Increasingly, the explosion in scientific knowledge is overwhelming both researchers and practitioners in the health professions. The managed care pharmacist today needs a constant and current sense of the basic pharmaceutical sciences, clinical pharmacy, pharmacy management systems, health policy and ethics, new drug introductions, pharmacoeconomics, and pharmacoepidemiology. Monitoring the ever-changing pharmaceutical industry is now more than a mere pastime.

Fortunately, there has been a corresponding growth in support available to the pharmacist manager, practitioner, and researcher, in the form of free Internet resources and other proprietary databases that allow access to published materials, organizational contacts, and other resources for informed decision making.

Evidenced-based clinical approaches, cost-effective care strategies, and program descriptions and evaluations can all be found in databases described below.

Knowing how to navigate these information services is crucial to avoiding information overload. This article will first describe some information retrieval databases that can be used to search for articles relevant to pharmacy administration. It will then outline search criteria to determine the yield of each database and demonstrate how to decide the relevance of potential information sources. We restricted the scope of this article to computer-searchable and accessible databases.

### Bibliographic Databases

The bibliographic database is the most common source for published articles. Most bibliographic databases allow users to locate articles by keyword, author, and title. The search results usually yield title, authors, source, and an abstract of the article.

The abstract usually provides enough information about the relevance of an article to support a decision about whether to obtain a full-text copy. Articles from core journals can be found in a local library or university library system and sometimes through an interlibrary loan. Many information database providers will supply a photocopy of articles or allow users to download the article for a fee.

### MEDLINE


MEDLINE is the premier medical information source. Since June 26, 1997, the MEDLINE database has been accessible, free of charge.

MEDLINE covers medicine, nursing, dentistry, veterinary medicine, the health care system, and the preclinical sciences. It contains bibliographic information from over 3,900 biomedical journals published in the United States and 70 foreign countries, for a total of 9 million records dating back to 1966. The database is updated every week; each month about 33,000 new citations are added.

Using "pharmacy," "pharmaceutical," or "pharmacist" in keyword searches on MEDLINE produces 14 titles, including the American Journal of Health-System Pharmacy, the Journal of Clinical Pharmacy and Therapeutics, and the Journal of the American Pharmaceutical Association.

Many users find that modifying a search term even slightly can bring very different results. For example, using "asthma" as a keyword for a MEDLINE subject search articles brought up 2,262 articles. However, if "asthmatic" is used, the search produces only 707 articles. Because no mechanism has yet been established to directly link two terms like this, even a minor difference in phrasing may mean missing an important article.

A remedy for this problem is to make use of NLM's Medical Subject Headings (MeSH) thesaurus. MeSH indexes articles in NLM databases using a hierarchical system to structure a set of terms or subject headings. You can choose to either broaden or narrow the search terms according to the "tree" structure of the thesaurus, or choose related terms with which to link the tree's branches. For example, the hierarchical structure of the MeSH term "drug utilization" is:

N. Health Care
N4. Health Services Administration
Organization and Administration
Pharmacy Administration
Drug Utilization
Drug Utilization Review

### Authors

Swu-Jane Lin, M.S., Ph.D., is Visiting Assistant Professor in Pharmacy Administration, and J. Warren Salmon, Ph.D., is Professor of Pharmacy Administration, University of Illinois at Chicago, Chicago, IL.

AUTHOR CORRESPONDENCE: Swu-Jane Lin, M.S., Ph.D., University of Illinois at Chicago, 833 S. Wood St., M/C 871, Chicago, IL 60612-7229; Tel: 312-355-5666; Fax: 312-996-0868; E-mail: slin5@icarus.cc.uic.edu.

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Clearly, using MeSH effectively can produce a search result that is comprehensive and consistent. Consequently, the MeSH thesaurus system is now built into all NLM-produced databases, including MEDLINE; users simply input any keyword and then select “find MeSH/meta terms.” The system will respond with a list of suggested search terms. For example, if you type in “asthmatic” as a keyword, and then select “find MeSH/meta terms,” the MeSH suggested list of search terms does indeed include “asthma.”

