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Public Health Surveillance Using Electronic Health Records: Rising Potential to Advance Public Health

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Abstract

Background: Public health surveillance has traditionally relied on manual processes including paper-based reporting by clinicians. The introduction of electronic laboratory reporting increased the efficiency and completeness of infectious disease surveillance but clinical and risk factor data are often still collected manually. The use of electronic health records (EHR) has significant promise to enrich surveillance by collecting these data automatically and by expanding surveillance to chronic diseases (e.g., diabetes, hypertension, obesity). However, the extent of the use of EHRs for public surveillance is not well studied.

Evidence Acquisition: The peer-reviewed medical literature was searched for descriptions of the use of EHRs for public health surveillance.

Evidence Synthesis: This literature is very limited. The largest body of work describes the experience of the Electronic Medical Record Support for Public Health system (ESPnet) currently being used in Massachusetts, Ohio, and Texas. It shows both the potential and challenges of using EHRs for surveillance.

Discussion: Routine incorporation of EHR data into surveillance provides a unique opportunity to expand the breadth, quality, and efficiency of surveillance efforts. However, more research is needed to document the potential benefits and limitations of EHRs.

Implications: Surveillance practitioners should work with health systems and EHR vendors to explore the use of EHRs. Policymakers should increase financial support for EHR-based surveillance by building requirements into Meaningful Use and other initiatives. In addition, clinical medicine and public health should work together to develop meaningful surveillance measures that can simultaneously improve the care of individuals and populations.

Keywords
Public health surveillance, electronic health records, meaningful use

INTRODUCTION

Public health surveillance is the systematic collection, analysis, and dissemination of data on disease and health status in the population. Public health agencies have traditionally relied on clinicians and laboratories to report communicable diseases and relied on surveys, registries, hospital discharge data, and birth and death certificate analyses to estimate incidence and prevalence of non-infectious conditions including chronic diseases, cancers, and health behaviors. These systems have provided health departments and policymakers with a rich picture of health in society, but collecting data using these methods is laborious, expensive, prone to under-reporting and significant delays, and ill-suited to providing granular data on rare conditions or populations.

Surveillance took a big step forward 20 years ago when some clinical laboratories began reporting test results directly to health departments using electronic protocols. Electronic laboratory reporting improved both the completeness and timeliness of reporting, particularly for communicable diseases.[1] Some jurisdictions have also been able to use electronic laboratory reporting to improve surveillance of diabetes (via reporting of hemoglobin A1C laboratory results), lead poisoning in children, and heavy metal poisoning in adults.

Nonetheless, electronic laboratory reporting has many limitations. Laboratories have limited access to patients' clinical and demographic data; hence laboratory reports typically lack details regarding patients' symptoms, risk behaviors, pregnancy status, prescribed treatments, or detailed contact information. To obtain this information, public health staff must follow up with healthcare providers and/or patients, a laborious, time-consuming, inefficient, and often frustrating process. Moreover, laboratory surveillance cannot detect conditions that cannot be diagnosed using laboratory tests alone, including some infections (e.g., culture-negative tuberculosis); many chronic diseases (e.g., obesity, asthma, hypertension); mental health disorders (e.g., depression, opioid abuse); and key health behaviors (smoking, exercise, drug and alcohol abuse).

The proliferation of electronic health record (EHR) systems carries enormous potential to enrich the breadth, efficiency, and granularity of public health surveillance. EHR systems include highly detailed data on patients including demographics, clinical diagnoses, laboratory tests (both positive and negative), diagnostic studies, prescribed medications, vaccines, and selected health behaviors.

These data have the potential to revolutionize public health surveillance by making large amounts of detailed data from large and diverse populations available to public health agencies in a timely and efficient manner.

The American Recovery and Reinvestment Act (ARRA) and the Meaningful Use program have spurred widespread adoption and implementation of EHRs.[2] The number of hospitals with EHRs has grown from 13% when the law was passed to 70% in 2012 (https://www.healthit.gov/sites/default/files/oncdatabrief16.pdf); EHR use by office-based physicians increased from 48% to 72%. Despite the increasing penetration of EHRs, public health agencies have been slow to utilize their potential for public health surveillance.

