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Public Health Informatics: A Brief Review of the Field

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Authors' contributions

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ABSTRACT

In the global community of today, the importance of accessing timely and relevant information has increased in value. However, with the exponential increase in data and data sources, innovations to monitor, control, and effectively manipulate data are required, especially to resolve current mysteries. In addition, with the sophistication of informatics systems, consumers are becoming curious to learn about the technology for their own benefit. In learning information technology, tools become available that gives the consumers ideas and knowledge in conducting research about their health and other health information data. For clinicians it is highly useful to become knowledgeable about health information system as well as larger public health issues. PHI is highly utilized in many global health organizations, government agencies, and medical organizations across the United States as well as in the world.

Keywords: Public health; informatics; computer assisted decision making; surveillance; literature review.

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1. INTRODUCTION

Approximately two decades ago, public health informatics (PHI) was formally recognized as an applied scientific discipline formed to further improvements in public health monitoring and assessment as well as healthcare service delivery and performance. The whole collection of the technical information has been subdivided into various healthcare practices and associated disciplines [1]. Leveraging information technology, PHI provides an array of substantive capabilities to conduct research and implement the outcomes associated with a particular study to any of a number of field professions. On a technical level, PHI integrates different levels of research and implementation through human-computer interaction. As such, "The public health focuses on population and society's role in monitoring and achieving good health and quality of life" [2, p. 25].

In order to effectively manage public health practice and enhance the well-being of society, multiple resources that provide accurate, high-quality and timely information are required [3]. Public health professionals have stood as pioneers in the development and adoption of computerized information systems and surveillance programs [4] with the explicit goal of enhancing the quality of life and facilitating strategies that protect public health. The purpose of the present paper was to briefly examine how research activities and outcomes conducted through public health informatics (PHI) provide improvements in the maintenance and delivery of the health care system, including enhancement of the detection of merging threats to public health. With advance information technology system, the PHI has been considerably utilized by organizations charged with monitoring public heath, healthcare organizations, and even primary care practitioners. The competences cogently communicated and well-designed public health informatics system are applied and delivered by skillful and knowledgeable practitioners. PHI serves to inform public health via the field's ability to investigate and design data based on large-scale population metrics and to match or compare he results with other data solutions [5]. Although most organizations and employers utilize computer information system, as a discipline PHI possesses multiple capabilities of structures and content of data sources commonly available to public health practitioners. Indeed, information sharing offers an array of benefits that can impact quality improvement activities and, more important enhance engagement among critical heath constituencies including clinicians in the effective and timely use of information [6].

2. BACKGROUND

The United States is known for burgeoning health care expenditures and in fact is among the fastest growth rates in health spending of all developed countries [7]. Among Americans, there is considerable variation in attitudes about the use of health care technology. Unfortunately, differences in technological affinity as well as perceptions that vary along demographic dimensions remain an issue [7]. The capabilities of the information technology are phenomenal. Nonetheless, across the world information technology system is utilized to retrieve an individual's information, to monitoring emerging patterns of illness, and to detect emerging or imminent threats to public health. Biomed Central defined public health informatics as the, "systematic application of information and computer science and technology to public health practice, research, and learning that integrates public health and information technology" [1, p.1]. In addition, within the healthcare industry, it is a highly important infrastructure necessary to provide quality service delivery and performance. As the technological information systems continuously are used to guide further research for advance program design, PHI provides a variety of resources to assist people in furthering

their ends [2]. Because medical practitioners are dedicated of providing care to patients, PHI is also available to provide helpful tools to use to retrieve information.

3. THE OBJECTIVES OF PUBLIC HEATLH INFORMATICS

One of the objectives specified in a recent article in Health Informatics Journal is a need to determine if PHI is sufficiently addressed as a core competencies among those trained in public health [8]. The public health informatics system provides various services for multiple stakeholders, from patients to public health administrators. As with the implementation of any new methodology and/or technology, a variety of ethical issues must be considered. These have been discussed in varying detail elsewhere [3,5,8,9]. At any rate, with PHI consumers have the opportunity to expand their technical knowledge and develop ideas for excellent service and performance. PHI demonstrates it capabilities for medical records become paperless. It produces several benefits such as encouraging the administration to provide additional training for professionals to incorporate with business as well as partner with clinicians for excellent patient care service delivery.

