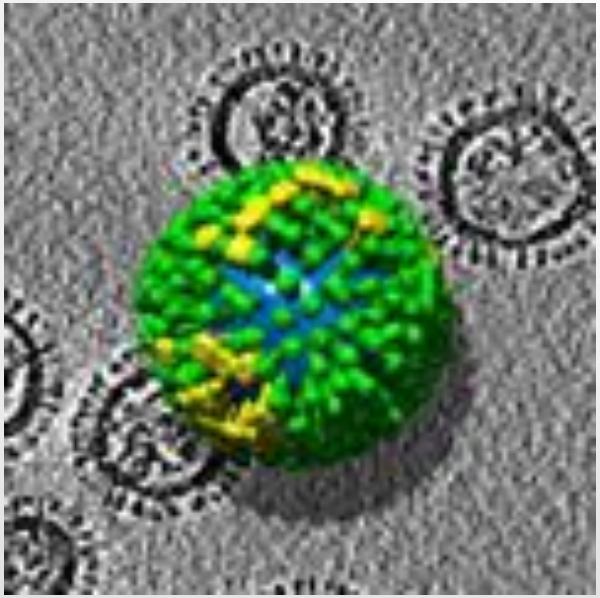
Information Technology and its Role in Management of Avian Influenza

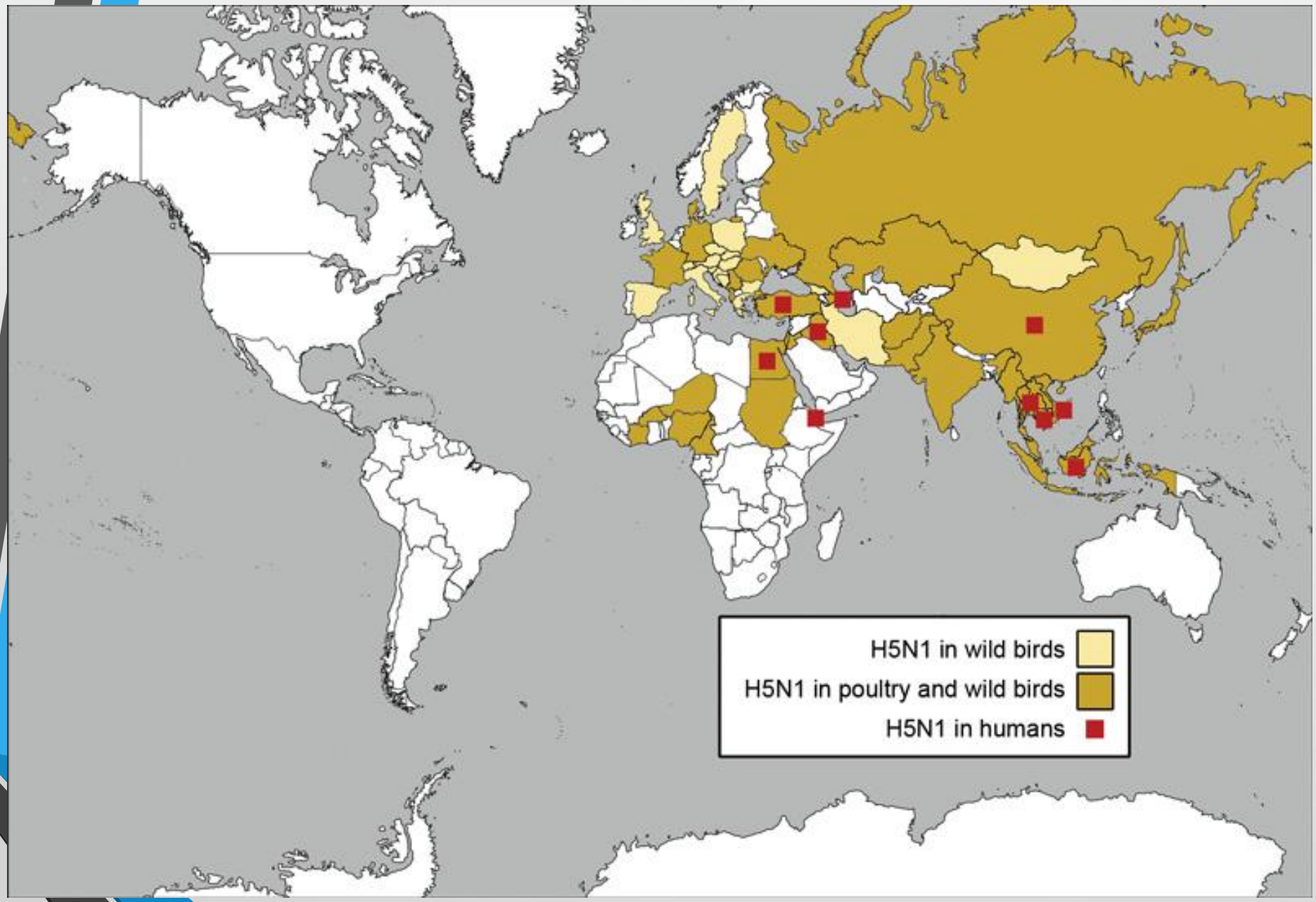


Victor Levy, MD, FACG, FACP

Assistant Professor of Family Medicine

University of South Florida College of Medicine

March 4, 2007


H5N1 in wild birds
H5N1 in poultry and wild birds
H5N1 in humans

CDC

The Problem
Radio Communication: Jan. 23, 2008
In Midst of H5N1 Flu Outbreak

EMS Dispatch: Hello, ED 2

Admin, Hospital ED: Yes, EMS, Go Ahead

EMS Dispatch: Are you still on ambulance diversion

Admin: Yes, we are

EMS: We have a suspected outbreak in a nursing home, 34 patients require transfer to an emergency facility. Can you accept any?

