MEDINFO 2004
M. Fieschi et al. (Eds)
Amsterdam: IOS Press

Overcoming Information Overload: an Information System for the Primary Care Physician

G. Octo Barnett[a,b], Michael J. Barry[b,c], Celeste Robb-Nicholson[b,c], Mary Morgan[a]

[a]*Massachusetts General Hospital Laboratory of Computer Science, Boston, MA, USA*
[b]*Harvard Medical School Department of Medicine, Boston, MA, USA*
[c]*General Medicine Unit, Massachusetts General Hospital, Boston, MA, USA*

Abstract

Primary Care Office InSite (PCOI) is a Web-based intranet application that provides ready access to a collection of information useful in primary care. The PCOI Web site was developed by, and is widely used within, the Massachusetts General Hospital (MGH) and its affiliated community practices. Over 1600 users logged 60,000 separate sessions in the past year. The site contains clinical practice guidelines, patient educational material, drug prescription and cost information and referral information, all designed for use during routine patient care activity. A continuing and dynamic collaboration between the users and developers of the system, just-in-time access and a 'one-stop portal' to a variety of resources have resulted in a very high approval rating by the users.

This paper discusses the important characteristics of the Web site, specific functions that improve the workflow of the practicing clinician, and limitations of the present implementation.

Keywords

Database Management Systems; Evidence-Based Medicine; Decision Making, Computer Assisted

Introduction

One of the recommendations from the Institute of Medicine (IOM) report on improving the delivery of medical care was to utilize information technology in daily practice to increase the use of scientifically valid decision-making [1]. Studies have repeatedly shown that the information needs of primary care physicians (PCPs) are not being met [2,3]. While there is a wealth of information available on the Internet, this information is not efficiently indexed, nor is it optimally organized for use during patient care sessions. In addition, the

PCP's information needs extend beyond specifics about particular diseases and their management; the PCP also needs information about the resources of the local environment, and how a patient's particular insurance coverage may impact care decisions.

The information needs of primary care physicians and their information-seeking behaviors have been widely studied. The findings have been remarkably similar among clinicians at different levels of training and practice settings and across different cultures. An excellent review by Smith [4] summarized a group of studies showing that the questions are often complex and multidimensional, and that doctors are most likely to seek answers to their questions from other doctors. Many of the questions arising in patient care can be answered, using electronic sources, but this is time consuming and expensive—and demands information skills that many doctors lack. In addition, patient education is an important and sometimes neglected aspect of the visit. Available electronic sources of appropriate and relevant patient information may be difficult to identify and sometimes may be contrary to the physician's patient care plans.

The typical primary care patient visit lasts 10-15 minutes. During that brief time, the PCP must review the patient's chart, take a history, perform the necessary physical exam, discuss his/her findings, write prescriptions, fill out a billing/encounter form and write a note in the chart. At the same time, he or she must respond to the patient's concerns and questions and supply emotional support. It is not surprising that PCPs, stressed by the demands of administrative information processing, rarely search external sources for information. Most physicians give first priority to the variety of administrative information demands, such as writing the clinical note, while relying on their personal clinical knowledge and memory rather than published guidelines or the medical literature [5] for answering clinical questions. As McKibbon et al note, "Because of other demands on their time, clinicians preferred to take less than two minutes per question to find answers [6]."

Many of the clinical questions that go unanswered during daily practice can be usually answered, at least in part, from the literature or from specialty specific electronic resources. In an Oregon study, medical librarians were asked to use only online resources to answer 60 PCP-generated questions. Time or cost restrictions were not applied to the searches. These "gold standard" searches averaged 43 minutes in length and $27.37 in cost. The clinicians judged the answers "relevant" in 56% of cases, and said that the information provided a "clear answer" to 46% of their questions [7]. Aside from the impracticality of time and cost involved in such a search, recommendations in the literature are not tailored to the particular patient and the local environment, and often are complex and contradictory. There has been increasing attention to developing both ambulatory medical records systems (AMRS) and guidelines that promote evidence-based medicine, but less attention to mechanisms to transfer evidence into clinical practice and to keep up with the ever-increas-

ing amount of clinical trial data. The reality is that it is nearly impossible for any non-automated information service to provide cost-efficient, timely information under the two-minute deadline needed to satisfy a PCP. Shifting the work of answering questions that arise in daily practice to a computer-based information resource may provide the Just-in-Time information [8] desired at the point of care.

