Section A. Identifiers

1. **Name and Title of Submitter**
   Justin Pendarvis, MPH
   Epidemiologist, Communicable Disease Control Division

2. **Public health organization name**
   Infectious Disease Bureau, Boston Public Health Commission

3. **Public health information system name**
   Boston Syndromic Surveillance System (B-SYNSS)

4. **Address**
   1010 Massachusetts Avenue

5. **City, state, and ZIP code**
   Boston, MA 02118

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8. **Description of community (ies) served**
   The Boston Public Health Commission (BPHC) is the local board of health for the city of Boston, serving a diverse resident population of 589,141 and a daytime population of roughly 1.2 million. Boston is the gateway to New England, with an international airport and harbor, and home to many colleges and universities with large student populations. The city has a large medical community and hosts many high profile events. Public events like the 2004 Democratic National Convention, Boston Marathon, Baseball World Series, NBA Championships, and Super Bowl victory parades bring additional populations into the city and require enhanced disease surveillance.

   B-SYNSS primary users are within the Communicable Disease Control Division at the Boston Public Health Commission (BPHC). Data providers and participating healthcare sites in Boston include ten acute care emergency departments, two urgent care centers, Boston Emergency Medical Services, and a homeless healthcare program.

9. **Number of FTEs**
   a. **In entire organization (list by staff category)**
      Boston Public Health Commission, total – 1,132 FTEs
      Infectious Disease Bureau, total – 63.36 FTEs
      Communicable Disease Control Division – 16.47 FTEs

   b. **Directly involved in submission project**
      Project Staff – 2.98 FTEs --- (FY08)

Project Staff, by Role

Role	Percent Time
IT/IS Project Manager	0.85
CDCD Epidemiologist	0.6
CDCD Public Health Nurse	0.5
CDCD Public Health Nursing Supervisor	0.3
CDCD Director	0.1
CDCD Administrative Asst	0.48
CDCD Project Manager	0.15
Total	**2.98**

10. Description of public health program(s) directly affected by submission

B-SYNSS directly supports public health and emergency response users within the city of Boston by monitoring and characterizing acute care activity across the city. In addition to disease surveillance, the data also supports other public health activities such as environmental hazards monitoring and drug and alcohol surveillance. B-SYNSS provides enhanced situational awareness during outbreaks and high profile public events.

The BPHC's Infectious Disease Bureau is the primary user of the system. The Communicable Disease Control Division (CDCD) within the Infectious Disease Bureau is responsible for the prevention and control of communicable disease in Boston, and the system supports a team of public health nurses, epidemiologists and physicians in targeting surveillance and responding to public health events. Data and findings from B-SYNSS are communicated with other divisions at BPHC, including the Office of Environmental Hazards, Office of Public Health Preparedness, Communications Office, and Division of Emergency Medical Services. Situation awareness reports of communicable disease activity are provided at Boston Medical Intelligence briefings. The Office of Public Health Preparedness, Division of Emergency Medical Services, and the Infectious Disease Bureau partner in planning and managing mass dispensing of counter measures in disease prevention and control. Aberrations of public health significance that involve non-Boston residents are referred to the Massachusetts Department of Public Health and other local health departments for follow-up.

11. List the names of the members of the Electronic Public Health Information Team (who will be considered authors of the application)

Justin Pendarvis
Michael Donovan
Jennifer Ridge
Julia Gunn
M. Anita Barry

Section B. Guidelines for Application

The Organization

The Boston Public Health Commission (BPHC) is the nation's first health department, created in 1799, when Paul Revere was named Boston's first health officer. At that time, the board of health was formed to fight a potential outbreak of cholera. In its current configuration, the Boston Public Health Commission is a political subdivision of the Commonwealth of Massachusetts created pursuant to the Boston Public Health Act of 1995, G.L. c. 111 App. § 2-1. The BPHC is the local board of health for the city of Boston, and its mission is to protect, preserve and promote the health and well-being of all Boston residents, particularly those who are most vulnerable.

Boston is the largest municipality within Massachusetts, with a population of 589,141 (2000 US Census). The day time working population roughly doubles to an estimated 1.2 million. The city covers 45 square miles, and is home to a diverse population with wide variability in demographics across 16 distinct neighborhoods. Within the city are three medical schools, nine acute care medical centers/hospitals, 26 community health centers, and three schools of public health. Boston's hospitals serve as major local, regional, national, and international referral sites for complex or unusual medical problems.