Admin: Just a moment . . . . . .

The collapse of the hospital emergency services during the winter

Servei d'Urgencies, Servei d'Admissions, Ciutat Sanitaria i Universitaria de Bellvitge, L'Hospitalet de Llobregat, Barcelona.
Escarrabill J, Corbella X, Salazar A, Sanchez JL.

: Aten Primaria. 2001 Feb 15;27(2):137-40

“Human H5N1 Infection”

So many cases,

Why so little knowledge?”

2006 Euro Surveillance

An episode of pandemic influenza "A Perfect Storm"

- A new flu virus must emerge from the animal reservoirs that has never previously infected human beings.
- The virus has to make humans sick (most do not)
- It must be able to spread efficiently through coughing, sneezing, or handshaking

Information Technology

Definition #1 (MIT) This term includes computer modeling, simulation, innovative uses of artificial intelligence, automated knowledge discovery, data mining, and data warehousing.

Definition #2 (N.A.S.A.) Any equipment or interconnected system that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange transmission, or reception of data or information.

The Solution: Information Technology (IT)

Why IT for Avian Flu?

1. Significant data available
2. Need to detect patterns
3. Rapid, authoritative decision making
4. Need to aggregate/assemble data in an ongoing, real time fashion
5. Instant communication

Support for the IT Solution

By the Health Care Industry and Consumers

All are "at risk"

Support for the Solution

- Physicians
- Government
- Hospital Systems
- Payers
- Consumers

American College of Physicians

Position Paper April 3, 2006

Physician access to 2-way communication with public health authorities and to information technology tools for diagnosis and syndrome surveillance

Physician Experience in Health Information Exchange Initiatives: HIE Features Physicians Have Experience With

Outside Laboratory Results	100%
Outside Imaging Results	87.5%
Hospital Admission and Discharge Notes	87.5%
Emergency Department Notes	75%
Other Provider's Outpatient Encounters/Visit History	12.5%
Clinical Data from Claims/ Payer Data	62.5%
Medication Histories from Other Providers (sites)	12.5%
Public Health Reporting And Surveillance	37.5%
Web Based Disease Registries	25%

For physicians practicing in Regions with Health Information Exchange Organizations, the most Common features are Lab And Radiology information Exchange

eHealth Initiative Practicing Clinicians Working Group, March 2006

Physician Experiences in HIE Initiatives: Ranking of Most Valuable Aspects of HIE

1. Outside Laboratory results
2. Medication histories from other providers (sites)
3. Other provider's outpatient encounters/visit history
4. Hospital admission and discharge notes
5. Outside imaging results
6. Emergency department notes
7. Claims/payer data
8. Public Health reporting and surveillance
9. Web based disease registries

Currently, access to outside lab results is one of the most valuable aspects of HIE per working group members

eHealth Initiative Practicing Clinicians Working Group, March 2006

Health Information Exchange and Practice Transformation: Engaging physicians – lessons learned

HIE data access, usability and work flow-
where the rubber meets the road

- Be aware that a project of this nature will affect all physicians and potentially their practice workflow. Don't try to change the provider work flow – build on it instead.
- Small practices often require additional technical support for implementation.
- Don't create any more barriers to access than necessary.
- Make sure it works all the time.

Health Information Exchange and Practice Transformation: Engaging physicians – lessons learned

HIE data access, usability and work flow-

where the rubber meets the road

- Lack of physician acceptance of technology will result in failure
- Providing relevant training by and for physicians
- Acknowledge that providers and staff don't always share or articulate their concerns. They may just stop using the product and not raise an issue that might be easily 'fixed'. They may be unaware of how to access functionality that is available to them.

Sources: eHI HRSA Period 1, Funded Communities 2005-2006

Support for the Solution

Physician buy-in depends on

- Beta tested models
- Incorporation w/standard process
- Locally/regionally acquired data

Need to be placed in

- Non-academic settings
- Emergency settings

Physicians need to see its significance/value

Health Information Exchange and Practice Transformation: Engaging physicians – lessons learned

Value = Relevant + Reliable + Integrated Into Work Flow

Physicians and H5N1 Flu

- Global Initiative on Sharing Avian Influenza Data (GISAID)
- Virologic, clincial, and epidemiological data is included in agreement
- WHO participating in agreement

Department of Health and Human Services

- American Health Information Community (AHIC)
- Office of the National Coordinator for Health Information Technology (ONC)
- State Alliance for eHealth
- eHealth Initiative
- Agency for Healthcare Research and Quality (AHRQ)
- Indian Health Services (HIS)

American Health Information Community (AHIC)

Membership announced by HHS Secretary Michael Leavitt on September 13, 2005

Federally chartered advisory committee which provides input and recommendations to HHS on how to make health records digital and interoperable

BioSurveillance Workgroup (One of five AHIC workgroups)

Charge: Within one year, essential ambulatory care and emergency department visit, utilization, and lab results data from electronically enable health care delivery and public health systems can be transmitted in standardized format to authorized PH agencies within 24 hours.

AHIC Bio Surveillance Workgroup

Last meeting 2/2/07

- Surveillance systems
- Quality – best practices
- Population based research
- Health communication
- monitoring

The National Governors Association

"States will need to work closely with their federal partners to ensure the speed and quality of decision-making during a pandemic"

"The impact of a pandemic episode will be felt most acutely at the community and local level."

