INTRODUCTION

Geospatial Applications in Disease Surveillance:
Solutions for the Future

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ABSTRACT

Given the current attention on national health care reform and the electronic exchange of health information, this article highlights the major developments in disease surveillance and identifies a number of public health opportunities for geospatial thought leaders to undertake. Issues surrounding spatial data quality and resolution, the legal and ethical issues of volunteered geographical health information, and the technical demands of formulating a synthetic and integrative disease surveillance system represent the types of research questions that only geographers can address successfully.

Keywords: Disease Surveillance, Electronic Health Information, Geospatial Applications, Public Health, Syndromic Surveillance

INTRODUCTION

One of the compelling forces behind this special theme issue on “Geospatial Applications in Disease Surveillance” is the current attention on health care reform in the United States. An initiative to improve the delivery of health care services is the electronic exchange of health information (Friedman & Parrish, 2011; Roski & McClellan, 2011). The goals of the national health information exchange (HIE) are to expedite the delivery of health information and increase health care access (Cebul et al., 2011; Romano & Stafford, 2011). Disease surveillance is an application of electronic health information exchange that is designed to monitor and respond to disease outbreaks. Currently, there is a large body of published research in medical geography and spatial epidemiology (Boulos, 2004; Cheung et al., 2008; Cromley & McLafferty, 2012; Meade, 2010). Accordingly, there is also a good collection of work on biosurveillance, as it pertains to public health (Brownstein et al., 2009; Horst & Coco, 2010; Lombardo et al., 2003). However, there is very little published research addressing the requirements and development of a pro-active, spatio-temporal, disease surveillance system that incorporates the health and environmental factors necessary for a rapid response to and recovery of a disease outbreak. The contents of this issue present a number of geographic solutions towards this goal in disease surveillance, since such a system entails the integration

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of many moving parts across multiple scales, and the interdisciplinary coordination of many different governance bodies.

At the most basic level, disease surveillance refers to a system designed to monitor disease in a community by detecting patterns of data that are indicative of an outbreak (Jiang & Cooper, 2010). An infectious disease threat, combined with a concern over man-made biological or chemical events, prompted the World Health Organization (WHO) to update their International Health Regulations (IHR) in 2005 (WHO, 2005). The new 2005 IHR is a legally binding instrument for all 194 WHO member countries that significantly expanded the scope of reportable conditions and is intended to help prevent and respond to global public health threats. Electronic disease surveillance systems, such as those used in syndromic surveillance, have great potential to improve health security (CDC, 2007; Chretien et al., 2008; Soto et al., 2008). Epidemiologists using electronic disease surveillance have the potential to detect irregular disease activities earlier than traditional laboratory-based surveillance, as well as monitor the health of their community in the face of a known threat.

Syndromic surveillance is a type of real-time surveillance system that relies on the detection of clinical aspects of disease before confirmed diagnoses are made (Bradley et al., 2005; Cakici et al., 2010; Mandl et al., 2004). A more sophisticated form of disease surveillance is a system that manages “health-related data and information for early warning of threats and hazards, early detection of events, and rapid characterization of the event so that effective actions can be taken to mitigate adverse health effects” (CDC, 2010). A fully developed disease surveillance system is able to manage the following three aspects: detection, response, and recovery. In this paper, I argue that the skills and experiences of professional geographers are essential to the field of disease surveillance. The following sections will briefly describe the current landscape of disease surveillance, and discuss how geographic knowledge is crucial to the understanding and response to disease outbreaks.

LANDSCAPE OF DISEASE SURVEILLANCE

Put simply, disease surveillance can be divided into three parts: detecting, understanding, and responding to the spread of disease. Much research has been conducted on disease detection – among these are syndromic surveillance research and efforts to monitor sentinel clinics for disease outbreaks (Flores-Figueroa et al., 2011; Ginsberg et al., 2008; Kirian & Weintraub 2010; Moise et al., 2011; O’Connell et al., 2010; Short et al., 2011). Syndromic surveillance systems attempt to detect a disease before an actual diagnosis is made, by using ancillary data sources to predict a clinical outbreak. These data sources present information from different points along the continuum of the disease process, so public health officials can provide health care facilities and professionals with advanced notice of a disease outbreak. Such data sources include sales records of prescriptions and other disease-related consumer products (such as Kleenex tissues, orange juice and over-the-counter medicines), work and school absenteeism records, and increased visits and calls to health care facilities and providers (Mandl et al., 2004). Syndromic surveillance is one of the positive by-products of the international initiative to implement health information exchanges (ISDS website, 2011).

In collaboration with the US Department of Defense (DoD), the Johns Hopkins University Applied Physics Laboratory (JHU/APL) collaborated with the US Department of Defense (DoD) to develop the Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE). ESSENCE collects, processes, and analyzes non-traditional data sources (i.e. chief complaints from hospital emergency departments,
Integrated Ontologies for Spatial Scene Descriptions
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