Technology and Health Information Technology in Colorectal Surgery: Electronic Literature Support

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Clin Colon Rectal Surg 2013;26:31–35.

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Abstract

Keywords

- MEDLINE
- PubMed
- Embase
- video
- website
- e-library

The advent of the Internet has revolutionized the management of reporting and accessing research and data. The authors review the current resources available to surgeons through websites, accumulated published data repositories, and libraries. The change in how we publish and present peer-reviewed data over the last 20 years is also discussed as well as the future of health information technology.

Objectives: On completion of the article, the reader should be able to identify the changes that have taken place in the management and reporting of health information, and identify the numerous web resources geared toward the health information technology related to colon and rectal surgery that are currently utilized.

Improved access to information has been one of the hallmark ways in which the digital revolution has permanently altered the medical field; today, a variety of electronic resources are available to the colorectal surgeon to aid in research and everyday clinical decision making.

Electronic literature support comes in several forms. Online databases allow the surgeon to easily search thousands of journals for relevant articles, look up specific drug information, or access video libraries providing detailed stepwise instructions on multiple operations. Institution-specific electronic textbook collections obviate the need for a trip to the library; this fact alone has led to the cry that “print is dead.” Electronic reference management software helps the researcher organize all of these sources and prepare reference lists with the click of a button. For both research uses as well as everyday practice, clinical decision support tools such as UpToDate® or the *Cochrane Reviews* are available electroni-

cally to help answer difficult or confusing clinical dilemmas with the best available research. These resources will be discussed in turn below.

Online Sources

MEDLINE

MEDLINE is the National Library of Medicine’s primary electronic bibliographic database and is the primary component of PubMed. MEDLINE’s distinguishing feature is that all 19 million biomedical articles in the database are indexed with medical subject headings (MeSH), which collectively constitute the NLM-controlled vocabulary thesaurus that can be used to search PubMed. About 5,400 journals from 80 countries, in addition to the United States, have been selected for MEDLINE indexing; the database stretches as far back as 1946 in some cases. Each week between Tuesday and Saturday, 2,000 to 4,000 references fully indexed with MeSH headings are added to MEDLINE.¹

PubMed

PubMed is an online database of abstracts from the biomedical research literature maintained by the NIH’s National Center for Biotechnology Information (NCBI, under the National Library of Medicine). Though it is based primarily on

entries in the MEDLINE database, PubMed also contains several citations not listed in MEDLINE. These include citations that have been submitted but not yet indexed with MeSH and uploaded to MEDLINE, citations that predate 1946, and citations to author manuscripts by NIH-funded researchers.² The database currently contains over 21 million entries from over 27,600 medical and scientific journals worldwide, and is the most frequently consulted online scientific medical resource in the world. For many abstracts, links are provided to free fulltext articles via independent publishers or PubMed Central (PMC); the latter contains 2.3 million free fulltext articles. Users at various institutions may have access to more fulltext articles depending on their institution's individual agreements with publishers.

PubMed is notable for its relative ease of use as well as its breadth. The database may be queried by keyword or any available bibliographic parameter, such as author, title, publication date, or journal. In addition, for articles indexed in MEDLINE, PubMed is searchable using MeSH. For example, one could access PubMed, click on the MeSH section, and search for a MeSH heading like "colorectal surgery." Using that MeSH heading to search all of PubMed would then return every article in the MEDLINE database tagged with that subject heading. PubMed includes several other user-friendly features, such as a single-citation matcher, the ability to perform clinical queries, storage of searches and collections of citations, a spellchecker, and many different filters.

Embase

Embase is an electronic database of biomedical articles that expands on MEDLINE's information by adding information pertaining to pharmacology and pharmaceutical sciences. A proprietary database produced by publisher Elsevier B.V., it contains all the entries in MEDLINE (with MeSH terms), plus an additional five million indexed references. Although MEDLINE contains ~19 million articles, Embase contains over 25 million indexed entries from over 7,600 peer-reviewed journals. These additional entries cover more recent articles on medical drugs and devices in the market, as well as over 600,000 conference abstracts starting from 2009. Elsevier's life science thesaurus, Emtree, is similar to but more than twice as large as the MeSH database.³ Notably, Emtree allows for indexing of over 30,000 drugs by chemical name, trade name, and laboratory or research codes linked to those names.⁴

