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EXECUTIVE SUMMARY – PART I
A number of syndromic surveillance systems exist in the Seattle area to detect the outbreak and progression of influenza-like illness (ILI): emergency department (ED) visits, laboratory results, school absences, etc. This information is used to guide public health and emergency response actions.

The Seattle Fire Department provides emergency medical services to approximately 65,000 patients per year. Firefighters are frequently the first point of contact by a health care worker with a person who may have an influenza-like illness. This presented an opportunity to collect symptom data at the point of contact and evaluate its effectiveness in detecting the outbreak of influenza or other infectious disease.

The Seattle Fire Department started the Situation Found (Sit Found) Program in July 2007 and collected influenza-like symptom data on 30,000 patients. SFD engaged FirstWatch® to monitor the real-time data and provide alerts to SFD management when events exceeded thresholds. Responses to dispatcher questions during 9-1-1 calls were added to the monitoring process.

Generally, the Sit Found Program is similar to other syndromic surveillance systems used around the world. Part I documents the research that lays the foundation for evaluation and refinement of the program. Part II includes the evaluation results, lessons learned and recommendations for changes in the program going forward.

A. PURPOSE OF THE PROGRAM
The Seattle Fire Department wants a process to detect early outbreak of influenza as part of its infectious disease disaster plan (a sub-set of the department’s overall disaster plan). Objectives of the infectious disease plan are to

1. Alert SFD management and medical director of infectious disease outbreaks in order to trigger response tactics.
2. Protect firefighters - who are first response emergency medical service providers – so they can continue to provide service to the community
3. Minimize the spread of infectious disease through enhanced prophylactic measures taken at the onset of an outbreak.
4. Assist public health agencies in planning for and responding to infectious disease events.

The purpose of this report is to provide guidance on refining the SFD infectious disease monitoring program to further the above objectives. The report also includes background on the program the Department implemented in 2007 and an evaluation of the program to date.

B. SCOPE OF THE REPORT

1. Part I
Survey Prior Studies: Several studies of syndromic surveillance systems and methods of detecting infectious disease outbreaks, including bioterrorism, have been published over the past few years. These studies provide guidance on establishing an effective surveillance program and provide the foundation for some of the conclusions and suggested follow-up actions to improve the SFD program.
Implications for an Seattle Fire Situation Found Program: Based on the research, this part of the report describes what the Situation Found program – or any similar syndromic surveillance program - should include to return the greatest value.

Situation Found Program Description: This part of the report includes a description of the automated system, data sources and data collection process, including limitations on the system and data. An overview of the First Watch monitoring/alerting system is included.

2. **Part II**

Validate the use of a real-time syndromic surveillance system: Analyze the data collected and confirm that the system SFD implemented is useful in detecting early outbreaks of infectious disease. The primary sources of data include the Seattle Fire Department Situation Found application (capturing symptom data at the point of patient contact), 9-1-1 dispatch system, Seattle Fire Department patient medical reports, King County public health syndromic surveillance data, and University of Washington Virology laboratory data.

Steps in the validation include

1. Compare the data collected with other syndromic surveillance systems, and confirmed cases of infectious disease.
2. Test the hypothesis that there is a relationship between the SFD Infectious Disease Monitoring Program and other validated disease monitoring systems.

Identify Issues and Lessons Learned in Using Real-time Syndromic Surveillance: Much was learned over the past 3 years in collecting, evaluating and interpreting data collected from the pilot and ongoing use of the Situation Found and First Watch system. In addition, the department wants to use historical syndromic system data, patient medical profiles and demographics to refine the “model” for an early warning system.

C. PRIOR STUDIES

This is not a comprehensive survey of research on disease outbreak surveillance. The information below is intended to provide a foundation for evaluating the Fire Department’s infectious disease program and making improvements in the program.