NGA
Center for Best Practices

What It Took

- Leadership – from the Government and Commissioner of Finance and Administration
- Commitment – from the health care leaders in Memphis
- Focus – didn't try to do it all at first; focused on EDs
- Low-profile – no promises that can't be kept
- Common challenges – understanding that plan-based systems, quality initiatives, P4P and other changes are best addressed through dialogue
- Passion from the clinical community – the "wow" factor from emergency department physicians
- Legal and policy infrastructure

http://www.volunteer-ehealth.org

Summary of our Lessons

- Strong leadership – almost coercive – required to initiate the effort
- Possession of patient data should not confer a competitive advantage
- Data exchange does not have to be expensive and can evolve
- Technologies can be inclusive & create markets
- Addressing major impediments to regional data exchange is essential for any advanced use of health information technology

Summary of our Lessons

- Current approaches may not reach potential in the current payment climate; states must foster sustainability models
- Federal guidance will make a difference
- If you build your institutional system right and evolve collectively, you can create enormous value on the margin
- Things are going to happen no matter what the federal appetite

Building the Solution

How? Formatting collection and retrieval

What? Type of data

Where? Site of the collection

When? Prospective vs retrospective; real time vs "near real time"(!)

Who? Physician, physician extender, paramedical staff, administrator/clerk

Why? Objectives with metrics

Using IT Wisely

INTERACTION

DATA	Unstructured	Structured
Unstructured	**Adhoc access to Knowledge**	**Knowledge management**
Structured	**Business Intelligence**	**Business Process**

Jeff Raikes
Microsoft

Available Solutions

Data and Syndromic Surveillance Systems Currently in Use

The “CuSum” concept

Federal Government (CDC)

1. Biosenic
2. FluAid
3. FluSurge
4. BioNet
5. Early Aberration Reporting Systems (EARS)

EPR

Flu Net

World Health Organization

State

DOH

eHealth initiatives (Tennessee)

County

DOH

(NYC)

Public Health Initiatives elsewhere

Australia

Academic Institutions vs Non Academic

Electronic Surveillance Syndromic Systems

1. Defining a patient's clinical condition by
    a) Standardized sets of text terms used to identify and classify hospital ED chief complaints or "diagnosis"
    b) Chosen ICD-9 codes
2. Variances from typical reporting rates of 1a or 1b generates a "signal"

Electronic Surveillance Syndromic Systems

3. Review actual signals to determine if patient's condition was correctly identified and classified.
4. Determine whether signals correlate with a reportable communicable disease or other public health concern.
5. If signal deemed to warrant further investigation, interview of clinical staff takes place.

Data Used for Syndromic Surveillance

- private practice billing codes (ICD-9)
- chief complaint free terminology
- ED discharge diagnosis
- ED nurse triage terminology
- telephone triage terminology
- OTC and prescription medications
- school absenteeism

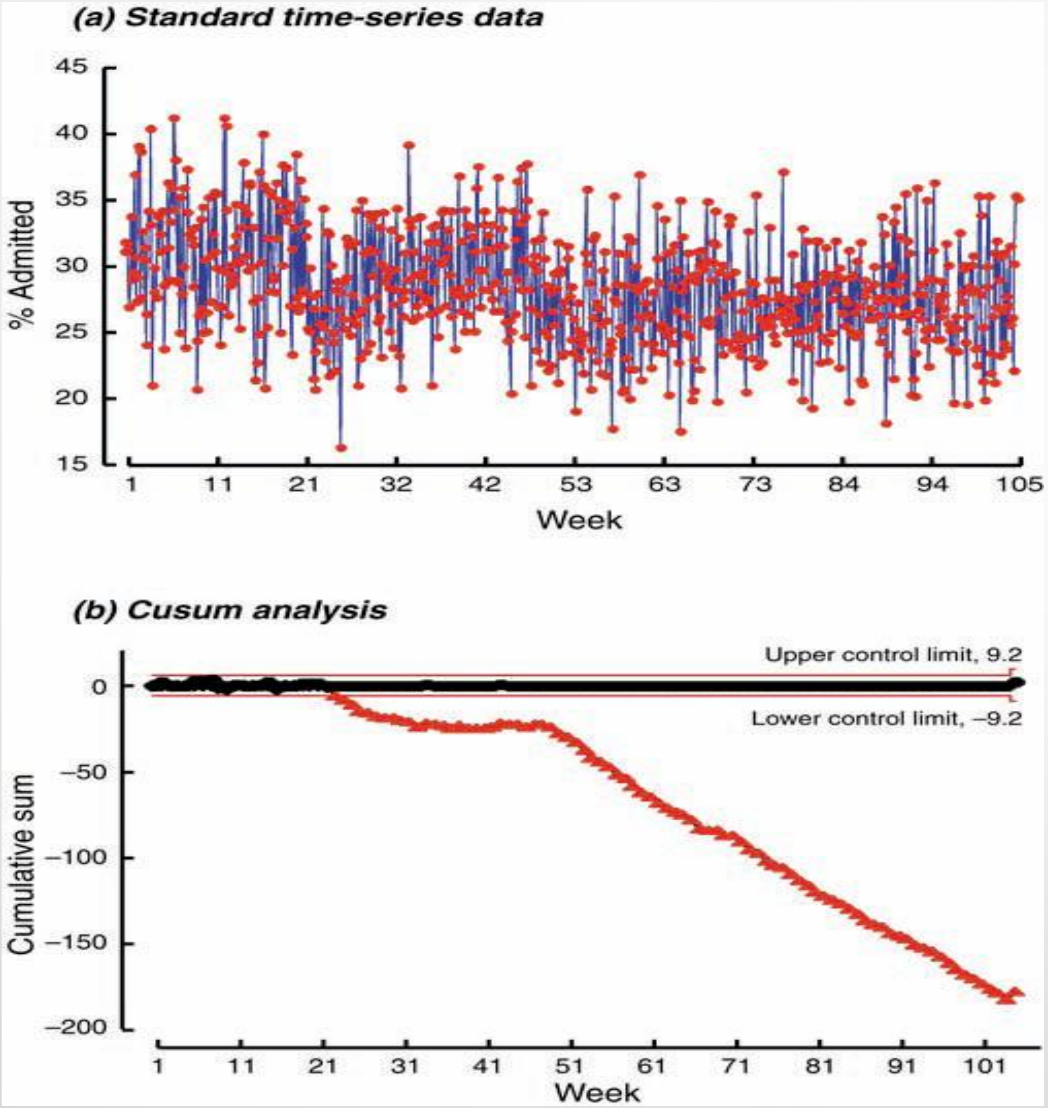
CDC Recommendations for Syndromic Survelliance Systems

