular contraction; FBS, fasting blood sugar; NSAID, nonsteroidal anti-inflammatory drug.

- **DOE**
  - **High**: Number of assumptions required to assume patients will benefit
  - **Low**: Decrease overall mortality

<table>
<thead>
<tr>
<th>Drug A lowers cholesterol</th>
<th>Drug A decreases CV mortality/morbidity</th>
<th>PSA screening decreases mortality</th>
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<tr>
<td>Antiarrhythmic A decreases PVCa</td>
<td>Antiarrhythmic A decreases symptoms</td>
<td>PSA screening improves quality of life</td>
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<td>Carvedilol use decreases neurophil chemotaxis in patients with asthma</td>
<td>Carvedilol use decreases adrenergic, length of hospital stay, and symptoms of acute asthma</td>
<td>Carvedilol use decreases asthma-related mortality</td>
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<tr>
<td>Antibiotic A is effective against common pathogens of otitis media</td>
<td>Antibiotic A disturbs middle ear effusions in patients with otitis media</td>
<td>Antibiotic A decreases symptoms and complications of otitis media</td>
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<td>Insulin therapy in type II diabetes mellitus improves glucose control</td>
<td>Insulin therapy prevents weight gain and decreases cardiovascular risk</td>
<td>Insulin therapy decreases overall mortality</td>
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<tr>
<td>Tight control of type I diabetes mellitus can keep FBS &lt;140 mg/dL</td>
<td>Tight control of type I diabetes can decrease microvascular complications</td>
<td>Tight control of type I diabetes can decrease mortality and improve quality of life</td>
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<td>NSAID A decreases pain of osteoarthritis</td>
<td>NSAID A decreases pain of osteoarthritis better or more frequently than less-toxic agents</td>
<td>NSAID A improves functional ability in patients with osteoarthritis</td>
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- **POEM**

We had about many of our patients' illnesses. We knew that, for example, two antiarrhythmics were shown to suppress ventricular arrhythmia and thus were believed to be beneficial for patients at risk for sudden death. However, the Cardiac Arrhythmia Suppression Trial (CAST) subsequently demonstrated that patients receiving these medications were more likely to die than were similar patients not taking them. Many patients received these agents because the available evidence focused on the disease (ventricular arrhythmia) rather than the patient, and we prematurely assumed an overall benefit to the patient.

One way to distinguish a POEM from a DOE is to determine whether the information requires assuming or knowing (Figure 2). If we identify a cancer earlier or suppress a patient's arrhythmia, it makes sense (ie, we assume) that the patient will live a longer, more productive life. On the other hand, until the anticipated outcome is verified by clinical trials, we do not know that it will actually occur. Counterintuitively as it might seem, the error is in assuming that treating the disease is the best interest of the patient.

Once a POEM has been identified, frequency of contact with the problem in clinical practice must be considered. When clinicians read to "keep up," POEMs that clinicians can use to evaluate the diagnosis, treatment, or prognosis of an illness seen frequently in clinical practice are top priority. These common POEMs will
have the greatest impact on our patients and therefore the greatest relevance. Common POEMS should be sought and carefully scrutinized. The least relevant information is a DOE involving a rare or unusual disorder. Figure 3 illustrates the ranking from a common POEM (eg, PSA screening decreases the mortality and morbidity of prostate cancer) to an uncommon DOE (eg, the role of 21-hydroxylase deficiency in the development of congenital adrenal hyperplasia).

The validity of information defines to what extent the knowledge gained as a result represents the "truth." Well-designed clinical trials that minimize bias are more likely to provide valid conclusions. This is the foundation of the scientific method. The assessment of validity is time-consuming and may be difficult for clinicians without formal training in epidemiology. As previously mentioned, excellent guides for critical review of the medical literature, including useful checklists, are available. Validity assessment can be done individually or in conjunction with others, or, with great care and caution, delegated to those with the appropriate training and available time. It is not enough to ask a colleague simply whether it is a "good article." A specialist may be no better at evaluating new information than you are. Rather, a source well vetted in critical appraisal must be consulted. This source might be a colleague with expertise in epidemiology, local journal clubs that can spread the burden of finding and evaluating new information, or published rigorous evaluations, such as the ACP Journal Club (a supplement to Annals of Internal Medicine). This month, The Journal of Family Practice begins providing a similar service for primary care.