1. **Syndromic Surveillance & Electronic Medical Records (EMR)**

Syndromic surveillance involves the capture of *indicators* of disease or bioterrorism prior to clinical diagnosis of the disease or bioterrorist event. Indicators include chief complaints recorded at emergency departments, nurse hot-line information, data from ambulance/EMS field reports, etc. School absenteeism and pharmacy and/or over –the-counter drug sales, avian deaths and other data sources should be distinguished from systems that measure medical signs and symptoms. They are only intended to provide an exogenous indicator of abnormal events that might be associated with a disease outbreak – i. e., a surrogate. The information collected (a) may not be detailed enough to segregate different types of diseases and/or (b) may not be associated with any disease case definition (specific or cluster).
Syndromic surveillance data does not necessarily identify causative pathogens, nor will the data necessarily include pathogen-specific symptoms. However, there is a logical and provable relationship between the syndrome data collected and the object or purpose of the surveillance. Some syndromic surveillance systems are targeted to specific diseases (e.g., influenza) and others are intended to identify a range or class of illnesses. This fact is important to note in designing a surveillance system and comparing results between systems. (Further discussed in Part I.C.3, below)

Automated syndromic surveillance and EMR systems have proven to be effective in identifying a range of respiratory, gastronomical, and influenza-like illnesses and can be effective in identifying bioterrorism and novel diseases that have no prior documented diagnosis.

An advantage of automated syndromic surveillance and electronic medical reporting (EMR) systems is that they are timelier than clinical diagnoses and laboratory tests, and are typically more accurate and complete for purposes of guiding public health response. Since the information is routinely collected, standardized and immediately available it can be used to alert public health officials of a potential outbreak before a disease evolves into an epidemic or pandemic. The early warning can expedite the clinical investigations necessary to confirm the etiology of the observations (disease, chemical agent, etc.), which in turn can expedite response tactics and improve outcomes (i.e., lower contagion, reduced morbidity and mortality, etc.).

2. Dispatch and EMS Electronic Systems

Electronic patient care reporting (ePCR) systems and dispatching systems used by ambulance companies and fire agencies are another class of syndromic surveillance systems (hereinafter referred to collectively as EMS-based systems). These systems are highlighted separately in this report since the Seattle Fire Department program is based on this class of surveillance systems and these systems are capable of capturing disease-specific symptoms as well as general syndromes.

a. Emergency Medical Systems

Emergency medical systems collect data that can augment and enhance the value of other syndromic surveillance data and should be considered in the family of pre-diagnostic systems used for outbreak detection. However, more work is needed to validate the usefulness of these systems for infectious disease detection. The key (and obvious) reason for validation is because other factors can cause variation in the observations. The cause of disease and disease spread are dependent on three factors: and agent (disease, chemical, etc.), a host, and the environment. So, the host or patient characteristics such as age, gender, occupation, family history and environment characteristics such as living conditions, housing, temperature, and heat all impact the disease process. As suggested in at least one study the demographic and symptom/illness profiles of people using emergency care systems (i.e., people calling 9-1-1) may be significantly different from ambulatory patients using ED, clinics, or other health providers and these differences have a causative impact on the instance of disease and disease spread. This suggests that EMS-based syndromic surveillance systems should include demographic and other information in the data collection and validation processes to weed out or minimize false positives.
b. Dispatch Systems

A recent study conducted in Australia has shown that even when demographic or environmental data and patient profiles are unknown dispatch data can be highly associated with confirmed diagnosis of influenza:

“This study confirms similar recent work in the United States and Denmark that ambulance dispatch data can provide an alternative and cost-effective ILI (influenza-like illness) surveillance system. Because data are immediately entered into a database at the time of dispatch, this system has the potential to provide real-time surveillance at low cost. The project has demonstrated the important role of emergency prehospital (sic) medical services dispatch data in infectious disease surveillance. Ambulance dispatch data display seasonal trends that are similar to those observed in locum-service and General Practice sentinel surveillance systems. Recognition of this capability by the broad pandemic preparedness planning community is currently extremely limited”

A related study of the telephone triage used in health care systems (aka nurse hot lines) indicate that the protocols used and information collected over the phone can be highly associated with influenza outbreaks and that these systems can identify the outbreaks in advance of traditional reporting systems.

A number of jurisdictions around the country are using 9-1-1 dispatch protocols – i. e., questions and responses during caller interviews – to identify influenza outbreak. It appears from the prior studies that this information - in combination with other syndromic surveillance information - can be a powerful tool in the early detection of infectious disease outbreak and bioterrorist activity.