- Data which is collected should exist for reasons other than surveillance
- Data should be recorded and accessible in a recognized, consistent and electronic format
- Data should be available for analysis shortly after the patients initial visit
- Sufficient historical data sources should be available that represent a reasonably static and definable population
- Syndromes should be validated against traditional data sources
- Thresholds set for their systems should achieve high sensitivity and positive predictive value

CuSum Analysis

- “Cumulative Sums” method: tracks the cumulative sum of consecutive differences (+/-) between individual measure & standard
- Initially developed by manufacturing industry to detect Salmonella
- Developed for rapid detection of small shifts from the process mean
- Provides estimates of when the change occurred
- Estimates the magnitude of change

2 Percentage of patients presenting to the Emergency Department who were admitted



The initial fall in the percentage admitted probably reflected the early decline in presentation rate, but the trend was maintained after the presentation rate increased, showing change in medical practice in response to the increased load.

Cusum analysis subgroup size, 7; target, 31%. A change in symbol shape and colour indicates that control limits have been transgressed. ◆

CuSum Analysis

Advantages voice by proponents:

- Simple
- Allows detection of trends at an early stage
- Provides a clear demonstration of the progressive impact of minor individual changes
- Requires setting a target (metrics are clear)
- Provides immediate, graphically comprehensible, locally useable, and thus persuasive information

Figure 2. Cumulative sum (CUSUM) chart signaling a significant signal corresponding to a confirmed influenza A outbreak occurring December 2000 and January 2001. CUSUM decision interval (horizontal broken line)