Cochrane

Cochrane Reviews are published by the Cochrane Collaboration, an international network of over 28,000 researchers and healthcare providers. These documents are systematic reviews of primary research in healthcare and health policy designed to assess the accuracy of diagnostic tests as well as the effectiveness of healthcare interventions. Each review addresses a specific research question, i.e., whether conclusive evidence exists for a given treatment, by combining all available primary research on a topic that meets prespecified inclusion criteria (these vary; for example, only randomized controlled trials of the highest quality addressing a given subject). Data are synthesized using consistent, prespecified methods, which

limits bias and random error. Accordingly, Cochrane's approach is unique in the systematic, rigorous way in which the various Cochrane author teams approach every review.^{5,6}

e-Libraries

Medical libraries across the country have adapted to the proliferation of Internet-based information technology systems by developing what are known as "e-libraries," or collections of material available electronically via the Internet. At the Johns Hopkins Hospital, the Welch Medical Library currently provides its users with access to over 5,000 electronic journals, 400 databases, and 8,000 e-books. Additionally, a service known as WelDoc provides users with access to any materials not included in the immediate Johns Hopkins University collections.

There are a myriad of benefits to electronic access. Users not on campus are able to access these resources from anywhere in the world. Typically, depending on agreements with publishers and other owners of content, users will have to connect to their institution's network through some type of login system or virtual private network. Resources are then available either directly or via the institutions e-library website. Moreover, the digitization of resources creates the possibility for more complete and thorough searches. For example, users can search PubMed and then use their e-library's automated links to access fulltext articles of publishers with whom their library has contracted, or pull up complete *Cochrane Reviews* provided their institution possesses the correct agreements. In addition, most e-libraries contain a variety of e-books that obviate the need for purchasing expensive and heavy textbooks. Limitations to the access of e-books vary by agreements with the publishers. Some e-books may only be accessed by a limited number of an institution's users at any one time, for example.

Though the proliferation of e-libraries has greatly increased the accessibility of resources and information for many users, they have also resulted in a corresponding decline in the relevance and use of brick-and-mortar library facilities as print collections diminish. During the fiscal year 2010–2011, the Johns Hopkins Welch Medical Library building was visited 38755 times—an average of about 100 visits a day. That number represents a 51% decline from the number of visits in fiscal year 2003–2004 (79542). Meanwhile, in that same year, campus users accessed nearly 20 million electronic journal articles, all of which are available without ever setting foot in the Welch library (→ **Fig. 1**).⁷ The building was slated to close to patrons this year, secondary to lack of use and maintenance concerns. However, several stakeholders from across the Hopkins medical community raised concerns and the proposal has been put on hold. In the interim, the institution has been assessing how to balance the need for quiet study and learning space alongside basic amenities and infrastructure upgrades. A committee of both faculty and students is currently meeting to identify how best to use the Welch Library building in the future.⁸ This represents a pivotal and dynamic shift occurring in universities across the country. Five years from now medical libraries housed in buildings may cease to exist.

Fig. 1 Visits to the Welch Medical Library at the Johns Hopkins East Baltimore (Medical) campus, and the number of electronic journal articles accessed by Johns Hopkins users. While physical visits to the library have steadily dropped over the last decade, e-journal use has increased dramatically.

Reference Management Software

Reference management software can be used by authors to keep a digital database of citations from which bibliographies can be generated. Typically, these programs will allow a user to input citations manually in a program window or website, or even capture them automatically from the Internet. Users can then use the software to mark citations as they write in a word processing program, and specify the exact format of bibliography they desire for the program to create when finished. Reference Manager, sold by Thomson Reuters (Philadelphia, PA), was the first such program of its kind, and has the ability for multiple users to add and edit bibliographic records at the same time. Endnote is an example of another Thomson Reuters reference management program that can either be used locally on one's computer or across the web.⁹ Refworks (ProQuest, LLC, Ann Arbor, MI), meanwhile, is an entirely web-based program that also allows multiple and simultaneous use of an online database of references.¹⁰ Refworks is generally considered the easiest resource to use and also has an application that will automatically detect and reference a citation within an Internet browser. Endnote is a more sophisticated program that allows for advanced features like automatic downloading of PDFs with the ability to annotate and archive such documents. Whereas Refworks is completely Internet-based, Endnote's web-based capabilities are less extensive than the local desktop program one installs on a personal computer. All of these programs significantly streamline the time-consuming and often complex task of preparing and formatting citations properly prior to publication of an article. They allow for automatic reorganization of references, the storage of those references for later projects, and are a great time saver.