EVIDENCE ACQUISITION

Using PubMED, the existing literature (English language, peer-reviewed medical literature) on EHRs was reviewed to summarize the experience to date and to define obstacles and opportunities for further development, and for descriptions of the use of EHRs for public health surveillance.[3]

EVIDENCE SYNTHESIS

This literature is very limited. The largest body of work describes the experience of the Electronic Medical Record Support for Public Health system (ESPnet) currently being used in Massachusetts, Ohio, and Texas.[4] It shows both the potential and challenges of using EHRs for surveillance.

ESPnet is configured as a stand-alone server that is paired with the host EHR behind the host medical practice's firewall and is responsible for all public health surveillance functions. Locating ESPnet on a separate server relieves the host EHR from some computing burden, allows ESPnet to be customized to different EHR systems, and allows greater flexibility to modify surveillance definitions or reporting criteria without imposing upon the host practice. Each night, the ESPnet server collects data from all patient encounters in the preceding 24 hours. These data include patients' demographics, diagnoses, laboratory tests, prescriptions, vaccines, problem list, and social history. ESPnet then applies algorithms to identify conditions of public health interest such as reportable diseases, vaccine-adverse events, influenza-like illness, chronic conditions, or care patterns. When such a condition is found, ESPnet then transmits the information to the health department using a mechanism

appropriate to the condition. These include individual case reports with personally identifiable information for reportable communicable diseases and de-identified aggregate summaries for chronic diseases and influenza-like illness.

ESPnet algorithms are designed to enhance sensitivity, positive predictive value, and generalizability by incorporating data from different parts of the EHR to identify cases. Active tuberculosis, for example, is defined on the basis of an order for pyrazinamide (a medication used only to treat tuberculosis) or for an ICD9 code for tuberculosis and either a concurrent order for an AFB smear (from any body part) or a prescription for ≥2 anti-tuberculous medications. ESPnet algorithms have been shown to have high predictive value across a number of conditions (Table 1).[4]

ESPnet does also permit public health officials to initiate custom queries against clinical practices' EHR data. These queries can be submitted using structured query language. Clinical partners have the option to review and approve proposed queries before they can execute against their data.

Notwithstanding ESPnet's promise, there are few data assessing whether ESPnet in practice can improve population health outcomes or save costs. In addition, the accuracy and completeness of ESPnet surveillance depends on the accuracy and completeness of patients' EHR data. Additional challenges include the need to customize ESPnet disease maps in each new clinical site and the need to continually modify ESPnet mappings and algorithms whenever clinical partners introduce new laboratory assays or when health authorities modify disease definitions.

Another approach to public health surveillance with EHRs is use of continuity of care documents (CCDs).[5] CCDs are a standard clinical summary that the 700+ federally certified EHRs must be able to produce (http://oncchpl.force.com/ehrcert). Data transmission of CCDs is standardized, and CCDs must meet the Meaningful Use requirements familiar to both EHR vendors and public health departments. With appropriate selection criteria, such as ESPnet's case-detection algorithms, CCDs could be generated for a range of diseases of public health interest. Because CCDs are standardized across all EHRs, initiating of surveillance and updating algorithms could occur more rapidly across many EHRs. No literature citations using CCDs for surveillance could be found, but this approach has promise for the future.

Table 1. Electronic medical record support for public health (ESP) case reporting in Massachusetts and Ohio, June 2006–July 2011

Condition	Validation Period, Month/Year, Range	Cases Flagged by the ESP Platform During Validation Period, No.	Confirmed Reportable Cases[a] During Validation Period, No. (%)	Confirmed True Positive Cases[b] During Validation Period, No. (%)	Total Cases Reported by ESP from Inception to Present (June 2006–July 2011), No.
Chlamydia	6/2006–7/2007	758	758 (100)	758 (100)	10 406
Gonorrhea	6/2006–7/2007	95	95 (100)	95 (100)	2056
PID	6/2006–7/2007	20	20 (100)	20 (100)	122
Acute hepatitis A	6/2006–12/2009	13	13 (100)	8 (62)	21
Acute hepatitis B	6/2006–1/2010	19	19 (100)	17 (89)	56
Acute hepatitis C	6/2006–5/2008	15	15 (100)	15 (100)	74
Tuberculosis	6/2006–1/2010	26	25 (100)	16 (64)	168
Syphilis	6/2006–5/2008	59	59 (100)	59 (100)	313

Note. Validation findings are from Atrius Health alone. Total cases include cases from both Atrius Health and MetroHealth.