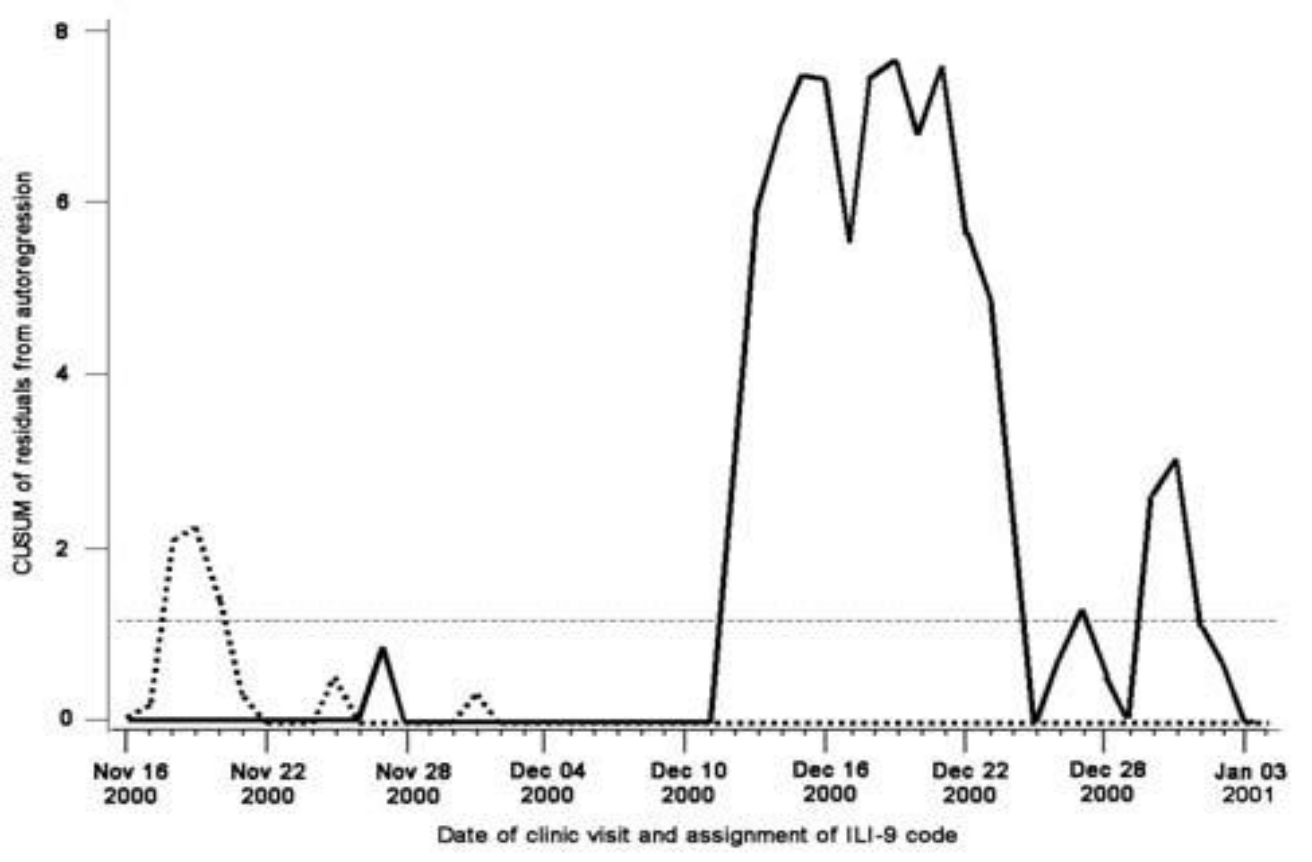
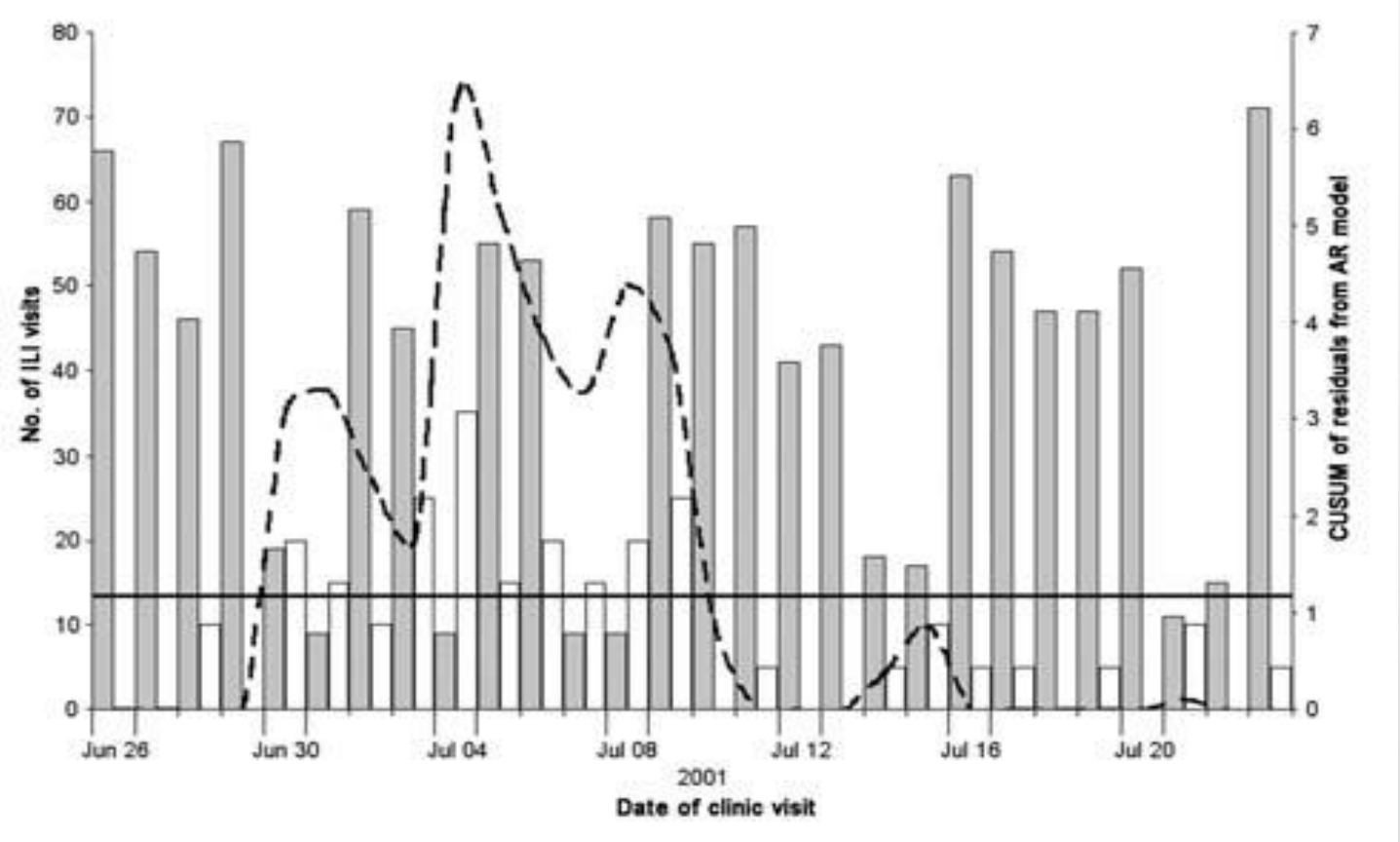


Figure 3. Cumulative sum (CUSUM) control chart of a hypothetical anthrax release occurring June 26, 2001. CUSUM of the residuals (broken line) is charted over the observed number of influenzalike (ILI) visits to the HealthPartners Medical Group (gray bars) and the additional outbreak-associated ILI cases (white bars).



Federal Government Initiatives

- Biosense supports efforts of the HHS Office of National Coodinator for Health Information Technology (ONC)
- American Health Information Community

(AHIC)

Biosurveillance Workgroup

Electronic Medical Records

Public Health Information Network (PHIN)

5 Key Elements

1. Early event detection (Biosense)
2. Outbreak management
3. Connecting laboratory systems
4. Countermeasure and response administration
5. Partner communications and alerting

