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Spatial aberration vs. geographical substance: Representing place in public health surveillance

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ABSTRACT

Public health surveillance involves the routine and ongoing collection, analysis and dissemination of health information for a variety of stakeholders—including both public health officials and the public. Much of the current focus of public health surveillance is on detecting aberrations in space—largely inspired by concerns about bioterrorism and newly emerging infectious diseases. We argue that the current focus on spatial aberrations has limited the development of public health surveillance by excluding a more explicit geographical understanding and representation of place. A more place-focused public health surveillance could represent geography in ways that are useful to a broader audience, provide information on the social and physical contexts related to health, facilitate a better understanding of health inequalities, and can benefit from local knowledge. Geographers can make important contributions to public health practice by contributing to more meaningful definitions of place in the design and operation of public health surveillance systems.

1. Introduction

Public health surveillance is "the systematic, ongoing assessment of the health of a community, based on the collection, interpretation, and use of health data and information" with the goal of disseminating the information to a wide range of stakeholders (Thacker, 2010). Public health surveillance may be best understood by distinguishing it from public health research; while the purpose of public health research is to understand health in populations, the purpose of public health surveillance is to provide timely information in support of decision making. Public health research is often cross-sectional, with an emphasis on answering specific research questions. Public health surveillance does not answer specific questions, but provides routine and ongoing information about patterns in health and health care, setting a baseline for comparison to historical and future patterns (Declich and Carter, 1994). The immediate consumers of most public health research are members of the research, clinical practice and policy making communities, while health surveillance activities directly support decision making at many levels (individuals, public health officials and policy makers) and with a broad purpose. Health surveillance information can inform personal risk assessments, health care practitioners, non-governmental advocacy organizations, and governments at national and international scales.

While distinctions between public health research and public health surveillance gain epistemological traction in the health sciences, most geographic contributions to public health surveillance have been restricted to methodology (Openshaw et al., 1988; Rushton and Lolonis, 1996; Rogerson, 1997; Rogerson and Yamada, 2004) and issues of governance and infection control (Ali and Keil, 2006; Budd et al., 2009). Although the practice of public health surveillance is often outside the scope of academia, the relatively small contribution of geographers to public health surveillance, when compared to their much larger contribution to public health generally, has resulted in a public health surveillance emphasizing the detection of spatial aberrations (such as disease clusters) over characterizing and broader geographies of health. As a result, within public health surveillance geography is usually a matter of representational convenience, with little consideration of the broader meanings and implications of geography and place on health. These limitations have contributed to a practice of public health surveillance that is focussed on the collection of biomedical departures from 'normal', and has limited the scope of information produced, as well as failing to support a more complete and contextually informed understanding of public health.

In this paper, we highlight the tension between spatial aberration detection and the representation of place within public health surveillance. Our focus is on understanding this tension at regional and local scales, rather than at the international scale, and in this way, our discussion focuses more on the practical challenges of designing and implementing public health surveillance systems,

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rather than on the political obstacles to global health governance. We proceed by first describing the history and development of public health surveillance, including a discussion of the primary motivations for modern public health surveillance practice. We then argue that the historical focus on spatial aberration detection has limited the way geographic health information is represented by defining place only in terms of statistical anomaly. Finally, we discuss how public health surveillance could be enhanced by adopting a more place-based approach, comprised of judicious and informed definitions of place, and the independent acquisition and analysis of data in these places.

2. History and development of modern public health surveillance

One of the first systematically collected sources of health surveillance data was from the *Bills of Mortality,* weekly publications on deaths occurring in the City of London and surrounding parishes. While thought to have been inspired by the early 16th century to warn the population of outbreaks of the plague, by the mid 17th century, they reported cause specific mortality, and eventually birth figures as well. In 1662 John Graunt published *Natural and Political Observations Made Upon the Bills of Mortality*, and in the process described some of the key metrics used in health surveillance—including counts, proportions and rates (Hald, 2005). He noted year-to-year consistencies in some causes of death as well as differences in mortality by sex and between urban and rural residents (Rosen, 1993). Roughly 200 years later William Farr, a civil servant, statistician and contemporary of John Snow, oversaw the collection, analysis and reporting of similar health statistics with a more explicit purpose to inform decisions about public health. Farr set up classification systems for reporting causes of death, and established important methodological conventions often overlooked in the reporting of health statistics at the time—such as ensuring that numerators and denominators of mortality rates matched (Langmuir, 1976). At the time that Snow advanced understanding of cholera, Farr and his contemporaries in Germany and the United States were concerned with compiling and reporting information on several infectious diseases simultaneously (Declich and Carter, 1994). These early health surveillance activities differed from Snow's study of cholera in London in terms of application rather than method. Snow's data collection lead to the removal of pump handles thought to be the source of the cholera outbreak, and while the intervention was too late to impact public health, his work was an important contribution to understanding the origin of cholera, and the development of germ theory (Paneth, 2004). The information generated from early surveillance activities involved the collection of similar data, but served to inform politicians, medical officials and the public about the state of public health rather than to advance understanding the disease (Thacker, 2010).