3. Foundation for Validating the Surveillance Systems

a. Case Definition Based Systems

Systems that are designed to detect a specific disease or category of related diseases (cluster) should capture information consistent with a recognized clinical case definition or case definitions within a cluster. This will increase the chance that surveillance data can be matched with confirmed diseases and give public health officials and operators of the system the ability to isolate known disease types and provide the ability to distinguish known/inconsequential types from novel types.

For example, the Center for Disease Control’s (CDC) case definition for influenza-like illness (ILI) is “fever over 100 degrees Fahrenheit and cough and/or sore throat”. A system designed to only detect ILI should, therefore, measure patient temperature and note the presence of a cough or sore throat. A system designed to include ILI and other related illnesses – i. e., a cluster – may only include a patient’s affirmation of fever, cough or sore throat and other symptom data (e. g., difficulty breathing, gastronomical distress), environmental data (e. g., exposure) or demographic data (e. g, age, sex, race). Symptoms or chief complaints such as fever, cough, respiratory or gastrointestinal distress may not fit a specified case definition of a disease of interest or may fit a wide range of diseases some of which are of nominal public health concern.

The cluster case definition then may not identify an outbreak of a specific disease but still be valuable in determining when an outbreak occurs that is significant from a public health perspective. It just means it is little harder for public health officials to distinguish a real significant pattern from coincidental events or events that are not important.
b. Systems without Case Definitions
As mentioned previously, surrogate data sources such school or work absenteeism and over-the-counter drug sales can vary dramatically for reasons other than infectious disease – e. g., a new FDA approved drug may cause a spike in consumer OTC purchases.

If the objective of the surveillance system is to detect general diseases (even more non-specific than clusters), or intended to detect novel disease or bioterrorism activity, the symptom and other data collected will be necessarily broad. Many of these systems have been proven to indicate outbreaks however validation must include a comparison of data from non-specific/surrogate surveillance systems with systems that contain specific medical information.

c. Standard Coding Schemes
Standard symptom codes have been effectively used in categorizing data collected and evaluating results – e. g., the International Statistical Classification of Diseases and Related Health Problems codes (ICD codes) used by the CDC and World Health Organization. In addition, various statistical techniques can be used to assess the probability of important versus unimportant events and to isolate disease types coding/categorizing of data is consistent.

d. Multi-System Approach to Validation
Numerous approaches to surveillance exist without a clear preferred method for evaluating the usefulness or effectiveness of the surveillance system. Validation can be done using multiple methods or following a comprehensive evaluation framework similar to the one recommended by the CDC. A common element of either approach is the use of multiple sources of information. As implied in the preceding sections, automated surveillance systems can generate a lot of “false positives” and collect information about naturally occurring or “normal” events (non-outbreak). The challenge is to evaluate the multiple, disparate sources of data and devise a methodology and process that gives the desired results. Statistical models and techniques have been effectively used to compare data from disparate syndromic surveillance/EMR systems to validate the usefulness of the system under study.

In King County Washington the County Department of Public Health uses multiple sources of information for surveillance of the infectious disease, particularly influenza. These include traditional laboratory test results, school absenteeism, emergency department (ED) visits, the percent of ED visits with influenza-like illness, and death due to infections. Part II of this report uses some of these sources of information to evaluate the infectious disease monitoring program implemented by the Seattle Fire Department.

e. Analytical Techniques for Validation
The most common methods for associating surveillance data with outbreaks are based on time-series, process control and regression analysis or a combination of those. Most of the studies recognize the seasonal or cyclical nature of disease in the community, the cyclical nature of surveillance data (e. g., OTC drug sales, school absenteeism), and the cyclical nature of contacts with health care systems (i. e., time of day, day of week.) Seasonality and the cyclical nature of the data needs to be incorporated in the statistical routines to validate the surveillance system.
Also, the models that are best at predicting outbreaks and triggering alerts are very complex and require a substantial understanding of statistics, model building, and expertise in using the software designed for this type of analysis (e.g., SPSS, SAS, etc.)

The validation of Seattle Fire’s program in this report relies on less sophisticated and complex statistical techniques. The results, however, are useful in identifying when and where more complex, sophisticated and more accurate techniques should be used in the future.