The Communicable Disease Control Division (CDCD) is within the Infectious Disease Bureau of the BPHC and is responsible for communicable disease surveillance and control. Massachusetts and city of Boston regulations require that notifiable conditions diagnosed in Boston be reported to BPHC. In 2008 the BPHC CDCD investigated over 3000 reported cases of infectious disease.

The CDCD utilizes multiple surveillance systems to detect and assess potential public health threats in the city of Boston. These include: reportable disease and outbreak reporting by health care providers and biological laboratories (research and diagnostic), review of death certificates, trend analysis of Boston EMS transport data and poison control calls, and syndromic surveillance of Boston emergency departments (EDs) and community-based urgent care centers. CDCD staff are on-call 24 hours a day to respond to potential public health emergencies or reports of immediately notifiable diseases.

Management

1. Objectives

Surveillance and epidemiological response serve as the foundation for any jurisdiction's ability to effectively respond to and mitigate the effects of disease outbreaks or acts of bioterrorism. To enhance Boston's preparedness to respond to such an event, BPHC developed a coordinated, comprehensive surveillance system for detection of bioterrorism or other infectious public health events. This system was designed to address known limitations of traditional passive surveillance systems that rely on reporting of specific diseases while leveraging advances in health information technology.

Key objectives and goals of the system:

- Improve sensitivity and specificity of disease surveillance by expansion to critical points of care and ability to refine syndromes as epidemiologic information becomes available

- Provide early recognition and response to large-scale public health events, such as outbreaks or acts of bioterrorism

- Enhance situational awareness during public events or in combination with other data sources to support accurate epidemiologic assessments

- Maintain a scalable platform for secure storage and access of confidential information describing health seeking behavior and infectious disease surveillance

2. Project Organization

Roles & Responsibilities
The B-SYNSS application is maintained and operated by the BPHC CDCD. Distinct strategic roles are divided among project staff to maintain technical operability and public health usability. Specific project roles and responsibilities include:

- The CDCD/IT Project Manager is responsible for maintaining data quality and ensuring day-to-day (24/7) operation. This includes technical oversight of daily data tasks, updates to system configuration, troubleshooting data transmission errors, and maintaining a technical helpdesk for BPHC IT and IT at participating healthcare sites. A major responsibility of this position is to maintain technical linkages with sites' IT personnel, which allows for the quick resolution of most technical issues as they arise.

- The CDCD Director provides project oversight, guidance, and strategic planning, and coordinates review with CDCD epidemiology staff to ensure the technical approach meets programmatic needs.

- CDCD Epidemiologists perform daily surveillance and data analysis, periodic evaluation of syndromes by correlation with diagnostic data, initial response to alerts, and incorporate the syndromic surveillance output with descriptive epidemiology from other data sources for a more comprehensive and complete surveillance product.

- CDCD Public Health Nurses provide follow up with clinical sites, and the clinical interface with points of care to conduct epidemiologic investigations as needed.

- The CDCD Outreach & Education Project Manager assists in the development of risk communication messaging for public notification of findings and clinical advisories.

Implementation Timeline

In early 2000 the BPHC established a citywide Surveillance Task Force (STF) to develop and outline a strategy and methodology for a near real-time surveillance system. The STF included many key stakeholders: hospital infectious disease specialists, emergency department physicians and nurses, local and state health departments, Boston EMS, and representatives from a local zoo and the regional poison control center. Members of the STF worked with information system personnel at their respective sites, and developed a simple, secure and reliable surveillance methodology – requiring little if any additional work at the site.

Based on the recommendations of the STF, in October 2000 the BPHC Board approved a city regulation requiring acute care sites to submit information on the number of patient visits for each 24-hour period to a secure data system at BPHC. The regulation went into effect in January 2001, and from 2001 to 2004, BPHC performed daily review of volume surveillance, working with sites through established points of contact to review any aberrations and conduct epidemiological investigations as needed. The initial successes of the system included improved communication with points of care, identification of opportunities for education around infectious disease issues, and establishing follow-up mechanisms for signals or indications of unusual activity.

