



# INFORMATION RESOURCES FOR PUBLIC HEALTH PRACTICE

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## INTRODUCTION

### BACKGROUND

This paper examines information resources of particular value in supporting the practice of public health. The users of these resources are assumed to be public health practitioners; practice, in the sense used throughout this examination, occurs at the local level, where the programs and interventions that comprise public health interact with the community.

The observations and examples that form the basis of this paper are taken from work done in connection with the Information Network for Public Health Officials (INPHO) project in Washington State.\* (The needs assessment portion of this work is described elsewhere in this issue of the *Journal of Urban Health* by Patrick O'Carroll and his colleagues.)

From 1995 to date, I have worked with staff from the Washington State Department of Health and the University of Washington in training staff of local health departments throughout the state in the use of Internet resources. I also have assisted with focus groups on on-line resource and informatics training needs for segments of the public health workforce in the state (also described by O'Carroll and associates in their article). In keeping with my experience, the focus here is on the work of the practitioner rather than the policymaker or educator. Practitioners are assumed to be staff of local health departments, although they may be affiliated with other agencies or community-based organizations. Some practitioners, especially at the senior manager or administrator level,

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\*INPHO is a Centers for Disease Control (CDC) initiative to facilitate information infrastructure development among state and local health departments. Refer to the CDC INPHO Web site at <http://www.cdc.gov/inpho/inpho.htm>.

also may serve in policy or educator roles, but the assumption in this examination is that a part-time practitioner is the same as a full-time practitioner.

#### DEFINITIONS

*Public health practice.* It is accepted and understood that public health is a complex, multidisciplinary field. Where does the practice of public health fit within this? It is now customary to define public health practice in terms of its widely accepted core functions: assessment, policy development, and assurance. These terms are useful in explaining what public health encompasses and what is done under the umbrella of public health. Especially from the standpoint of information resources, the core functions approach to defining public health practice serves to illustrate the diversity of resources required to support the array of functions. Assessment encompasses assessing community health needs, investigating the occurrence of adverse health effects and health hazards, and analyzing the etiologic and contributing factors of health outcomes in the community.<sup>1</sup> These are all data-intensive activities. Policy development includes advocacy, priority setting, and development of plans and policies. These rely on data, as well as legal and regulatory information. Assurance includes managing resources and developing an organizational structure, implementing and evaluating programs, and informing and educating the public. Work in these areas requires drawing on case studies and best practice examples from the literature. The practice of public health encompasses the information domains of the health sciences and the social sciences.

*Information resources.* *Information resource* is used to refer to any data or information collection, whether stored and accessed electronically or not. *Knowledge base* refers to electronically stored and accessed collections of data or information. *Search engine* refers to software that mediates or provides access to a knowledge base.

The content of public health information resources may be categorized as (1) data, (2) legal or legislative material, and (3) literature. Also, if literature, is it published through traditionally accessible channels, as with most monographs or journal articles, or is it "grey" literature, an amorphous underground of technical reports, internal documents, and other types of material that can be difficult to find and acquire? Data account for the overwhelming majority of what the public health practitioner seeks. Legal and legislative materials are a distant second, and literature a more distant third. The reasons for this are beyond the scope of this paper, but some of the implications are considered in the Discussion section.

I use a conventional distinction between data and information: *data* may be raw or analyzed, but *information* represents a higher order of compilation, synthesis, or other value added to the data. Information for one application may be data for another. The distinction is not critical to this discussion, but for clarity, the two terms are not completely interchangeable. (I make a similar distinction between data files or data sets and databases: *data files* refer to collections of numeric data, often in tabular format, whereas, *databases* consist of records that may be numeric or text and that are structured according to a common data dictionary. A data file is usually retrieved as a whole, but a database requires a search engine, through which the user submits queries to the database, and only records matching the query are retrieved.)

#### METHODS

A literature search—of the MEDLINE and HealthSTAR databases of the National Library of Medicine (NLM)—on the combined concepts of public health and information resources\* turned up remarkably little. This is evidence that little study has been done of the information needs of the public health workforce or the characteristics of information resources used in public health practice. However, several of the relevant articles that were retrieved were useful background for this paper.<sup>2-5</sup>

I have drawn on the training and focus group experience described above in selecting resources for this review. I cite both resources that are used, as well as those that I think would be used, because of their content and usability, if users were aware of them and knew how to use them.

