網際網路對醫療資訊傳播的影響
Impact of Internet on Medical Information Distribution

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ABSTRACT

This paper describes the Internet phenomenon and how its exponential growth affect the pattern of medical information distribution.   Its impact on the healthcare industry as a whole is also discussed.   A search results are presented to demonstrate the density of medical information on the Internet.   Several medical resources are described under the categories of clinical research and community-oriented information server.

KEYWORDS: Internet. Medical Information

摘要

本文描述網際網路近年來的成長及其對醫療資訊傳播之影響，亦探討其對醫療界之衝擊。文中以網路搜尋的結果展示網際網路上之醫學資訊密度，並以臨床研究及民眾導向分類描述網際網路上的重要醫學資源。

關鍵詞：網際網路・醫療資訊

Introduction

Internet is a global computer network that is growing exponentially in recent years. More than 45 million users from all over the world are connected to this ubiquitous computing and communication network. Through the years, we have enjoyed the

convenience of electronic mail (e-mail) which let us receive letters that was written a few minutes ago by friends thousands of miles away without even leaving our desk. The Internet also enabled us to transfer digital files to and from anyone connected to the net with ease. However, not until the invention of World-Wide Web (also called WWW, triple-W or "the Web") did we realize the great potential of the Internet. Using state-of-the-art computer techniques, the Web allows presentation of multimedia components such as picture, sound and video on the Internet. Innovative applications such as Virtual shopping center, MTV library, Virtual museum and many more others are being established on the Internet at accelerated pace.

Except for vigorous commercial use, the World-Wide Web concept can be a great tool to facilitate the distribution of biomedical information, remote medical education and even health care provision because of its expressiveness of multimedia components and its interactive nature.

Background

According to the "Internet Domain Survey" conducted by Network Wizard, a communication company that specializes in Internet survey, the Internet composed of

9,472,000 host computers at January 1996 (FIGURE GR). It is easily the fastest growing medium and information repository in the world. The most dramatically expanding area of the Internet is the World Wide Web. Graphically speaking, the Web is a loose network of sites and documents tied together by hyperlinks. The Web allows an organization to publish documents with multimedia components such as images, sound and video on the Internet at minimal cost.
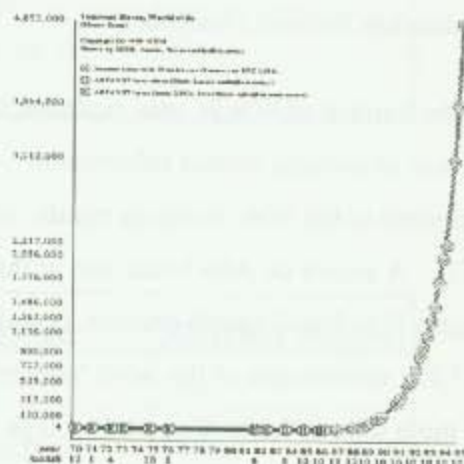

FIGURE GR. The growth of host computers connected to the Internet from 1970 to 1995.

The number of computer users who are visiting the World Wide Web (WWW) is increasing almost geometrically and the number of sites that Web surfers can visit is growing exponentially. In 1993, one source listed 130 sites. By December of 1994 that number stood at 30,000. In August of 1995 it had jumped to more than 120,000. Every month, more than 8,000 new sites make their debut on the World Wide Web. In terms of the amount of information, there is a total of 3.5 Terabyte or 35,000,000,000,000 byte of information retrieved from the WWW during the one month period of April, 1995 according to statistics from NSFNET (National Science Foundation Network) backbone.

As the number of WWW sites explodes, the amount of medical related information published to the Web increases rapidly as well. A search on Alta Vista, one of the largest Web-based search engines, revealed 667,521 occurrences of the word "cancer" on more than 100,000 Web pages. For people that use medical or medically related information, the Internet has evolved gradually from an "interesting place" to a compelling resource for medical researchers and clinicians.

Preliminary Study

Internet Seach Results

In order to understand the scale of medical information that we can obtain from the Internet, we selected 10 of the most popular World Wide Web search engines as our starting point. These include (1) Alta Vista (2) Open Text (3) Lycos (4) WebCrawler (5) Magellan (6) Yahoo (7) Excite (8) Point (9) InfoSeek and (10) ALIWEB.

With the consultation from one of the authors who is an urologist, we chose the field of prostate cancer research as the testbed for this study since the diagnosis and treatment for prostate cancer is still under active development and early treatment often leads to excellent results.