Based on the initial success and positive experiences of participating sites, members of the STF expressed an interest in expanding the volume-based system to include additional data elements as part of a syndrome-based surveillance system. In 2004, the Boston Public Health Commission, in collaboration with CDC and the Massachusetts Department of Public Health developed and implemented an electronic emergency department-based syndromic surveillance system prior to the 2004 Democratic National Convention (DNC). The application was developed between December 2003 and June 2004, and was implemented in July 2004. A city reporting regulation was again passed, requiring all emergency departments to submit a limited dataset for each patient visit.

The initial configuration of B-SYNSS performed statistical analysis of seven mutually exclusive syndrome definitions, with web-based visualization of time series for selected stratifications and the ability to review line lists of individual visit records. In 2006, the system underwent major revisions to allow custom, non-exclusive syndrome definitions and incorporate a custom data dictionary for classification of terms specific to the data from participating sites.

Implementation

1. Public Health Organization – Segments Involved

B-SYNSS is utilized by BPHC CDCD staff to perform daily review of all acute care visits to Boston emergency departments and other select health care sites. Data and visualizations are reviewed 7 days a week. Parallel runs of the EARS statistical program produce four separate sets of output for four distinct types of data; emergency department data, corresponding ICD9 codes, urgent care sites, and 911 calls to Boston EMS. Each data source is further stratified by age, site, neighborhood, gender, and region, except for the EMS calls which are only stratified by neighborhood. Table views and time series graphs are both reviewed for observations that are higher than expected or show short or long term upward trends. Time series with indications of

aberrant activity can also be viewed as a line list, allowing the reviewer to scan for clusters in descriptors, presentation, demographics, geography, or other combinations with public health significance.

Given the relative lack of specificity compared with traditional disease surveillance, information from B-SYNSS is interpreted in a highly contextualized environment. Follow-up algorithms and public health response to a signal or observation may change depending on information from other sources. Findings are communicated within the CDCD and with external partners as necessary. For example, clusters of carbon monoxide poisoning identified through B-SYNSS are investigated and forwarded to the BPHC Office of Environmental Hazards (OEH) for on-site inspections.

Daily uses include:

- Outbreak detection: each syndrome is monitored for short term increases in activity with particular focus on infectious diseases or processes. Demographics and other patient characteristics are used to target investigations or focus re-analysis. For example moderate increases overall may result from a large increase in young children with less of an effect in adults. This data allows more effective and targeted public health response and messaging to providers.

- Seasonal characterization: temporal and spatial patterns are compared to long-term trends for illness such as influenza, gastroenteritis, and meningitis. This allows for a comparison with past years and more nuanced interpretation of findings.

- Support of prevention messages: visualizations of disease activity are used in media and publications in support of public health messages to emphasize and communicate risks.

- Case finding: custom-defined, specific syndrome definitions increase the system's positive predictive value by capturing specific, relevant presentations of illness and more efficiently focusing follow-up.

2. Scope

B-SYNSS receives daily, de-identified patient-visit data including date of visit, chief complaint, gender, zip code of residence, age, and race from each site. A primary ICD9 discharge diagnosis code is collected when it becomes available. Data is received every 24 hours, and the chief complaint for each visit is categorized into non-exclusive syndrome groups based on the symptoms described in the chief complaint. Under the BPHC reporting regulation, sites electronically submit data in a standardized file format to BPHC. A data-dictionary specific to terms found in chief complaints of Boston hospitals is utilized for data preprocessing and symptom classification. Syndromes are stratified by age groups, zip codes, site of care, and gender, and analyzed for statistical aberrations in the number of daily visits using the Early Aberration Reporting System (EARSv4.5).

Technical functionality and system architecture can be subdivided into three areas: data transport, file processing, and data analysis and presentation.

***Data transport*:** Sites use industry standard security protocols to send ASCII files to BPHC. A Linux server provides the SSH protocol suite enabling hospitals to send securely using either the Secure File Transfer Protocol (SFTP) or Secure Copy (SCP). Two sites use FTP to send data that has been encrypted at the site and decrypted upon receipt using PGP public/private keys. A master batch file runs sequentially through the programs needed to move data through the BPHC firewall to a Windows server, compile the data files, and analyze the resulting dataset.