Data current as of: 04/11/2006 08:00 AM EDT

Refresh Data

Patient Visit Status

426 Total Patient Visits

Current Settings

Geographical

Atlanta-Sandy Springs-Marietta, GA

Date Range

03/28/2006-04/11/2006

Data Category

ED - Chief Complaint Syndrome - Specific

Custom Settings

Selection Criteria

Display Options

Filter Settings

Metro Reporting A

Atlanta-Sandy Sp

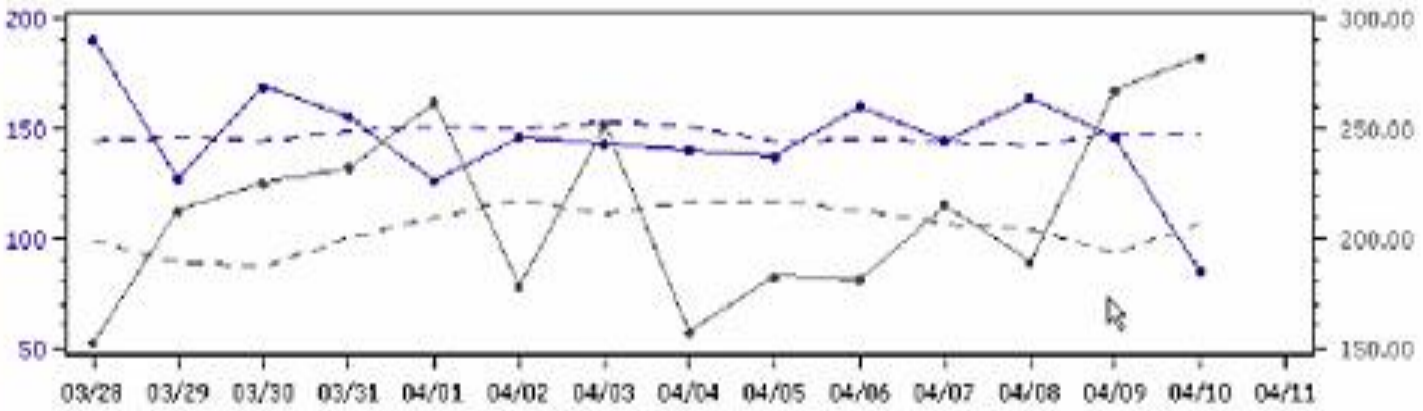
Update Region

Time Series

Metro Reporting Area: Atlanta-Sandy Springs-Marietta, GA

Data Category: ED - Chief Complaint Syndrome - Specific

Time Period: Date Range: 2 Weeks End Date: 04/11/2006



Total Records
Total-Records Moving Average
Statistically Significant Result
Rate *
Rate-Moving Average

* Rate per 1000 visits

Date	Count	Rate per 1,000 Visits	Total Records	Links
04/10	24	282.35	85	map / patient list
04/09	39	267.12	146	map / patient list
04/08	31	189.02	164	map / patient list
04/07	31	215.28	144	map / patient list
04/06	29	181.25	160	map / patient list
04/05	25	182.48	137	map / patient list
04/04	22	157.14	140	map / patient list
04/03	36	251.75	143	map / patient list
04/02	26	178.08	146	map / patient list

Biosense: Vision

- Provide local, state, and nationwide situational awareness
- For benefit before, during, and after a health event
- Help to confirm or refute the existence of an event
- Monitor an event’s size, location, and rate of spread

Patient Distribution Map

Metro Reporting Area: Atlanta-Sandy Springs-Marietta, GA

Data Category: ED - Chief Complaint Syndrome - Specific

Date Range:04/05/2006-04/11/2006

Patient Visit Status

Total Patient Visits=179

Current Settings

Geographical

Atlanta-Sandy Springs-Marietta, GA

Date Range

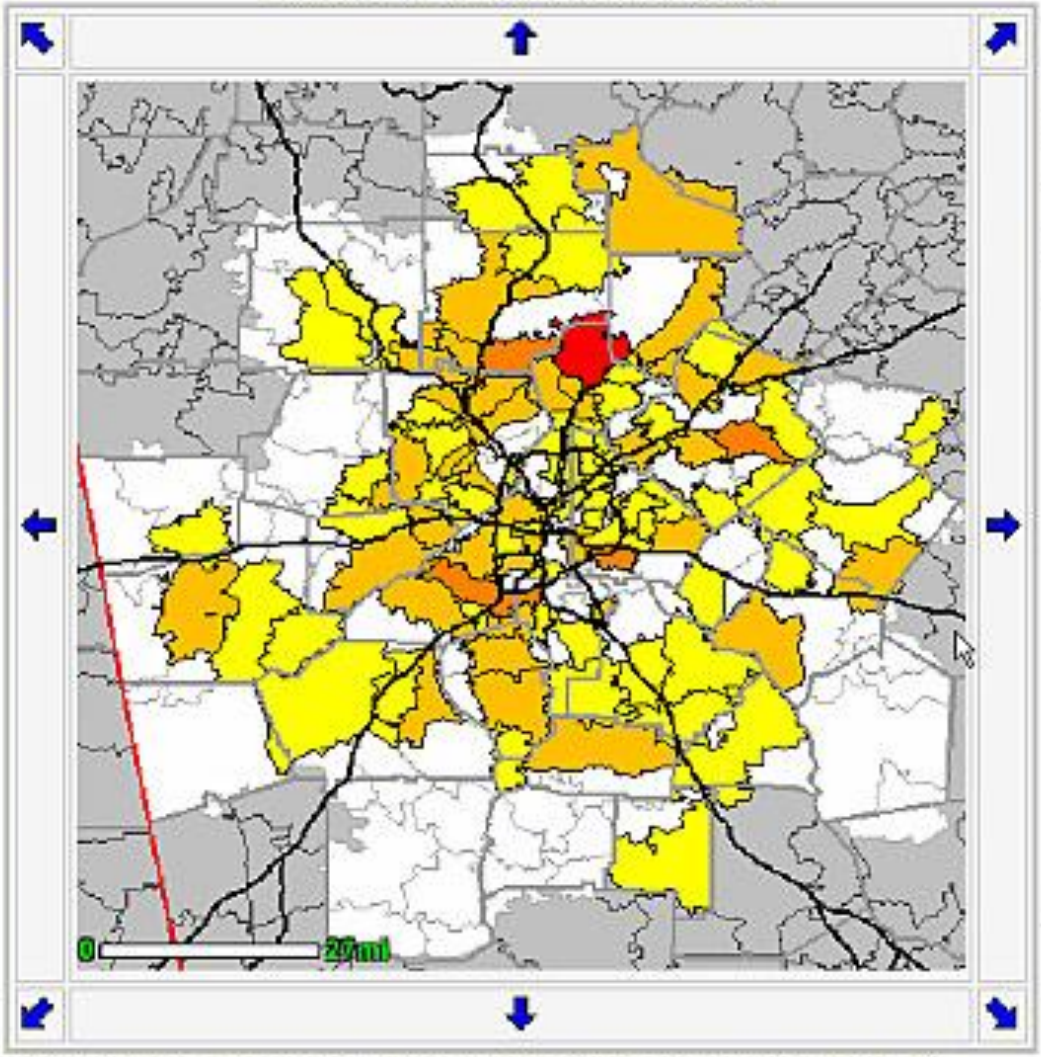
04/05/2006-04/11/2006

Data Category

ED - Chief Complaint Syndrome - Specific

Custom Settings

Display Options



Map Tools

Zoom In

Zoom Out

Reset Map

Legend

- Interstates
- States
- County Boundary
- Zip Boundary
- Out of jurisdiction

Data Range
(5 Levels)