A series of queries were submitted to the Internet search engines and the counts of using "prostate cancer", in addition to "treatment" and "staging", as keywords were recorded. Since every search engine has its own syntax for combining keywords, the readers will notice differences between the queries submitted. Within each engine's flexibility of search, we did our best to find the counts of (1) prostate cancer (2) prostate cancer with treatment information (3) prostate cancer with

staging information. The search results
are as the following:

Search Engine: Alta Vista

Search for	Query Submitted	Matches (pages)
Prostate Cancer	+"prostate cancer"	5000
with Treatment	+"prostate cancer" +treat*	3000
with Staging	+"prostate cancer" + stag*	1000

Search Engine: Open Text

Search for	Query Submitted	Matches (pages)
Prostate Cancer	prostate AND cancer	891
with Treatment	prostate AND cancer AND (treat OR treatment)	702
with Staging	prostate AND cancer AND (stage OR staging)	231

Search Engine: WebCrawler

Search for	Query Submitted	Matches (pages)
Prostate Cancer	"prostate cancer"	326
with Treatment	"prostate cancer" AND (treatment OR treat)	163
with Staging	"prostate cancer" AND (stage OR staging)	56

Search Engine: Lycos

Search for	Query Submitted	Matches (pages)
Prostate Cancer	prostate cancer (options: match all terms, strong match)	3289

Search Engine: Magellan

Search for	Query Submitted	Matches (pages)
Prostate Cancer	Count of "prostate" minus count of "prostate -cancer"	1389

Search Engine: Yahoo

Search for	Query Submitted	Matches (pages)
Prostate Cancer	prostate cancer	15

Search Engines that do not give counts : Excite, Point, InfoSeek, ALIWEB

Four of the search engines were not listed because they only give a list of matched sites instead of the counts we need. Of the 6 that do return counts, Lycos, Magellan and Yahoo do not allow Boolean search and thus no accurate counts of "prostate cancer" combined with "treatment" or "staging" can be obtained. Differences in the data collection algorithm and policy may account for the great variation in the number of matched Web pages. For queries on "prostate cancer", Alta Vista turned out 5000 matches, while Yahoo found only 15 sites. One reason for this major difference could be that Alta Vista searches the whole Internet actively and aggressively by indexing all the contents of a Web site, while on the other hand, Yahoo only reviews voluntary submissions and does not index all the contents of a site.

MEDLINE Seach Results

To contrast the search results on the Internet, we also perform a similar search on the MEDLINE database. MEDLINE is the world's largest medical literature database from the National Library of Medicine in the United States which indexes more than 3200 medical journals and 6,000,000 citations. About 80% of the citations in MEDLINE come with an abstract, but the body of the article can be found in none of the citations. This database can also be queried on the Internet (in addition to the popular CD-ROM format) on several sites. The official MEDLINE Web site from Nation Library of Medicine can be found at : http://bbs.mc.ntu.edu.tw which requires a paid account to use. When we did a similar query to the MEDLINE database between 1985 and 1996, the result were as shown below:

MEDLINE database search

Search for	Matches (citations)
Prostate Cancer	710
with Treatment	344
with Staging	118

These numbers seem pale when compared to the results from the Internet search. The suitability of MEDLINE to be a potential candidate as a medical knowledge source is further impeded by its lack of body text and absence of hyperlinks between related topics.

Significance of Medical Information on The Net

This preliminary study gave us the insight that significant amount of information regarding prostate cancer can be found on the Internet. It may very well be the largest pool of digitized information on this specific topic. By properly utilize this highly accessible pool of information, we believe that useful amount of medical knowledge can be found to facilitate medical education and healthcare delivery.

Categories Of Medical Resources On The Net

Many medical or medically-related Web sites can be found on the Internet. Not all the sites aim for the same target audience. In general, sites set up by universities are more towards academic research or clinical practices while those established by companies tend to be more patient-oriented. The authors propose to classsify Web-based

medical resources into three different categories based upon their contents: research-oriented, clinical-oriented and community-oriented. We also call the WWW servers that serve such information Biomedical Information Servers (BIS) in the following text.

