17 Using Informatics to Promote Community/Population Health

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Objectives

1. Provide an overview of community and population health informatics.
2. Describe informatics tools for promoting community and population health.
3. Define the roles of federal, state, and local public health agencies in the development of public health informatics.

Key Terms

Behavioral Risk Factor Surveillance System (BRFSS)
Bioterrorism
Centers for Disease Control and Prevention (CDC)
Community risk assessment (CRA)
Epidemiology
National Center for Public Health Informatics (NCPHI)
National health information network (NHIN)
National Health and Nutrition Examination Survey (NHANES)
Public health (PH)
Public health informatics (PHI)
Public health interventions
Regional health information organization (RHIO)

INTRODUCTION

In late fall of 2002, severe acute respiratory syndrome (SARS) appeared in China. By March of 2003, SARS became recognized as a global threat. According to World Health Organization (WHO) data, more than 8,000 persons from 29 countries became infected with this previously unknown virus, and more than 700 persons died. The last SARS cases in 2004 were due to laboratory acquired infections. In addition to isolation and quarantine for diagnosed cases, computerized global **surveillance** and data collection helped to avert the potentially negative impact of a widespread global epidemic. Many surveillance systems, loosely termed **syndromic surveillance** systems, use data that are not diagnostic of a disease but that might indicate the early stages of an outbreak. Outbreak detection is the overriding purpose of syndromic surveillance for terrorism preparedness. Enhanced case-finding and monitoring the course and population characteristics of a recognized outbreak also are potential benefits of syndromic surveillance. New

Key Terms *Continued*
Risk assessment
Suicide Prevention Community Assessment Tool
Surveillance
Surveillance data systems
Syndromic surveillance
Youth Risk Behavior Surveillance System (YRBSS)

data have been used by **public health** personnel to enhance surveillance, such as patients' chief complaints in emergency departments, ambulance log sheets, prescriptions filled, retail drug and product purchases, school or work absenteeism, and medical signs and symptoms in persons seen in various clinical settings. With faster, more specific, and affordable diagnostic methods and decision-support tools, timely recognition of reportable diseases with the potential to create a substantial outbreak is now possible. Tools for pattern recognition can be used to screen data for patterns needing further public health investigation. During the 2003 epidemic, the **Centers for Disease Control and Prevention (CDC)** worked to develop surveillance criteria to identify persons with SARS in the United States, and the surveillance case definition changed throughout the epidemic to reflect increased understanding of SARS (CDC, 2007).

Utilizing the SARS outbreak description as a springboard, this chapter will introduce the reader to community and population health informatics. We will describe informatics tools for promoting community and population health and define the roles of federal, state, and local public health agencies in the development of **public health informatics (PHI)**.

USING THE FOUNDATION OF KNOWLEDGE MODEL

The collection and processing of population health data creates the information that becomes the basis for knowledge in the field of public health. There is an ever-increasing need for timely information about the health of communities, states, and countries. Knowledge about disease trends and other threats to community health can improve program planning, decision making and care delivery. Patients seen from the perspective of major health threats within their communities can benefit from opportunities for early intervention. Information technology now allows for the integration and analysis of diverse data sources in a spatial-temporal context that supports the development of predictive models and the development of timely interventions (Kopp et al., 2002).

The core public health functions are: "The assessment and monitoring of the health of communities and populations at risk to identify health problems and priorities; The formulation of public policies designed to solve identified local and national health problems and priorities; To assure that all populations have access to appropriate and cost-effective care, including health promotion and disease prevention services, and evaluation of the effectiveness of that care" (MedTerms, 2007). "Public health is a field that encompasses an amalgam of science, action, research, policy, advocacy and government" (Yasnoff, Overhage, Humphreys, & LaVenture, 2001, p. 536).

Historically, Dr. John Snow might be designated the father of public health, because in 1854, he plotted information about cholera deaths and was able to determine that the deaths were all around the same water pump in London. He convinced authorities that the cholera deaths were associated with that water pump, and when the pump handle was removed, cholera disappeared. It was Dr. Snow's focus on the cholera population rather than on a single patient that led to his discovery of the cholera outbreak (Vachon, 2005).