Methods

In 1996, the Massachusetts General Hospital (MGH) and the General Medicine Unit began a number of operation improvement initiatives to identify and implement changes that would improve patient care, increase patient satisfaction, and promote cost-effective decision-making. An early initiative of the General Medicine Unit was the development of evidence-based clinical guidelines focused on clinical relevance and potential to improve medical care efficiency and effectiveness. Specialty content experts reviewed individual guidelines, but an advisory board of the General Medicine Unit determined their final form. We soon realized that distributing the guidelines in the form of a large notebook would inhibit physicians from accessing this material in their routine patient care practice, and that it would be difficult to distribute new or revised material in a timely fashion. Therefore we shifted the distribution protocol to take advantage of Web technology to facilitate indexed searching, ease of navigation, and linking of related patient instruction materials to patient-centered clinical guidelines to better respond to the point-of-care physician information needs. We also extended the Web site to include information assistance in the spectrum of issues that PCPs encounter in the areas of pharmacy, insurance, referral opportunities, appropriate laboratory testing, and patient communication. The Web site is organized into the following sections on the home page. The strategy is to provide 'one-stop shopping' and 'just-in-time' access to 'point of care' information and resources important to the day-to-day practice of General Internal Medicine:

- **Primary Care Guidelines** provides access to relatively short, patient-centered, action oriented guidelines for the specific diseases/problems encountered. Each guideline provides the specific recommendations deemed appropriate for the MGH primary care practice, and links to literature references from which these recommendations were derived.
- **Patient Information** leads to patient educational materials that have either been developed by the PCOI teams or borrowed from other organizations (after review and approval by the PCOI team). Patient instructions reflect the same interpretations and recommendations contained in the Primary Care Guidelines. Several of the handouts are available in Spanish and an Easier to Read format. Many physicians use these printed instructions extensively and feel that this is one of the most valuable components of the Web site, resulting in significant time savings for both the physician and the patient.
- **Drug Information** contains the Drug Formulary for each Insurance plan. It also contains links to helpful PCOI developed recommendations about the appropriate use of many of the commonly used drugs. The information about which drugs are covered by the patient's particular insurance has proven to be of great value and a significant time saver for the individual physician, since most physicians find it impossible to maintain accurate knowledge about this rapidly changing information.
- **How To....** provides institution-specific information about procedures such as admitting a patient to the Hospitalist Service at MGH or ordering an exercise stress test on the weekend. Easy access to such information about the many different procedures and protocols in a large hospital is of great use to any new staff physician, and provides a ready resource of information about infrequently ordered procedures.
- **Useful Forms** contains many forms used in the course of clinical practice... everything from a pharmacy prior authorization form for a specific insurer, to a handicap placard application, to a referral from for cardiac rehabilitation, to a bone density referral form. These may be downloaded and printed from local printers. The material on this Web site is replacing much of the printed material that must be kept on file in the physicians' offices and practices.
- **Medical Calculators** provides access to clinically important formulae such as the 10 Year Myocardial Infarction Risk Assessment Calculator and the Breast Cancer Risk Assessment tool. Other calculators provide a way to derive such clinically important numbers as a body mass index.
- **Clinical Access Guide** provides telephone numbers and helpful information on scheduling protocols for different units or specialists with particular interests at MGH.
- **Practice Alert** provides important new clinical information such as FDA alerts and important changes in MGH protocols.
- **What's New** provides links to new material that has recently been added to the site; this is useful since the site is in a continuing state of evolution and enhancement.
- **Links to other resources** allow the user to access a number of different external sites such as UpToDate, PubMed, DXplain, CDC, etc. This makes it possible for the user to keep a single home page and yet access other useful resources – "one stop shopping".
- **Search capability** allows the user to find information on a specific topic by typing one or two descriptive words into the search box at the top of every page. The search function (using Google) will find those pages of the Web application where the content most closely matches the terms entered.
- **Feedback** There is a button on each page that allows the user to create an email message to the developers about current functions or suggestions for new content to be added. One of the critical aspects of the evolution of the Web application has been the dynamic and continuing collaboration among the Web site authors, the system

developers and the users. This feedback capability is heavily used, and is the initiation for much of the new content that is added on an almost daily basis to the site.

Results

The PCOI Web site has become enormously popular among MGH-affiliated primary care providers. Table 1 shows how the use has dramatically increased over the past three years.