#### FINDINGS

##### PRODUCERS OF INFORMATION RESOURCES

A practitioner may be interested in the incidence of *Escherichia coli* O157:H7 outbreaks nationally, but more often is interested in a cluster in his or her own jurisdiction. In some larger city or county jurisdictions, those data may be collected locally, but even if they are, they may not be as easily applied as data

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\*The term *information resources* is not represented directly in NLM's medical subject headings (MeSH) indexing vocabulary, but "information management," "information science," "information services," "information storage and retrieval," and "information systems" are. These terms were combined, along with "informatics," "information technology," and "information resources" as text words and intersected with "public health" (including all of the more specific terms subsumed under it). This is by no means a foolproof strategy, but was intended to elucidate the core of relevant material that might be in the databases. Of the articles retrieved, a title scan revealed almost none that appeared to be relevant.

from a source farther up the hierarchy. This could be due to different definitions of terms, cases, and time periods. The World Wide Web (hereinafter the Web) is changing what is considered a local source versus a more distant one: from one's desktop it may be easier to delve into a data archive in Atlanta, Georgia, or Washington, DC, than to call a clerk at the county courthouse to check a file.

Often, local data are only available at the state or national levels. State health departments are required to collect prescribed health data, and local health departments rely on the state for much of the information they need about their communities. Because much of this activity is mandated, there is more consistency in how data are defined than when it is done on a more *ad hoc* basis and for varying purposes. Lack of consistent definitions and applications is a challenge in using local data. There is also a sense that data provided by government agencies at the state and, especially, the national levels are accurate because of the many layers of checks and approval through which the data must pass.

The primary producers of information resources and knowledge bases are reviewed next. Example resources are discussed. With 3,000 local health departments nationwide,\* there is obviously tremendous variation in what resources each of them produces and in what they have available to them locally; because of the disparity, few specific examples are discussed. With 50 states and 6 territories,† there is less variation. More specifics are offered. At the national level, everyone sees the same resources.

Local resources may be based on any form: paper, computer, or network. At the state level, all resources are assumed to be computer based, if not also available on line (through a local-area network, an intranet, or the Internet). All national resources are assumed not only to be on line, but also to be accessible through the Web. (As far as I am aware, this is at least *virtually* true.)

The following summaries of local and state information sources use information from a 1997 internal report produced by the National Information Center on Health Services Research and Health Care Technology (NICHSR)‡ adapted to and augmented with my own observations. These are selective lists of the

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\*National Association of County and City Health Officials (NACCHO) overview statement. Refer to the NACCHO Web site at <http://www.naccho.org/overview/index.html>.

†Association of State and Territorial Health Officers (ASTHO). Refer to the ASTHO Web site at [http://www.astho.org/html/state\\_health\\_agencies\\_on\\_the\\_web.html](http://www.astho.org/html/state_health_agencies_on_the_web.html).

‡I. Austin, M. Cahn, M. Schepartz, and C. Selden, State and Local Health Information Collections, National Information Center on Health Services Research and Health Care Technology, National Library of Medicine, internal report, 1997.

**TABLE I** Local Information Resources

Public	Private
Local health jurisdiction	Health care providers
Local social/human services agency	Individual/group practices
Other city/county agencies	Clinics/hospitals
City/county public library (government documents)	Plans/payers/insurers
Economic Development Council	Newspaper
Colleges/universities	Chamber of Commerce
	United Way
	Colleges

providers of significant information resources, and no attempt has been made to be comprehensive at any level.\*

As a general strategy, it is sensible to treat communication as integral to information access. This paper, however, considers data files, databases, and documents—not experts—to be the universe of this discussion.

#### **LOCAL RESOURCES**

There is tremendous variation at the local level in terms of what is available, which entity collects what data, how reliable and current the data are, and how usable the format is (Table I). A metropolitan area may have an abundance of resources, probably more than can be used effectively, whereas a rural area may not have many of the potential resources on which to draw and will be more dependent on the state for basic data and information resources.

The most basic and critical sources of data for local health agencies are the health care providers in the area. They are the ones who report the births, deaths, and morbidity for dozens of reportable conditions. These data, along with those from other local public health assessment efforts, form the basis for what the local health department knows about its community and what it forwards to the state.