Florence Nightingale should also be recognized as an early public health informaticist. Her recommendations about medical reform and the need for improved sanitary conditions were based on data about morbidity and mortality that she compiled from her experiences in the Crimea and in England. Her efforts led to a total reorganization of how and which healthcare statistics should be collected (Dossey, 2000).

Just as information has been recognized as an asset in the business world, health care is now recognized as information intensive requiring timely, accurate information from many different sources. Health information systems address the collection, storage, analysis, interpretation, and communication of health data and information. Many health disciplines such as medicine and nursing have developed their own concepts of informatics integrating computer, information, and cognitive science with the science of the professional domain. That trend has reached the field of public and community health, and public health informatics (PHI) represents "a systematic application of information and computer science and technology to public health (PH) practice, research and learning" (Yasnoff, O'Carroll, Koo, Linkins, & Kilbourne, 2000, p. 67). This area of informatics differs from others because it is focused on the promotion of health and disease prevention in populations and communities. PHI efficiently and effectively organizes and manages data, information, and knowledge generated and used by public health professionals to fulfill the core functions of public health: assessment, policy, and assurance (ATSDR, 2003). Public health changes the social conditions and systems that affect everyone within a given community. It is because of public health that we understand the importance of clean water, the danger of secondhand smoke, and the fact that seat belts really do save lives (Public Health Institute, 2008).

The scope of PHI practice includes knowledge from a variety of additional disciplines including management, organization theory, psychology, political science, and law, as well as fields related to PH such as **epidemiology**, microbiology, toxicology, and statistics (O'Carroll, Yasnoff, Ward, Ripp, & Martin, 2003). Public health informatics focuses on applications of information technology (IT) that "promote the health of populations rather than individuals, focus on disease prevention rather than treatment, focus on preventive intervention at all vulnerable points" (O'Carrroll et al., 2003, pp. 3–4). PHI addresses the data, information, and knowledge that public health professionals generate and use to meet the core functions of public health (PHDSC, 2007b). Yasnoff and others (2000) have defined four principles that define and guide the activities of PHI. These principles are (1) applications promote the health of populations, (2) applications focus on disease and injury prevention, (3) applications should explore prevention at "all vulnerable points in the causal changes" (p. 69) and (4) PHI must reflect the "governmental context in which public health is practiced" (p. 69).

The Institute of Medicine (IOM) defines the role of public health as "fulfilling society's interest in assuring conditions in which people can be healthy" (as cited in Khoury, 1997, p. 176). Functions of public health include prevention of epidemics and the spread of disease, protection against environmental hazards, promotion of health, disaster response and recovery, and providing access to health care (PHDSC, 2007).

COMMUNITY HEALTH RISK ASSESSMENT (TOOLS FOR ACQUIRING KNOWLEDGE)

As the public has become more aware of harmful elements in the environment, **risk assessment** tools have been developed. Such tools allow assessment of pesticide use, exposure to harmful chemicals, contaminants in food and water, and toxic pollutants in the air to determine if potential hazards need to be addressed. A risk assessment may also be called a threat and risk assessment. "A 'threat' is a harmful act such as the deployment of a virus or illegal network penetration. A 'risk' is the expectation that a threat may succeed and the potential damage that can occur" (PCMag.com Encyclopedia, 2007).

"Risk factor assessments complement vital statistics data systems and morbidity data systems by providing information on factors earlier in the causal chain leading to illness, injury or death" (O'Carroll, Powell-Griner, Holtzman, & Williamson, 2003, p. 316).

"Health risk assessments are used to estimate whether current or future exposures will pose health risks to broad populations" (CEPA, 1998, p. 4) and are used to weigh the benefits and costs of various program alternatives for reducing exposure to potential hazards. They may impact public policy and regulatory decisions. Health risk assessment is a constantly developing process based in sound science and professional judgments. There are usually four basic steps ascribed to risk assessment. They include hazard identification, exposure assessment, dose-response assessment, and risk characterization. Hazard identification seeks to determine the types of health problems that could be caused by exposure to a potentially hazardous material. All research studies related to the potentially hazardous material are reviewed to identify potential health problems. Exposure assessment is done to determine the length, amount, and pattern of exposure to the potentially hazardous material. Dose response is an estimation of how much exposure to the potential hazard would cause varying degrees of health effects. Risk characterization is an assessment of the risk of the hazardous material causing illness in the population (CEPA, 1998). The question the risk assessment has to answer is how much risk is acceptable?

