Public health informatics, surveillance system, expert system

Ashu Marasinghe [*]

PUBLIC HEALTH INFORMATICS : PRIORITIES, CHALLENGES, AND OPPORTUNITIES

Public Health Informatics is a growing academic discipline increasingly contingent on the propagation, manipulation and synthesis of information from a variety of resources. PHI is the intersection of information technology and health care. It deals with the resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in public health. Public health practitioners now do much of their surveillance, support, reporting, data analysis, and data collection via the internet or on computer systems. This article reports and reviews on the issues involved in PHI specially focus on priorities, challenges, and opportunities with their practical applications.

1. INTRODUCTION

The health sector's most preventable limitations can be linked to data, information, or knowledge that are unreachable or reveal poor quality. Lost information, poor documentation, lack of access to available knowledge, and reliance on memory all obstruct the delivery of high quality health care services [1]. Advances in medical informatics and treatment facilities often take too many years to reach patients; many therapeutic interventions in use are not supported by verification of effectiveness [2]. Observe models vary across institutions and regions, resulting in varying health outcomes and costs of care. Patients trying to create informed health judgments often encounter incompatible information with varying degrees of quality[3]. The health sector has initiated to unleash the transformational power of information and communications technology (ICT) [4]. The field of health informatics focuses on using computer systems to advance health through administration of the knowledge base and improved decision support. The desired health informatics results should be compelling, such as enhanced public health, better quality as perceived by consumers, and lower costs. Strategies to reach these outcomes should originate from the differentia of health, opportunities to influence other efforts, and lessons from successes inside and outside the health industry [5]. Public Health Informatics (PHI) is the intersection of information technology and health care. It deals with the resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in public health. Public health practitioners now do much of their surveillance, support, reporting, data analysis, and data collection via the internet or on computer systems.

[*] Department of Management and Information Systems Engineering, Nagaoka University of Technology, Japan

2. PUBLIC HEALTH INFORMATICS

Public Health Informatics defined in several different ways according to observations. In the wiki, it is defined as, “Public Health Informatics has been defined as the systematic application of information and computer science and technology to public health practice, research, and learning. It is one of the sub domains of (bio) medical or health informatics. In the same way that Public Health as a distinct field relates to healthcare generally, public health informatics is distinguished from healthcare informatics by emphasizing data about populations rather than that of individuals. The activities of public health informatics can be broadly divided into the collection, storage, and analysis of data of interest to the various activities of public health”. [6] Friede and his colleagues define public health informatics as, “Public Health Informatics is the application of information science and technology to public health practice and research. Specifically, this means developing innovative ways to use inexpensive and powerful computers, on-line databases, the capacity for universal connection of people and computers, and multimedia communications to support the mission of disease prevention and health promotion”.[7] Practical PHI work, ideally guided by PHI professionals who are qualified and experienced in both information technology and public health, involves bringing together experts in both fields to conceptualize new ways of applying informatics to solve public health questions [7].

The practice of public health informatics goes further than applying known information technology applications. Somewhat, it involves synthesizing information from both disciplines, which is leading to new ways of thinking about and working in public health reserach area[7]. Public health informatics is primarily an engineering discipline, that is, a practical activity, under girded by science, oriented to the accomplishment of specific tasks[8]. The scope of public health informatics includes the conceptualization, design, development, deployment, refinement, maintenance, and evaluation of communication, surveillance, and information systems relevant to public health[8]. It requires the application of knowledge from numerous disciplines, particularly information science, computer science, management, organizational theory, psychology, communications, political science, service engineering, epidemiology, microbiology, toxicology, statistics, and law.