Electronic Reference Material

Electronic Textbooks or "e-Books"

Many medical institutions offer e-libraries that provide access to a variety of e-books. At Johns Hopkins, the Welch Medical Library offers access to 8,000 e-books, including

complete editions of textbooks such as the *Sabiston Textbook of Surgery* and *Schwartz's Principles of Surgery*. As with other e-library resources, these materials are accessible to any user with an Internet connection and the proper login information. Advantages to e-books include obviating the need for a physical trip to a library, and the ability to save digital content (images, tables, etc.) for use in presentations and other electronic applications.

Precise access limitations surrounding resources vary by agreements with publishers. Generally, a publisher will send a contract to a library or institution stipulating the terms under which their content can be accessed. Some publishers allow unlimited access to a given resource for a yearly fee, e.g., an entire campus will be able to access a resource. Other publishers only contract for a certain number of "seats" to a resource, such that only a given number of people can access a resource at a given time. These vendor-specific rules inevitably lead to a lack of uniformity in terms of both technological platforms as well as access.

Video Sites for Surgeries

The proliferation of broadband Internet access has made streaming video an everyday reality, and many surgeons now take advantage of a variety of websites offering videos of procedures. One such site is Medline Plus, which offers links to videos of many different procedures and operations at varying levels of medical sophistication, from simple explanations to detailed step-by-step videos.¹¹ A related site that provides content to Medline Plus is ORLive.com, which offers both streaming live videos of surgery as well as an extensive archive of procedures. The site has videos aimed at all levels of users. ORLive.com advertises itself as useful for clinical education, consumer education, product launches, and physician promotion.¹² Another site, MEDtube.net, bills itself as "the world's largest online catalogue with high-quality content of clear practical and educational value."¹³ Founded by two surgeons, the site was launched in July 2011. Content uploaded to MEDtube.net is reviewed by MDs prior to publication on the site. Unlike other sites, MEDtube.net is aimed specifically at healthcare

professionals, and users must go through a free registration process prior to viewing some content. Finally, no mention of streaming video in this age would be complete without also noting the extensive collection of operative videos available on Youtube.com. As is the case with many other Youtube videos, quality is variable.

UpToDate®

One of the most powerful and comprehensive electronic reference sources for practicing clinicians is UpToDate® (www.uptodate.com), an online database of physician-written articles aimed at helping providers make optimal point-of-care decisions. Published by Wolters Kluwer (Alphen aan den Rijn, The Netherlands), UpToDate® articles are written by a network of over 5,100 physicians and edited by 46 in-house physician editors.¹⁴ Articles are updated frequently with the latest available evidence in the literature. The database currently contains articles on 9,500 topics across 19 specialties, with most focusing on questions and dilemmas that arise in clinical practice. A typical article will review epidemiology, pathophysiology, and treatment options, with a summary at the end that provides both a recapitulation of the article's main points as well as treatment recommendations in bullet-ed format. Additionally, UpToDate® maintains a website of free, patient-focused articles written on a nontechnical level that explain diseases and their treatments in a manner easily understood by nonmedical personnel. UpToDate® is available to professional users via individual subscriptions, or more commonly, via an institution's subscription to the service. A mobile application for Apple devices is currently available, and an Android application is under development; additionally, UpToDate® is accessible through the mobile web browser of any subscriber's device.¹⁵ A recent article in the *Journal of Hospital Medicine* found that adoption of UpToDate® use was associated with small, but statistically significant improvements in length of stay, risk-adjusted mortality rates, and quality performance, at least in smaller nonteaching hospitals.¹⁶ Whether or not this a reflection of the quality of the individual physician practicing evidence-based care or the impact of that care remains to be seen, but is certainly intriguing.

