Medical Search Engines

Bob Badgett
University of Texas at San Antonio, USA

Suresh Chalasani
University of Texas at San Antonio, USA

Rajendra V. Boppana
University of Texas at San Antonio, USA

Jacqueline A. Pugh
University of Texas at San Antonio, USA

INTRODUCTION

Twenty years ago, researchers identified the difficulties physicians have answering the clinical questions that arise during medical care (Covell, Uman & Manning, 1985). Fifteen years ago, the "evidence-based medicine" movement arose (Cohen, 2001) and exhorted clinicians to use computers to look up the answers to questions as they arise during clinical care.

Fortuitously for the proponents of evidence-based medicine, the Internet matured in the 1990s (Hersh 1996 #3370), epitomized by the launching of PubMed by Al Gore in June 1997. PubMed, developed by the National Institutes of Health, provided the first free access to millions of biomedical research articles at MEDLINE.

Unfortunately, the Internet has not fulfilled its potential to assist physicians in answering clinical questions. A recent study found that physicians obtain answers to only 40% of questions that arise during patient care (Ely, Osheroff, Chambliss, Ebell & Rosenbaum, 2004); this rate is not much different than the rate of 30% reported 20 years ago (Covell et al., 1985).

BACKGROUND

This chapter focuses on information retrieval of general medical information by health care professionals. We will review research on information retrieval and medical publishing in order to describe the idealized medical search engine for health care professionals. This chapter does not address retrieval of patient-specific information, which is done by electronic medical records. This chapter does not address retrieval of general medical information by patients, although the principles are similar.

Performance parameters of the idealized medical search engine: We propose that the idealized medical search engine should provide scientifically valid and actionable answers to 95% of questions received. In addition, the total time to use the search engine, including query formation, searching, and interpretation of results, should be less than two minutes. An ideal search engine should search and include search results from all relevant sources.

The first parameter, scientifically valid answers, comes from research showing that knowledge resources vary in the validity of their content. Antman, Lau, Kupelnick, Mosteller, and Chalmers' (1992) seminal study using cumulative meta-analysis to retrospectively summarize changing medical evidence over multiple years showed that expert opinion as reflected in review articles and textbook chapters either may conflict with evidence or may delay 15 years in incorporating new evidence. Fortunately, new online hypertexts, such as UpToDate, PIER, Clinical Evidence, and others, implement systematic editorial processes such as peer review of chapters, extensive attribution of evidence with footnoting, regular and frequent updates, systematic literature surveillance or searches, grading of source evidence, and other techniques that presumably increase the validity of the content of hypertexts. We label these online resources systematic hypertexts and propose that they replace textbooks as a principle information resource.

The importance of succinct, actionable answers is demonstrated in surveys that ask physicians desirable

traits of an information resource (Ely et al., 2004) and in studies of uptake of content by physicians and medical students (Beck & Bergman, 1986; Grol, Dalhuijsen, Thomas, Veld, Rutten & Mokkink, 1998). Many of the systematic hypertexts listed previously use bulleted lists and succinct recommendations rather than the traditional prose structure of printed textbooks. This attention to usability adds further justification for these hypertexts to be a principle information resource.

The importance of providing fast answers is noted in studies of the barriers to the pursuit of evidence (Dee & Blazek, 1993; Ely et al., 2002). In a study that directly observed physician behavior, an average of two minutes was spent to answer each question (Ely et al., 1999). Although our parameter of two minutes may seem stringent, Sackett and Straus (1998) found that even two minutes was a barrier to using resources. Unfortunately, breaking the two-minute barrier will require medical publishers to write more succinct and usable content. One of the most commonly used current knowledge resources, UpToDate, may require 15 minutes to read and interpret (Lucas et al., 2004). The medical outpatient visit is packed with information management and competing demands that may reduce quality of care (Redelmeier, Tan & Booth, 1998) or even prevent care (Yarnall, Pollak, Ostbye, Krause & Michener, 2003). Therefore, physicians must find answers quickly.

The need for an information resource to answer a high proportion of questions is found in studies that show belief that an answer that exists to a question is a strong determinant of whether a physician will pursue an answer (Ely et al., 2004). We arbitrarily designate 95% as the proportion of questions that should be answered by a knowledge resource in order to encourage physicians to continue using the resource.

THE IDEALIZED MEDICAL SEARCH ENGINE

Features of the Idealized Medical Search Engine Needed to Achieve Satisfactory Performance

To achieve 95% success within two minutes, we propose that the idealized medical search engine should have the following features. First, the search engine should search multiple information resources. Second, the main targets of the search engine should be high quality systematic hypertexts. Third, MEDLINE should be among the other targets of the search engine in order to answer. Fourth, the search form should be easy to use and accept natural language or Boolean results. Fifth, query expansion should use a broad thesaurus such as the Unified Medical Language System (UMLS). Sixth, links to the documents retrieved must be carefully fused into a single page of information. The order of the fused results is based on three dimensions: publication date, publication type (primary vs. secondary vs. tertiary), and publication quality.

The search engine should access multiple information resources in order to achieve completeness of search space. Studies have shown that no single information resource can answer more than 80% of questions (Alper, Stevermer, White & Ewigman, 2001; Fenton & Badgett, 2005; Lucas et al., 2004). This search engine should be a federated search that simultaneously queries multiple resources and then returns the results to the user in a single Web page. This is in contrast to the more common structure of an Internet portal that gives the user access to multiple resources, but the user must manually search the resources in sequence. We discuss next the details on how the search results should be displayed after fusing and sorting.

The principle targets of the search engine should be high quality tertiary publications. Others have noted the need to search tertiary publications first (Haynes, 2001). Research has shown that physicians can query textbooks faster than MEDLINE (Chambliss & Conley, 1996). The quicker use of textbooks is due to the more organized representation of medial knowledge in tertiary publications in contrast to the fragmented nature of the millions of citations on MEDLINE. As already noted, the ideal tertiary publications to be targets of a search are systematic hypertexts. Systematic hypertexts strive to improve validity of content by using processes such as peer review (Goodman, Berlin, Fletcher, & Fletcher, 1994), attribution (Kunst, Groot, Latthe, Latthe & Khan, 2002), frequent updating, stating the search date of the current version (Kunst et al., 2002), objective grading of underlying evidence, and structured literature searches. In addition, systematic hypertexts strive to improve usability by use of actionable and prescriptive recommendations (Ely, Osheroff, Chambliss, Ebell & Rosenbaum, 2005; Grol et al., 1998), succinct and bulleted summaries (Beck & Bergman, 1986; Ely et al., 2005), and layered content in which summary recommendations precede detailed explanations.