Online Practice Guidelines:
Issues, Obstacles, and Future Prospects

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Abstract The “guidelines movement” was formed to reduce variability in practice, control costs, and improve patient care outcomes. Yet the overall impact on practice and outcomes has been disappointing. Evidence demonstrates that the most effective method of stimulating awareness of and compliance with best practices is computer-generated reminders provided at the point of care. This paper reviews five steps along the path from the development of a guideline to its integration into practice and the subsequent evaluation of its impact on practice and outcomes. Issues arising at each step and obstacles to moving from one step to the next are described. Last, developments that could help overcome the obstacles are highlighted. These include 1) more rapid knowledge acquisition using data mining, 2) better accommodation to imprecise knowledge in clinical algorithms using fuzzy logic, 3) development of a shareable model for guideline representation and execution, and 4) more widespread availability of clinically robust information systems that support decision-making at the point of care.

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The need to reduce variability in practice, control costs, and improve patient care outcomes has stimulated the development of myriad practice guidelines over the past several years.1–6 Yet systematic reviews have shown that the mere existence of these guidelines does not necessarily lead to changes in practice.7,8 Problems with the dissemination of guidelines are frequently cited as a major reason for failure to impact practice.9–11 Certainly, if clinicians are unaware of best practices, they cannot implement them; and if they haven’t been convinced of their utility, they will not use them. Even before the “guidelines movement” came into being, nursing literature reflected a long-standing concern with the difficulties of promoting the utilization of research findings in practice.12–14

A Response to a Problem: Online Practice Guidelines

One response to the dissemination problem has been to increase accessibility by making practice guidelines available online. A review of current applications shows a wide range of what is meant by this. In some settings, text guidelines are made available within an agency’s existing information system or by means of an intranet using World Wide Web technology. At Partners HealthCare System in Boston, Massachusetts, for example, clinicians can access a variety of text guidelines using an intranet application known as “Handbook.” Figure 1 illustrates the text that is displayed when the guideline for “Endocarditis Prophylaxis for Procedures” is selected. Some organizations like the U.S. Agency for Health Care Policy and Research (AHCPR) and the Canadian Medical Association have public Web sites where the guidelines developed by the agency can be accessed at will.15 This type of application solves the problem of accessibility to the guideline itself. But access to the knowledge embedded in the guideline can still be problematic when the guideline is long and complex and the answer to a specific question is needed quickly. In today’s environment, clinicians have less time than ever to elicit from the patient the specific problems needing attention and then apply the appropriate knowledge for diagnosing or treating the problems.17 Recent
publications have stressed the need to adapt an industrial paradigm, namely, supplying clinical information to clinicians "just in time" to influence the decision at hand. One method of dealing with this need is to provide selective access to the knowledge embedded in the guideline. By entering search phrases or choosing index words, the clinician can be guided to pertinent sections of the guideline, thus enabling rapid retrieval of the needed information. For example, guidelines available at the AHCPR Web site can be accessed by entering search words; Figure 2A illustrates what happens when a user, after selecting the urinary incontinence guideline, has entered the search phrase "urge incontinence." This causes the first section of the guideline where the phrase "urge incontinence" occurs to be displayed, as shown in Figure 2B. Another method of providing access to relevant portions of a guideline is to manually index a guideline with key words, then supply an interface that allows the clinician to select from the list of key words. Jenders et al. describe how the AHCPR Pressure Ulcer Prevention and Treatment Guidelines were indexed and made available to clinicians in this manner.

Interactive algorithms can increase decision support based on guideline knowledge. By entering parameters that are specific to a particular patient, the clinician can get recommendations tailored to that clinical situation. In the more sophisticated applications, a rationale is provided for the recommendations given. No data are stored about any individual patient—the application is used as a reference only. Figure 3 illustrates a prototype system for Web-based access to algorithms for pressure ulcer prevention and treatment adapted from the AHCPR guidelines. The specific topic selected in the illustration is management of tissue loads. After responding yes or no to a series of questions (with the option of getting an explanation of the question if desired), a recommendation is provided. In the illustration, an explanation of the rationale for the recommendation has been requested and is displayed at the bottom of the screen.

The most sophisticated form of online guideline is when a guideline is embedded in a computer-based patient record system. In this situation, programmed rules derived from the guideline operate in the background. The rules are triggered by patient data; when necessary, data unavailable in the record are sought from the clinician interactively; patient-specific recommendations are provided interactively or by various messaging methods. There are only a few examples of this advanced form of guideline-based decision support (see, for example, references 26–30), and only a very few are aimed at nurses. At Boston's Brigham and Women's hospital, physicians get evidence-based advice about the appropriateness of certain radiology orders based on information entered with an order. Figure 4 illustrates the advice given when a physician orders an abdominal radiograph to determine the cause of gastrointestinal bleeding. Figure 5 summarizes the range of decision support offered by online guidelines based on the degree of structure and integration with the patient's record.