Table 1: Use over three years

Calendar Year	Number of Sessions/ week
2001	1,121
2002	1,391
2003 (partial year – 8 months)	1,977

At present, the site averages over 25,000 page hits/week. Out of 257 MGH PCP's, only 49 have used the system less than 10 times in this calendar year. Table 2 shows the most popular topic areas, and the percentage of total hits to each of the topics.

Table 2: The most popular topic areas

Most Popular Topic Areas
Drug Insurance Formulary (30% of hits)
UpToDate (12%)
Patient Instructions (10%)

The popularity of the formulary is related in part to easy access to the timely insurance coverage information. The other MGH specific topic areas together generated 30% of the hits (with the most popular being Patient Instructions). The most popular of the external resources was UpToDate; no other external resource generated more than 2% of the hits. The most popular of the Patient Information resources was the "Step-One/TLC Diet", with the second being "Calcium Supplements for Women". The most popular Primary Care Guideline was "Routine Vaccination in Adults" with the second being "Cholesterol Screening". The most popular Useful Form was the "Quit Smoking Service".

In each of the past three years, we evaluated PCOI with a paper survey distributed to all the approximately 250 MGH PCPs who are potential users of PCOI (with over 70% return rate). The results of the survey for the past three years are given in Table 3.

Table 3: Survey results

Year	Very useful-it helps me give much better patient care	Saved 10+ minutes/day
2001	32%	17%
2002	53%	46%
2003	70%	63%

A ranking of 5 on a 1 to 5 scale was to indicate that the Web site was "very useful- it helps me give much better patient care"; in the last survey, 70% of the users gave a rank of 5. One of the design objectives for the PCOI application was that it would save the PCP time. In the survey, we asked how much time, if any, was saved by use of PCOI. Over half the PCPs believe that use of the PCOI saves over 10 minutes/session (and 30% of the physicians said it saves between 25-30 minutes/day). This assessment that use of the system both supports better patient care and also saves time is a most impressive testimony to the value of the system. This positive affirmation explains why MGH and the General Medicine Unit have provided financial and personnel support to the development of the application and continue to fund both the technical support and the continuing content development.

Discussion

We believe that the acceptance of the PCOI Web site is related to two important characteristics: (1) it provides 'one-stop shopping' -- a portal to both educational resources and workflow support; and (2) it has a high ranking according to the algorithm proposed by Shaughnessy [9] for assessing the usefulness of such Web-based techniques.

$$\text{Usefulness of medical information} = \frac{\text{relevance x validity}}{\text{work to access}}$$

Relevance is based on the **frequency of exposure** to the problem being addressed and the **type of information** being presented. **Validity** is the likelihood of the information being true, and **work to access** is the time and effort that must be spent extracting the information. Using this measure, PCOI achieves a high ranking in that the material in PCOI is selected and created by the physicians who are intimately familiar with the problems and the need for specific information. The authors of the material in PCOI have a strong commitment to evidence-based research and attempt to create material that has a documented evidence base. The collaboration between the authors/editors of the content and the users is a key element in both the relevance and the validity. We have spent considerable effort in designing and indexing the content so that access is relatively simple and fast. In addition, the workflow support and easy access to administrative resources has been critical in achieving actual savings in time as a result of using the application.

One of the primary goals in the development of the PCOI was to improve patient care. We have not been able to assess this in any quantitative fashion, although there has been anecdotal evidence of specific instances where this was achieved. However, there is no doubt that most of the PCP users believe, that in many situations, the application has made it possible to know what are the key diagnostic, treatment or referral actions appropriate for a given problem, and that the patient information sheets have both saved patient and physician time and reinforced patient discussions during the clinical encounter.

Perhaps the major challenge of the project is the effort required to add new material and to update and keep the old content current. Changes, edits, and new content are introduced on an almost daily basis. Since user acceptance is absolutely dependent on comprehensiveness, accuracy, and relevance of the content, it is obvious that the success of the application depends on a continuing commitment to respond to this challenge.