A matrix of local agencies and private entities may be sources for data of

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\*A side note: Since my professional training is in library and information science, I have to remind myself that the most valued and frequently sought information resource in a public health setting is another person—an experienced colleague or an acknowledged expert—not a document or a database. This, however, is in keeping with what has long been known in primary care. It is not hard to understand: colleagues trust each other, talking to someone with the same professional background who uses the same jargon eases communication, and a person either has an answer or may be able to refer you to someone who does. For this reason, the most valuable information tools for the public health worker are a telephone, (increasingly) e-mail, and a good directory and address book.

**TABLE II** State Information Resources

Public	Private
State health department	Health professional associations
Other state agencies	Medical/hospital/public health/etc.
Ecology/environment/natural resources	Health care providers
Social services	Payers/plans/insurers
Labor and industries	University
Licensing	School of Public Health
Employment security	Institute/center
State patrol	Health sciences library
Public instruction	
Corrections	
Data center	
Planning	
Library	
State university	
School of Public Health	
Institute/center	
Health sciences library	
Board of Health	

significance to the health of the community, such as the county economic development council's data on pockets of low-income populations, for example, which are useful in planning targeted services.

#### STATE RESOURCES

The state health department is the collector, compiler, and producer of the most frequently relied on data for local public health (Table II). Within federal law, the state board of health determines what data the health department will collect. At a minimum, these are births, deaths, and morbidity for a range of reportable conditions, also determined by the state board.\* Other likely data resources include (1) use, cost, and performance data for health care facilities; (2) immunization rates; (3) locations and levels of environmental hazards; and (4) surveys of behavioral risk factors.

According to the Association of State and Territorial Health Officers (ASTHO) Web site, all but 7 of the 50 state health departments have Web sites.† They vary widely in the scope and depth of the information resources they provide: some provide information primarily for the public, others augment that with resources of use to local staff, but all of these are publicly accessible. Some of the data that

\*In the case of Washington State, refer to the Revised Code of Washington, Title 70, Chapter 58, Vital Statistics, available at [http://leginfo.leg.wa.gov/pub/rcw/title\\_70/chapter\\_058/](http://leginfo.leg.wa.gov/pub/rcw/title_70/chapter_058/).

†ASTHO, op. cit.

are transmitted from local to state health departments identify individuals and therefore must be kept confidential. A publicly accessible Web site is not a secure environment for such data, but some state health departments have developed or are developing secure Web sites, along with their public access sites, for authorized users only. Sensitive data can be uploaded or downloaded securely from these sites with user names, passwords, and encryption techniques.

The New York State Department of Health is noteworthy for having a highly sophisticated and comprehensive Health Information Network (HIN) that is accessible to authorized state and local staff through a secure statewide network. This is an example of a highly developed knowledge base and search engine that organizes state health data and makes it accessible.\* The Washington State Department of Health (WSDOH) and the local health departments in the state are in the planning stages of developing such a knowledge base. A WSDOH-managed secure statewide network already exists, and tests are being conducted in the transmission of data from local health departments and a few large managed-care providers.

A daunting variety of resources maintained by other state agencies is used by public health practitioners. This is another indication of how broad the field is and how difficult it is to find needed information. Some general examples include the following:

1. Environmental health information is spread across state health departments and those for ecology or natural resources, for example. Human health effects and environmental concerns intersect in areas such as air and water quality or soil characteristics, which are important for the siting of wells for drinking water and septic tanks in rural areas.
2. Licensing of health care facilities and providers is a regulatory concern of public health, and this function often is spread among departments of health and licensing.
3. Social services departments may have responsibility for state provision of medical care for low-income families. This function is combined with health in smaller states and is separate in others. Knowing enrollees in these programs—how many and where they are—is of interest to public health to determine eligibility for other programs.

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\*Demonstration of the HIN by Ivan Gotham of the New York State Department of Health at the Washington State Department of Health Public Health Laboratory, Seattle, Washington, February 23, 1998.

4. Employment security data can provide measures of jobless rates and income levels, which are useful in planning outreach programs.
5. Law-enforcement agencies collect crime data of public health significance (injuries resulting from car crashes, for example).
6. Labor and industries offices collect data on work-related or job site injuries.
7. Public education agencies have information on child nutrition and school nurse programs that may be of use.

