

Public Health Surveillance: A local health department perspective



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Objectives

- Current public health surveillance
- Characteristics of the ideal surveillance system
- Boston's enhanced surveillance system for bioterrorism and mass casualty events
- Future plans

Types of Surveillance

- Notifiable disease reporting
- Active surveillance
- Laboratory based surveillance
- Population based surveillance

Notifiable Disease Reporting

- Health care providers are required by law or regulation to notify public health about:
 - Named pathogens
 - Specified diagnoses
 - Outbreaks or clusters of illness
- Usually a passive system, but can use enhanced passive technique
- Reporting requirements differ among states

Notifiable Disease Reporting: Why it's incomplete

- Unaware of the requirement to report
- Confused about the mechanics of reporting
- Concern about confidentiality
- Someone else's job
- Unconfirmed case (wrong diagnosis, no lab)
- Forgot to do it

Active surveillance

- Public health staff review records and other data on site (for example, at a hospital)
- Provides fairly complete data
- Very labor intensive and requires a sustained effort - resources become a problem

Laboratory based surveillance

- Laboratories are required to report certain positive test results to public health
- Isolated laboratory data are incomplete
 - False positives, false negatives
 - Skewed testing (publicity, specific signs and symptoms)
- Molecular microbiologic techniques enhance epidemiologic investigations

Population Based Surveillance

- Illness in closed communities (such as incarcerated populations)
- Absenteeism rates
- Insurance claims data
- Sales of specific products (such as anti-diarrheal medications)

The Ideal Surveillance System

Fast, cheap, and easy...

The Problem

- Traditional surveillance systems based on the reporting of specific diseases have limited potential for early detection of mass casualty events such as bioterrorism or pandemic influenza.

Milwaukee: Cryptosporidium Infection Related to the Public Water Supply

- Estimated 400,000 people had outbreak associated diarrhea.
- 285 laboratory confirmed cases.
- Recognition of the outbreak was delayed:
 - Non-specific nature of the symptoms
 - Limited laboratory testing
 - Infrequent use of the health care system by people with diarrhea

Identification of the Outbreak

- Shortages of over the counter anti-diarrheal medications
 - pharmaceutical sales data impacted by sales & is unlikely to detect small case numbers
- Retrospective data indicated changes in health care utilization patterns prior to identification of the outbreak

Agents of Concern: CDC Category A

- *Bacillus anthracis* (anthrax)
- *Clostridium botulinum* toxin (botulism)
- *Yersinia pestis* (plague)
- variola major (smallpox)
- *Francisella tularensis* (tularemia)
- Viral hemorrhagic fever

Agents of Concern: CDC Category B

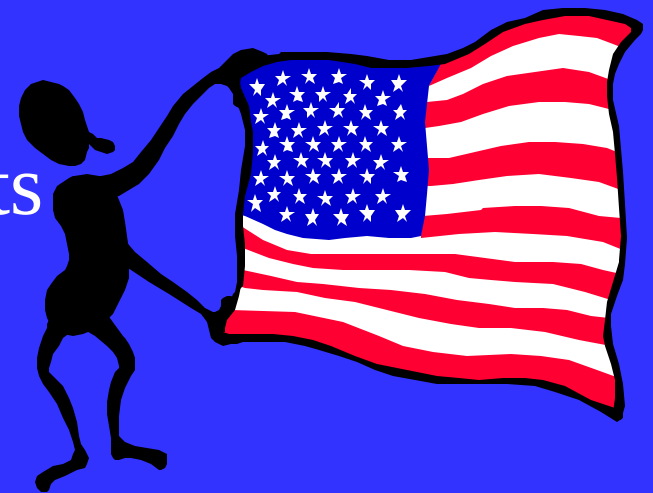
- *Coxiella burnetti* (Q fever)
- *Brucella* species (brucellosis)
- *Burkholderia mallei* (glanders)
- ricin toxin from *Ricinus communis* (castor beans)
- epsilon toxin of *Clostridium perfringens*

Agents of Concern: CDC Category C

- Nipah virus
- hantaviruses
- tickborne hemorrhagic fever viruses
- yellow fever
- multidrug-resistant tuberculosis