MicroMedex

MicroMedex is another popular Internet-based database focused on drugs. Published by Thomson Reuters, MicroMedex is an amalgamation of many different drug databases and aims to be an authoritative, complete source of drug information.¹⁷ Drugs can be searched by trade or generic name, with entries containing information on treatment uses, dosing, contraindications and adverse effects (down to individual case reports), pregnancy cautions, class, regulatory status, mechanism of action and pharmacokinetics, and toxicity ranges. MicroMedex also provides a variety of unique useful tools, including patient-tailored dosage and toxicity calculators, a drug-interaction checker, an intravenous drug compatibility checker, and a mobile application for Apple devices as well as mobile web accessibility through any web-enabled mobile device.¹⁸

Society Websites

Several professional societies, such as the American College of Surgeons (ACS) and the American Society of Colon and Rectal Surgeons (ASCRS), maintain websites for their members with a host of resources. At www.fascrs.org, society members can access an electronic version of the *ASCRS Textbook* along with a variety of materials on continuing medical education (CME) topics. They may review grant and award opportunities, access the journal *Diseases of the Colon and Rectum*, and even review inherited colorectal cancer registries. The site also has links to its regular newsletter and to policies and practice position statements provided by the ASCRS. ASCRS also includes a database of speakers available to lecture on topics, broken down by state of residence.¹⁹

The ACS's web portal, www.efacs.org, is designed to facilitate access to several "members only" resources and benefits. These include access to a variety of databases, publications, scholarships and other awards, educational opportunities including CME, and insurance products.²⁰ In addition, within the eFACS web portal, there exists many specialty-based "communities," including a Colon & Rectal Surgery community, which offer topics of the month, fulltext review articles, online technical videos, and case presentations with expert opinions regarding management.

Society websites also provide links to the American Board of Surgery website. Currently, electronic access to board websites is the easiest and most efficient means of continued documentation required for board certification and maintenance of certification. Instituted in 2005 for diplomats of the American Board of Surgery and The American Board of Colon and Rectal Surgery, maintenance of certification requires documentation of continued medical education and the quality of outcomes for all surgeons every three years. The web has made the institution of these quality initiatives a reality.

Journal Websites

Virtually every journal maintains a website through its publisher. These websites typically have a listing of the table of contents of their most recent issue, along with a searchable database of abstracts available free to the public. However, only subscribers are able to access fulltext versions of articles, with individual users required to purchase articles for usually more than \$10 an article. Beyond this, these websites offer little more than what is available on PubMed. The website for the journal *Diseases of the Colon and Rectum* has links to an Apple mobile device application for the journal, as well as instructions for contributing authors and an online manuscript submission system.²¹

Journal websites have enhanced the method of access and ease of reviewing of all primary and review of articles submitted for publication. No longer are multiple copies or reprints needed for mailing to multiple reviewers. Turnover time of submitted articles is now only dependent on the time it takes for reviewers to complete the reviewing assignments. Authors no longer have a need for maintaining reprints to mail to inquiring investigators. Data from articles are easily accessed

for presentation and reproduction with appropriate citation of credit. The printed journal is more of a rarity than the norm.

The Future: A Paperless—and Publisherless—World?

Recent legislative advances have furthered the move away from paper and toward a digital age in the biomedical world. NIH's new Public Access Policy is designed to ensure the public can access any published research funded by that institution. As part of federal legislation enacted in 2008, all peer-reviewed manuscripts accepted for publication based on NIH-funded research must now be submitted electronically to the National Library of Medicine. NLM, in turn, is required to make those manuscripts publically accessible in complete form in PubMed.²²

This policy effectively removes private publishers from the research process. Advocates argue that the policy enables both scientific competition and collaboration and ensures that taxpayers who have already funded research do not have to pay again to see the results of that work. However, major publishing groups like the Association of American Publishers argue it represents an unfair government mandate on private-sector publishing.²³ Another bill in Congress, the Federal Research Public Access Act of 2012, would extend to all government-funded research the requirement for electronic versions of published work to be publically accessible.²⁴

Conclusion

Currently, individual institutions must come to their own agreements with large academic publishers for access to scholarly journals and publications not funded by NIH research, often at significant cost. As an increasing number of institutions cancel their print subscriptions to academic journals, publishers have adapted by increasing the electronic availability of their materials. How major publishers will adapt in an environment heavily influenced by the Public Access Policy remains to be seen. To be sure, publishers make significant contributions in the editing, formatting, and distribution of scientific ideas. As science has shifted over the centuries from the exchange of letters, to indexes, to peer-reviewed journals, one wonders how the digital age will affect the next step in that progression. The paperless revolution is already here; a revolution in publishers' already-changing role in medical research may be soon at hand.

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