The WSDOH Web site, as an example, provides access to all department reports and publications. Below is a summary of the data files it makes available (most of them as downloadable files rather than viewable on screen):

- pregnancy outcomes by age and county
- induced abortions, by many factors
- total and age-specific pregnancies by county
- total and age-specific pregnancy rates by county
- total and age-specific live births by county
- fetal deaths by woman's age and county
- female population by age and county
- population estimate tables
- estimated state population, 1994–1996
- estimated population, counties and cities, 1994–1996
- 1990–1996, 2000 population estimates by age, sex, and race/ethnicity for state and counties

Associations are consistent providers of information resources about their members, services, and expenditures. Some state associations have research and evaluation branches, as well as funding, and can form partnerships with local and state health departments to conduct surveys, gather data, and produce resources that can be valuable additions to what government alone can do. In Washington State, for example, the Washington Health Foundation is a research and advocacy organization supported by the state hospital association and a few other like-minded organizations. The foundation generates numerous project reports, publications, and county-level data of interest to local public health (Washington Health Foundation Web site at <http://www.whf.org/>).

Also significant at the state level are universities and colleges, particularly schools of public health or departments of preventive medicine, and health sciences libraries. Knowledge bases are the bread and butter of academics. Partnerships here can benefit both the academic and practitioner communities.



Washington INPHO is a case in point. The CDC initiative is being implemented through a partnership between the state health department and the University of Washington (UW), including the School of Public Health and its community practice unit, the Northwest Center for Public Health Practice (NWCPHP), and the UW Health Sciences Library. The Washington INPHO Web site is a beginning attempt to provide public health practitioners an organized knowledge base. It provides links to other resources by topical area:

- news and events—updates from the NWCPHP, WSDOH bulletins, *Morbidity and Mortality Weekly Report (MMWR)*, on-line calendar
- diseases, injuries and disabilities—infectious diseases, injuries, chronic diseases
- risk factors—substance misuse, behavioral factors
- prevention information—immunizations, health education, CDC guidelines, nutrition, travel, disaster response
- environmental health—toxic and hazardous waste, water and waste sanitation, food protection, poison control
- special populations and topics—teen pregnancy, maternal/child health, women's health, school health, minority health, occupational health
- public health agencies and organizations—Washington local health departments, Washington tribal health, federal and international links

It also provides access to various on-line tools:

- state laws and administrative codes
- health statistics resources—state and CDC sites
- training resources—state and CDC resources
- software for public health—EpiInfo and EpiMap
- public health practice—resources on core functions
- funding sources/jobs—foundation and government funding sites and state/national job notices
- on-line journals—link to the UW Health Sciences Library
- Internet search—general Internet search tool page

The NWCPHP Web site (<http://healthlinks.washington.edu/nwcphp>) is allied with the Washington INPHO site. It provides an on-line calendar of public health events in the state (conferences, training, meetings, etc.); a news alert service; a compilation of directories of telephone numbers and e-mail addresses for people at UW, local health departments, WSDOH, CDC, and the US Depart-

ment of Health and Human Services (DHHS); and other practical information relating to the center's other programs.

#### NATIONAL RESOURCES

The federal government is the largest and most important source of knowledge bases for public health (Table III). It is at the national level that there is uniform richness of resources. The Web is the ideal mechanism for the federal government to disseminate more information more quickly and cheaply than ever before. It would be difficult to overestimate the power of the Web in revolutionizing access to information, especially for the practitioner at the local level, who is most likely to be isolated from these resources.

Much of the data that are submitted at the local level reside, eventually, in federal data files and databases, having gone through a process of data homogenization that eliminates many of the problems with comparability that plague data at lower levels. The price is that there may be less fine-level detail, and the data will be less current.

*Agency for Health Care Policy and Research.* As its name indicates, the Agency for Health Care Policy and Research (AHCP; Web site at <http://www.ahcpr.gov/data/>) is an agency with resources primarily for policymakers rather than practitioners. However, as the lead agency charged with supporting research designed to improve the quality of health care, reduce its cost, and broaden access to

**TABLE III** National Information Resources

Public	Private
Agency for Health Care Policy and Research (AHCP)	American Public Health Association
Agency on Aging (AOA)	National Association of County and City Health Officials (NACCHO)
Census Bureau	Association of State and Territorial Health Officers (ASTHO)
Centers for Disease Control (CDC), all centers	Public Health Foundation
Environmental Protection Agency	American Hospital Association
Food and Drug Administration	American Cancer Society
Health Care Financing Administration (HCFA)	American Diabetes Association
Health Resource and Services Administration (HRSA)	American Heart Association
Indian Health Service	American Lung Association
National Institute of Health (NIH): National Cancer Institute (NCI), National Library of Medicine (NLM)	American Medical Association
Occupational Safety and Health Administration (OSHA)	March of Dimes
Office of Disease Prevention and Health Promotion (ODPHP)	Other related associations/organizations
Substance Abuse and Mental Health Services Administration (SAMSHA)	
Social Security Administration	

essential services, it covers areas of interest to practitioners as well. As is true of the Health Care Financing Administration (HCFA), AHCPR provides many data on the cost and utilization rates of health care services by diagnosis-related group, principal diagnosis, and principal procedure; it also provides information on human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) services costs and utilization and health care informatics standards.