D. IMPLICATIONS FOR SEATTLE FIRE SYNDROMIC SURVEILLANCE PROGRAM

To get the most value from EMS-based and other syndromic surveillance systems several steps should be taken in designing the infectious disease monitoring program. Most of these steps are recommended in the CDC working group paper Framework for Evaluating Public Health Surveillance Systems for Early Detection of Outbreaks:

1. Establish clear objectives for the surveillance system.

2. If consistent with the objectives of the surveillance system include symptom data associated with established case definitions (specific or cluster).
   a. Include symptoms that may have no pre-defined etiology (if that is part of the system objectives.)
   b. Include patient profile, environmental and demographic data if consistent with case definitions and/or if these factors are reasonably related to the outbreak activity of interest.

3. Use standard coding schemes to ensure that symptom data is consistently and accurately collected across different systems.

4. Implement an automated data capture system.
   a. Simplicity in the User Interface (UI) design should be a major feature of system. This will reduce human error and increase compliance.
   b. Collect data in a form and structure that allows it to be matched with data from other systems. E.g., to match surveillance data to a dispatching system (CAD) the surveillance system should capture the CAD incident number along with other data.

5. Establish a baseline over a period of time – e.g., 2-3 years – that can be used to distinguish abnormal events form normal events. For example, influenza occurs in a cyclical, seasonal manner in all communities. If the objective of the surveillance is to identify influenza outbreak above normal levels then the system must be able to compare current observations against a baseline that accounts for normal fluctuations.
   a. For novel or unknown events (e.g., bioterrorism) consider analyzing data over shorter time-frames to minimize the effects of seasonal/cyclical behavior.
6. Validate the data collected against other surveillance system data – e.g., laboratory results, ED visits, school absenteeism, drug sales, patient diagnosis (if available), etc. In other words, use multiple systems.
   a. Laboratory confirmed disease diagnosis – the “gold standard” - should be a mandatory part of the validation, regardless of other data sources used in the evaluation.

7. Conduct ongoing system evaluation and adjust the surveillance system model based on that evaluation. Care should be taken to update the baselines that span significant lengths of time (if such a baseline is required) otherwise a change in the data collected or methodology for determining an outbreak may not be useful until a new baseline is established (which may take several years.)

As described in Part I.E of this report the SFD Infectious Disease Monitoring Program did not nor does it currently meet all of the recommended steps for a surveillance program. However, these steps will be used in drawing conclusions and making recommendations moving forward with the program.

E. SEATTLE FIRE INFECTIOUS DISEASE MONITORING PROGRAM DESCRIPTION

1. Objectives
In 2007, the Seattle Fire Department (SFD) implemented a field medical reporting system with objectives similar to those stated in the Purpose section of this report:

1. Identify infectious disease outbreaks based on influenza-like symptoms found by Seattle firefighters responding to EMS incidents.

2. Determine if the firefighter disability leave is related to exposures to patients with influenza-like symptoms to conclude that the leave taken is an on-the-job disability.

3. Enhance the personal protective equipment (PPE) program to minimize firefighter exposure to suspected influenza-like illness and contagion.

2. Symptom & Other Data Sources

   a. Symptoms
   The Department used symptoms to identify infectious disease that could include influenza, non-influenza virus diseases, bacteriological or other disease types. (See Attachment A for a description of non-influenza viruses and symptoms.) The symptom data collected included: Cough, Fever, Gastrointestinal, Rash, and Respiratory.

   Formal case definitions were not used due to the nature of the EMS response activity: (1) the reason for the 9-1-1 call may not be a disease related illness, (2) the EMS program in SFD (and most fire/EMS agencies) does not include training or techniques to treat or remediate infectious diseases in the field so it is not possible to collect all of the information required by a pre-diagnostic case definition – e.g. influenza-like illness, and (3) EMS agencies typically do not carry the instruments necessary to verify a symptom. For example, firefighters do not have thermometers and do not take the temperature of a patient to verify if they have a fever.
However, as noted by the prior studies on the use of ambulance/dispatch data, the Department believed the more general symptom data, when combined with other information, would be useful as an early warning of infectious disease.

