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Some Methodological Issues in Biosurveillance

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Commentary

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Comments on 'Some methodological issues in biosurveillance'

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Rarely does one get to be a participant in the frontier of a new discipline or area of research. But since 9/11 the field of syndromic surveillance has provided public health researchers and practitioners just such an opportunity. Some of the $5 billion in funds awarded by the Centers for Disease Control and Prevention (CDC) during fiscal years 2002–2007 to states, territories, and several large local jurisdictions to enhance public health capacities to detect, respond to, and recover from bioterrorism events have been allocated to expanding or improving surveillance systems [1]. These expansions have included developing public health capabilities in the area of biosurveillance and its sub-field, syndromic surveillance. The aim of these new systems is to use near 'real-time' data and automated tools to detect and characterize outbreaks (natural or intentional) before conventional methods.

Several systems have become popular for use by state and local health jurisdictions in conducting these syndromic surveillance activities, including the Early Aberration Reporting System (EARS), BioSense, and the Electronic Surveillance System for the Early Notification of Community Based Epidemics (ESSENCE II) [2–4]. In the initial years of implementing syndromic surveillance systems, state and local health departments used the applications primarily to detect bioterrorism-related events [5]. However, due to developing needs, the public health community has applied biosurveillance more broadly to other situations, including influenza and fire-related illness surveillance, as well as to affirm the absence of outbreaks after a disaster [6]. In Monterey County, California, we have had similar needs and particularly wanted a program that we could use for local purposes. We began using EARS in 2005 because of its flexibility for developing syndrome definitions and applied it to a variety of situations, from daily ongoing surveillance for influenza-like illness to emerging situations such as respiratory syndromes potentially associated with an aerial spraying of pesticide (Monterey County, unpublished data).

The field is young, and Fricker (this issue) is timely in his advocacy for the standardization of terms and methods used for biosurveillance and particularly syndromic surveillance. Public health practitioners should support such standardization and have outlined areas for further research and evaluation [7]. An equally pressing issue is the statistical methods that are currently used for biosurveillance. Fricker does an admirable job of summarizing how methodologies from the field of industrial statistical process control have been adapted for use in detecting attacks by terrorists on the health of a population.

A comprehensive understanding of bioterrorism is relatively recent in the literature and, for research purposes, the number of modern bioterrorist events that resulted in actual cases have been few [8]. However, there has been an apparent recent increase in the use of biological agents with 40 of 56 confirmed criminal cases and 19 of 27 confirmed terrorist cases in the 20th century occurring in the 1990s [8]. While these provide a relative paucity of events for modeling purposes and for developing effective syndromic surveillance methods, they underscore the necessity of surveillance methods that can be used to improve time to event detection and to help ensure that a bioterrorist attack is detected. This is likely why there appears to be general support in public health for an expansion of syndromic and other public health surveillance systems. The majority of public health jurisdictions surveyed in the United States use some form of syndromic surveillance [5]. Internationally, the World Health Organization revised the International Health Regulations in 2007 to include the concept of syndromic surveillance as part of an expanded traditional disease notification system. May *et al.* [9] provide a review of its uses in developing nations.

There is a national recognition of the potential usefulness and importance for developing syndromic surveillance systems. In December 2009, proposed regulations were released by the Centers for Medicare and Medicaid Services in the United States defining 'meaningful use' of electronic health records (EHR). In addition, the Office of the National Coordinator for Health Information Technology released an interim final rule describing the required certification standards

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for EHR. Under the 2009 federal economic stimulus package, health-care providers who demonstrate meaningful use of certified EHRs will qualify for incentive payments through Medicaid and Medicare. A specific objective (495.6(c)(16)(i)) of the meaningful use criteria states that the EHR systems should have the 'capability to provide electronic syndromic surveillance data to public health agencies and actual transmission according to applicable law and practice.' However, while used widely, and though interest for its continued use may be growing, there is also a rising tide of criticism as to the appropriateness of the methods used in relation to their intended purpose. While it may be tempting to criticize the usefulness of biosurveillance, it is still early in the process of developing this interesting field and much still needs to be done to assess the strengths and limitations of the developed systems. Fricker (this volume) summarizes several recent papers that 'discuss various issues, challenges, and important research needs associated with effective implementation and operation of electronic biosurveillance systems' and, as he notes, there has been relatively little published on methods and applications of syndromic surveillance or biosurveillance. There is an important need for the development of such methods for current applications of biosurveillance as well as for guiding future opportunities, such as those presented by adding additional information about the patients, via EHR, and the pathogens, via advances in molecular epidemiology [10, 11].