**Fully Integrating Highly Structured Guidelines into the Clinical Setting**

Reviews of the effectiveness of various methods of guideline dissemination show that the most predictable impact is achieved when the guideline is made...
accessible through computer-based, patient-specific reminders that are integrated into the clinician’s workflow.\textsuperscript{35–40} If this is known to be true, why don’t we see more examples of it in the literature and in practice? The reason is that there are many obstacles between developing an officially accepted guideline and making it available in the form of patient-specific reminders. Figure 6 summarizes the steps along the path. Experience has shown, however, that the path is not smooth. What follows is a discussion of the issues that must be faced at each step and the obstacles that often occur. (These are summarized in Table 1.) In the final section, we highlight developments that may help in overcoming the obstacles, making it easier to deliver the promise of influencing practice through evidence-based guidelines.

### Step 1: Develop the Guideline

Cook et al.\textsuperscript{41} describe a clinical practice guideline quite simply as an “attempt to distill a large body of medical expertise into a convenient, readily usable format.” Despite the simplicity of the description, developing a good practice guideline is an exhausting and expensive process.\textsuperscript{42,43} Cook and colleagues developed a model describing the steps involved, which begin with assembling a multidisciplinary team to define the problem, distill the available knowledge, and

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**Figure 2**: A, Example of a text guideline that allows the clinician to retrieve sections of interest. Here, the clinician wants to search for sections related to “urge incontinence.” B, Having entered the search, the clinician has been presented with a list of sections containing the phrase “urge incontinence,” has selected a section, and gets the text shown here.
produce recommendations. The guideline must then be implemented and used; process and outcome data must be collected and analyzed; and this information must be combined with updated knowledge to reformulate the recommendations.1 The process is so complex that organizations around the world that have had experience with the development process are beginning to publish guidelines on how to develop guidelines.44–48

Obstacles
Many agencies can attest to the difficulties in achieving consensus on practice guidelines, which range from a sometimes inadequate scientific knowledge base, to conflicting evidence, to an inability to agree on recommendations.49,50 These obstacles have led to many aborted attempts to develop practice guidelines on particular topics. In the United States, the sheer magnitude of the task is what spurred the creation by Congress of the Agency for Health Care Policy and Research. One of the charges of this agency was to develop authoritative practice guidelines based on best available evidence.

Step 2: Develop an Algorithm from the Text
Guideline
In order to develop rules that can be processed by the computer, the text guideline must be converted to an

![Figure 3](image-url) Example of an interactive algorithm, this one on managing tissue loads. The clinician has responded to a series of questions and has received the recommendation shown above. When the clinician then asks the system to "explain" the recommendation, the explanation appears at the bottom of the screen. There is also an optional link to vendor descriptions of the recommended product.

![Figure 4](image-url) Example of an evidence-based guideline embedded in a patient record system. Here, the physician has ordered an abdominal radiograph, has responded to prompts for the patient's history, and gets this advisory.
algorithm. The criteria for each decision point in the algorithm must be fully specified without ambiguity. "Waffling" statements such as "in certain circumstances," "under some conditions," and "some experts advise" cannot be computed until the circumstances and conditions are defined precisely. Because clinicians at the point of care will not accept guideline recommendations at face value, the rationale for each recommendation must be clearly stated, with supporting references. Barahona et al.\(^5\) describe the "deep medical knowledge" that is needed to develop clinical guidelines. They assert that this knowledge, often implicit in the guideline itself, must be made explicit for two reasons: 1) to enable better transfer to computer-based decision support systems and 2) to promote greater acceptability among clinicians.\(^5\)

Obstacles

Those who have had experience with trying to develop computable algorithms from text guidelines cite the following problems: incompletely specified decision criteria, ambiguity, and failure to account for all possibilities in the clinical situation (lack of comprehensiveness).\(^2,5\) Trying to fill in the gaps in order to produce a computable algorithm is tantamount to amending the guideline, a process which may or may not be feasible, depending on the resources assigned to the project.

Step 3: Disseminate Rules and Protocols in a Local Environment

Even when a computable algorithm is achieved, the guideline must be implemented in a particular clinical setting. Ultimately, all clinical decisions are made in a local environment, which includes the practice culture, the characteristics of the particular clinician, and the characteristics of the particular patient. Efforts to educate clinicians and patients about best practices range from publications and continuing education courses to "detailing" by personnel specifically hired for the task.\(^5,6\) In some cases, organization leaders launch major initiatives to promote a culture change that places high value on evidence-based practice.\(^5,6\)

Among the many obstacles to achieving clinician acceptance of practice guidelines is conflict with personally held values and beliefs. Even when efforts to educate clinicians about practice guidelines are well carried out, there is evidence that guidelines that conflict with individual practitioners' values and beliefs are unlikely to be followed.\(^6\) Some clinicians resent the very notion of guideline-based practice, denigrating it as "cookbook medicine." The degree of decision-making autonomy provided to practicing clinicians has been related to satisfaction and professionalism, and some view prescribed practice parameters as an infringement on their professional responsibility.