Besides symptoms, the other data collected in the field includes (1) whether the person was exposed to an infectious disease recently, (2) whether the person recently travelled from a place with a known outbreak, (3) sex, and (4) age.

b. Medical Report Data
Additional information is collected through the medical incident report (MIR) completed for each patient. The MIR includes the following types of information:

1. Incident number (which allows the MIR to be matched with the symptom data and 9-1-1 incident record. This also allows all data to be geo-coded and associated with census tract, other geographic area and other demographic information.)
2. Location of the emergency (home, other residence, outside, specific venues in Seattle, etc.)
3. Patient medical condition – e. g., cardiac arrest, Glasgow information, vital signs, etc.
4. Mechanism of injury/illness - e. g., fall, medical illness, motor vehicle, firearms, burn, blunt instrument, etc. There are over 30 mechanism types.
5. Medical type – e. g., trauma, illness, obstetric/gynecologic, psychiatric, etc. There are over 100 sub-types used to characterize the injury/illness.
6. Medical procedures – e. g., drugs administered. AED used, etc.
7. Narrative

The MIR has over 90 different fields of data that provides a detailed medical profile of each patient. One limitation on the MIR data is timeliness: MIRs are paper forms completed by firefighters. The form is sent into headquarters, digitized and processed by a data entry operator. It typically takes 6-to-8 weeks between the date of the incident and the date when the information appears in the database and available for analysis. This limits use of the MIR information for any sort of “early warning” system, however the information is valuable in validating the real-time data, establishing and calibrating baselines, and making changes to scope and objectives of the program.

c. 9-1-1 Incident Data
The 9-1-1 incident record includes date/time of call, address, nature of call, dispatcher comments including whether the patient experienced fever, cough, or febrile respiratory illness, and the specific emergency medical dispatch (EMD) protocol used. The protocol code is recorded as part of the incident record – e. g., code 32/7 represents “Sick Unknown/High Fever or Cough”.

The SFD protocols used to track influenza-like symptoms are not exactly like the protocols recommended by the CDC for influenza-like illness during an epidemic or pandemic outbreak. However the CDC guidelines are evolving and may change in the coming years, particularly as a result of the 2009 H1N1 pandemic. During the 2009 H1N1 outbreak the CDC recommended 9-1-1 call takers ask callers “if they, or someone at the incident location, has had nasal congestion, cough, fever or flu-like symptoms.” However, the dispatcher questions are very similar to the CDC guideline and sufficient for this study and evaluation of the surveillance system being used by SFD.
d. Public Health Information
The King County Public Health (KCPH) Division publishes syndromic surveillance and related information on a weekly basis. This includes the number of ED visits at County hospitals and the number of ED visitors with influenza-like illness. The data is organized by age group and includes patients who live in Seattle ZIP code areas. KCPH data is available for every week starting with August 11, 2007 through August 14, 2010.

A minor limitation with using the data for validation is ZIP code. Seattle ZIP codes extend outside of the Seattle city limits and the territory served by the Seattle Fire Department. Another limitation is that the patients are only Seattle residents (who live in those ZIP codes.) A substantial number of patients seen by SFD live outside of the City. Also, the point of contact with patient was somewhere other than the patient residence. These aspects of the KCPH data should not affect the statistical analysis or usefulness for validation. However, any geographic/spatial analysis should take the ZIP coverage area, incident location and patient residency into consideration.

The University of Washington (UW) Virology Laboratory also publishes weekly data on the number antigen tests conducted (for RSV, PIV, ADV, FluA, FluB, MPV), the PCR test for 12 different viruses, the number of antigens found by type: Influenza A (FluA), Influenza B (FluB), Parainfluenza (PIV), Adenovirus (ADV), Respiratory Syncytial Virus (RVS), Metapneumovirus, and Rhinovirus. The data is available for every week starting with July 7, 2007 through August 28, 2010.

Over 98% of the lab test requests come from three (3) hospitals in Seattle: Harborview, University of Washington Medical Center and children’s Hospital (and 80%-85% are from Children’s). Most of the patients that are subjects of the tests are from Seattle (over 90%).

