Using electronic health record alerts to provide public health situational awareness to clinicians

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ABSTRACT
Alerting providers to public health situations requires timeliness and context-relevance, both lacking in current systems. Incorporating decision support tools into electronic health records may provide a way to deploy public health alerts to clinicians at the point of care. A timely process for responding to Health Alert Network messages sent by the New York City Department of Health and Mental Hygiene was developed by a network of community health centers. Alerts with order sets and recommended actions were created to notify primary care providers of local disease outbreaks. The process, effect, and lessons learned from alerts for Legionella, toxogenic E coli, and measles outbreaks are described. Electronic alerts have the potential to improve management of diseases during an outbreak, including appropriate laboratory testing, management guidance, and diagnostic assistance as well as to enhance bi-directional data exchange between clinical and public health organizations.

BACKGROUND
Information exchange between public health departments and clinicians at the point of care has the potential for tremendous benefit, but strengthening this communication exchange is challenging. In emergencies, it is crucial that health departments are able to convey information, and public health agencies have developed timely approaches. This includes the New York City Department of Health and Mental Hygiene (NYC DOHMH), which has implemented a local health alert network (HAN) to notify providers of a potential health threat using email and secure website posting. Between 40 and 50 numbered health alerts are sent out by the NYC DOHMH annually. These reports range from notification of infectious disease outbreaks, to updates on influenza activity, medication shortages, and mosquito control operations. However, because they are broadcast to all interested parties without regard to location, population, or clinical context, translation into actual clinical practice can be problematic.

Incorporating notifications into an electronic health record (EHR) has the potential to bring contextually relevant information into the hands of clinicians during a clinical encounter and has been demonstrated to positively impact prescribing behavior1 as well as improve performance of preventive care.2–4 It is a logical progression to assume that EHR notifications providing information about potential diagnoses and appropriate confirmatory tests will result in increased diagnostic testing to aid public health investigation and management. Strategies to address this gap have begun to appear, including a system that incorporates up-to-date epidemiologic data into decision rules,5 but development of real-world systems that present context-specific public health information to clinicians has lagged.

The Institute for Family Health (IFH) in New York City, which has a strong public health focus and solid ties with the NYC DOHMH, decided to leverage its existing system to fill this gap by using electronic clinical notifications within an existing EHR. This was done using a system called “Best-Practice Advisories” (BPAs), an application within the Epic Ambulatory EHR6 that presents alerts with hyperlinked order sets to the clinician during a patient encounter. These customized, practice-specific alerts can be programmed by the institution’s clinical leadership to fire according to predetermined triggers, either individual or in combination, using inclusionary or exclusionary logic, ranging from chief complaints entered by nursing staff, vital signs, or diagnoses entered by providers.

The IFH is a freestanding community health center network dedicated to developing innovative ways to provide primary health services to medically underserved populations. It operates 15 full-time and nine part-time federally qualified community health centers in the Bronx, Manhattan, and the Mid-Hudson Valley, providing primary care, mental health, and dental services, regardless of an individual’s ability to pay. Each year, Institute health centers provide more than 225,000 visits to 75,000 patients. The Institute currently employs over 600 individuals including 122 primary care providers and family medicine residents, 4 dentists, 45 nurses and medical assistants, and 57 mental health professionals and social workers.

METHODS
A flexible and rapid approach evolved to produce BPAs in emerging situations. The workflow for BPA development involves a senior executive clinical team whose members participate in the initiation and review of alerts. The President and CEO are part of the clinical leadership team responsible for initiating and reviewing proposed alerts along with the Senior VP for Quality Improvement, Chief Medical Information Officer (CMIO), Senior VP for Clinical Services, and Upstate and NYC Regional Medical Directors.
Alerts may come from a variety of sources; in the case of public health situational awareness, when a member of the Institute’s clinical leadership team receives a HAN notification that may impact on primary care in one or more of our practices, he or she proposes a BPA to the CMIO. Because the vast majority of HAN messages do not directly impact on primary care, either impacting inpatient or specialty situations, or are notifications of online resources and other public health activities, many are not proposed as potential clinical alerts. During the eight months covered by this report, 34 HAN notifications occurred; only four of these were relevant to primary care practice, all of which were translated into BPAs.

