Information Retrieval (Search)

What is Biomedical & Health Informatics?
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Information retrieval (IR)

- Field concerned with organization and retrieval of predominantly text-based information
  - But multimedia (e.g., images, sounds, video, etc.) and more complex databases are increasingly a part
- When I began work in this area (circa 1989), few physicians or scientists and virtually no patients had done an on-line search
  - Now everyone is searching!
More history: Who said the following and when?

• “It has become increasingly difficult to keep abreast of and to assimilate the investigative reports which accumulate day after day. My friend ... was ill at ease because he felt unable to control even the area of his own discipline; one suffocates, he once told me, through exposure to the massive body of rapidly growing information.”

Answer

• The previous was said by Bernhard von Langenbeck, a German surgeon, in 1872
• Another insightful quote comes from Herbert Simon (1971), an early artificial intelligence (AI) researcher,
  – “What information consumes is rather obvious: it consumes the attention of its recipients. Hence a wealth of information creates a poverty of attention, and a need to allocate that attention efficiently among the overabundance of information sources that might consume it.”
IR process and field

- Overview of IR process
- Field of IR
- Pertinence of IR to health and biomedicine

IR system

- Metadata
- Content
- Search engine
- Queries
- Retrieval
- Indexing
The intellectual tasks of IR

- **Indexing**
  - Assigning metadata to content items
  - Can assign
    - Subjects (terms) – words, phrases from controlled vocabulary
    - Attributes – e.g., author, source, publication type

- **Retrieval**
  - Most common approaches are
    - Boolean – use of AND, OR, NOT
    - Natural language – words common to query and content

IR also a growing part of “knowledge discovery” from scientific literature

- All literature
- Possibly relevant literature
- Definitely relevant literature
- Structured knowledge
- Information retrieval
- Information extraction, text mining
Major challenges in IR

- We have gone from information paucity to information overload
- Many topics we want to search on have multiple ways to be expressed – e.g., diseases, genes, symptoms, etc.
- The converse is a problem too: Many words and terms used to express topics have multiple meanings
- Balancing open access vs. providing for cost of production and maintenance

IR is now “mainstream”

- Internet (and likely search engine) use is now ubiquitous
  - Not only in developed countries (Perrin, 2015) but across world – http://www.internetworldstats.com
  - 71% of Internet users (59% of US adults) have searched for health information, with 35% using it for self-diagnosis (Fox, 2013)
- “Search engine optimization” (SEO) is a key function used by many companies and organizations (Moz, 2015)
  - https://moz.com/beginners-guide-to-seo
  - Some are lucky, e.g., last name of “Hersh”
The Web has changed the nature of search

• Three major uses (Broder, 2002)
  – Informational – seeking information (39-48%)
  – Navigational – looking for a specific page, e.g., a home page (20-24%)
  – Transactional – perform transactions, e.g., on-line purchasing (30-36%)

• We are in the era of “adversarial” search – there is content we do not want to retrieve (Castillo, 2011; Smith, 2014)
  – Some of the content we might not want to retrieve is “fake news,” which came to the fore in 2016 (Holan, 2016)

• Growing privacy concerns about tracking our searching (Huesch, 2013; Libert, 2015)

IR and online access firmly planted in health and biomedicine

• Biology is now defined as an “information science” (Insel, 2003)
• Pharmaceutical companies compete for informatics/library talent (Davies, 2006)
• Clinicians cannot keep up – average of 75 clinical trials and 11 systematic reviews published each day (Bastian, 2010)
• Search for health information by clinicians, researchers, and patients/consumers is ubiquitous (Purcell, 2012; Google/Manhattan Research, 2012)
  – It’s even part of “meaningful use” – text search over electronic health record notes (Metzger, 2012)
Use is ubiquitous among physicians (Google/Manhattan Research, 2012)

- Most have multiple devices – 99% with a desktop or laptop, 84% with a smartphone, and 54% with a tablet
- Spend twice as much time using online resources as print resources
- Even physicians aged 55+ heavy users – 80% own a smartphone, 84% use search engines daily, and 9 hours per week is spent online for professional purposes
- Search engine use a daily activity – 84%, with average of six searches done per day and 94% using Google
- When looking for clinical or treatment information, about a third click first on sponsored listings from a search
- About 93% say they take action based on searching – everything from pursuing more information to sharing with a patient or colleague to changing treatment decisions
- On smartphones, searching is preferred over mobile apps – 48% of use time with a search engine, 34% with mobile apps, and 18% going to specific Web sites in a browser or with a bookmark
- Spend about 6 hours per week watching online video, with about half of that time spent for professional purposes

What kind of health information do consumers search for? (Fox, 2011)

<table>
<thead>
<tr>
<th>Health topic</th>
<th>% searching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific disease or medical problem</td>
<td>66%</td>
</tr>
<tr>
<td>Certain medical treatment or procedure</td>
<td>56%</td>
</tr>
<tr>
<td>Doctors or other health professionals</td>
<td>44%</td>
</tr>
<tr>
<td>Hospitals or other medical facilities</td>
<td>36%</td>
</tr>
<tr>
<td>Health insurance – private or government</td>
<td>33%</td>
</tr>
<tr>
<td>Food safety or recalls</td>
<td>29%</td>
</tr>
<tr>
<td>Environmental health hazards</td>
<td>22%</td>
</tr>
<tr>
<td>Pregnancy and childbirth</td>
<td>19%</td>
</tr>
<tr>
<td>Medical test results</td>
<td>16%</td>
</tr>
</tbody>
</table>
How to find more information about IR in health and biomedicine

- From me!
  - Web site: www.irbook.info
- Chapters in other books, e.g., Shortliffe (2014), Sanchez-Mendiola (2014)
- OHSU BMI 514 – Information Retrieval
- Plenty of other books, journals, and other sources

Why is IR pertinent to health and biomedicine?

- Growth of knowledge has long surpassed human memory capabilities
- Clinicians have frequent and unmet information needs
- Researchers must frequently update their knowledge in new areas quickly
- Primary literature on a given topic can be scattered and hard to synthesize
- Non-primary literature sources are often neither comprehensive nor systematic
- Web is increasingly used as source of health and biomedical information