The MeSH system also provides a “concept” list to help you map a query better. For example, using “disease state management” as a keyword on MEDLINE will return more than 2,000 articles (as of February 10, 1999), only a few directly related to disease state management programs. To tackle this problem one must use a concept as a second search term and once again select “find MeSH/meta terms.” The Internet Grateful Med (an interface of MEDLINE) will provide a list of meta-thesaurus concepts which will include “managed care programs.” Using this phrase as a second search term produces 20 fully relevant articles.

Because MEDLINE has a clinical orientation, false negatives (failure to retrieve relevant articles) and false positives (retrieval of irrelevant articles) could be common in searches for articles related to administration and management. A database such as HealthSTAR that is oriented to health service might be of more use.

HealthSTAR
www.nlm.nih.gov/pubs/factsheets/online_databases.html#healthstar
HealthSTAR is a bibliographic citation database created in 1996 by merging two NLM databases, HEALTH (Health Planning and Administration) and HSTAR (Health Services/Technology Assessment Research).

HealthSTAR contains three million citations from 1975 to the present, both clinical (emphasizing the evaluation of patient outcomes, the effectiveness of procedures, programs, products, services, and processes) and nonclinical (emphasizing health care administration, economics, planning, and policy).

IPA (International Pharmaceutical Abstracts)
www.ovid.com/databases/index.cfm
IPA is the bibliographic database most specific to pharmacy administration and pharmacy service research. Produced by the American Society of Health-System Pharmacists (ASHSP), it covers approximately 600 titles ("subjects of drug therapy, toxicity, pharmacy practice, legislation, regulation, technology, utilization, bio-pharmaceutics, information processing, education, economics, and ethics as related to pharmaceutical science and practice"), and contains over 300,000 records from 1970 to the present. JMCP is indexed in IPA.

IPA includes all abstracts from ASHSP-annual and midyear clinical and home care meetings, as well as American Pharmaceutical Association (APhA) and American Association of Colleges of Pharmacy (AACP) meetings; articles from state pharmacy journals, and articles that offer continuing education credit. IPA provides numerous references on topics relating to pharmacoeconomics and pharmaceutical care. The paper version of the database is updated semi-monthly, and the CD-ROM version is updated monthly.

CINAHL (Cumulative Index to Nursing and Allied Health Literature)
www.cinahl.com
CINAHL is an index database that covers journal articles, dissertations, and other publications in nursing and allied health from 1982 to the present. It indexes some research instruments and provides full text of selected others; a special feature is the collection of nursing standards as well as the state nursing journals.

The database, www.cinahl.com, produced by CINAHL Information Systems, covers over 950 journals in cardiopulmonary technology, emergency services, health education, med/lab technology, medical assistance, medical records, occupational therapy, physical therapy, psychological technology, respiratory therapy, social sciences, and surgical technology, with some attention to biomedicine, the behavioral sciences, management, and education. Currently, the database contains over 250,000 records, is updated monthly, and is available in both CD-ROM and online. CINAHL indexes 14 pharmacy and pharmacology-related journals.

EMBASE (Excerpta Medica Database)
www.elsevier.com
EMBASE, the Excerpta Medica database produced by Elsevier Science, indexes literature in biological science, biochemistry, clinical medicine, human medicine, forensic science, pediatrics, pharmacy, pharmacology and drug therapy, pharmacoconomics, psychiatry, public health, biomedical engineering and instrumentation, and environmental science. Its comprehensive treatment of drug-related information makes EMBASE obviously useful for drug-related searches.

EMBASE covers over 3,800 journals from approximately 70 countries; it currently contains over 7 million records, adding more than 400,000 each year. Like the NLM databases, EMBASE uses a thesaurus system, EMTREE, a hierarchically structured, controlled-subject vocabulary, to help users retrieve articles. EMTREE contains more than 39,800 controlled vocabulary terms (21,240 drug terms and 18,630 medical terms) and 120,000 synonyms. The company also produces subsets of EMBASE for specific disciplines. The EMBASE Pharmacoconomics & Disease Management database is devoted to such research areas as health care costs, managed care, pharmacoconomics, economic evaluation, health insurance, quality of life, treatment outcomes, resource management, hospital costs, and practice guidelines. It currently contains more than 138,000 abstracts and citations from the past eight years.