Risk factor systems are used throughout the country and may be local, regional, or national in scope. Risk assessment tools exist for specific health issues such as the **Suicide Prevention Community Assessment Tool**, which addresses general community information, prevention networks, and the demographics of the target population as well as community assets and risk factors. Other risk assessment tools include the **Youth Risk Behavior Surveillance System (YRBSS)**, the **Behavorial Risk Factor Surveillance System (BRFSS)**, and the **National Health and Nutrition Examination Survey (NHANES)**. Pennsylvania's Office of Mental Retardation began an assessment initiative in 1998 to collect information on the movement of this specific population from state-operated facilities into community settings. The goal of this assessment process was to ensure that this population had access to necessary health care and that their needs were being met (PHRAP, 1998).

Determining the presence of risk factors in a community is a key part of a **community risk assessment (CRA)**. Communities may be concerned about what in the environment affects or may affect the community's health, the level of environmental risk, and other factors that should be included in public health planning. Ball (2003) defines value as "a function of cost, service, and outcome" (p. 41). The value of a community risk assessment is in providing information crucial to planning, building consensus of how to mobilize community resources, and allowing for comparison of risks with those of other communities. The goal of a CRA is risk reduction and improved health. A CRA may identify unmet needs and opportunities for action that may help set new priorities for local public health units. A CRA may also be used to monitor the impact of prevention programs.

AGENCY SUPPORT OF EPIDEMIOLOGY AND THE MONITORING OF DISEASE OUTBREAKS

There is a need to define the role of federal, state, and local PH agencies in the development of PHI and IT applications. The availability of IT today challenges all stakeholders in the health of the public to adopt new systems to provide adequate disease surveillance and challenges us to improve outmoded processes.

Preparedness in public health means more timely detection of potential health threats, situational awareness, surveillance, outbreak management, countermeasures, response, and communications. These needs are advancing the scope of epidemiologic surveillance, which includes data on disease incidence and prevalence and physical environment profiles. Surveillance uses health-related data that signal a sufficient probability of a case or an outbreak that warrants further public health response. Although historically syndromic surveillance has been utilized to target investigations of potential infectious cases, its utility to detect possible outbreaks associated with **bioterrorism** is increasingly being explored by public health officials (CDC, 2007). Early detection of possible outbreaks can be achieved through timely and complete receipt, review, and investigation of disease case reports, by improving the ability to recognize patterns in data that may be indicative of a possible outbreak early in its course and through receipt of new types of data that can signify an outbreak earlier in its course. New types of data might include identification of absences from work or school, increased purchases of healthcare products, including specific types of over-the-counter medications, presenting symptoms to healthcare providers, and laboratory test orders (CDC, 2007). A comprehensive surveillance effort supports timely investigation and identifies data needs for managing the public health response to an outbreak or terrorist event.

Geographic information systems are now being used to look at the geographic prevalence and incidence of disease, identification of at-risk populations, differentiation of risk factors, intervention planning in anticipation of epidemics, and local and global monitoring of disease in a real-time perspective (Kopp et al., 2002).

In order to appropriately process public health data, PHI has a need for a standardized vocabulary and coding structure. This is especially important as national public health data is collected so that data variables can be understood across systems and between agencies. A standardized vocabulary must address local language use vs. universal language usage for public health.