3. PRIORITIES, CHALLENGES, AND OPPORTUNITIES IN PHI

Public health needs to make more successful use of informatics to support its task. Public health could make use of related technology to enhance the timeliness and effectiveness of survey and surveillance systems; rapidly and effectively communicate scientific findings to the public; and offer services to underserved populations[7]. The task of public health scientists is often to help in establishing a sensible stability between, on the one hand, local needs, political priorities and availability of resources, and on the other hand, knowledge about causes and consequences of various public health problems as well as cost-effectiveness of different programmes[9]. U. S. Department of Health and Human Services has named several priority areas realted with public health. Those are disease prevention, eliminating health disparities, public health preparedness, and improving health literacy [10]. , Yansoff .et al proposed four principles of PHI, flowing directly from the scope and nature of public health, that differentiate it from other informatics specialty areas. These four principles define,

guide, and provide the context for the types of activities and challenges that comprise this new field[8]:

1. *The primary focus of public health informatics should be on applications of information science and technology that promote the health of populations as opposed to the health of specific individuals.*

2. *The primary focus of public health informatics should be on applications of information science and technology that prevent disease and injury by altering the conditions or the environment that put populations of individuals at risk.*

3. *Public health informatics applications should explore the potential for prevention at all vulnerable points in the causal chains leading to disease, injury, or disability; applications should not be restricted to particular social, behavioral, or environmental contexts.*

4. *As a discipline, public health informatics should reflect the governmental context in which public health is practiced.*

PHI faces many challenges today: wide geographic distribution of public health data; cultural, social, religious, and political impediments to data sharing; a dynamic and complex environment – global in scale; rapid growth of public health data, integration of different data sets in to one central system (e.g., combine police data and hospital data in injury surveillance system) an environment containing many redundant application and data silos; a wide variety of complex requirements (e.g., disease surveillance, alerting, event detection, etc.); and of course significant and chronic financial constraints. PHI2007 participants concluded that there is great potential for public health informatics opportunities to improve health in low-resource settings [11].

• *Support of primary and secondary prevention (via electronic health records, improved laboratory systems)*

•*Delivery of public health services by strengthening and streamlining data collection*

• *Collection of data for research studies (drug and vaccine trials)*

• *Environmental health interventions (bio-surveillance, road safety, and geographic mapping systems applications)*

• *Communications among geographically dispersed health workers and consumers*

A key opportunity in the PHI is to develop integrated health information systems that support the delivery of high quality health care as well as enhance the health of the public through prevention. Public health informatics requires the cooperation of and data contribution from both health care and non-health care sources [11].

4. APPLICATIONS IN PHI

PHI applications can divide in to 3 categories: Geographic Information System (GIS), Surveillance Systems, and Expert Systems (decision making systems).

GEOGRAPHIC INFORMATION SYSTEM (GIS)

The phrase "geographic information systems" was first used in the 1960s to refer to a computerized system for asking queries of maps showing current and potential land use in Canada [12]. GIS technologies progress the ability of practitioners, planners, and researchers to organize and link datasets. Geography provides a near-universal link for categorization and integrating records from multiple information sources into a more logical whole. This capability to link datasets can help public health practitioners plan more cost-effective interventions [13]. GIS technology provides public health practitioners and researchers with a number of new types of data. For example, with GIS technology, local public health departments can use global positioning systems (GPS) to obtain signals from satellites to decide latitude-longitude coordinates for point locations not found in TIGER files, such as rural residences, wells, and septic tanks [13].