***File processing**:* Data is converted from the ASCII file format and imported into a SQL Server Database using SQL Server Integration Services (IS). Prior to import, chief complaint data is standardized using the medical text processor, EMT-P. The EMT-P program was created by the University of North Carolina, and utilizes Perl, Java, and the National Institute of Health's Unified Medical Language System© to correct typos, misspellings, and standardize text into medical concepts. A pre-processing module created by BPHC translates terms that are not recognized by EMT-P due to local and site-specific chief complaint coding. (i.e. pna = pneumonia). EMT-P then processes and translates the chief complaint terms into the appropriate concepts, and a post-processing module concatenates one-to-many concepts, de-duplicates terms, and translates site-specific fields before final import into the SQL Server Database.

Data analysis and presentation: Data is analyzed using the SAS-based EARS program developed by CDC, which aggregates data, performs statistical analysis, and outputs HTML. The EARS HTML output is hosted on an external facing, SSL enabled and password protected web server, for access from any web browser. A navigational HTML and JavaScript menu was also created to navigate the output and multiple data sources. Summary SAS datasets are also available for users to perform additional analyses in either SAS or MS Excel.

3. Integration Level

Technical integration of B-SYNSS with other information systems is ongoing. BPHC CDCD is currently developing an electronic web-based case management system for infectious disease surveillance, scheduled to go into production in June 2009. The Boston Surveillance System (BoSS) allows full integration with the Massachusetts Department of Public Health's disease surveillance system and electronic laboratory reporting. CDCD was recently awarded funding to create a secure, web-based disease surveillance dashboard which will incorporate disease surveillance from all BPHC CDCD based sources, including BoSS and B-SYNSS data for a comprehensive approach to citywide disease surveillance.

Syndromic surveillance methodologies have advanced rapidly and are being widely adopted and modified by local and state health departments, as well as CDC. As a result, data standards vary widely between systems and there is little national guidance or consensus on messaging and terminology standards; systems contain a combination of the standards employed for other, existing medical record information systems. However, the BPHC CDCD has participated in data exchange projects with other jurisdictions to explore the feasibility and value of shared aggregate data from distributed, local surveillance systems. The DiSTRIBuTE (Distributed Surveillance Taskforce for Real-time Influenza Burden Tracking and Evaluation) project, sponsored by the International Society for Disease Surveillance (ISDS) is one such approach. As a contributing partner in DiSTRIBuTE, an automated data extract describing influenza-like illness from B-SYNSS is transferred to a secure ISDS server for visualization and comparison with other local jurisdictions. This approach leverages local systems to provide a mutually beneficial tool for

monitoring influenza activity and enhancing situational awareness. BPHC supports this collaborative approach, which provides previously unavailable information while limiting the operational burden on local systems.

B-SYNSS is a secure, web-based application, allowing users access from any web browser and the ability to add users or access from any site within the jurisdiction.

4. Privacy Protection

Data received by CDCD is non-identifiable; each record is assigned a unique identification number by the healthcare site and is part of the dataset that is transferred daily. In the event that further investigation is warranted, CDCD staff contact the specific institution to request medical records or additional information per local board of health authority to collect pertinent information as part of epidemiological investigations. Additional investigation is typically the result of an unusual cluster of illness, unusual presentation or chief complaint, or a chief complaint with particular public health significance. Transfer, storage and output of data is secured and HIPAA-compliant, including:

- Secure transfer methods for transmitting daily data files (SFTP, SCP, PGP)
- Web server using SSL encryption
- BPHC network secured by CISCO firewall
- User-based access authorized by BPHC with assigned user ID and password
- Data processing and storage on internal server accessible only via SSH

5. System Implementation

The initial configuration of B-SYNSS was based on the surveillance needs for a large national security event, the 2004 Democratic National Convention (DNC). Syndrome definitions focused on detection of bioterrorism-related disease etiology, and just-in-time trainings for epidemiological staff provided a brief overview of methods and strategies for rapid integration with the overall surveillance activities of BPHC. The core data transfer methods have remained unchanged to limit technological barriers to participation by healthcare sites. However, epidemiologic process redesign has incorporated technical findings and practical approaches informed by experience.

In 2005, to improve the ability of BPHC to interpret data, enhancements to the basic syndromic surveillance system included obtaining two years of historical data from nine hospitals, plus historical laboratory data from two of the nine hospitals. Historical baseline data facilitated the validation of syndrome definitions and the understanding of temporal and spatial patterns of communicable diseases, such as influenza, that occur annually.