Some clinicians have ethical concerns about implementing guidelines whose primary aim is to reduce costs.\(^6\) Others worry about the legal ramifications of using their professional judgment to override nationally promulgated guidelines of care.\(^6\)

Lack of confidence in the validity of the guideline is frequently cited as a reason for poor acceptance.\(^6\) This is a legitimate concern, as hard evidence for the recommendations prescribed in guidelines is often lacking and their ability to impact outcomes is even less proven.\(^6,8\) Even when a guideline is based on good evidence, applying it in a certain specific environment may yield no benefit or even harmful results, as Wein-
Table 1

Summary of Steps and Obstacles to Online Guidelines Fully Integrated into Practice

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Obstacles</th>
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<tbody>
<tr>
<td>Step 1: Develop guideline.</td>
<td>Distill relevant knowledge, provide recommendations reflecting “best practices.”</td>
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<tr>
<td>Step 2: Develop algorithm from text guideline.</td>
<td>Distill decision points and criteria for decisions; convert to decision flow-chart or decision table.</td>
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<tr>
<td>Step 3: Disseminate rules and protocols in a local environment.</td>
<td>Implement guideline in local setting through education of clinicians, “detailing” by personnel, reminders, etc.</td>
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<tr>
<td>Step 4: Integrate guideline-based rules into clinical record system with computer-based reminders.</td>
<td>Install software that runs guideline algorithm within electronic patient record; use existing data or query clinician for needed data; provide patient-specific reminders integrated into workflow.</td>
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<tr>
<td>Step 5: Examine impact on processes and outcomes, monitor new knowledge, and refine guideline as needed.</td>
<td>Establish mechanisms for measuring impact on processes and outcomes; carry out as appropriate. Establish mechanisms for periodic review of knowledge and revision of guideline as appropriate.</td>
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It is theoretically possible to build a system that allows local variation of the guideline, even at the practitioner level. Fridsma et al. propose a model for doing that, as does Lobach. It seems paradoxical to produce practice guidelines to reduce variations in practice and then build in mechanisms that facilitate local variations, but it seems to be necessary in order to achieve clinician acceptance.

One of the most frequently cited reasons for poor compliance with guidelines is difficulty applying recommendations that are made for populations of patients to the case of a particular patient. Poring through pages of prose to find a recommendation that applies to the case at hand (if one can find the pages of prose to begin with) is simply not practical in today’s health care environment.

The final reason sometimes cited for the failure of guidelines to gain acceptance at a local level is lack of administrative support in 1) promoting a culture where evidence-based practice is valued and recognized, 2) providing the information technology infrastructure needed to support clinical decision-making.
Step 4: Integrate Guideline-based Rules into the Clinical Record System through Computer-based Reminders

It was stated earlier that the most effective method of influencing clinical decision-making is to provide online, interactive, patient-specific reminders that are delivered in time to affect the decision being made. But such a capability depends on having a relatively robust computer-based patient record, in order to have the data to make appropriate recommendations. Patient demographic data, laboratory findings, diagnostic test results stored in coded format, medication and treatment orders and, ideally, patient findings are all essential to the provision of patient-specific recommendations in the context of a particular guideline. In addition, there must be some mechanism for sending messages to the responsible clinician, ideally in a way that is integrated with the workflow. There are several examples in the literature, but the sophisticated information systems needed for this type of application are the exception rather than the rule.

Obstacles

There is currently an insufficient technologic infrastructure in most settings to provide patient-specific, guidelines-based decision support. Attaining successful clinical systems is a long, arduous, and risky endeavor. It will be some years before these systems are widespread enough to provide the foundation for such support. Whether these systems will be designed with clinical decision support in mind is another matter, and if they are not, then additional work must be done to try to provide appropriate “hooks” to the data and to the clinician interface.

Even when the infrastructure is available to support online decision support, designing the system to be easy to use and no more time-consuming than traditional methods is often problematic. Failure to address these concerns is often cited as a reason for poor compliance with automated reminder systems.

Another concern is the accuracy of the data on which the algorithms operate. In a recent review of studies on the subject, Hogan and Warner conclude that the “studies report highly variable levels of accuracy” of data in computer-stored records. Litzelman and Tierney cite incompleteness of data (even in their notably robust computer-based patient record) as a significant reason for inappropriate reminders to clinicians. Kuperman et al. describe an application especially designed to retract alerts in cases where erroneously entered data that caused alerts are subsequently corrected.