*Census Bureau (Department of Commerce).* The Census Bureau (Web site at <http://www.census.gov/>) is useful for demographic data. The Census Bureau site provides direct access to public census data files, special report output, interactive software tools, mapping tools, and many search functions.

*Centers for Disease Control and Prevention.* Through its many centers, CDC (Web site at <http://www.cdc.gov/>) is the primary producer of knowledge bases in public health.<sup>6</sup> Only the most noteworthy resources are highlighted here.

- *MMWR*—the premier knowledge base for epidemiologists and outbreak/disease investigators. It contains brief articles on timely issues and provisional notifiable disease data submitted weekly from state health departments. Weekly issues, recommendations and guidelines, surveillance summaries, supplements, summary of notifiable diseases, and other *MMWR* publications are available through the Web site.
- Prevention Guidelines Database—contains over 400 official recommendations and guidelines for the prevention of disease, injury, and disability. Most of these documents were published originally in *MMWR*.
- CDC WONDER—access to about 40 text and numeric databases through a uniform query and output system. Numeric databases can provide, for example, the numbers and rates of sexually transmitted diseases, cancer cases, or deaths in the US. Users can request data for any disease and demographic group by submitting queries against available data sets (background document at <http://wonder.cdc.gov/Wonder/background.html>). It includes many of the major CDC resources: *MMWR*, Prevention Guidelines Database, *Emerging Infectious Diseases Journal*, and Healthy People 2000 Objectives. CDC WONDER is both a knowledge base and a search engine.
- HazDat (Hazardous Substance Release/Health Effects Database)—information on hazardous substances from Superfund and other emergency sites. Includes site location and other characteristics, contaminants, community impact and health concerns, Agency for Toxic Substances and Disease Registry (ATSDR) recommendations, environmental fate, exposure routes, and

substance-specific information and has key word searchable entries (consult <http://atsdr1.atsdr.cdc.gov:8080/hazdat.html>).

Surveillance resources include the following:

- 1995 Assisted Reproductive Technology Success Rates—includes fertility clinic reports by state
- Behavioral Risk Factor Surveillance System—includes background about the survey, publications, questionnaires, and state coordinators
- Birth Defects Surveillance—describes a birth defects surveillance system, includes recommendations to prevent spina bifida and other defects, prevention services, and contacts
- Cancer Registries Program—includes national cancer registry program data for 1997 and 1994
- HIV/AIDS Surveillance Report—contains tabular and graphic information about US AIDS and HIV case reports, including data by state, metropolitan statistical area, mode of exposure to HIV, sex, race/ethnicity, age group, vital status, and case definition category for 1993–1997
- sexually transmitted diseases—surveillance reports 1993–1996 and 1998 prevention guidelines
- 1996 Tuberculosis Surveillance Report—tabular information by many factors, by state, and so on
- Youth Risk Behavior Surveillance System—selected summaries and graphs of national data by risk factor

Other noteworthy resources include

- Laboratory information resources—various guidelines, recommendations, reporting systems.
- National Center for Health Statistics (NCHS)—the primary health statistics agency in the US. (Refer to the paper by Cahn, Selden, and Auston in this issue of the *Journal of Urban Health* for a table of some of the public use data sets produced by NCHS.) Although a tremendously rich storehouse of data, it is my observation that NCHS resources are rarely used by practitioners, perhaps because it is time consuming to do the research necessary to apply the data. NCHS resources are more typically used in policy and academic communities.

*Environmental Protection Agency.* The Environmental Protection Agency (EPA; Web site at <http://www.epa.gov>) resources are rich, but they overlap a great

deal with the CDC's ATSDR and NLM's Environmental Health resources. However, they do provide unique access to environmental data through Geographic Information System and other mapping tools. There is also a Household Waste Management tool that can be used to find reliable information about reducing the waste that consumers generate and dealing with hazardous wastes in the home.