In 2006, B-SYNSS was redesigned, both in terms of process and architecture, to incorporate functional changes in EARS and the review of 60,000 medical records to develop a “dictionary” of key words or phrases used in chief complaints. These changes were necessary to improve the accuracy of syndrome definitions and applicability to daily public health practice, including the ability to monitor non-infectious disease based syndromes and create new definitions for case finding during outbreaks. In addition it overcame the limitations of classifying chief complaints into multiple syndromes and decreased differential misclassification of symptoms. For example,

an individual visit described as “vomiting, fever and headache” can be assigned to differential interpretations such as ‘gastroenteritis’ or ‘influenza-like illness’, however the initial system configuration used probabilistic determinations to assign complaints to a single syndrome.

Epidemiologic review of findings occurs on a case by case basis to improve follow-up and response. Periodic review of non-classified complaints is used to define additional terms for inclusion in chief complaint coding.

6. Current State

B-SYNSS currently monitors 19 syndromes for daily aberrations. Data is received daily from 10 hospital emergency departments, 2 urgent care centers, Boston EMS, and a homeless healthcare agency. In 2008, total visits averaged 1360 per day, and ranged from a high of 1647 to a low of 884. Data containing ICD9 codes for each hospital emergency department and the urgent care centers are received when available, typically within two weeks.

Syndrome definitions currently monitor for the following conditions, however ad hoc definitions are quickly created as needed for additional clinical presentations:

Animal Bites
Hemorrhagic illness
Influenza-like Illness, Broad (includes most febrile, respiratory illness presentations)
Influenza-like Illness, Narrow (strict influenza-like illness definition)
Vomiting
Diarrhea
Acute Gastroenteritis
Alcohol Related
Neurological Conditions
Overdoses
Carbon Monoxide Poisoning
Respiratory Infections
Violence Related
Dehydration
Sepsis
Communicable Disease – observations of terms that may indicate a notifiable condition
Febrile Rash Illness

Value

1. Impact on Population Health and Public Health Practice

Prior to the introduction of B-SYNSS, only anecdotal information was available on citywide diseases seen in emergency department visits; no systematic data collection was in place. Historical data allows public health to more accurately interpret current observations, and the availability of electronic data has shifted the methodology for active surveillance. BPHC is now able to actively monitor community-wide health seeking behavior, providing a noninvasive, timely method for collecting information from busy facilities.

The B-SYNSS application has complemented and enhanced disease surveillance in Boston, and several case studies illustrate the utility and extent to which initial objectives have been met:

Sensitive and Specific Approach

B-SYNSS is a robust and sensitive system for characterizing acute care visit data. The application maintains a complete dataset on all emergency department visits in the city of Boston since 2004. Data from the system has been used to identify increased incidences of carbon monoxide poisoning, heat related illness among non-elderly, influenza, and situation awareness during measles outbreaks. In these situations, BPHC conveyed information epidemiology and control measures to health care providers and others, often with the assistance of partners such as MDPH, so that steps could be taken to minimize risk.

The flexibility of the system also allows creation of specific syndromes using the chief complaint data dictionary. For example, due to the 2006 outbreak of mumps in the mid-western United States, BPHC built a "mumps" category within B-SYNSS, which selects chief complaints for "facial swelling" plus "fever", while excluding complaints that are associated with dental problems. Targeted surveillance for mumps was critical given the large numbers of college and university students in Boston and the demographic pattern of the outbreak.

Early disease recognition

Use of the system to track seasonal illnesses, such as influenza and gastroenteritis, have also proven very useful for both the health department and local providers. Characterization of influenza captures the 2-4% increase in visits for influenza-like illness seen at Boston emergency departments each season, and correlates strongly with reported cases of influenza, while providing a valid point of comparison with other regional and national systems. (See Figure 1) Important age-related effects observed in B-SYNSS have improved our understanding of influenza epidemiology in the area and will continue to inform public health practices on influenza control, particularly as it pertains to pandemic influenza. These findings have been reported by BPHC at annual conferences for disease surveillance.