One limitation with this data is that Rhinovirus and Metapneumovirus tests were not conducted for every time period between July 7, 2007 and August 28, 2010.

e. Demographic Data
SFD geo-codes every incident record and matches those records with census tracts, a database of adult care facilities regulated by the State of Washington and property use information from City’s Department of Planning & Development and King County Assessor’s Office. This allows SFD to match each surveillance event record with apartments, commercial properties, nursing homes, schools, etc.

f. Firefighter Illness Data
City policy does not allow the collection of specific data on the nature of illnesses or injuries. However, from the Situation Found and CAD database the Department can determine how many times an individual is exposed to a potential infectious disease and correlate that to sick leave taken. Not having data on firefighter illness is a significant limitation on measuring how well the Sit Found program meets one of the stated objectives: determining when illness results from on-the-job exposure to infectious disease.

g. Compliance Data
Compliance means that an incident that should be processed through the SFD infectious disease monitoring program was actually processed – i.e., firefighters recorded the existence of, or lack of symptoms for the incident they were dispatched on. The compliance rate was calculated for the July 7,
2007 through August 28, 2010 period and varied from 30% to close to 90%. The obvious concern is that compliance (or lack thereof) could have an impact on the quality of the symptom data, so compliance will be used in part of the evaluation of the program.

3. **Computer System Description & Data Capture Process**

There are two main components of the “system” used for surveillance: a real-time data capture component and a component that conducts evaluation/analysis and alerting.

   a. **Situation Found Program – Data Capture**

The SFD system used to capture data was developed in-house and is called the Situation Found (aka Sit Found) Program. It is a client server application using Microsoft Windows.NET software and SQL Server database. The client application runs on mobile computers in all fire vehicles and on fire station desktop computers. Firefighters are instructed to enter data into the application in the field (immediately after seeing a patient) or upon return to the station.

Whenever an emergency medical service (EMS) dispatch occurs data is sent to the Situation Found database running on a dedicated server. Data includes the incident number, type of emergency, a code indicating the emergency medical dispatcher (EMD) protocol used, dispatcher comments, and date/time of the incident. Only the fire companies dispatched to the incident will see the incident number, etc., on the Situation Found screen on their mobile computer. Once the firefighters are finished with the incident they open up the Situation Found screen, it queries the Sit Found database for the most recent incident data and presents that on the screen. Firefighters then complete the form (screen field entries). (The incident will then disappear from the screen.) All incomplete incidents for the company will stay on Sit Found screen until cleared.

The mobile computer version of the Sit Found application is touch screen enabled so firefighters only need to push a small number of on-screen buttons to complete or “clear” an incident. It literally takes less than 10 seconds to clear an incident on the Sit Found screen.

The information collected through the Sit Found Program for each incident includes:

1. No symptoms (in which case the incident is cleared from the screen)
2. One or more of the following symptoms: Cough, Fever, Gastro, Rash, Respiratory
3. Whether the person recently traveled to a place with a known infectious disease outbreak
4. Whether the person was recently exposed to anyone with an infectious disease
5. Sex: male or female
6. Age category of the patient: < 2, 2-4, 5-17, 18-44, 45-64, >65

Also, the program allows the entry of symptoms for multiple patients. Below is screen shot of the client application as it appears on the mobile computer:
b. FirstWatch© - Monitoring, Analysis and Alerting

The FirstWatch syndromic surveillance program was implemented in July 2007 to monitor the Sit Found database in real-time. A small application runs on a PC in the SFD datacenter and “listens” for new data in the Sit Found database – i.e. a cleared incident or an incident with a dispatch protocol that includes “fever, cough or febrile respiratory illness”. Once the program detects a qualified incident the data is copied, encrypted and sent over a secure network connection (VPN) to the FirstWatch server in California. There, the information is analyzed and processed according to the business and mathematical rules set up by SFD and FirstWatch. The program is accessible to authorized users through the FirstWatch© web application interface. This is a secure web-connection using SSL VPN.

If alerting has been enabled (as it is for the influenza-like symptom monitoring) the FirstWatch© system sends e-mail alerts to designated individuals. Each e-mail allows the receiver to immediately log onto FirstWatch and obtain graphs, charts and details about the source of the alert. Historical information can be retrieved for more in depth analysis and exported to Microsoft Excel or to a KML file that can be rendered in Google Earth.

Four alert triggers are used:

1) Actual Events (STD)- the number of symptom events over a 24 hour surveillance period are compared to an hourly 14-day moving average of events. (I.e., an average is calculated for each hour based on 14 days of data.) When the actual number of events for an hour exceeds the average for that hour by two standard deviations the threshold is exceeded.

