SPECIAL ARTICLE

Lifelong Self-directed Learning Using a Computer Database of Clinical Questions

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Physicians often have self-perceived knowledge gaps when they are seeing patients. Traditional continuing medical education is designed to meet the knowledge gaps of groups rather than individual physicians with specific patient problems. Physicians with clinical information needs are advised to critically evaluate high-quality original research in order to practice "evidence-based medicine." But this advice may be unrealistic for busy clinicians.

We propose a system for documenting self-perceived information needs using a computer database. Concise answers to these needs are included in the database along with reference citations supporting the answers. The system tracks continuing education efforts, directs patient care decisions, and focuses lifelong learning on relevant topics. We emphasize the importance of being sensitive to personal information needs and the benefits of maintaining a record of these needs.

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Physicians make most patient-care decisions on the basis of their personal knowledge. When a need for additional information is perceived, physicians must decide whether to make do with their current knowledge or to consult other sources. This decision depends on many factors, such as how busy the physician is[1] and the urgency of the patient's problem.[2] Sources of additional information may include textbooks, journal articles, colleagues, and computers.[3,4]

Physicians are often frustrated by their inability to answer clinical questions,[3] which tend to be highly specific and may require on-the-spot answers while the patient waits in the examination room.[1,3,5] Textbooks often do not contain answers to such practice-based questions, possibly because authors have incomplete knowledge about the needs of their readers.[6] When faced with clinical questions about specific patients, physicians are advised to critically evaluate original research before making management decisions.[7-11] However, a literature search for every question that arises would be unrealistic,[5,12] and, when observed in practice, physicians do not use this "evidence-based" approach.[1,3,13] Instead, busy clinicians seek quick answers from readily available, highly digested sources.[5,12,14-16]

Physicians are encouraged and often required to take continuing medical education (CME) courses throughout their careers. Most CME programs are designed to meet the broad needs of groups rather than the specific needs of individuals.[17] Adult learners, however, tend to seek highly specific information directed at their individual needs.[18-20] Adults are motivated to learn when they can focus on solving a problem that is immediate and relevant.[18-22]

The purpose of this article is to describe a system for documenting and supporting self-directed learning as it relates to individual information needs in practice. The system employs a computer

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database to build a continuously growing permanent record of clinical questions and answers. One of us, a family physician with both private practice and academic experience, has recorded over 1000 questions during a 4-year period. The system has several key elements: the database includes answers that meet individual information needs; the answers are continuously updated; and the system is used to (1) encourage and document lifelong learning, (2) direct patient care decisions, and (3) educate medical students and residents. Although our description stems from a primary care perspective, the key elements are relevant to any specialty, both to those in private practice and to those in academic medicine. Physicians may increasingly adopt systems such as the one we describe because doing so can provide important educational and patient care benefits, and because computer technology can make the process practical.

BUILDING AND USING A CLINICAL QUESTION DATABASE

The system we propose consists of two elements: (1) a computer database that contains the questions and answers, and (2) a hard-copy article file that contains printed information used to answer the questions.

Questions

We define a question as a need for information expressed as a single interrogatory sentence or a group of closely related sentences. Most questions are easily identified and verbalized: "Is it safe to use the nicotine patch during pregnancy?" Occasionally, identifying the exact question may require some effort. Physicians will be more likely to find helpful answers if they progress from a vague sense of uncertainty to a focused question expressed in an answerable form.[23,24] For example:

1. "I'm not completely comfortable with this patient's problem."
2. "I'm not sure what's causing this patient's vertigo."
3. "I wonder if I could be missing an acoustic neuroma."
4. "Can a patient with an acoustic neuroma present with vertigo in the absence of hearing loss or tinnitus?"
5. "In this 50-year-old woman whose only symptom is vertigo, do I need to rule out an acoustic neuroma? And if so, how?"

A question asked by a patient is included in the database only if the physician does not know the answer and considers finding an answer important. For example, "I'm going on a Caribbean cruise, and I heard about a shot for motion sickness that lasts 2 weeks. Is there such a shot?" Similarly, the question could originate during an interaction with a medical student or resident, but it would be included in the database only if it were considered important to the teaching physician who did not already know the answer. A question can be general and likely to recur with future patients ("What is a basic evaluation for dementia in an elderly patient?") or highly specific to one patient and unlikely to recur ("Could her oral contraceptive have caused her aseptic necrosis of the tibia?").