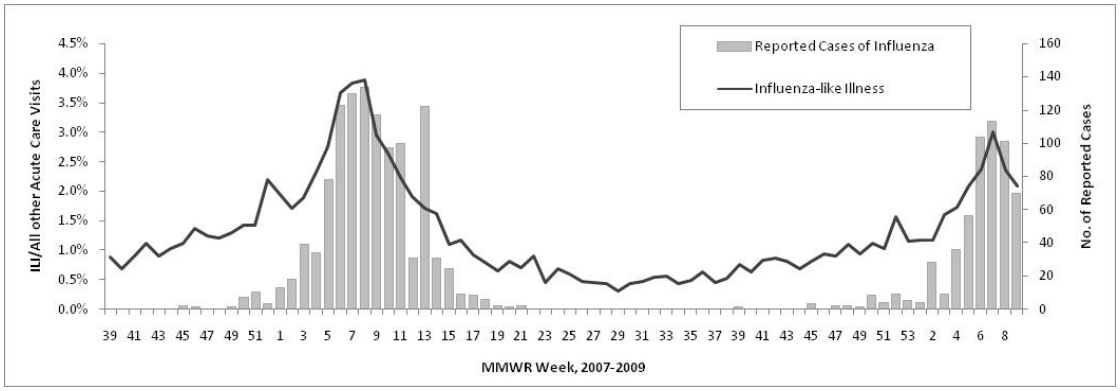

Figure 1. Influenza-like Illness and Reported Cases of Influenza, 2007-2009

Gastroenteritis surveillance alerted BPHC to early increases in disease activity in December 2006. The early recognition of unusually high rates of illness allowed BPHC to prospectively collect and arrange testing for clinical specimens as institutional outbreaks occurred, in partnership with the National Calicivirus Laboratory at CDC. (See Figure 2) Based on laboratory findings, the high levels of gastroenteritis observed in B-SYNSS correlated with the emergence of a novel strain of norovirus. This strain had shown similar virulence while circulating in Europe, and it was the first identification of the strain in the United States. Surveillance of subsequent seasons continues to demonstrate the ability of B-SYNSS to characterize gastroenteritis activity

and comparative burden based on historical data on circulating virus and emergency department usage. Findings are used in near real-time to produce clinical advisories, inform media, and inform more proactive city-wide public health response.

Improved situational awareness

During major public events in Boston, site security and terrorism are major concerns for public safety officials. B-SYNSS data is monitored closely for early indications of disease or unusual presentations and communicated to public officials to aid in planning, enhance situational awareness, and effectively allocate limited resources. During periods of heightened surveillance CDCD may lower the threshold for investigation to increase the sensitivity of the system. In addition, B-SYNSS data is used to compile regular reports and status updates; use of the system in this way ensures rapid communication, establishes pathways for the flow of critical information, and better prepares public health and public safety officials to handle emergencies.