Tables of Content Indexes
A bibliographic database is very useful for retrieving information addressing a specific area of interest, for example, asthma disease management. However,
there are times when one might wish to survey journals in a particular field to watch for potentially useful implications or applications or simply in order to keep up with research in that area. For example, a user interested in asthma disease management might want to see what is being published generally in Chest and the Journal of American Health-System Pharmacy. Databases that provide “tables of contents” can be searched by subject for a quick scan of the titles and authors of articles published in each issue of a relevant journal to see which might warrant reading of the abstract or even the full article. Making good use of searchable databases for tables of contents can save time and money.

Current Contents Life Sciences
www.isinet.com/prodserv/cc/ccprod.html
Current Contents, published by the Institute for Scientific Information, has seven weekly editions in agriculture, the arts, and others; medical articles are indexed under Life Sciences. Complete bibliographic data for journal articles, reviews, editorials, corrections, and conference proceedings are included, but the database does not provide abstracts. The database is provided in print, CD-ROM, and other media; the print and CD-ROM versions are updated weekly.

Current Contents indexes over 1,370 journals. The keywords “pharmacy” or “pharmaceuticals” retrieved 14 pharmacy-related journals.

E-mail Service for Tables of Content

Some Web sites of academic associations and publishers will e-mail tables of contents to subscribers, free of charge. For example, the American Medical Association, www.ama-assn.org will e-mail tables of content for nearly a dozen journals, including JAMA, Archives of Family Medicine, and Archives of Internal Medicine.

The vast majority of journal publishers provide tables of contents and often abstracts online. Sometimes, one can even find online the full text of articles addressing certain key issues.

Full-Text Articles

To accommodate the increasing demand for remote access to documents, more and more full-text databases are becoming available online. Several proprietary databases can be accessed both through a local library or the Internet.

OVID
www.ovid.com/products.cfm
The OVID Company provides six full-text databases: the Core Biomedical Collection (CBC), Biomedical Collections II (BC2), III (BC3), and IV (BC4), the Mental Health Collection (MHC), and the Nursing Collection (NURC). The CBC contains articles from 1993 to the present, the others articles published after 1995.

The MHC covers 10 journals, each of the other five collections about 20 journals. The only journal that contains the word pharmacy in its title is the American Journal of Health-System Pharmacy in the BC4 database. Interested readers should visit the Web site for a complete list of included journal names and some general information about these full-text databases.

ABI/Inform
www.oclc.org/oclc/man/6928fsdb/abi_inform.htm
This database compiled by the UMI Company contains citations from 1,805 periodicals. Articles included relate to business and management and have been published in international professional publications, academic journals, or trade magazines. Full text is available online for selected periodicals.

Using “health” as the keyword in a title search returns some 29 publications with full-text articles in the database. These periodicals include the Health Care Financing Review, Health Care Management Review, Health Services Research, Hospital & Health Networks, and the Journal of Health Politics, Policy & Law. Drug Topics and Pharmaceutical Executive both provide full-text articles. Its business and management orientation and the full-text articles make this a particularly convenient resource.

Medscape.com

www.medscape.com
Some Web sites that provide information to both consumers and health professionals also provide full-text articles. One is Medscape, which provides the full texts of selected articles from about 60 medical journals and news periodicals, including Drug Benefit Trends, U.S. Pharmacist, and JMCP. Keyword searching is available.

Again, many journal publishers provide full-text articles on their own sites. For example, two years worth of JMCP has been posted on www.amcp.org, with older issues being added as time permits.

Citation Database

The Science Citation Index compiled by the Institute for Scientific Information indexes references (footnotes or bibliographies). What makes the SCI different from other bibliographic databases is its ability to track not only references cited by an article, but also articles that have cited that article. The SCI can be used to discover who is referencing what research and to track the studies published by others in a particular field of interest.

SCI thus allows researchers to track the history or methodology of an idea since its first appearance. How often an article is cited suggests the impact of that article on the field.

The SCI covers approximately 3,500 journals in a broad range of disciplines; it can be found at www.isinet.com/jis/products/citation/sc/index.html. Using “pharmacy” and “pharmaceutical” as keywords retrieved 16 journal names, including the American Journal of Health-System Pharmacy, the Journal of Clinical Pharmacy and Therapeutics, and Pharmacy World & Science.

Newspapers and Magazines

The UMI Company has compiled a database that abstracts reports from 32 newspapers, including the New York Times, the Wall Street Journal, and the Washington Post. Though this is obviously useful, the lack of full-text articles is a disadvantage.