A potential BPA is then discussed via email and conference call with available clinical leadership. If approved by this group, the alert and order set are created and checked on one test patient case, bypassing the usual testing and piloting process, then implemented in the relevant sites. This structure has allowed alerts to be implemented in the active EHR shortly after their being sent out by the Department of Health (DOH). Alerts are triggered within a clinical encounter by disease-specific symptoms, signs, or diagnoses. The structured data elements may be entered by a nurse or medical assistant before the clinical encounter or by the treating provider during the encounter. The alert appears during the encounter as a bright yellow pop-up window and contains a link to the relevant order set and other information. Order sets contain lab and medication orders and management guidance if necessary. The system records both the alert being triggered and the link to the order set being used. Examples of cases to illustrate the BPA development process follow.

CASE DESCRIPTIONS

Case #1: Legionella outbreak
On July 24, 2007, a HAN advisory was broadcast stating that there was an observed increase in cases of Legionnaires’ disease in specific sections in the Bronx. The CMIO received the email the next morning and consulted with the CEO and the VP of Quality Improvement and they agreed to release a BPA specifically for the Institute’s Parkchester (Bronx) Health Center. The alert was triggered by chief complaints of cough OR chest pain OR fever OR chest congestion OR cold symptoms and included orders for sputum culture, Legionella urine antigen, chest x-ray, and complete blood count, as well as outpatient antibiotic prescriptions appropriate for community-acquired pneumonia. This BPA was activated on July 27, 2007; it triggered on 142 patients during the time it was active and orders were activated in 5 instances (3.5%). While there were no patients diagnosed with pneumonia at that center that season, there were two orders for Legionella urine antigen, a test that had not been ordered in the five years prior to this alert.

Case #2: toxigenic E coli contaminated hamburgers
On September 28, 2007, the NYC DOHMH sent out a health alert of a multi-state E coli O157:H7 outbreak associated with contaminated ground beef in counties surrounding New York City. This alert specifically recommended culture and sensitivity testing for Shiga toxin-producing E coli in patients with bloody diarrhea or hemolytic uremic syndrome. The BPA was released on October 1; triggers included either chief complaints of diarrhea OR stomachache OR diagnoses of gastroenteritis or diarrhea OR melena/bloody stool. Orders included requests for a Shiga-toxin assay along with routine stool culture. The “Management” section included the following: “The only current treatment of EHEC infection is supportive, with monitoring for the development of microangiopathic complications such as HUS. Antiperistaltic agents increase the risk of systemic complications. Antibiotic therapy has no established effect on the duration of acute diarrhea.” During the period that the alert was active, the BPA triggered on 287 patients and providers activated the order set 65 times (22.6%), but no instance of E coli O157:H7 was identified.

Case #3: measles outbreak in Brooklyn
On February 25, 2008, the NYC DOHMH sent out health alert #5 stating that two cases of measles had been diagnosed in children with likely local transmission. The next day, after consulting with the executive clinical team, the CMIO developed an alert that fired with chief complaints of fever AND rash. The alert stated “Fever+Rash...Consider Measles!” with a hyperlink to the CDC measles treatment web page. The order set contained orders for measles serology in addition to blood, nasopharyngeal, and urine samples requested by the NYC DOHMH. The orders included contact phone numbers to arrange specimen pickup, prompting testing of the phone numbers and an impromptu clarification about the specimen type required. Seven days after the HAN notification, a potential case was identified through the system. Specimens were sent to the DOH for pickup, but the illness was determined not to be measles. In the following months, the alert triggered on 198 patients, with providers activating the order set on four occasions (2%).