*Food and Drug Administration.* The Food and Drug Administration (FDA) Web site (<http://www.fda.gov/opacom/7govern.html>) includes federal-state regulatory information, and the Center for Food Safety and Applied Nutrition provides information about retail food protection, milk safety, seafood safety, food recalls, and foodborne illness.

*Health Care Financing Administration.* HCFA (Web site at <http://www.hcfa.gov/stats/>) administers Medicare, Medicaid, and Child Health Insurance Programs. Its Web site is a good resource not only for statistics, but also for information on state health care reform progress, federal and state health care legislation, and payer/provider managed-care plans. Resources include

- statistical highlights and information about persons covered by Medicare/Medicaid, provider institutions and agencies, health care spending, and administrative/operating costs
- analysis of recent trends in health care spending, employment, and prices
- data overview tutorial—designed for anyone interested in gleaning an overview of the Medicare/Medicaid data

Statistical reports and files include

- influenza immunizations paid by Medicare
- mammography services paid by Medicare
- Medicare enrollment for 1966–1996
- Medicare Provider Analysis and Review (MEDPAR) 1990–1996
- summary tabulations of diagnosis-related group data for hospital stays
- Medicare + Choice/(AAPCC) payment rates
- national health expenditures 1960–1996

*Health Resources and Services Administration.* The Health Resources and Services Administration (HRSA; Web site at <http://www.hrsa.dhhs.gov/>) is charged with ensuring the quality of health care through appropriate health professions workforce capacity and practice in primary care and public health. Several relevant resources are available, notably those dealing with collaborative efforts

between public health and primary care from the Office of Public Health Practice. The HRSA Web site is largely descriptive of what it is and does rather than a gateway to the information resources of the agency.

*National Cancer Institute.* Of the many resources of the National Cancer Institute (Web site at <http://www.seer.ims.nci.nih.gov/>), the Surveillance, Epidemiology, and End Results Program is probably of greatest interest. It collects and publishes cancer incidence and survival data from population-based cancer registries that cover approximately 14% of the US population. County-level statistics from 1973 to 1994 are available, including incidence, mortality, and survival data.

*National Library of Medicine.* NLM (consult <http://www.ncbi.nlm.nih.gov/> PubMed/ and <http://igm.nlm.nih.gov/>) is chiefly known as the producer of MEDLINE, the bibliographic database of peer-reviewed journal literature in biomedicine and health care. MEDLINE is accessible through one of two Web-based search engines: PubMed and Internet Grateful Med (IGM). (The dominant characteristics of each are discussed below.)

A series of health services-specific databases are under the guidance of NICHSR (consult <http://www.nlm.nih.gov/nichsr/nichsr.html>)\* at NLM. HealthSTAR is a bibliographic database that covers health services, health administration, and technology assessment literature. It includes citations and abstracts (when available) of journal articles, monographs, technical reports, conference proceedings, book chapters, and newspaper articles from 1975 to date. It also includes selected records from the MEDLINE database. At this time, HealthSTAR is accessible only through the IGM search engine.

A search of the MEDLINE and HealthSTAR databases for public health-related material produced the results summarized in Table IV.

"Public health" occurs as a subject heading in 11% of MEDLINE records (from 1990 to date). It occurs in 47% of HealthSTAR records. Public health is a topic of these articles, but it may not be the central topic. When used as a major heading—to limit retrieval to those articles in which public health is the central topic—the respective percentages dip to 2% and 10%. Of over 3 million records, 3% is still an enormous amount of material, but the comparison indicates the increased focus in HealthSTAR on public health topics.

Other relevant NLM resources include (refer to Cahn and colleagues, elsewhere in this issue, for more background on these and other NLM resources)

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\*The NICHSR Web pages include links to many relevant sites, some of which are referred to in this paper.

**TABLE IV** Public Health-Related Material Available

Database	No. Records* (1990-1998)	Minor† PH	%	Major‡ PH	%
MEDLINE	3,080,000	325,766	11	51,976	2
HealthSTAR	1,498,000	706,553	47	134,265	10

\*The total number of records is a close approximation as of mid-February 1998. Refer to <http://www.nlm.nih.gov/databases/> for more information on NLM databases.

†Minor: Internet Grateful Med was used to search both databases for the occurrence of "public health" (pre-exploded) as a MeSH term; that is, for those records indexed with the heading Public Health, or any of the 465 more-specific concepts (in 21 broad areas) subsumed under it. Refer to the on-line MeSH area for details. The retrieved articles are at least peripherally relevant to a public health topic, with 11% of the articles in MEDLINE and 47% of those in HealthSTAR in this category.