The physician may hesitate to record questions that seem embarrassingly simple or basic. The database, however, should be confidential, and the physician may feel particularly motivated to seek information considered fundamental to any physician's knowledge base. Conversely, the physician may hesitate to enter a question that is thought to have no answer. "How can I reliably distinguish between a viral upper respiratory infection and bacterial sinusitis?" is a question that currently has no satisfactory answer for the primary care physician. Such questions, however, should be entered into the database so that currently incomplete answers[25] can be supplemented with future research. Occasionally, such questions have indeed been answered, at least at the level of published opinion or consensus. If not answered, these questions may serve as fertile ground for original research. Finally, drug dosage questions are best left out of the database, because they are easily answered with other more readily available sources.[26,27]

Answers

An answer is defined as information that partially or completely meets the needs expressed in the question. An answer does not have to be exhaustive to be useful. Many questions require only brief answers from readily available sources in a personal library.[14] If these sources prove

inadequate, the physician may pursue an answer by searching the literature or by asking a colleague. A literature search may provide a more current and authoritative answer.[7,28] However, a colleague can often provide a faster, more practical answer that may require complex judgments tailored to an individual patient. In practice, physicians are more likely to turn to colleagues than to the literature.[1,3]

Procedure for Using the Database

Typically, questions arise during interactions with patients. We present a step-by-step procedure for using the proposed system:

1. Write a brief note on any scrap of paper when the question occurs. For example, a healthy woman with an unexpected low platelet count might prompt this note: "? causes low plat. Mary Smith."
2. Depending on the urgency of the question, search the database while the patient waits, or within a few days, to determine whether the question has already been asked and answered. To find a previously entered question, search the database for words in the question, the answer, the patient name, or other fields. If not previously entered, record the question and its ancillary information (Table 1). Enter the patient's name to allow for recall of the patient who might benefit from subsequent revisions to the answer, such as a new treatment for a chronic disease. Require a password to maintain patient confidentiality.
3. If the answer is needed urgently or if time permits, answer the question using whatever sources are needed and enter the answer into the database. The answer may consist of a single word (eg, "Yes"), or a list (eg, the differential diagnosis of thrombocytopenia), or several paragraphs of text. Enter the references used to answer the question in a separate field.
4. If the question cannot be answered immediately, then record only the question, the date, and the patient's name. When time allows, pursue answers to these questions as a form of individual continuing medical education. If the same question recurs with subsequent patients, the priority for finding an answer may increase.
5. Except for textbooks, include in the article file all printed materials used to answer the questions. Such materials may include journal articles, package inserts, continuing medical education materials, patient education materials,

TABLE 1

Fields in the Database of Clinical Questions

Field	Field Type*	Example
Question number	Alphanumeric	000147
Primary subject area	Alphanumeric	Adult hematology
Secondary subject area	Alphanumeric	Laboratory medicine
Tertiary subject area	Alphanumeric	
Question date	Date	10/11/96
Question	Alphanumeric	What would cause an unexpectedly low platelet count in an otherwise healthy adult?
Answer date	Date	10/12/96
Last update	Date	10/12/96
Answer	Memo	1. drugs 2. viral infections 3. paroxysmal nocturnal hemoglobinuria 4. lab artifact (eg, platelet clumping) 5. other[1]
References	Memo	1. Wallach J. *Interpretation of Diagnostic Tests*. 5th ed. Boston: Little, Brown and Company, 1992.
Patient name	Alphanumeric	Mary Smith
Physician name	Alphanumeric	Jane Doe, MD

* Alphanumeric fields are limited to 255 characters. Date fields can be written in a variety of formats but can only contain dates. Memo fields can contain an unlimited amount of text.

and personal communications that can be documented in writing.[29] Occasionally, a patient's management plan can be photocopied from the medical record and included as the answer to a question about a similar patient. The prototype article file was organized according to specialty area,[29,30] but many other systems for organizing article files have been described.[31-34]

ANALYSIS OF A PROTOTYPE DATABASE

One of the authors collected 1062 questions over a 4.3-year period. The motivation for starting this database arose from the frustration of forgetting difficult-to-find answers, from a personal need to document professional growth, and from a sense of empowerment that developed from selecting and organizing relevant information taken from an overwhelming amount of available knowledge. We present selected analyses of this database to illustrate the potential for obtaining more generalizable information from a larger sample of physicians. Such information could help determine the content of clinically oriented textbooks.

In the prototype database, 106 (10%) of the 1062 questions occurred more than once (Table 2). One question occurred 6 times, 1 occurred 5 times, 9 occurred 4 times, 13 occurred 3 times, and 82 occurred 2 times. Of the 1062 questions, 540 (51%) occurred during supervision of residents or medical students, and 756 (71%) were related to information needs about individual patients. Most questions (792 or 75%) were at least partially answered, and 176 (22%) of the answered questions included at least one informal consultation with a colleague as part of the answer. Most of the remaining questions were answered by textbooks and journal articles.