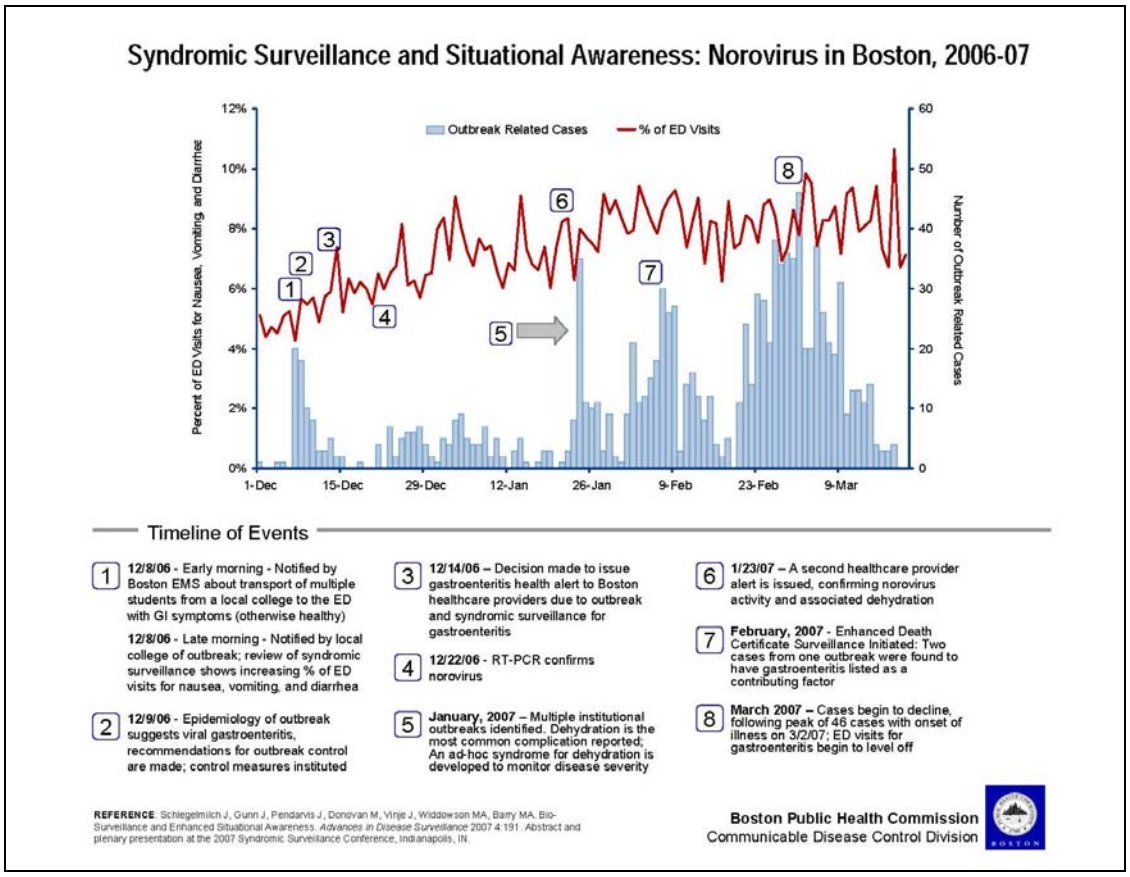

Figure 2. Syndromic Surveillance and Situational Awareness: Norovirus in Boston, 2006-07

During the 2004 DNC, B-SYNSS data was reviewed and reported daily during morning briefings, with follow-up and debriefing of any signals by early afternoon. The review and investigation process had the added benefit of increasing the frequency of communication with acute care providers to reinforce reporting requirements and increase awareness of public health priorities among healthcare providers. This process has been repeated during the 2004 and 2007 World Series, and during other major city-wide events. In addition, during many major events the B-SYNSS identifies increases in alcohol and violence related visits. These types of observations can

be used to target public safety interventions, such as targeted police presence or limiting access to alcohol, for future events.

Secure, scalable platform
The technology and architecture of B-SYNSS allows ready expansion to additional sites, as well as with other forms of surveillance. Current plans are to integrate data with the newly developed BPHC infectious disease surveillance application, as well as with a patient tracking application developed in collaboration with Boston EMS. The system can accept simple data formats readily produced by almost all electronic information systems through secure transfer protocols. The B-SYNSS architecture has been designed to clean, standardize and process data on receipt in order to lower the processing and development burden on data providers.

2. Costs and Benefits Offsetting Costs

Costs
Funding and support for B-SYNSS has been provided through BPHC, the CDC, National Center for Infectious Diseases (NCID), Bioterrorism Preparedness and Response Program (BPRP), and MDPH. BPHC conducted a formal study[1] of the costs associated with the initial development and operation of B-SYNSS. BPHC reviewed all costs associated with B-SYNSS during the period from December 2003 and June 2004 prior to its implementation in July 2004, and during the first 12 month operational period, from July 2004 to July 2005. Data on costs were collected from fiscal record review, internal interviews and time studies, as well as documentation of planning meetings, equipment purchases, and salary data.

In the BPHC study, the total direct cost of developing, implementing, and using B-SYNSS over the 19-month period was $422,899. BPHC's operating cost (including necessary upgrades) of $196,302 over a 12-month period fell within the range found in previous studies, and enhancements to the system during that period added another $74,389 in cost. In this study, the costs incurred by participating hospitals were not assessed. However, because all participating hospitals were already operating electronic information systems from which surveillance data was extracted, and no modifications were required, we estimated the costs to these hospitals to be minimal.