Bioterrorism Events in the United States

- 1984, The Dalles, Oregon
 - Salmonella in salad bars
 - 751 ill (45 hospitalized)
- 1996, Dallas, Texas
 - Shigella in micro-lab donuts
 - 12 ill (4 hospitalized)



Anthrax Cases, 2001

Anthrax Among Outbreak-related Cases 2001						
Cases	FL	NYC	NJ	DC	CT	Total
Inhalational	2	1	2	5	1	11
Cutaneous						
Confirmed	0	4	3	0	0	7
Suspected	0	3	1	0	0	4
Total	2	8	7	5	1	22

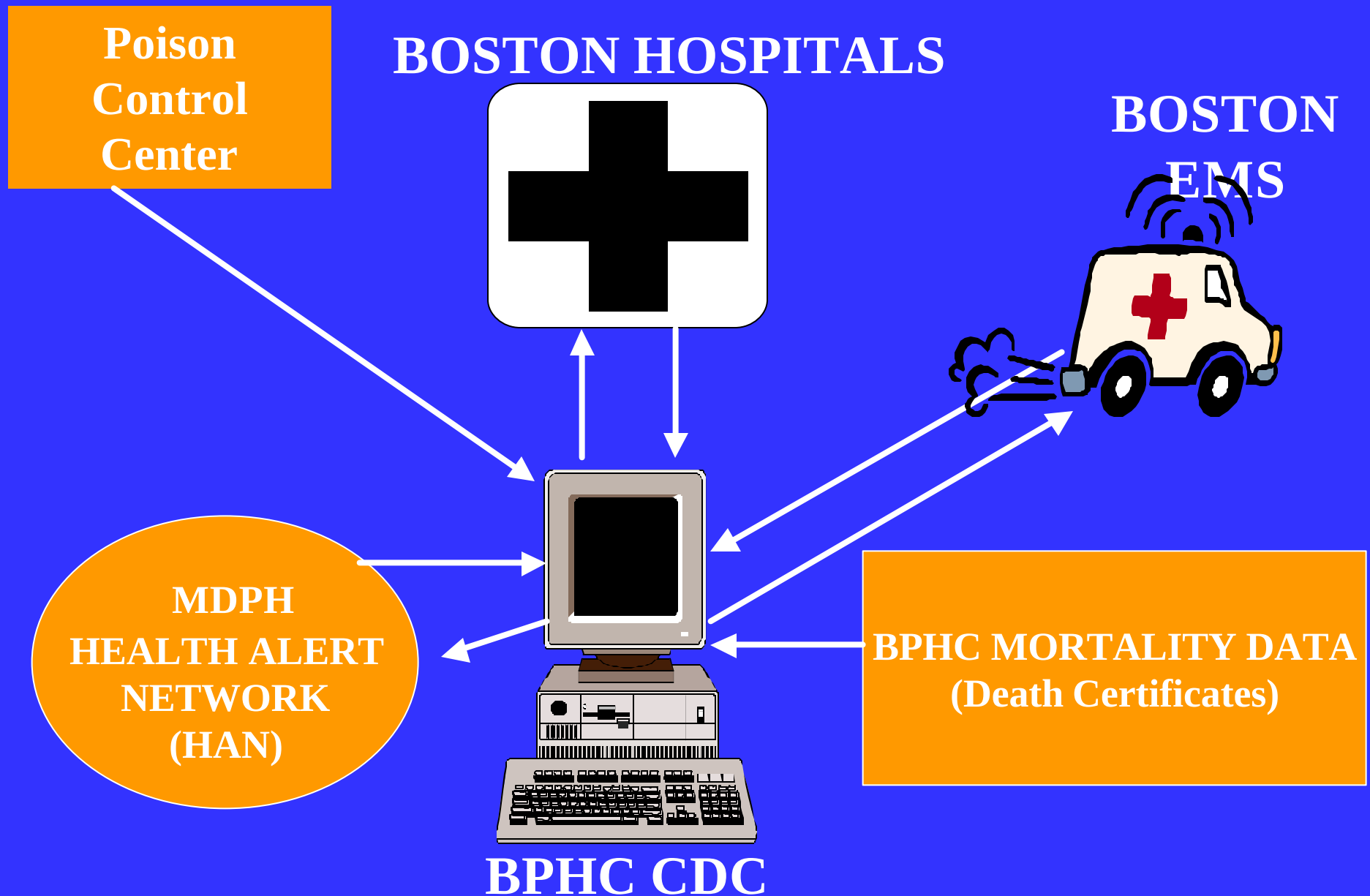
The Ideal Surveillance System

- Sensitive (with enough specificity to make it workable)
- Timely
- Provides complete data
- Cost effective
- Linked to an effective follow-up system to interpret initial signals