4. REVIEW OF THE LITERATURE, INTEGRATION WITH OTHER FIELDS AND RELEVANT EXAMPLES

Beginning in 1995 [9], PHI has been defined as a specific albeit interdisciplinary field where the advances in computer technology were seen as highly adaptable to advance health care [10]. Although a number of definitions have been introduced into the literature [3,11], all carry the common theme that PHI as the name implies, is a marriage of medicine (public health), computer science, and information processing (informatics) [12]. Nonetheless, although medical in nature, the field is distinguishable from other areas of informatics such as those consumer-based, biomedical, and medical in nature. As such, PHI is focused on population-level information designed at amelioration and prevention at each node within a causative chain, and serves as applied science within relevant government settings where public health is a core goal [3].

As new trends in monitoring, intervention, and aggregation of data emerged and accelerated during a concurrent explosion in hardware and software advances in the computing sciences, PHI coalesced within public health as a natural outcome of the Zeitgeist of the times [3,11-15]. As a result, a myriad of goals developed including the promotion of public and consumer health, knowledge management, information assurance practices [10] as well as the development of public health information sources and supporting infrastructure [16].

By the very nature of their responsibilities, individuals and organizations involved in public health in an official capacity are responsible for detection and monitoring of risks, both environmental and biological in nature. Such responsibilities are distinct from those of involved in primary medical care who are charged with frontline diagnosis and treatment. With the emergence of PHI as a field, population level surveillance has moved beyond detection of trends in population health to the inclusion of emerging and often novel threats associated with syndromic surveillance [17]. Briefly, Syndromic surveillance has been used for early detection of outbreaks, to follow the size, spread, and tempo of outbreaks, to monitor disease trends, and to provide reassurance that an outbreak has not occurred. Syndromic surveillance systems seek to use existing health data in real time to provide immediate analysis and feedback to those charged with investigation and follow-up of potential outbreaks [18, p.5].

Such informatics strategies are useful as ways of getting out in front of virulent forms of infectious diseases in a globally linked world as well as biological agents used as tools of terrorism [19,20]. Concomitant with this type of monitoring, is the use of geographic information systems (GIS)-based images for mapping out distribution patterns to assess emerging patterns of distribution of threats to public health, whether the threat is environmental or biological [17]. As an analytic strategy, this differs from the more traditional use of public (or restricted) digital health records used for diagnosis and treatment. Thus, the use of the tools in PHI brings to bear novel strategies and resources for the timely detection and management of disease clusters, ecological analyses, and vectors of exposure [17].

During the economic crisis of the past decade, the American Recovery and Reinvestment Act was passed. Among other things, the act brought considerable economic stimulus monies to fund the continued implementation of electronic health records and health information exchanges with the goal of having a fully modernized system in place by 2014 [21]. In addition to the informatics developments described earlier, elements of the system was seen as a means to provide information about geographic areas that have concentrations of unfavorable health indicators or were comprised of populations of underserved groups [22]. Through the development of such information gathering and repository strategies, accurate information about an entire population groups could be determined, rather than from only those who sought services in the past. Thus, these systems permit assessment of disparities of health status among different population subgroups along a number of dimensions including sex, race, and age [22].

Nonetheless, there are unanticipated roadblocks and challenges that can undermine the best of intentions. In a nutshell, all programs entail risk but unforeseen roadblocks can nonetheless present an opportunity to improve upon existing strategies. While the utilization of PHI to inform and enhance local, state, and national health is a laudable goal, lack of proper consideration of contextual elements of the program during implementation can lead to failure [23]. Here, a government program designed to create a monitoring framework utilizing a primary care based framework to detect and track hepatitis B is instructive. Multiple breakdowns in program effectiveness occurred as a result of erroneous assumptions about a number of factors including the IT and software milieu, participants, and available infrastructure. Analysis of program failures revealed that inadequate attention to the key technological and health care as well as a variety of social and political factors undermined success [23].

Conversely, other programs in PHI have produced more direct positive effects. Salient examples can be found in among public health strategies that deal with common viral diseases such as Lyme disease in the United States and, more globally, Malaria. The most common vector borne disease in the United States [24,25], Lyme disease is caused by a tick-borne spirochete (*Borrelia burgdorferi*). First, widely reported in the 1980s, it is now tracked at the national level. Although a concern in the United States, malaria is a severe problem especially in Africa [26]. Globally, the disease kills between one and a half to two and a half million people a year [27].

Using the tools of PHI, models of Malaria outbreaks and vector habits have been developed [28,29]. In the United States, the use of GIS analysis has proven quite effective in identifying climate and habitat considerations conducive for the spread of the disease via deer ticks [24,25,30]. On the basis of such data, environmental interventions to inhibit the establishment of Lyme disease causing virus have led to reductions in risk to human populations [31].