The question is often raised as to why physicians' information processing needs are not met by some of the excellent National Library of Medicine and commercial Web-based applications. Two of the most obvious competitors are UpToDate and NLM's Medline and MedlinePlus. UpToDate is an excellent source of

medical knowledge and is heavily used by the PCP at MGH. UpToDate provides information more in the form of a "textbook" focusing on disease description and alternative treatments. The PCOI guidelines are shorter, more focused on the immediate treatment issues of a patient with specific characteristics, include information about specific diagnostic or treatment issues, and reflect the best practice patterns of the MGH General Medical Unit. MedlinePlus is an excellent and comprehensive resource for patient educational material and is used by our authors in their creation of the patient educational material for the PCOI Web application. However, the MedlinePlus site can be intimidating in its complexity and comprehensiveness. The MedlinePlus information may be appropriate as a comprehensive coverage of a topic; the PCOI patient information material is usually much shorter, directed toward a specific topic and appropriate to be printed out, and discussed with the patient at the visit. The MedlinePlus information often represents a diverse set of recommendations from a variety of organizations; the PCOI Web material is consistent with the clinical information that is contained in the PCOI physician guidelines and has been vetted by the same authors who wrote the guidelines. One of the strengths of PCOI is that it provides a single portal to access other resources such as UpToDate, Medline and MedlinePlus. This portal strategy allows an integration of knowledge access with workflow support in a single home page.

The major limitations of the present site are several:

1. It is difficult to keep the users aware of the vast array of information that is contained on the site; we provide a search capability that is of value, but even with this capability, we often are asked by users to provide capabilities that are already on the site but of which the user is unaware.
2. The effective use of the material requires a reliable networking technology and relatively high-speed computers in both the individual physician office and exam rooms; this is not always the situation.
3. It is difficult to keep the information up to date. It is easier to request volunteer authors create new material than to succeed in urging them to take the time and effort to update previously created material.
4. Perhaps most importantly, the PCOI Web application is a separate application from the electronic ambulatory medical record system available to most of the MGH PCPs. The system would be much more valuable if there were a coherent integration of the two systems. Unfortunately this requires more granularity of data recording in the AMRS, a common vocabulary, and a better understanding of how to integrate the functions of creating a clinical note and knowledge access.

Conclusion

A Web-based application was developed and implemented to provide primary care providers (PCPs) ready access to a collection of information and to workflow support useful in primary care. A continuing collaboration of users and developers of the resource, and the use of a portal "one-stop shopping" metaphor has resulted in a Just-In-Time resource that is heavily used and deeply appreciated by the PCPs affiliated with the Massachusetts General Hospital. The major challenges are the continuing expansion of the content to meet new needs, the requirement to keep the content current, and the desire to integrate the Web application with the electronic medical record.

Acknowledgements

We thank the MGH PCOI team and the MGH PCOI Advisory Board for their many years of creative collaboration. The assistance of Steve Atlas, M.D. in highlighting the useful characteristics of PCOI is gratefully acknowledged. The success of this project was in large part due to the continuing support of the MGH General Medicine Unit and the MGH administration.

References

[1] Institute of Medicine: *Crossing the quality chasm: a new health system for the 21st century*. National Academy Press. 2001.

[2] Covell DG, Uman GC, Manning PR. Information needs in office practice: are they being met? *Ann Intern Med.* 1985; 103:596-9.

[3] Green ML, Ciampi MA, Ellis PJ: Residents' medical information needs in clinic: are they being met? *Am J Med* 2000;109:218-23.

[4] Smith, R, What clinical information do doctors need? *BMJ* 1996;313:1062-1068.

[5] Cabana MD, Rand CS, Powe NR, Wu AW, Wilson MH, Abboud PA, Rubin HR. Why don't physicians follow clinical practice guidelines? A framework for improvement. *JAMA* 1999;282:1458-65.

[6] McKibbon KA, Richardson WS, Walker-Dilks C. Finding answers to well-built questions. Evidence-Based Medicine [*EBM Notebook*] 1999;4:164-7.

[7] Gorman PN, Ash J, Wykoff L: Can primary care physicians' questions be answered using the medical journal literature? *Bull Med Libr Assoc* 1994;82:140-6.

[8] Chueh H, Barnett GO., "Just-in-time" clinical information, *Acad Med* 1997; June,72(6):512-7.

[9] Shaughnessy AF, Slawson DC, Bennett JH. Becoming an information master: a guidebook to the medical information jungle *JFam Pract* 1994:39:489-99

Address for Correspondence

G. Octo Barnett, M.D.

MGH Laboratory of Computer Science,

50 Staniford Street, 5th Floor, Boston, MA 02114
obarnett@partners.org.