Enhanced Surveillance in Boston

- Emergency department visits
- Urgent care visits
- Boston EMS calls
- Death certificates
- Poison Control Center

VOLUME SURVEILLANCE SYSTEM DESIGN: DATA SOURCES



Enhanced Surveillance in Boston: Hospitals

- Every 24 hours volume data is electronically sent by SFTP to the Boston Public Health Commission (BPHC)
- Threshold data for each site based on historical data has been calculated
- If threshold is exceeded an initial assessment is automatically sent to an onsite contact

Calculations

Binomial distribution: adjust for month and day of the week

Number of events=average daily volume by month

n=Boston population (1990 census)

p= number of events/n

Upper CI= $p + ((1 - \alpha) \cdot (\sqrt{p(1-p)/n}))$

Upper threshold = Upper CI(n)

Enhanced Surveillance in Boston: Hospitals (Cont'd)

- If a cluster or any unusual cases of illness are identified on initial assessment, BPHC nurses/epidemiologists investigate further
- Data are typically available within 12 hours after the close of a 24 hour period

Enhanced Surveillance in Boston: Other Sites

- Poison Control Center: daily volume data being sent, thresholds being adjusted
- Boston EMS: type of calls of interest selected, automatic data transfer being developed
- Death Certificates: database developed; timeliness of data input being addressed

Enhanced Surveillance in Boston

Preliminary Findings

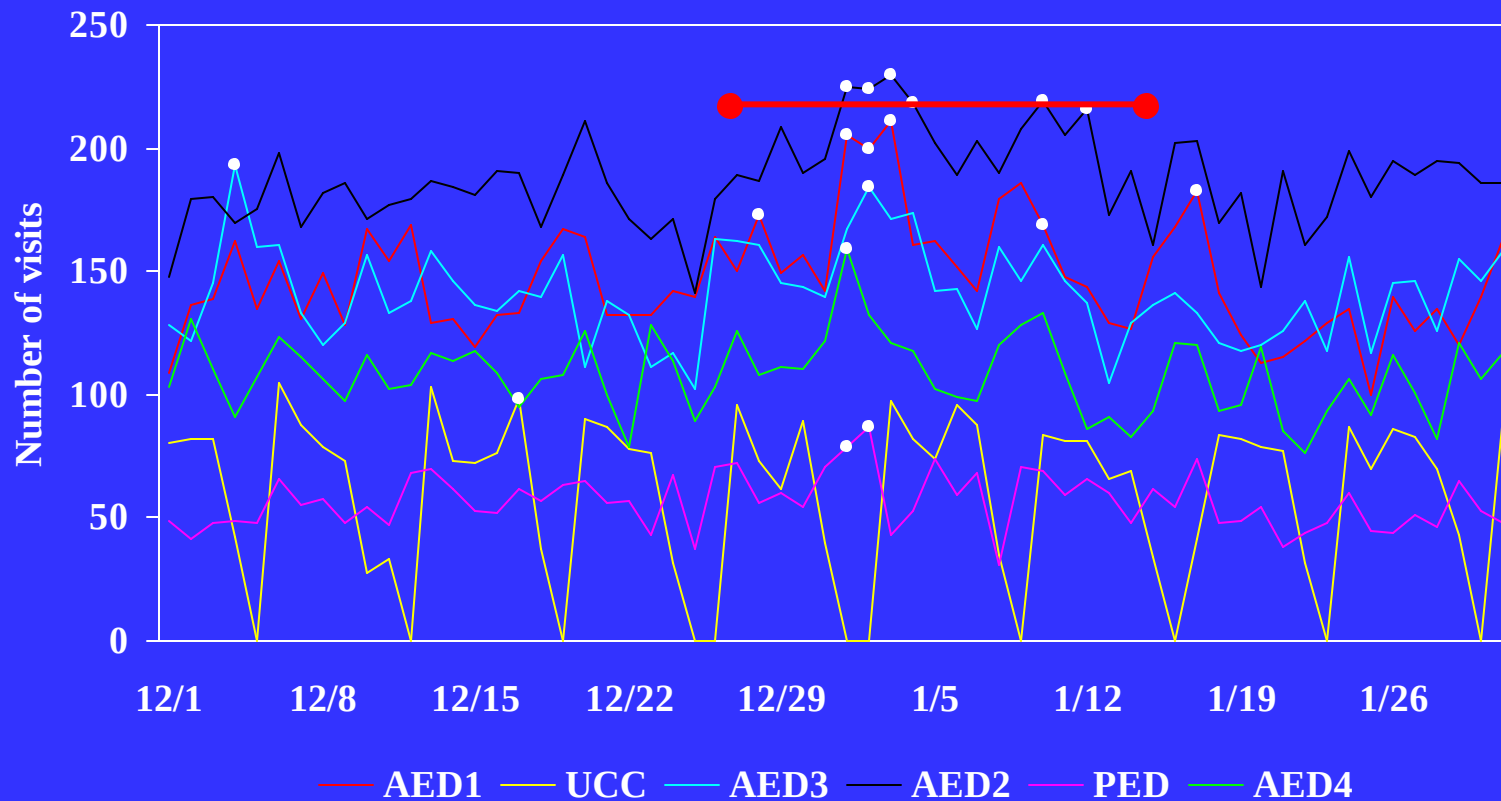
- System detected morbidity associated with a heat wave (retrospective)
- Volume data corresponded well with influenza activity in 1999 and 2000
- System identified changes in health seeking behavior post September 11