By the late 19th century, several US states and many countries in Europe had notifiable communicable disease registries used for disease surveillance purposes (Thacker, 2010). These activities were concerned primarily with monitoring infectious diseases in individuals, and controlling spread to the population. However, other surveillance activities also included more general observational surveys and the collection of data about the environment. For example, German medical officers were responsible for surveying district water quality, health care provision as well as the health of local populations, and completed regular reports of their findings (Rosen, 1993). In New England, Lemuel Shattuck advocated the collection of not only health data, but data on population characteristics such as socioeconomic status and occupation (Thacker, 2010). Nevertheless, it was not until the 1950s that the meaning of surveillance was formally broadened to include the practice of monitoring trends in the health of the population (Langmuir, 1971).

Early debates about whether surveillance should be restricted to infectious disease and mortality, or should be applied more broadly have largely converged on a more inclusive definition today. The term 'public health surveillance' is now commonly used over the historical term 'disease surveillance' in recognition of this more comprehensive purpose (Thacker and Stroup, 1994). The scope of public health surveillance now also includes the reporting of chronic diseases such as diabetes (Desai et al., 2003), acute care visits (Hirshon, 2000), quality of life (Hennessy et al., 1994), adverse reactions to immunization (Greene et al., 2009), physical activity levels (Macera and Pratt, 2000) and environmental exposure to disease causing agents (Backer et al., 2001). Recent interest in 'syndromic surveillance' has further broadened the scope of health surveillance using non-traditional sources of data to quickly identify changing patterns in disease symptoms, rather than waiting for clinically or laboratory confirmed disease diagnoses (Lawson and Kleinman, 2005). Examples of syndromic surveillance include monitoring indirect indicators of disease such as emergency department admissions (Heffernan et al., 2004) calls to telephone help lines (Cooper et al., 2007) and school and work absenteeism (Besculides et al., 2005).

In spite of its broadening scope, by the early 1990s public health surveillance (and in particular, infectious disease surveillance) was becoming less important to public health practice, at least partly due to the perceived epidemiological transition from infectious to chronic non-infectious diseases in some parts of the world (Berkelman and Hughes, 1993; Osterholm et al., 1996). Budget cut backs in public health lead to declines in several areas of public health surveillance, including food-borne illness and tuberculosis control (Berkelman et al., 1994). Budgetary pressures also lead to an increased privatization of laboratory services and decentralization of data, hindering the coordination of data collection and public health intervention (Dowdle, 1993). While it is unclear if this change was due to a political trend towards privatization and decentralization of public health, the early nineties marked a period of widespread decline. However, growing concerns about the security of Russia's biological weapon arsenal and the 1995 sarin gas attack in Tokyo quickly renewed interest and funding in public health surveillance systems, and in particular, syndromic surveillance as part of bioterrorism defense (Henderson, 1999). This change was reinforced following the attacks on the United States in the fall of 2001. Between 2001 and 2004, the United States federal government spent almost 15 billion dollars on defense against bioterrorism threats (Shuler, 2004), considerably more than the 100 million per year spent in the late nineties (Bellamy and Freedman, 2001).

Much of the funding and research interest in new surveillance activities over the last decade continues to be inspired by concerns about bioterrorism-related public health threats (Mandl et al., 2004), and a large number of systems and methods have been developed with the primary aim of detecting bioterrorism-related outbreaks (Bravata et al., 2004). While many surveillance systems have 'dual-use' civilian public health applications (Fraser and Brown, 2000), funding from bioterrorism preparedness was key to their original development. This has resulted in conflicts between levels of government, particularly in the United States where federal national security funding has been used to entice local authorities to participate in nationally coordinated bioterrorism surveillance programs (Fearnley, 2008). Legislated responsibilities and practical differences exist at different levels of government; local authorities are typically involved in short-term and localized disease control and prevention, while national authorities often have more strategic, and longer-term interests