Research-oriented Biomedical Information Server

A research-oriented BIS should serve information that can aid biomedical researchers in different aspects of their research. For example, a Biomedical Research Project Database will let researchers find potential collaborative partners or valuable referential research projects from all over the world. In addition, a BIS that provides medical literature databases such as MEDLINE or AIDSLINE should be considered research-oriented since it aids the researchers in literature review and sometimes data collection. A Gene Bank or Protein Sequence Information database will let researcher search for the most up-to-date genetic code. While disease database such as tumor registry or AIDS patient registry will provide invaluable statistics and numeric clues to projects trying to find risk factors, causes or cures for such diseases. Some of the Web sites and its URL (Universal Resource Locator, the address of a Web site on the Internet) that

fall into this category are listed below:

- GenBank, National Center for Biotechnology Information, NIH
  http://www.ncbi.nlm.nih.gov/
- Protein Sequence Database
  http://www.ncbi.nlm.nih.gov/Recipon/bs_seq.html
- AIDS Clinical Trial Database
  http://health.nyam.org:8000/public_html/network/index.html
- Grant Database, Federally-Funded Research in the U.S.
  http://medoc.gdb.org/best/fed-fund.html

Clinical-oriented Biomedical Information Server

A clinical-oriented BIS aims to support clinicians or other healthcare providers in their daily medical decisions. For instance, a Practice Guidelines and Clinical Protocol Database keep clinicians informed about the latest development or consensus on medical practices. A Clinical Formula Bank can save physicians time in calculating various clinical parameters such as anion gap by hand. Furthermore, a Medical Decision Support Program Library on-line can provide tools that advise physicians on a specific patient's diagnosis or treatment. On the other hand, today's Internet also provide physicians with abundant educational materials such as Dermatology Image Bank, x-ray teaching

films or patient simulation cases. Some of the clinical-oriented Web sites and its URL are listed below:

- Clinician's Handbook of Preventive Services
  http://indy.radiology.uiowa.edu/Providers/ClinGuide/PreventionPractice/TableOfContents.html
- AHCPR Clinical Guidelines
  http://text.nlm.nih.gov/ftrs/gateway
- Multimedia Teaching Files and Patient Simulations
  http://vh.radiology.uiowa.edu/Providers/Providers.html
- The Interactive Patient
  http://medicus.marshall.edu/medicus.htm
- Taipei Medical CollegeMedical Image Bank
  http://www.tmc.edu.tw/medimage/default.htm
- OncoLink (Oncology Information Server)
  http://cancer.med.upenn.edu/

Community-oriented Biomedical Information Server

- The purpose of a community-oriented BIS is to satisfy the general public in their needs on medically-relation information. Such BIS can provide service such as medical Q and A, epidemic disease information, introduction to local hospitals and clinics or even a physician search engine that can match your symptom to

physicians with proper expertise. If applied appropriately, an organ database or donor/recipient matching database can be a life-saver for patients that desperately need an organ transplantation. Some examples of community-oriented BIS are listed below:

- Patient's Guide for Medical Problems
  http://text.nlm.nih.gov/ahcpr/ahcprp.html
- Iowa Health Book
  http://vh.radiology.uiowa.edu/Patients/IowaHealthBook/PatientInfo.html
- Physician Finder
  http://cos.gdb.org/maps/cos/exp/states/expstates.html
- Taipei Medical College Hospital, Opthalmology, Patient Information on Floaters
  http://www.tmc.edu.tw/hospital/ophthalmology/patients/floater.htm
- How Glasses Work - North Bay Network
  http://www.nbn.com/youcan/glasses/eyeglasses.html

Discussion And Conclusion

An Web-based BIS distinguishes itself with other information distribution modalities in that it is ubiquitous, interactive, concurrent, up-to-date and freely searchable. It is available as long as an Internet connection is present (basically, a phone line would suffice.) It is interactive in the way that you can have

real-time feed-back on your input. Many people can access the same piece of information in the same time and this information can be frequently updated without formidable cost like reprint a book. Unlike a book, the content of a BIS can be searched in many different ways such as Boolean search where you can combine several criteria to accomplish a search or natural language search that let you enter your request in spoken English.

New mechanisms such as Java (from Sun Microsystem) and visual script (from Microsoft) are still under development that will make BIS even more powerful than we can describe today. Information provided by BISs all over the world will gain more attention from healthcare providers and researchers. It is almost inevitable that those BISs become a necessary resource of information for those related to the healthcare industry. As the improvement of functionality and the richness of contents progress rapidly, we believe that a BIS can contribute not only to the distribution of biomedical information but advancement in the efficiency and quality of medical care and biomedical research.

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