An additional obstacle to widespread patient-specific decision support based on guidelines is the fact that even if a computable algorithm were developed from a text guideline and made generally available, each site must then program the algorithm to fit in its own technical environment. The programming resources needed to achieve this goal can be considerable, leading to extended delays in implementation and little ability to reuse either the knowledge or the programs.

Step 5: Examine Impact on Processes and Outcomes, Monitor New Knowledge, and Refine Guideline as Needed

There is universal agreement that assessing the impact of guidelines on processes and outcomes of care is essential. When guideline recommendations are based mainly on expert opinion, it is critical that data be gathered to demonstrate their validity in clinical practice. Weingarten asserts that even when a guideline shows good evidence of validity in general populations, it may not be portable to particular environments. There are some examples of attempts to evaluate the clinical validity and impact on patient outcomes of particular guidelines, and Weingarten cites several of them. In addition, Petrucci et al. demonstrated that when recommendations from an incontinence guideline were carried out, the number of wet incidents among patients decreased significantly in comparison with the number in units where the recommendations were not available. Willson et al. reported that preliminary results of an automated reminder system pertaining to pressure ulcer prevention indicate a significant reduction in the incidence of pressure ulcers. East et al. showed that standardization of care in critically ill patients with adult respiratory distress syndrome was dramatically improved after implementation of automated protocols, with consequent reduction in patient mortality.

Since knowledge is not static, it is also important to build in the ability to keep abreast of new knowledge and incorporate it into guidelines as appropriate. New knowledge may require substantial revision of the recommendations, necessitating revision of the derived algorithms and a whole new cycle of implementation. Continuous quality improvement applies not only to the care delivered under practice guidelines, but to the guidelines themselves.
Obstacles

The obvious obstacles to this process are the expense and effort required. Some organizations have taken on the task of maintaining the validity of the content for particular topics.\textsuperscript{76,77} For some, a commitment to examining the effects of guidelines on costs, processes, and outcomes of care is not so much an academic pursuit as a strategic imperative, since outdated or invalid guidelines embedded in the organization’s clinical practice have such potential for harm.

Promising Developments

A vision of the future with respect to online guidelines is one where the obstacles to each step in Figure 6 are overcome. Advances in clinical research, partly assisted by technology, can improve the clinical knowledge base, possibly shortening the time to consensus for achieving evidence-based guidelines. When randomized controlled trials do not provide answers, new technologies such as data mining may help. By this technique, large accumulated clinical data bases are searched to ascertain correlations among findings, diagnoses, treatments, and outcomes, thus enabling the discovery of knowledge based on experience.\textsuperscript{78,80} Better experimental and empirical evidence could decrease the need to rely on expert opinion, which is often the source of difficulty in achieving consensus about best practices. Clearer guidelines well supported by evidence may more easily gain clinician acceptance.

Clearer guidelines based on better evidence would also make it easier to construct algorithms and decision tables, leading more readily to computer-based decision support applications. When knowledge remains imprecise, advances in computing methods such as fuzzy logic may assist us in developing decision-support algorithms that take into account the imprecision of the knowledge base.\textsuperscript{80}

In an ideal world, these algorithms and tables will be developed in standard interchange formats that permit installation in a wide variety of technical infrastructures, with only moderate programming needed for local requirements. The InterMed Collaboratory\textsuperscript{81} has as one of its goals the generation of a shareable model for clinical guideline representation. According to its investigators, “The purpose of this representation is to facilitate the sharing of clinical guidelines, as well as the documentation amplifying on the guideline or particular steps thereof. It enables the construction of translation facilities for conversion of guideline information to and from site-specific formats, and provides a substrate upon which to build software components that wish to interchange guideline data at runtime.”\textsuperscript{82} Such a capability would greatly shorten the amount of time currently needed to implement patient-specific decision support based on particular guidelines.

The strategic value of clinical information has increased dramatically since the advent of managed care in the United States. This has stimulated concentrated efforts to develop more advanced clinical information systems. This impetus could lead to an environment where robust systems with structured, coded clinical data provide integrated decision support as a commonplace resource. Evaluation of the effects of guideline-based decisions on patient outcomes can be facilitated by the clinical information system, providing the means to refine the guideline and improve practice still further.

Evidence-based practice made possible through practice guidelines makes great sense to clinicians, payers, and policymakers alike. Efforts to achieve that goal have been labor-intensive and uneven in their impact. Technology holds great promise to make evidence-based practice a reality, leading to the ultimate goal of high-quality, cost-efficient patient care.

References

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