Similarly, through modification of an existing source of health records, new avenues to assistance with public health surveillance are available and these strategies are consistent with PHI. For example, death records often contain information that when properly used and mined for information, can assist with detection and patterns of influenza as well as viral and bacterial pneumonia [32]. In addition, utilizing a Death certificates pipeline and Meta Map software [33], can inform public health professionals with systematically assessing the impact of extreme environmental conditions such as severe winter conditions or prolonged heat waves on a vulnerable populations or relevant public health threats such as severe acute respiratory syndrome [34-36].

While concerns remain about data security and privacy, electronic heath records [37,38] can act as a mechanism of change to enhance stability population level health as well as enhance the overall level of health within a given population [39]. Further, electronic health records are a valuable mechanism for providing timely data for population and disease registries, such as registries of designer drugs of abuse or newly diagnosed cancers [c.f.,40]. Digitizing health records along with central protected government access can enhance government estimates of health and disease burdens [41]. Further, critical population subgroups can be quickly identified, reducing costs, while facilitating program planning, implementation, review, and refinement [42]. However, for population health data to remain both accessible and protected, adherence to rigors standards is required [41]. Fully embracing specific standard such as the Public Health Reporting Initiative within the Standards and Interoperability Framework [43] and the International Classification of Functioning, Disability and Health [44] are important steps. Certainly these are critical to fully and effectively utilises the rich data of use to public health professionals.

In addition to syndromic surveillance strategies, adaptive cooperative organizational systems can monitor control measures in a manner far superior to that when monitoring is limited to the local organizational level. For example, using a computer simulation to model organizational behavior in Orange County California hospitals, Lee and colleagues [45] convincingly demonstrated that inter-hospital cooperation and data sharing facilitate so-called contact isolation. Lee and colleagues research examined active control and data sharing mechanisms when dealing with a pressing issue of systemic infection-methicillin-resistant *Staphylococcus aureus*, or MRSA [46]. Thus, cooperative efforts across hospitals can enhance effective infection control, especially when infections have potentially costly and deadly consequences. While the research of Lee and colleagues involved the facilitation of data sharing, it is not hard to conceive of extended such strategies extended to national monitoring for changes in such opportune infections as MRSA or resistance to existing antiviral treatments [47].

In closing, knowingly society has been adapting to the use of information technology usage in home, office, and public access areas. The strategic plans in enhancing patient care delivery and delivery performance ultimately affect all areas of society. In addition, this topic is relevant when identifying barriers and in order to emphasize essential issues that must be addressed in order to embrace that intellectual use of data information recommendation [6]. Given this, it is not surprising that multiple centers of PHI exist at both federal and local levels. These include supportive organizations such as the CDC's Public Health Information Network PHIN, the National Center for Public Health Informatics, and the PHIConnect Center for Public Health Informatics [8].

3. CONCLUSION/RECOMMENDATIONS

The impact of PHI systems in the health care industry reduces the risk of medical errors and helps consumers to prevent risk of fatal diseases. With PHI, there are many aspects that relevant to patients' services. PHI systems involve the creation, storage, research, and contributions that facilitate clinical and public health decision-making. Medical practitioners utilize PHI to help improve their competency and service delivery. According to Collie and colleagues, "while coding is an important aspect of our professional knowledgebase, our most strategic contribution to the health reform agenda will be in assisting health services to leverage data and information for decision making and self–improvement" [6, p.29). Among the relevant solutions to these issues, company administration is mandated in offering computer training and its application to clinicians. The advantages associated with such solutions are seen in a marked increase in the ability to provide the proper care and quality of care to patients in all areas of public health and medicine.

The progression of advanced technology continues at a rapid pace. As a consequence, relevant constituencies struggle to incorporate new information without delaying new programs or systems. Further, information sharing at a comprehensive level will facilitate understand at both the individual patient and population levels [48].

As this brief review suggests, more needs to be done. Indeed, PHI is insufficient to resolve all of the challenges associated with modern public health in a global world. Nonetheless, it is clear that all areas of public health practice benefit from the continued development of informatics frameworks and technologies [14]. As a field, PHI lends itself not only to public health practices, but also to research, strategic outcomes, and learning [49]. Today, there is a recognition that the traditional high versus low risk dichotomy is no longer sufficient to drive positive changes in public health, once it is considered alongside of the myriad of indefinable lifestyle, economic, genetic, and environmental factors present [50]. PHI, with its interdisciplinary origins firmly based in public health, data analysis, and computer science, can contribute much to bettering the human condition.

CONSENT

Not applicable.

ETHICAL APPROVAL

Not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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