- < 2
- 2 - 4
- 4 - 6
- 6 - 8
- > 8

Data based on patient counts per zipcode region.

1 Patient(s) are not displayed on map because their home location is outside of jurisdiction.

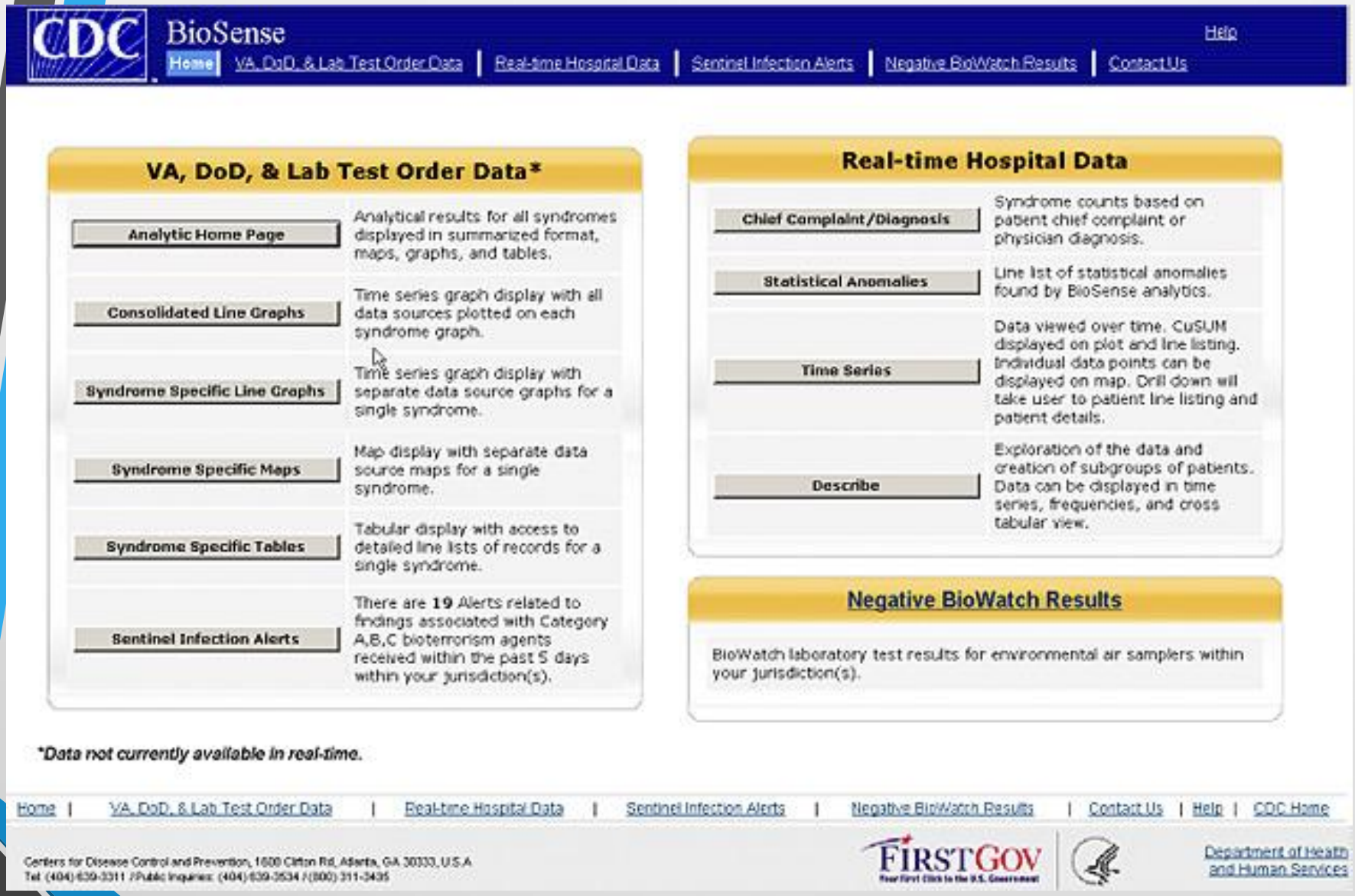
Biosense

To advance early detection by providing

- Standards
- Infrastructure
- Data acquisition for near real-time reporting
- Analytic evaluation and implementation

Biosense

- Data is categorized as pre-diagnostic or syndromic
- Definitions for each sydrome group were created by consensus
- Selected ICD-9 codes were categorized in one or more syndrome groups
- CuSum analysis is major component of system
- Data collected, besides, ICD-9 codes, includes demographics, chief complaints, radiology orders/results, lab orders/results and pharmacy data