The clinician's responsibility to manage new information is identified as a competency that the "physician of the future" must embrace. As a result, when considering the implementation of common POEMS in everyday clinical practice, the clinician must be responsible for ascertaining that the validity issue has been appropriately addressed.

The negative attribute that we must consider when evaluating the usefulness of information is the work, or how much effort it takes to obtain the information. "Work" connotes factors such as how long it takes to obtain the information, how much it costs monetarily, and the mental energy required to track down the answer.

The goal of using any information source is to find one with the highest usefulness score. Working too hard to establish validity will raise the work factor. On the other hand, a low work-factor source may also have low validity. The best source of information would provide highly relevant and valid information with minimal effort required to obtain it. Because sources such as this are rarely available, it is necessary to find a balance among the three factors.
Feeling Good About Not Knowing Everything

Studies evaluating the effect of research have shown that well-done clinical trials that should influence medical care fail to do so because the results are bogged down in the mire of clinically unimportant information. Clinicians are often so overwhelmed by the volume of DOE information that they fail to discover and act on the truly quality POEM information that is available. Because primary care clinicians are the protectors of their patients' best interests, they have a duty to act when POEMs are available.

The ventricular arrhythmia mortality data from the CAST trial showed that therapy based on DOE information was harmful. When quality POEM information is discovered, we must remain open to the possibility of abandoning a seemingly appropriate intervention based on DOE information. Likewise, we should avoid chang- ing our practice standards based on the discovery of new DOE information. We are not suggesting that innova-
tion should be withheld from clinical practice until they have been exhaustively studied. We do, however, believe that appropriate patient-oriented studies should be performed to validate hunches supported only by DOE, since otherwise, more harm than good may result. Understanding the interrelationship between rele-
vance, validity, and the work factor can help information makers improve their management of medical informa-
tion. Distinguishing between POEMs and DOE will minimize the potential for misapplying harmful medical "group" (Figure 3). In addition, focusing attention on identifying POEMs will dramatically reduce the time necessary to retain up to date. Allowing oneself the luxury to ignore or defect DOE information can do wonders for improving self-esteem and increasing free time without incurring a guilty conscience.

A warning: this approach to medical information management creates a two-edged sword. One edge al-
lows clinicians to disregard most of the published med-
ical literature (DOEs). The other edge, however, carries the responsibility to search out, evaluate, and, most im-
portant, implement new information that affects patients (POEMs).

So, back to our patient who wants the PSA test. Armed with the usefulness equation, we now recognize that the basis of the disagreement between our two sources is a different interpretation of DOE information. Our urology colleague recognizes that the PSA test will detect more disease at an earlier stage. Although we do not know for sure, we assume that people identified earlier in their disease live longer, and, therefore, we should screen all men in the risk group. However, our Audio Digest discussion acknowledges that very few men die of prostate cancer anyway, and that the majority of new cases we discover may face unnecessary and poten-
tially harmful therapy.

How are we to decide? We can only conclude that the information is currently incomplete and there is no right choice. We can either share this information with our patients and involve their input into the decision (a useful guide for patients has recently been pub-
lished49), or choose a direction, and remain open to the necessity of changing directions when better POEM in-
formation becomes available.

The Information Master

In the above scenario, the medical information system was used both to answer a question concerning a specific patient and to keep up with developments in patients that will affect clinicians' standards of practice and use of re-
sources. Making decisions, such as whether to recom-
mand routine screening for prostate cancer with the PSA test, will have a significant impact on the cost of medical care. "In a field filled with uncertainty and doubt, the difference between when in doubt, do it and when in doubt, stop could easily swing $100 billion a year.44 Primary care clinicians stationed on the front lines of health care management must recognize the power ob-
tained from the appropriate management of information.

Clinicians gather information for four basic reasons:

1. To keep up with new developments in clinical medi-
cine;
2. To answer a question related to a specific patient;
3. To review and reinforce previously learned information;
and (4) for fun or to keep up with a specific area of interest. Depending on why the medical information system is used, different sources will have different use-
fulness scores and, accordingly, will be more appropriate in some situations than in others. In forthcoming articles, we will outline how to further employ the usefulness equation to identify appropriate sources based on infor-
mation needs. Providing these additional tools will allow clinicians to become true medical information masters.

Knowledge is power.
—Sir Francis Bacon, in Meditations Sacrae, 1597

In a time of turbulence and change, it is more true than ever that knowledge is power.
—John Fitzgerald Kennedy
Address at the University of California, Berkeley, March 23, 1962

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