UMI also compiles ProQuest, which
Researching Managed Care Pharmacy Using Internet Searches

Pharmacy-Related Journals Covered and Articles Retrieved From Selected Databases, 1990 to February 1999

<table>
<thead>
<tr>
<th></th>
<th>MEDLINE</th>
<th>HealthSTAR</th>
<th>IPA&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Science Citation Index Expanded and Social Science Citation Index</th>
<th>Current Contents Life Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total journals collected</td>
<td>About 3,900</td>
<td>—&lt;sup&gt;b&lt;/sup&gt;</td>
<td>About 650</td>
<td>3,500</td>
<td>1,370</td>
</tr>
<tr>
<td>Journal titles with keywords pharmacy, pharmacist, or pharmaceutical</td>
<td>15</td>
<td>—&lt;sup&gt;b&lt;/sup&gt;</td>
<td>More than 216</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>Articles with keyword formulary</td>
<td>590</td>
<td>875</td>
<td>1,233</td>
<td>500</td>
<td>—</td>
</tr>
<tr>
<td>Articles with keywords&lt;sup&gt;a&lt;/sup&gt; disease state management</td>
<td>1,467</td>
<td>20,562</td>
<td>90</td>
<td>11</td>
<td>—&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>Articles with keywords&lt;sup&gt;a&lt;/sup&gt; economic evaluation and pharmaceuticals</td>
<td>19</td>
<td>49</td>
<td>9</td>
<td>3</td>
<td>—&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>Articles with keywords pharmacy network</td>
<td>46</td>
<td>59</td>
<td>27</td>
<td>2</td>
<td>—&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>Articles with keywords quality and pharmacy services</td>
<td>394</td>
<td>245</td>
<td>22</td>
<td>0</td>
<td>—&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup>When more than one keyword is used as a search term, the retrieving logic looks to see if the keywords appear in a citation, but not necessarily in the order as inputted by the user or as a specific phrase. Therefore, a user typing disease state management as keywords could retrieve an enormous number of irrelevant articles. Strategies to improve search results are explained in the text.

<sup>b</sup>HealthSTAR collected articles from a variety of sources, and a detailed list of all information sources is not available.

<sup>c</sup>This is only the estimated number of journal listings due to the use of abbreviations; consequently, one may have failed to retrieve some journals in IPA.

<sup>d</sup>Current Contents is a journal-based database, and keyword searches for articles are, therefore, not available.

Note: MEDLINE has the most sophisticated searching mechanism, processing keywords through a set of Automatic Term Mapping functions and matching them against a MeSH translation table, a journals translation table, and a phrase list. Some proprietary databases may match keywords with words in titles, abstracts, or keyword listed in an article in order to retrieve their search results.

Many newspapers provide free access to news at their Web sites. As with any other electronic data, online articles are searchable and can be saved and categorized. Users who find themselves overwhelmed by the enormous number of news articles available may like to try a filtering program.

A free program, PointCast, can be downloaded from www.pointcast.com/?pcnidx. PointCast aggregates news and information from over 700 sources and pushes it over the Internet onto a viewer's desktop. The long list of channels available includes a variety of sources of global and national news, business and industrial news, federal and state government information, and health care related information. One can tailor these channels to individual needs and interests, or choose to read only a particular section of a single broadcasting channel, for example, only health-related reports on CNN.

Of interest to pharmacists in managed care will be the link to the F-D-C Reports; the summary of current articles from more than 20 journals provided by SilverPlatter Information, Inc.; and the daily news releases from Johns Hopkins University and Health System, the NIH, and Reuters Health Information Services. The program allows access to AHRQ guidelines, and several channels devote themselves almost exclusively to managed care, pharmaceutical industry, legislative, and regulatory matters.

### Special Purpose Databases
Many public and private organizations that compile databases covering specific fields of interest put their work on the Internet for public use. The AHRQ (Agency for Healthcare Research and Quality) provides searchable and downloadable clinical practice guidelines (www.ahrq.gov/data) and the CONQUEST database, which is a compilation of clinical performance indicators (www.ahrq.gov/qual/conquest.htm).

The research organization RAND provides a bibliography of health-related research and a search engine for abstracts of RAND publications (www.rand.org).