DISCUSSION
We have described an innovative program designed to bring public health situational awareness into the clinical setting. Clinicians were given appropriate recommendations during urgent public health situations using BPAs in an outpatient EHR. Although we did not document the direct connection between the alert and the clinical reasoning leading to the action, a causal relationship may be inferred in Case 2 when a urine Legionella test was collected for the first time in five years soon after the alert firing. This project illustrates two key elements for success: the alert development process is rapid and flexible, and the alerts provide up-to-date local situational awareness, best practice management guidance, and DOH contact information. The benefits of providing these notifications include automated identification of potential cases and point-of-care distribution of DOH-recommended diagnostic testing.

While the creation of these alerts is performed manually, with the CMIO designated to translate HAN alerts into an operationalized alert, they can be proposed by any of the management team. Approaches to the alert development at other institutions have included internal committees of experts who develop and review protocols, which are then formulated into electronic tools’ and purchasing evidence-based clinical decision support content from outside vendors, governmental agencies, or specialty societies organizations. Both these practices may be inadequate to respond to the highly dynamic nature of emerging epidemics. Simplified review committee protocols and an easily customizable EHR alerting framework as demonstrated in our institution are necessary to provide timely point-of-care decision support.

Incorporating the newest national or local recommendations for treatment of diseases with public health implications is crucial. The alert not only guides clinicians toward diseases they would not typically consider, but as in the E coli case, the system was able to advise clinicians to use supportive care and avoid unnecessary antibiotic treatment. The appropriate lab tests in
coordination with the DOH were also suggested in each case, improving diagnostic efficacy. This demonstrated the ability not only to help the DOH collect necessary lab tests, but also to guide a wide variety of clinicians to appropriate treatment during urgent situations, a two-way benefit from situational information exchange. Lab testing in coordination with the DOH can also improve timeliness of diagnosis, as some samples can be expedited by coordinating directly with the public health laboratory.

The low rates of alert response in this alerting system are worth noting. During the one-year period from July 1, 2007 to June 30, 2008, there were 43,315 patients that received an alert. Response rates (defined by the provider clicking on the alert in order to open the attached order set) varied from 2% to 65% depending on the particular alert. The number of patients with public health alerts represented less than 1% of total alert volume, so it is unlikely that this type of alert was a high additional burden to clinicians. We were also unable to determine whether clinicians acted appropriately or inappropriately when they ignored alerts. However, we suspect that the relatively crude triggers (chief complaints of fever and rash for measles, for example) generated large numbers of false positive alerts, which were appropriately rejected by providers who were aware of the full clinical context. This potentially could be improved by increased computer-interpretabilit"y of the patient history, providing more detailed clinical data points combined with more specific, evidence-based triggers.

The need for clinical guidelines to be expressed with high specificity has been well documented in the literature, and evidence suggests that clinicians are less likely to be responsive to non-specific guidelines. Future EHR alerts must be implemented with this in mind to minimize the potential for alert fatigue, and this can be done by targeting the alert to the appropriate patients. At the present time this task must be undertaken by the local medical practice leadership who must first filter out which health department notifications warrant alerts, and then decide how to convert notifications to alerts and order sets recognized by their facility’s EHR. Technology to enable centralized decision rules created by public health organizations that can be plugged into generic EHR systems is currently elusive, but steps toward that solution are conceivable. Health departments could distribute alerts with tags specifying the demographic potentially impacted in addition to providing some decision support guidance, such as designating possible structured data triggers (chief complaint, vital sign parameters, diagnosis codes, or medication/procedure orders) that should be used in generating an alert.

In the context of a primary care ambulatory practice, the low number of directly applicable HAN messages allows the IFH clinical leadership to rapidly develop and roll out electronic decision support. As a direct consequence of this “just in time” support, we have demonstrated the ability to affect clinical behavior, and in one case rapidly supply clinical specimens back to the DOH, thereby providing critical data during disease outbreaks. Using the process described, the responsibility of setting priorities and clinical protocols for urgent public health situations could be more completely ceded to the central public health authority, allowing the clinical site to focus on operationalizing recommendations into workflow and disseminating context-appropriate information to clinicians in a form that allows immediate action. As use of electronic health records becomes the standard of care, clinical care could potentially benefit from further development of alerts originating from health departments, to be both tightly focused in addressing particular practice environments and automatically incorporated into patient care workflow.

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