Volume data and influenza

- In 2000 there were 103 episodes of a site exceeding threshold.
- However, 3 or more sites simultaneously exceeded threshold on only 4 days and 2 sites on 17 days.
- Most of the time (N=54), only one site exceeded threshold on a given day.

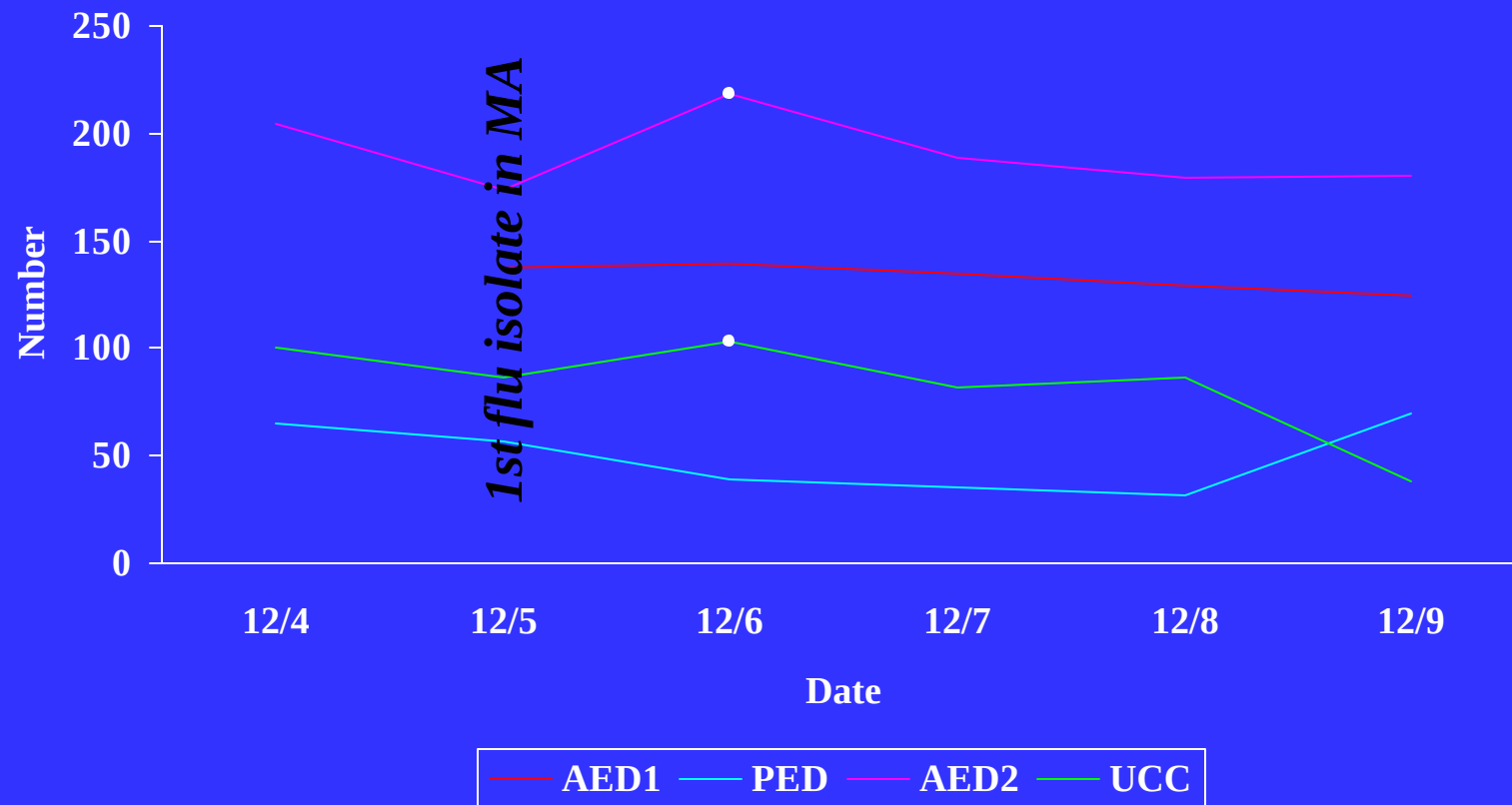
Daily volume by site

December 1, 1999 - January 31, 2000



- Days exceeding threshold
- Peak influenza activity in the U.S. (12/26 to 1/15/00)