[a]Reportable cases are defined as physician suspicion of disease. ESP algorithms are designed to report cases as soon as clinically suspected rather than waiting on definitive confirmation. This mirrors clinicians' statutory obligation to report as soon as they suspect disease. This policy helps facilitate timely public health responses to emerging threats.

[b]Confirmed cases defined per Centers for Disease Control and Prevention criteria.

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DISCUSSION

The published research on EHR-based public health surveillance is very limited. More research is needed to document the potential benefits and limitations of EHRs (Table 2). Nonetheless, the potential benefits of EHR-based public health surveillance merit the attention of public health practitioners. This is true not only because the increasingly constrained resource environment for public health requires innovation to improve efficiency, but also because of the potential public health benefits of truly timely and complete surveillance.

Public health practitioners should engage with health systems and EHR vendors to explore their use surveillance and should publish their experience in trying to implement EHR-based surveillance systems. Public health and informatics policymakers should devise ways to increase support for EHR-based surveillance systems including building requirements into Meaningful Use and other federal health information technology initiatives. In addition, clinical medicine and public health should work together to develop meaningful surveillance measures that can simultaneously improve the care of individuals and populations.

Table 2. Research questions for further exploration of electronic health records for public health surveillance

For communicable disease surveillance:
1. Does use of EHRs result in higher sensitivity and timeliness of completed investigations with an acceptable PPV compared with traditional electronic laboratory-based surveillance?
2. Can cost savings for the surveillance system be demonstrated when EHR data are used?
3. Are public health control measures for communicable diseases more effective, e.g., prophylaxis administered and secondary cases averted or identified more quickly?

For chronic disease surveillance:
1. Is the population coverage with EHRs sufficient to yield representative, population-wide data?
2. How do EHR-based data, which include only people in care, compare with population-wide survey data?
3. Are EHR data sufficiently detailed in terms of risk factor information (e.g., current smoker, past smoker) to yield population-based estimates comparable with those of current surveillance?

For surveillance in general:
1. What is the capacity of public health agencies to receive, analyze, and disseminate findings from surveillance reports from EHRs?
2. Can useful information about social determinants of health be gleaned from EHRs?

SUMMARY BOX

What is already known about this topic? Public health surveillance has become more timely and complete through the electronic reporting of clinical laboratory data indicative of diseases under surveillance. Collection of additional demographic, clinical, and risk data is still usually conducted manually by public health workers, which is very inefficient. Surveillance for conditions that do not have a characteristic clinical laboratory finding is slow, incomplete, or non-existent.

What is added by this report? The expansion of electronic health records (EHRs) in recent years provides an opportunity not only to greatly improve traditional surveillance, but also to open new avenues for new forms of surveillance, particularly for chronic disease. There are very few papers in the peer-reviewed literature describing the use or the benefits of using EHRs for public health surveillance. The limited experience thus far, particularly with a program called ESPnet used for surveillance in some clinical settings in Massachusetts, Ohio, and Texas, suggests that EHRs hold great promise to improve public health surveillance and identifies challenges to moving forward.

What are the implications for public health practice, policy, and research? A research agenda for use of EHRs in public health surveillance is proposed. Public health practitioners should engage with health systems developing EHRs to explore their use in surveillance and should publish their experience in trying to implement EHR-based surveillance systems. Public health and informatics policymakers should devise ways to increase support for EHR-based surveillance systems including building requirements into Meaningful Use and other federal health information technology initiatives.

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