‡Major: Same as for Minor heading, except with "public health" (and its more-specific headings) as a MeSH major term. A public health topic is a central focus of the retrieved articles, and 2% of MEDLINE and 10% of HealthSTAR comprise the highly relevant core of these databases.

DIRLINE, with citations to health services organizations and resources and accessibility through IGM, and the Toxicology and Environmental Health Information Program, which provides access to many databases, both full text and bibliographic. The databases of most direct interest to environmental health are

- HSDB—Hazardous Substances Data Bank
- IRIS—Integrated Risk Information System
- RTECS—Registry of Toxic Effects of Chemical Substances
- TOXLINE—Toxicology Online (bibliographic citations to peer-reviewed literature)
- TRI—Toxic Chemical Release Inventory

A Web-based interface to these resources became available in late 1998.

*Occupational Safety and Health Administration.* The Occupational Safety and Health Administration (OSHA; Web site at <http://www.osha.gov/>) provides access to publications and data on workplace injury and illness and industry profiles. The tables provided are national-level summaries.

*Office of Disease Prevention and Health Promotion.* The Office of Disease Prevention and Health Promotion (ODPHP; Web site at <http://odphp.osophs.dhhs.gov/>) fosters public and private cooperative efforts to promote preventive measures. ODPHP publishes reports on the Healthy People 2000 initiative and other public health initiatives, health promotion in communities, nutrition, and clinical preventive services. Of most immediate use to seekers of health information from

the federal government is Healthfinder™, a Web site that points to selected on-line publications, clearinghouses, databases, other Web sites, and support and self-help groups, as well as the government agencies and not-for-profit organizations that produce reliable information for the public (Web site at <http://www.healthfinder.gov/>).

*Substance Abuse and Mental Health Services Administration.* One resource of potential interest from the Substance Abuse and Mental Health Services Administration (SAMHSA; consult <http://www.samhsa.gov/> and <http://www.mentalhealth.org/>) is the Knowledge Exchange Network within the Center for Mental Health Services. The network provides publications and databases on mental health organizations and services.

*Social Security Administration.* The Social Security Administration (SSA; consult [http://www.ssa.gov/statistics/ores\\_home.html](http://www.ssa.gov/statistics/ores_home.html)) is not normally thought of as being a source of health information, but SSA provides a useful Web site for both consumers and those interested in data on research analyses of the old-age, survivors, disability, and supplemental security insurance programs. Such data could be useful for community profiling purposes.

#### **SEARCH ENGINES**

Search engines are software that mediate or provide access to a knowledge base. Three types of search engines are considered here. CDC WONDER (developed by CDC) is an example of a search engine that mediates access to data files. PubMed and IGM (developed by NLM) are examples of search engines that mediate access to literature databases.\* General Web search engines—such as AltaVista, Excite, and Yahoo!—provide access to Web pages and other Internet resources, such as news groups, discussion lists, and chat rooms.

As described above, CDC WONDER provides access to nearly 40 text and numeric databases available over the Web from CDC. WONDER enables the user to fill out a form to specify the parameters of a query. Available options may be used or not, depending on how specific or restrictive the query. The user indicates which data file to search, and a form screen opens that is specific to that file. For example, for the AIDS—Public Use data file, the user can specify multirisk value, birth country, case definition, sex class, HIV exposure group, age at diagnosis, race/ethnicity, diagnosis dates, report dates, and metropolitan statistical area and can choose the variable (age, sex, etc.).

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\*PubMed was originally developed at the National Center for Biotechnology Information at NLM to provide access to genetic sequence databases. It is used by molecular biologists for this purpose.



PubMed is the newest search engine to provide access to the MEDLINE database. It incorporates the standard search options familiar to those used to searching bibliographic databases: the ability to search for articles by specific authors, particular journals, specified key words in the title, and so on. It includes some powerful and unique features that are especially helpful in refining searches in a database as large as MEDLINE. One of these is the “related articles” feature. For every article in the database, PubMed computes a batch of articles related to it according to a sophisticated algorithm using term weighting.\*

Another noteworthy feature is the ability to invoke a research methodology filter to screen the retrieval of a query. For example, the clinical query filter (the only one available so far) allows the user to specify categories such as therapy, diagnosis, etiology, or prognosis and also to indicate whether the emphasis should be on sensitivity or specificity. Work is under way to add other NLM databases to PubMed.