From a public health perspective, there is much that we can do to contribute to the development and improvement of biosurveillance systems, especially due to our particular association with the data and the administrative requests for improving time to event notification. Fricker (this issue) lists several biosurveillance methodological areas for research where the public health community should continue to be actively involved, including algorithm performance standardization and expansion, establishing a commonly accepted set of performance metrics, monitoring for bioterrorism versus natural diseases, and biosurveillance system design. The area of standardized algorithms for biosurveillance is one where public health can be a leader, similar to other national surveillance systems. For example, the national Vital Statistics Surveillance System in the United States, which collects natality and mortality statistics, exemplifies the value of sharing of data between intergovernmental entities using common standards and procedures. It is possible that for syndromic surveillance the CDC will be the keeper of a validated set of syndrome definitions and algorithms, similar to case definitions for reportable diseases established by the National Notifiable Diseases Surveillance System. Such a system could also have established criteria for assessing the sensitivity and specificity of each syndrome definition, and a variety of regional data sets to use to validate new syndrome definitions and to assess new algorithms. As proposed by Fricker (this issue), much of this could be established by convening a national panel of experts that meets regularly to provide the recommendations regarding metrics and standards.

In order to encourage rapid advances in the biosurveillance performance, standardization, validation, and system design, I encourage researchers and practitioners in this field to develop collaborative partnerships. Recent efforts in Monterey County, California, may provide a model of how academic/public health partnerships can help with methodology advances for the field of biosurveillance systems in a mutually beneficial manner. Fricker (this issue) points out several challenges to conducting research in the area of syndromic surveillance methodology and applications. Our collaboration exemplifies one way to address these challenges. For example, the public health department negotiated the legal and regulatory challenges associated with access to the data using memorandums of understanding with the clinics and hospitals. It also had the information technology team for ensuring computer hardware and software were in place for collecting and assembling data and overseeing the ethical and procedural issues for safeguarding the data. Staff at the health department oversaw the managerial issues in implementing the entire system. However, recognizing a need for enhancing department capacity for research into biosurveillance system analytical decision processes, public health staff approached the Naval Postgraduate School (NPS) and its staff to collaborate on syndromic surveillance projects in this area.

The real-world data available to public health practitioners provide the opportunity to assess the reliability and validity of a biosurveillance system for bioterrorism events as well as for outbreaks of natural disease. To that latter end, the first collaborative project between the Monterey County public health department and the NPS has been the assessment of the reliability of signals using real-world data and several different detection algorithms for influenza-like illness. Using ICD-9 codes on actual diagnoses for influenza will provide an opportunity for assessing sensitivity and specificity of the algorithms. There are many other significant diseases that are of interest to public health and would provide opportunity for collaborative ventures of this nature. May *et al.* [8] summarize syndromic surveillance as applied in developing nations for the detection of outbreaks of vector-borne diseases, food-borne illnesses, and sexually transmitted diseases. The evaluation of detection algorithms as applied to these specific types of outbreaks could be similarly evaluated by collaborations between public health and academic institutions.

Meanwhile, though the systems currently available may have much room for improvement, there are several benefits for public health departments implementing and maintaining local syndromic surveillance systems, even during these developmental stages. These benefits include: (1) contributing to improved relations with healthcare personnel; (2) improved preparedness skills in health department staff through knowledge necessary for establishing a surveillance system, appropriate contacts, and health information exchange and informing technology avenues within the health department and between the health department and other agencies; and (3) contributing to a department's continuity

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of business planning. These benefits have been demonstrated in several recent applications of syndromic surveillance systems to natural disasters and emerging disease situations. Public health practitioners have reported on the usefulness of using syndromic surveillance systems to anticipate demands for emergency department care, plan staffing, and responding to a rapidly changing situation [6].

Field epidemiologists in public health are often called upon by their department administration to provide an assessment of the health effects of a local event. In Monterey County, public health officials were able to use a data-driven response to community concerns about the health effects of an aerial spraying of a pheromone-based liquid for an introduced agricultural insect pest by monitoring hospital and clinic data for increases in patients with respiratory-associated symptoms. This demonstrated the usefulness of syndromic surveillance tools that have the flexibility to modify or create new syndrome classification criteria in response to event-specific information needs. In this particular case, no unusual events were detected, but the lack of signals in the presence of a known event allowed the public health department to better respond to media and community inquiries about the health effects of the event.

Our charge as health professionals is to promote and encourage the wise use of syndromic surveillance and biosurveillance systems. We should seek partnerships with new partners, investigate system design using simulated and real-world data, and provide our expert knowledge as to the realities of the potential dynamics of pathogens, hosts, and the environments in which they act. This approach should form the basis for research into biosurveillance systems into the teens of the twenty-first century. With continued refinement and assessment, biosurveillance systems should become a regularly used tool by public health, one by which we can continue to monitor and ensure the health and safety of our local populations.

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