Volume Surveillance - 12/4 to 12/9/00

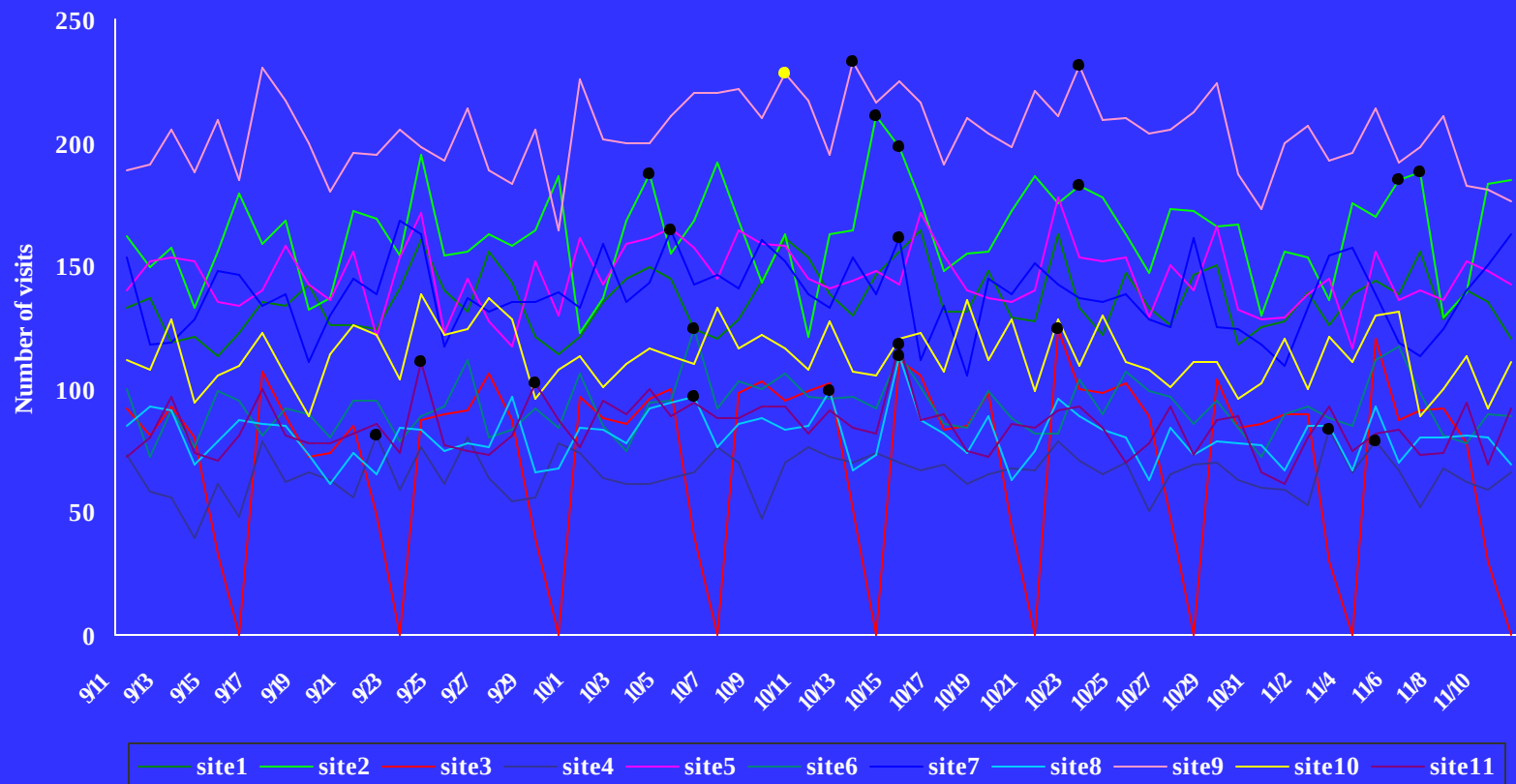


- Exceeded threshold

Volume data: Findings from 9/11/02 -11/11/02

Daily volume by site

September 11, 2001 - November 11, 2001



?Days exceeding threshold. No infectious disease clusters identified.

How many times did multiple sites exceed threshold on a given day?

- There were 22 episodes of a site exceeding threshold in the time period.
- For most (n=17) only a single site exceeded threshold on a given day.
- On two days, two sites simultaneously exceeded threshold.
- On one day, four sites simultaneously exceeded threshold.

Follow-Up with sites exceeding threshold and Boston Public Health Commission's (BPHC) Response

- Persons seeking nasal swabs and antibiotics for anthrax resulted in increased activity on 10/15
- No anthrax cases or anthrax contaminated environmental specimens were identified in Massachusetts
- The BPHC posted information on anthrax including updates to BPHC's website (www.bphc.org)
- Clinical advisories on anthrax were emailed to health care providers throughout the city

Enhanced Surveillance in Boston

Strengths

- Adjusts for site case mix
- Adjusts for seasonal changes
- City wide coverage
- Electronic

Weaknesses

- Non-specific for BT events
- Changes influenced by the business of health care

Conclusions

- Volume based surveillance is a feasible method for the early identification of a mass morbidity event
- A rapid follow-up system is a critical component to understanding initial signals