The time required to enter and answer questions was not recorded. To estimate the time required to enter questions and all associated variables except the answers, one of us re-entered a random sample of 10 questions taken from the 1062 questions in the database. The mean time required to enter one question was 69 seconds (range 42 to 95 seconds). The mean time spent searching for and entering answers is unknown

TABLE 2

Questions That Occurred Four or More Times in the Prototype Database

Question	No. of Occurrences*
What is the differential diagnosis of night sweats and hyperhidrosis (excessive sweating)?	6
How do you use the 24-hour urine creatinine excretion to tell if you have had an adequate collection of urine?	5
What should you do about colonic hyperplastic polyps?	4
What are the causes of sinus tachycardia?	4
What should we be doing about Group B strep prevention, screening, and treatment in pregnancy?	4
What should you do with a patient who has an asymptomatic carotid bruit?	4
What would cause a metallic taste?	4
What antihypertensives are least likely to cause erectile dysfunction?	4
Is aspirin just as good as warfarin for preventing strokes in patients with chronic atrial fibrillation?	4
In general, what things should you think about when a patient is planning to travel to an underdeveloped country?	4
What is the recommended treatment for a fungal nail infection and how should you make sure that's what it is?	4

*106 of 1062 questions occurred more than once.

but is estimated to have ranged from a few minutes to several hours.

DISCUSSION

During the office visit, most physicians have self-perceived information needs as they see their patients.[1,3] Searching for relevant answers can be difficult and time-consuming.[12,35] If the same question occurs in the future, the physician may not remember the answer and will then need to repeat the original search. By recording clinical questions and answers, this duplication of effort can be avoided. To be useful, however, the answers must be current. Answers to some questions in the prototype did not require updating ("Which nerve root supplies the index finger?"), but other answers were updated many times over the 4-year period ("What should we be doing about Group B strep prevention, screening, and treatment in pregnancy?").

After a patient visit, the physician may be motivated to answer clinical questions related to that patient before the next appointment. The answers can be entered into the database and then printed and consulted at the subsequent visit. Electronic medical record systems offer the potential for more efficient links with the question database.[4,36] Simply writing a note and attaching it to the patient's chart could serve the same purpose; however, such notes would be difficult to organize and find quickly if a patient with a smiliar problem were to present in the future.

Self-directed learning efforts are recognized as a form of continuing medical education.[37,38] For example, the American Academy of Family Physicians recognizes such efforts as a component of "elective credit," with 75 hours of such credit required every 3 years.[39] The American Medical Association requires 20 hours of self-directed learning activities per year to obtain the Physician's Recognition Award "With Commendation."[37] The proposed database documents these efforts, and a separate field could be added to record the time required to find answers. The effort required to type the questions and answers may improve retention of the newly acquired knowledge.[40,41] In Canada, physicians are encouraged to record their practice-based questions in a database similar to the one we describe. Using the Maintenance of Competence (MOCOMP) Program, physicians receive CME credit for documenting patient-related questions, their search for answers, and the effect of this search on their practices.[42-45] Although US physicians do not have such a program in place, the system we describe offers an individual approach to reaching some of the same objectives.

Ideally, clinical textbooks would contain answers to the questions that occur in practice. Current textbooks may not reach their potential usefulness because authors have little to guide their decisions about what information to include.[6,15] After many questions and answers have been entered into an individual database, the resulting document could be thought of as a personal textbook, which could prove more useful than traditional textbooks.

Will physicians take the time to use the system we describe? Considerable time must be spent

TABLE 3

Advantages and Disadvantages of Maintaining a Database of Clinical Questions

Advantages	
Patient care	Answers to recurring questions are readily available allowing clinical decisions to be based on previously researched answers rather than imperfect memories.
Continuing medical education	The system documents self-directed continuing education, identifies problematic areas needing further study, and tracks personal growth.
Knowledge retention	The effort required to type questions and answers may improve retention of newly acquired knowledge.
Sense of empowerment	The database supports focused learning efforts by organizing relevant material selected from an overwhelming amount of information in journals and textbooks.
Education of trainees	Interactions with medical students and residents often generate questions that can be entered, answered, and referred to when future interactions lead to the same or similar questions.
Disadvantages	
Expense	A computer and a database program are required.
Time	Time is required to record the questions and answers in the database and to access answers to recurring questions.
Limited scope	Initially, coverage of topics is limited when compared with textbooks or literature searches.

building the database before a net time saving can be realized from answering recurring questions. However, physicians already spend time answering questions[1,3,13]; the only additional time is that involved with documenting these efforts. Physicians currently make unfocused and often suboptimal attempts to "keep up" by reading journals and attending CME courses.[17] These efforts might be better directed at the points where patient care needs could be met by filling individual knowledge gaps. In Table 3, we summarize some of the advantages and disadvantages of creating and maintaining a database of clinical questions.

To practice effectively, we must have confidence in our knowledge base, and we must convey this confidence to our patients, our nurses, and our colleagues. When we confront our own knowledge gaps by documenting them in a computer database, the process can be humbling and disquieting. We risk paralysis if we go too far in being sensitive to our uncertainties. In a busy practice, we cannot pursue answers to every fleeting doubt. We need to be aware of our information needs, however, and welcome questions as opportunities for growth.[46] Only by accepting and identifying areas of ignorance can we begin to eliminate them.

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