In the early 1990s, the CDC launched a plan for an integrated surveillance system that moved from stand-alone systems to networked data exchange built with specific standards. Early initiatives were the National Electronic Telecommunications System for Surveillance (NETSS) and the Wide-ranging Online Data for Epidemiologic Research (WONDER). Six current initiatives reflect this early vision:

- PulseNet USA: A surveillance network for food-borne infections
- The National Electronic Disease Surveillance System (NEDSS): Facilitates reporting on approximately 100 diseases with data feeding directly from clinical laboratories allowing for early detection

- Epidemic Information Exchange (Epi-X): A secure communication system for practitioners to access and share preliminary health surveillance information
- Health Alert Network (HAN): A state and nationwide alert system
- Biosense: Provides improved real-time biosurveillance and situational awareness in support of early detection
- Public Health Information Network (PHIN): Promotes standards and software solutions for the rapid flow of public health information.

Certainly the events of September 2001 have created an acceleration in the need for informatics in public health practice. Today response requirements include fast detection, science, communication, integration, and action (Kukafka, 2006). In 2005, the CDC created the **National Center for Public Health Informatics (NCPHI)** to provide leadership in the field. This center aims to protect and improve health through PHI (McNabb, Koo, Pinner, & Seligman, 2006).

Information is vital to public health programming. The data processed into public health information can be from administrative, financial, and facility sources. Encounter, screening, registry, clinical, and laboratory data as well as surveillance data may be included. It has been recommended that the functions of population health beyond surveillance need to be integrated into the electronic health record and the personal health record. Such an initiative might allow for population level alerts to be sent to clinicians through these electronic record systems. Data on vital statistics from state and local governments are also used for public health purposes. It should be noted that databases created with public funds are public databases that are available for authorized public representatives for public purposes (Freedman & Weed, 2003).

APPLYING KNOWLEDGE TO HEALTH DISASTER PLANNING AND PREPARATION

The availability of data and speed of data exchange can have a significant impact on critical PH functions like disease monitoring and syndromic surveillance. Currently surveillance data are limited and historical in nature. Special data collections are needed to address specific public health issues, and investigations and emergencies are addressed and managed with paper. The future of PHI will offer real-time surveillance data available electronically, and investigations and emergences will be managed with the tools of informatics. "**Surveillance data systems** [boldface added], e.g., systems for infectious diseases, store information on exposure or trends in adverse health effects over a specified period of time that can be used by public health officials for planning, evaluation, or implementation of **public health interventions** [boldface added]"(ATSDR, 2003). "Syndromic surveillance for early outbreak detection is an investigational approach where health department staff, assisted by automated data acquisition and generation of statistical signals, monitor disease indicators continually (real time) or at least daily (near real time) to detect outbreaks of diseases earlier and more completely than might otherwise be possible with traditional public health methods" (Buehler, Hopkins, Overhage, Sosin, & Tong, 2004, ¶ 7)

INFORMATICS TOOLS TO SUPPORT COMMUNICATION AND DISSEMINATION

The revolution in IT has made the capture and analysis of health data and the distribution of healthcare information more achievable and less costly. Since the early 1960s, CDC has used IT in its practice and PHI emerged as a specialty in the 1990s. PHI has become more important with improvements in information technology, changes in our care delivery system, and the challenges related to emerging infections, resistance to antibiotics, and the threat of chemical and biological terrorism. Two-way communication between public health agencies, community clinicians, and clinical laboratories can identify clusters of reportable and unusual diseases. As a result, health departments can consult on case diagnosis and management, alerts, surveillance summaries, and clinical and public health recommendations. Ongoing healthcare provider outreach, education, and 24-hour access to public health professionals leads to the discovery of urgent health threats. The automated transfer of specified data from a laboratory database to a public health data repository improves the timeliness and completeness of reporting notifiable conditions.

PH information systems represent a partnership of federal, state, and local public health professionals. Such systems allow the capture of large amounts of data, rapid exchange of information, and strengthened links between these three system levels. Dissemination of prevention guidelines and communication among PH officials, clinicians, and patients has become a major benefit of PHI. IT solutions can be used to provide accurate and timely information that will guide public health actions. In addition, the Internet has become a universal communications pathway and allows individuals as well as population groups to be more involved and responsible for management of their own health status.