IGM uses the familiar form screen approach to query construction and includes several options to limit retrieval (e.g., by date of publication; journal title; subject—whether human/animal, male/female; and many age ranges). At this point, IGM is the only Web interface to the HealthSTAR, HSRProj, and DIRLINE databases.

Both IGM and PubMed employ the powerful search capabilities of the MeSH indexing language and include features of the Unified Medical Language System® (UMLS), which will map user terms through the UMLS Metathesaurus® to help develop, broaden, or refine searches.†

CDC WONDER, PubMed, and IGM are examples of search interfaces to highly relevant knowledge resources. General Web search engines, in contrast, provide access to the Web and other Internet resources, the majority of which are of no use to the practice of public health. Some are, however, including most of the resources reviewed in this paper. These tools are rapidly becoming more sophisticated in discerning among the overwhelming amount of material available. As a rule, however, a general-use tool should not be the first choice for the practitioner. Too much that is irrelevant or unverified will be retrieved. The Web’s greatest strength—that anyone can publish what they want—is also its greatest weakness, especially when the validity, comprehensiveness, and currency of information is crucial. Nevertheless, knowing how to use a few general tools well is necessary, including knowing their strengths and how they differ from

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\*Refer to <http://www.ncbi.nlm.nih.gov/PubMed/computation.html> for information on the algorithm theory and logic.

†For more information on the UMLS, refer to the NLM fact sheet at <http://www.nlm.nih.gov/pubs/factsheets/umls.html>.

each other. For example, Yahoo! is the most focused of the major Web search engines, whereas AltaVista is often considered the most comprehensive and powerful, making it particularly good when searching for obscure terms. Some specialized directories in health care have public health categories in which major resources are organized. These can be good shortcuts and reminders of the range of resources that may be available.

#### DISCUSSION

For the last 10 years or more, since the release of the Institute of Medicine's landmark report,<sup>7</sup> public health has been in transition from being primarily a provider of basic health care services for those who could not afford private care to—in the words of the Association of Schools of Public Health—a series of organized, interdisciplinary efforts that address the physical, mental, and environmental health concerns of communities and populations at risk for disease and injury (consult <http://www.asph.org/whatis.html>). The Institute of Medicine report defined the core functions of public health as described at the beginning of this paper. Assessing the health status of a community drives the development of policy to address identified health problems, and assurance completes the cycle by ensuring that health care services are available and used as needed, ultimately to lower the incidence of disease and disability, which in turn feeds into the assessment process, and so on.

Essentially, viewed from its core functions perspective, public health *is* information. Practicing public health is managing information—about and for the health of the community. This is important because, for the most part, the public health infrastructure does not reflect this realization, and the public health workforce is not trained or equipped to deal with it. It is a rare local health department that has staff trained in and dedicated to information management for the department. (Assessment coordinators, especially in larger departments, may serve much of this role, but rarely are they trained in information-management principles and techniques; they are concerned with the assessment function and do not support the information-management needs of the department as a whole.)

Local health departments do not have professional librarians or informatics specialists on staff. Library service, if available, is likely to be provided through an *ad hoc* arrangement with the local public library, possibly as part of the city/county government structure; occasionally, it may be through a nearby hospital or clinic library or, indirectly, through the state library. If there is access to such service, how likely is it that the health department has funds allocated for it? The acceptance of this—and other elements of basic information infrastructure—as a

cost of doing business is not yet there in the minds of those responsible for funding public health.

Web access at the desktop of public health workers overcomes some of these limitations. It makes access to an enormous universe of information potentially available, but without training and management support, that potential is not likely to be used effectively.

CDC's INPHO initiative<sup>8</sup> is a recognition of this transformation of public health to an information enterprise. It is also a recognition that the public health technical infrastructure has languished alarmingly. By investing in the computing and telecommunications capacity of public health systems, both access to information and the ability to manage information effectively are enhanced.

Public health practice is driven by data. Program planning, implementation, and evaluation rise and fall on the basis of data. Practitioners are oriented strongly toward action rather than research. There is neither time nor funding (or, often, inclination or training) for using research resources at the local level. Changing conditions—including increased pressure for improved performance, the availability of informatics training, and better resources—could change this scenario, however. Development of practice guidelines and other appropriate research tools is needed to transform traditional practice into evidence-based practice, an effective practice that harnesses information for healthier communities.

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