2) Syndrome to All (STA) – ratio of qualified events as compared against all events in the system – measured by hour of day, and day of week. The current ratio is compared to the hourly 14-day moving average of ratios. When the ratio for the current hour exceeds the average for that hour by two standard deviations the threshold is exceeded.

3) Cumulative Summary (CUSUM) – a time-series method using an hourly 14-day moving average that is designed to detect sudden changes in mean value of event of interest. When the observed counts exceed the expected counts (by a user defined value) the threshold is exceeded.
4) Geo Cluster Analysis – when 5 calls fell within a 1 mile radius the threshold is exceeded. These measures can be used individually or in combination to trigger an alert. For most of the study period the first three measures would have to exceed the thresholds before an alert was sent. The geo-cluster did not have alerting enabled.

c. System Architecture
Below is a high level diagram of the Sit Found Program and FirstWatch system architecture.

The Sit Found database remains in SFD’s datacenter and is used for external analysis. All of the analysis contained in this report is based on data from the Sit Found database and other databases matched to it.
**ATTACHMENT A – NON-INFLUENZA VIRUS DESCRIPTIONS**

**Respiratory Syncytial (sin-SISH-uhl) Virus (RSV):** symptoms are mild and similar to the common cold but can be severe in children and older adults. The virus infects lungs and breathing passages.

**Parainfluenza (PIV):** Human parainfluenza viruses (HPIVs) are a group of viruses associated with respiratory infections. HPIVs are second to respiratory syncytial virus (RSV) as a common cause of lower respiratory tract disease in young children. Similar to RSV, HPIVs can cause repeated infections throughout life, usually evidenced by an upper respiratory tract illness (e.g., a cold and/or sore throat). HPIVs can also cause serious lower respiratory tract disease with repeat infection (e.g., pneumonia, bronchitis, and bronchiolitis), especially among the elderly, and among patients with compromised immune systems. Each of the four HPIVs has different clinical and epidemiologic features. The most distinctive clinical feature of HPIV-1 and HPIV-2 is croup (i.e., laryngotracheobronchitis); HPIV-1 is the leading cause of croup in children, whereas HPIV-2 is less frequently detected. Both HPIV-1 and -2 can cause other upper and lower respiratory tract illnesses. HPIV-3 is more often associated with bronchiolitis and pneumonia. HPIV-4 is infrequently detected, possibly because it is less likely to cause severe disease. The incubation period for HPIVs is generally from 1 to 7 days.

**Adenovirus (ADV):** Most commonly cause respiratory illness; however, depending on the infecting serotype, they may also cause various other illnesses, such as gastroenteritis, conjunctivitis, cystitis, and rash illness. Symptoms of respiratory illness caused by adenovirus infection range from the common cold syndrome to pneumonia, croup, and bronchitis. Patients with compromised immune systems are especially susceptible to severe complications of adenovirus infection. Acute respiratory disease (ARD), first recognized among military recruits during World War II, can be caused by adenovirus infections during conditions of crowding and stress.

**Metapneumovirus (MPV):** Compared with respiratory syncytial virus, infection with human metapneumovirus tends to occur in slightly older children and to produce disease that is less severe. Co-infection with both viruses can occur, and is generally associated with worse disease.

**Rhinovirus:** Rhinovira are the most common viral infective agents in humans, and a causative agent of the common cold. It is lytic in nature. There are 99 recognized types of rhinovira that differ based on their varying surface proteins.
FOOTNOTES

1 King County Public Health web site for influence surveillance (http://www.kingcounty.gov/healthservices/health/communicable/immunization/fluactivity.aspx)


16 Centers for Disease Control and Prevention. *Case definitions for infectious conditions under public health surveillance*. MMWR 1997;46(No. RR-10).


18 Centers for Disease Control and Prevention. August 5, 2009. *Interim Guidance for Emergency Medical Services (EMS) Systems and 9-1-1 Public Safety Answering Points (PSAPs) for Management of Patients with Confirmed or Suspected Swine-Origin Influenza A (H1N1) Infection* Available at URL: [http://www.cdc.gov/h1n1flu/guidance_ems.htm](http://www.cdc.gov/h1n1flu/guidance_ems.htm)