Few PH professionals have received formal informatics training and may not be aware of the potential impact of IT on their practice. A working group formed at the University of Washington Center for public health informatics has published a draft of PHI competencies needed (Karras, 2007). These competencies include:

- Supporting development of strategic direction for PHI within the enterprise.
- Participating in development of knowledge management tools for the enterprise.

- Utilizing standards.
- Assuring that knowledge, information, and data needs of project or program users and stakeholders are met.
- Managing information system development, procurement, and implementation.
- Managing IT operations related to project or program (for public health agencies with internal IT operations).
- Monitoring IT operations managed by external organizations.
- Communicating with cross-disciplinary leaders and team members.
- Participating in applied public health informatics research.
- Developing public health information systems that are interoperable with other relevant information systems.
- Supporting use of informatics to integrate clinical health, environmental risk, and population health.
- Implementing solutions that assure confidentiality, security, and integrity, while maximizing availability of information for public health.
- Conducting education and training in PHI (CPHI, 2007).

Information technology is also valuable in the promotion of individual health literacy and knowledge that may encourage individuals to accept more personal responsibility for their health status and make more informed decisions about their health. Improved health status in individuals contributes to improved population health.

USING FEEDBACK TO IMPROVE RESPONSES AND PROMOTE READINESS

Improvement of community health status and population health depends on effective public and healthcare infrastructures. In addition to information from public health agencies, there is now interest in the capture of information from hospitals, pharmacies, poison control centers, laboratories, and environmental agencies. Timely collection of such data allows early detection and analysis that can increase the rapidity of response with more effective interventions. Yasnoff and his colleagues (2000) identify the grand challenges still facing PHI as the development of national public health information systems, a closer integration of clinical care with public health, and concerns of confidentiality and privacy.

Population health data must be considered an important part of the infrastructure of all **regional health information organizations (RHIOs)**, which are the building blocks for a **national health information network (NHIN)**. "These efforts call for collaboration of various organizations and agencies interested in clinical, public health and population health information to promote and protect the public's health"(PHDSC, 2007b). The public health data includes information about surveillance, environmental health, and preparedness systems and has client information like immunization registries as well as laboratory results reporting and analysis. It can provide information about outbreaks, patterns of drug-resistant organisms, and other trends that can help improve the accuracy of diagnostic and treatment decisions (LaVenture, 2005). An RHIO/NHIN can also support public health goals through broader opportunities for participation in surveillance and prevention activities, improved case management and care coordination, and increased accuracy and timeliness of information for disease reporting (LaVenture).

Public health informatics strives to ensure that health data systems will meet the data needs of all organizations interested in population health as national and international standards are developed for healthcare data collection. This includes standardization of environmental, sociocultural, economic, and other data that are relevant to population health (PHDSC, 2007b). Table 17-1 provides the

TABLE 17-1
Important PHI Sites

Name	Address	Web Site
American Public Health Association	APHA 800 I Street, NW Washington, DC 20001	www.apha.org
Center for Public Health Informatics	CPHI University of Washington 1100 NE 45th Street, Suite 405 Seattle, WA 98105	www.cphi.washington.edu
Centers for Disease Control and Prevention	Centers for Disease Control and Prevention 1600 Clifton Road Atlanta, GA 30333	www.cdc.gov
National Center for Public Health Informatics	The National Center for Public Health Informatics (NCPHI) 1600 Clifton Road NE Mailstop E-78 Atlanta, GA 30333	www.cdc.gov/ncphi
Public Health Data Standards Consortium	Public Health Data Standards Consortium c/o Johns Hopkins Bloomberg School of Public Health 624 North Broadway, Room 325 Baltimore, MD 21205	www.phdsc.org

names, addresses, and URLs for important organizations dedicated to public health data and informatics.

SUMMARY

The two most important thoughts we'd like to leave you with are: (1) the issue is not what data to collect but how to collect and share it; and (2) there is an ever-increasing need for timely information about the health of communities, states, and countries.

THOUGHT-PROVOKING Questions

1. Imagine that you are a public health informatics specialist and you and your colleagues have determined that the threat of a new strain of influenza indicates a need for a mass inoculation program. What public health data would have been used to determine the need for such a program?
2. What data will be collected to determine the success of such a program?

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