SURVEILLANCE SYSTEMS

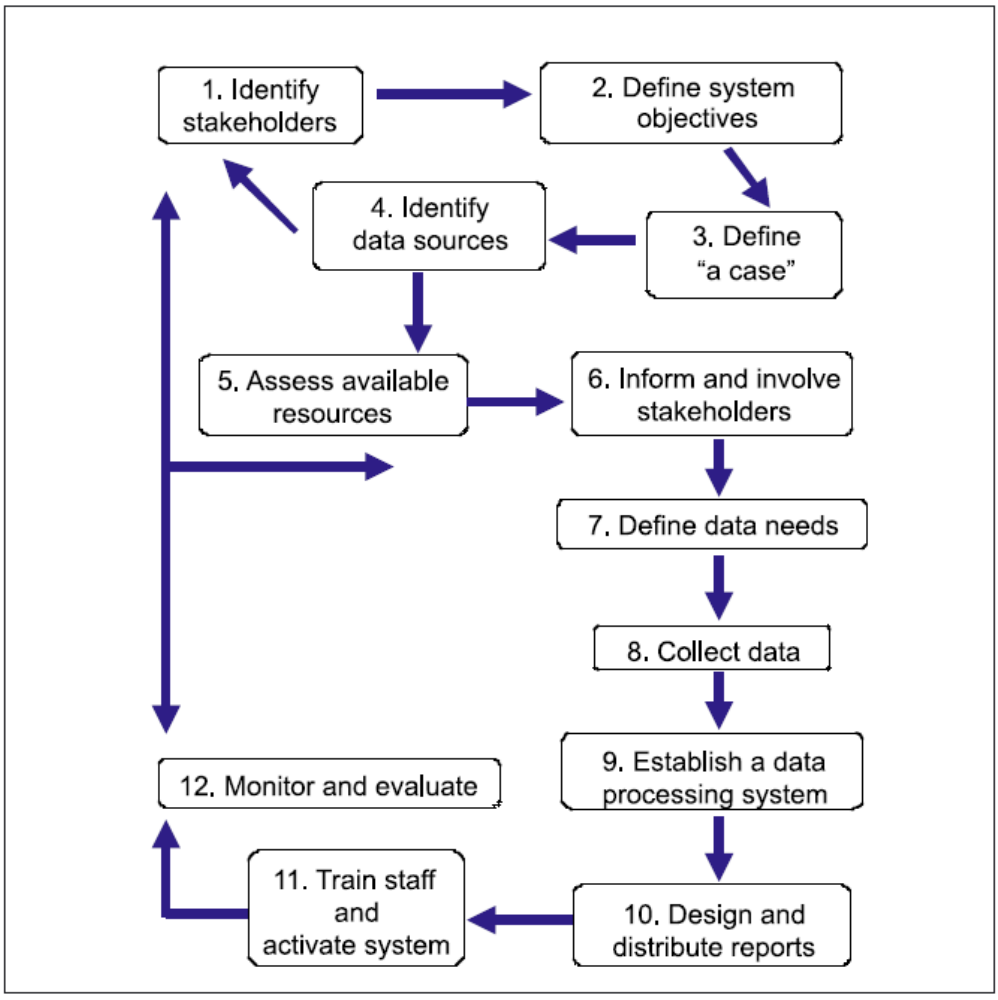

Fig.1 Designing and Building a surveillance system

EXPERT SYSTEMS

Expert System is a model of how human experts solve the problems. The human knowledge can be mainly classified into two main categories, that is, a domain knowledge and a problem solving knowledge. For example, how to measure the pressure level and to check the diabetics, etc. are some of the examples for domain knowledge. However, analyzing symptoms guessing of illness or injury are examples of problem solving knowledge. Therefore the problem solving knowledge is independent of domain knowledge [15]. This provides the basis for architecture of Expert Systems, User Interface, Inference Engine and Knowledge Base. User interface facilitate user to interact with the expert-systems. Knowledge base comprises of domain specific knowledge, here, all the relevant scoring protocols can be implemented as set of facts and rules.

For example,
If [Assess physiologic derangement] then Take to
critical care medical center
Else If[Assess anatomy of injury] then Take to
critical care medical center
Else If[…..

Inference Engine implements various strategies for exploration of knowledge base, *i.e.* Forward Chaining and Backward Chaining. The inference engine might be supported to both styles. In the forward chaining, we can start with facts and derive the conclusion, for example, by giving all the symptoms, we can ask expert system to which place to be taken. Or else, in backward chaining, we can begin with hypothesis "to take critical care medical center" and check which conditions to be satisfied, here, Expert System will ask question from the user to clarify missing information.

5. CONCLUSION

The efficient use of public health informatics engages much more than implementation of information systems. It is reliant on human factors, including the progress of competencies by those who would employ public health informatics and the development of teamwork by computer science professionals and health professionals. It is an enabler that maximizes its prospective when its users work as a team to integrate public health informatics. This trend will continue in future. Over the next years, we will see many more advances in the use of knowledge in support of the shared missions of health care and public health informatics to improve the life of each of us.

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