This study did not perform cost-benefit analysis, however the incremental cost for implementation and operation of B-SYNSS during the study period in Boston was relatively small, accounting for less than 15% of the BPHC communicable disease budget. Furthermore, as information technology based surveillance systems continue to expand into other areas such as emergency management, additional returns on the initial and continued investments are likely.

System benefits
Although syndromic surveillance was originally designed for the early detection of bioterrorism-related events, in Boston the system has demonstrated utility for tracking other public health issues (e.g., injury, asthma). Likewise, syndromic surveillance may have greater utility for post-event surveillance or disaster response scenarios to maintain situational awareness.

[1] Kirkwood A, Guenther E, Fleischauer A, Gunn J, Hutwagner L, Barry MA. Direct Cost Associated With the Development and Implementation of a Local Syndromic Surveillance System. *J Public Health Management Practice*, 2007, 13(2), 194-199.

The primary value of B-SYNSS is the ability to take 'the pulse' of Boston's communicable disease activity. The use of separate, distinct types of surveillance data is invaluable for providing actionable information. Public health response at a local level takes into account a myriad of factors, including disease processes, public perception, political accountability, and availability of resources to provide efficient and effective interventions.

To illustrate, during the 2008-09 influenza season, intense media coverage of a pediatric death was followed by a surge in visits to emergency departments for school age children describing influenza-like illness. However, at the same time case reports among that demographic showed no correlating increase. By monitoring both data sources concurrently, CDCD was able to provide targeted risk communication messages, offer influenza vaccination clinics, and respond to emotional needs of parents while offering assurances that overall flu activity was following historical patterns. The one week increase in visits decreased the following week, and no other age groups showed the same effects. Targeting mental health stressors, understanding media-driven health seeking behavior, and monitoring finite health resources improves the quality of healthcare across its spectrum, and B-SYNSS plays an important role in informing that practice.

3. Lessons Learned/Critical Success Factors

Business Processes

- The passage of a citywide regulation early in the process has been critical to the adoption and 100% coverage of the city's emergency departments, and has served as a template for establishing other novel sources of disease surveillance. A similar regulation is now in effect for occupational reporting of infectious disease exposures in infectious disease research laboratories in Boston.

- Business processes for daily review and monitoring should not be labor intensive. Resources should support public health response and surveillance of syndromes that relate to known significant morbidity and mortality (i.e. influenza, gastroenteritis, or meningitis).

- Systems should strive to limit the technical burdens for participation. Data standardization is ideal, however not always technically feasible for healthcare sites. Similarly, participation in the planning and implementation from both the clinical and IT perspectives are critical to a successful application.

Syndromic Surveillance: Practice and Interpretation

- A data warehouse with four years of historical data allowed greater understanding of trending, seasonal patterns, and the importance of establishing a baseline for evaluating statistical algorithms and surveillance signals.

- Integration with traditional public health response is critical; traditional surveillance methods play a key role in understanding syndromic surveillance signals. However, unlike traditional surveillance, during high profile events the lack of syndromic signals can be reassuring.

- There are many limitations and difficulties to working with chief complaint coding. Sensitive definitions that include large numbers of terms for nonspecific complaints obscure signals. Specific definitions that focus on diagnostic predictors help decrease the signal to noise ratio in syndrome definitions.

- Simple visualizations allow 'at-a-glance' assessments, and allow for better integration with multiple, complementary data sources to reveal patterns and identify aberrations.

4. Dissemination

B-SYNSS users have presented findings at the annual conference of the International Society for Disease Surveillance (ISDS) in each of the last five years. CDCD has presented findings on a variety of topics, including the use of syndrome definitions, signal interpretation, case studies, and the use of B-SYNSS data to improve situational awareness. Findings have also been published in MMWR (on seasonal norovirus) and the Journal of Public Health Management and Practice regarding costs. In addition, CDCD staff participate in expert panels, including the NACCHO informatics workgroup, the PACER project, and have hosted EARS webinars and an EARS user conference in Boston. System configuration and technical approaches have also been shared, including symptom coding and the integration of EMTP for chief complaint data processing.

5. Transportability

B-SYNSS has been developed on industry standard information architecture and open-source components. Although configuration has been largely customized to function within the BPHC IT environment, it is a non-proprietary system. The current system configuration was recently presented in a CDC-sponsored EARS webinar. Syndrome definitions and symptom classification tables are currently shared with other jurisdictions and surveillance systems.