At the CDC Wonder site (wonder.cdc.gov) CDC has put together some 30 data sets, several of which are searchable bibliographic databases. CBA/CEA (cost benefit/cost effectiveness) provides 3,206 articles retrieved from MEDLARS, CATLINE, and other sources of health policy, planning, and administration literature. CDP

does provide the full text of articles from 150 newspapers. This can be found at www.umi.com/hp/Features/Papers/Selectable.
(Chronic Disease Prevention) contains three bibliographic databases. The Health Promotion and Education database may be
Continued on page 213
of most interest to managed care pharmacists, as it contains over 20,000 bibliographic citations and abstracts on disease prevention and health promotion. The MMWR (Morbidity and Mortality Weekly Report) data set contains articles published in MMWR since 1982. Queries can be performed at the CDC Wonder site to find census, morbidity, and mortality data for subgroups of the U.S. population.

The Center for Health Care Strategies is a nonprofit organization affiliated with the Woodrow Wilson School of Public and International Affairs at Princeton University. The Center carries out and funds research on Medicaid managed-care programs and on chronic illness. Its Web site (www.chcs.org/chcsinfo.htm) summarizes research undertaken by the Center and has an index of issues in Medicaid managed care and a list of relevant links.

Guide to Searches
Table 1 illustrates the differences between some of the databases discussed and shows how they can be used efficiently across a small sample of pharmacy administration topics.

The problems arising when searching the information retrieval databases concern how to select both the appropriate database and the appropriate search term or strategy. An inappropriate database will have low relevance to the study topic. For example, using pharmaceutical care as keywords in a MEDLINE search for articles published after 1990 will retrieve more than 1,700 articles, but most concern the biological or clinical study of pharmaceuticals. This demonstrates that searching a concept against databases that are not designed to cover it will result in a significant number of false positive hits. Moreover, inappropriate database selection may cause a number of false negatives as well. For example, since the Journal of Health Economics is not indexed in MEDLINE, a MEDLINE search will fail to retrieve any articles from it.

Until an automatic tool is available, it is probably best to use IPA as the starting point for searches relating to managed care pharmacy. For a broader scope, HealthSTAR is also useful to search. Since HealthSTAR allows users to include health articles indexed by MEDLINE in the same query process, there is no need to repeat the query later in MEDLINE itself. Users may, however, sometimes need to consult MEDLINE for background articles, such as those addressing disease biology, pharmacology, or the clinical effects of pharmaceuticals.

For users who need to address general economic or managerial studies, databases include EcoLite, produced by the Journal of Economic Literature, and ABI INFORM. On the other hand, users with a narrower field of interest should look to databases that claim to provide the specific information. For example, EMBASE claims to collect a large number of articles on pharmacoeconomics.

The phrasing of a query term and the search strategy employed can also affect the hit and miss rate of a search. For example, some databases allow users to target searches by placing double quotation marks around the search phrase. If pharmaceutical care is used as a query term in MEDLINE to search for articles published after 1990, 1,760 citations are returned. If “pharmaceutical care” (with double quotation marks) is used, the result is a smaller but markedly more relevant 298 articles.

The problem is worsened when different databases interpret the same query differently. In MEDLINE, the query term disease state management will be interpreted as meaning any articles that have any of those three words appearing in any citation field. As a result, thousands of citations, mostly irrelevant, will be retrieved. If the same term is used to conduct a search on IPA, a much more modest number of articles will be recovered, but they will be much more relevant.

Three simple rules may make database searching more effective for researchers:
• Spend a little time learning about the scope and focus of any database you intend to search.
• Use “force mapping” (double quotes around the phrase) for specific phrases whenever possible.
• Use multiple search terms to refine your query; for example, by adding a concept term from the MeSH thesaurus.

Bearing these three rules in mind will greatly enhance the quality of Internet search results.

Conclusion
This article has delineated information retrieval resources to benefit managed care pharmacy and offered practical suggestions for their use. Information about the health sciences is continually altering and expanding, making it, as a body of knowledge, ever harder to master.1

In the future, intelligent information filtering systems will help users faced with large volumes of information by automatically retrieving and then filtering updates of relevant new medical information.3 These filtering systems will record the online behavior of the user, creating a profile of index terms contained in Web pages noted previously. In essence, information retrieval systems will take into account the user’s dynamically changing criteria of relevance.

References

Note
In just the last month (April 2001), the National Library of Medicine has integrated the MEDLINE