- Data from this system can be used to create educational messages for both health care providers and the public
- Additional research is needed to define the sensitivity of the individual or combined measures being used and the optimal combination to detect significant activity

Enhanced Surveillance in Boston: Lessons Learned

- Systems must be electronic
- Add on systems will not be sustainable
- Computers system go down (even for days)
 - Develop back up plans
- Don't abandon case reporting
 - No one system is perfect
- The more complex data - the harder it will be to retrieve it manually
- Build communication networks into the surveillance system

Enhanced Surveillance in Boston: Future Plans

- Capture more granular data
 - Chief complaint data
 - Natural language programming
 - Minimize human contact
- Add additional populations and types of health care sites
- Enhance the surveillance feedback loop
- Syndromic surveillance

Syndromes That May Be Associated With Bioterrorism

- **Pulmonary**
 - **Fever**
 - **Cough**
 - **Myalgias**
 - **Hypoxia**
- **GI**
 - **Fever**
 - **Nausea/vomiting**
 - **Diarrhea (+/-bloody)**
- **Rash and fever**
 - **Vesicular**
 - **Petechial**
- **Neurologic**
 - **cranial nerve palsies, HA, fever, confusion**
- **Septic Shock**
 - **DIC**
 - **Organ failure**

Syndromic Surveillance

- ICD-9 code data or chief complaints to identify potential BT-related syndromes
 - How much is to much
 - Follow-up is critical
 - Real time data is limited
 - Sustainability
 - Validity of chief complaint data - How do different populations describe illness

Questions?