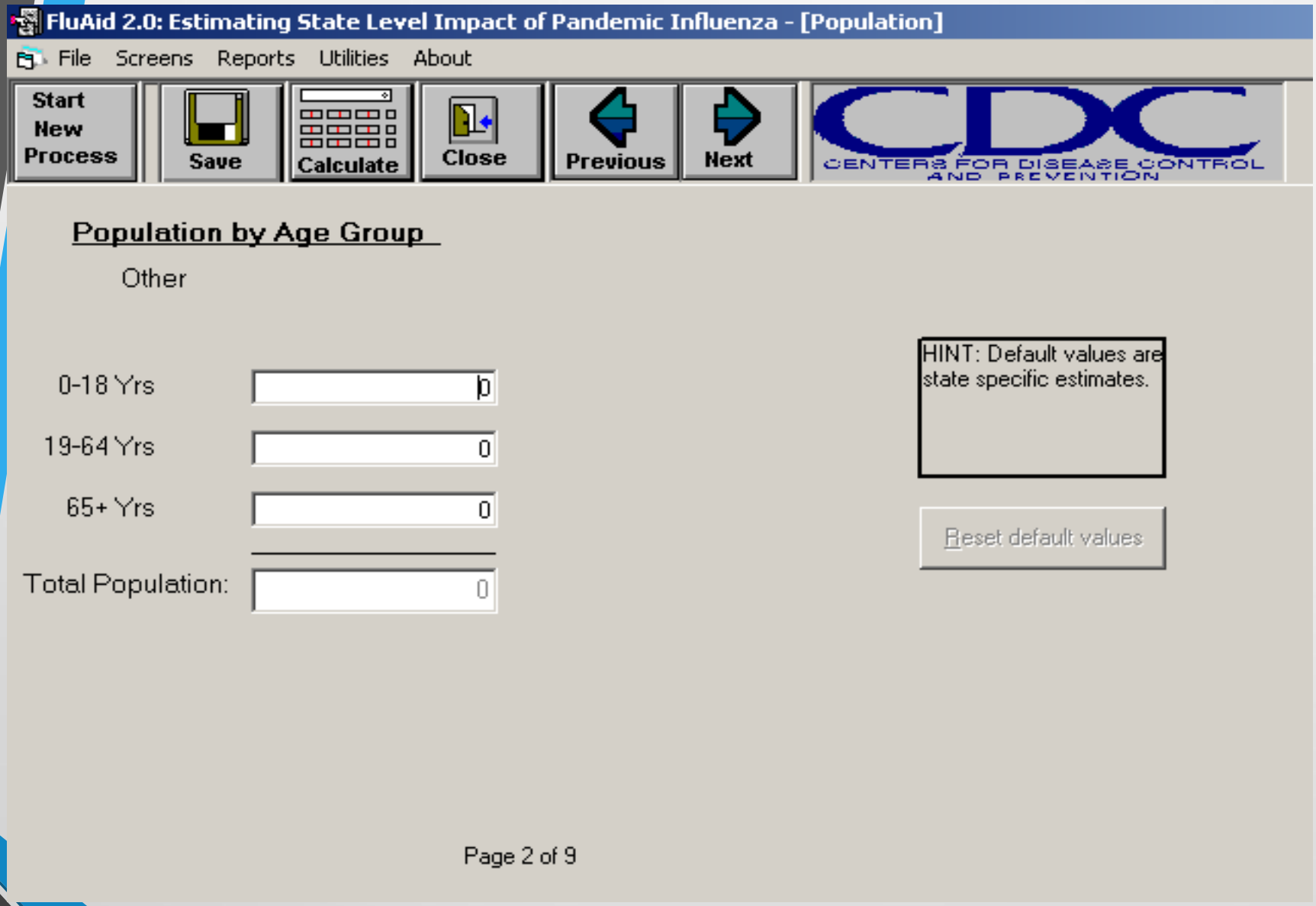

CDC
BioSense
Help
Home
VA, DoD, & Lab Test Order Data
Real-time Hospital Data
Sentinel Infection Alerts
Negative BioWatch Results
Contact Us
VA, DoD, & Lab Test Order Data*
Analytic Home Page
Analytical results for all syndromes displayed in summarized format, maps, graphs, and tables.
Consolidated Line Graphs
Time series graph display with all data sources plotted on each syndrome graph.
Syndrome Specific Line Graphs
Time series graph display with separate data source graphs for a single syndrome.
Syndrome Specific Maps
Map display with separate data source maps for a single syndrome.
Syndrome Specific Tables
Tabular display with access to detailed line lists of records for a single syndrome.
Sentinel Infection Alerts
There are 19 Alerts related to findings associated with Category A,B,C bioterrorism agents received within the past 5 days within your jurisdiction(s).
Real-time Hospital Data
Chief Complaint/Diagnosis
Syndrome counts based on patient chief complaint or physician diagnosis.
Statistical Anomalies
Line list of statistical anomalies found by BioSense analytics.
Time Series
Data viewed over time. CuSUM displayed on plot and line listing. Individual data points can be displayed on map. Drill down will take user to patient line listing and patient details.
Describe
Exploration of the data and creation of subgroups of patients. Data can be displayed in time series, frequencies, and cross tabular view.
Negative BioWatch Results
BioWatch laboratory test results for environmental air samplers within your jurisdiction(s).
*Data not currently available in real-time.
Home | VA, DoD, & Lab Test Order Data | Real-time Hospital Data | Sentinel Infection Alerts | Negative BioWatch Results | Contact Us | Help | CDC Home
Centers for Disease Control and Prevention, 1600 Clifton Rd, Atlanta, GA 30333, U.S.A.
Tel: (404)639-3311 / Public Inquiries: (404)639-3534 / (800) 311-3435
FIRSTGOV
Department of Health and Human Services

Biosense (cont'd)

- Pigeonholing of symptoms/signs/misclassification
- Small events: "For many outbreaks, an astute clinician may be the best detector"
- Baselines requires a certain period for data aggregation ("ramping up")

Flu Aid 2.0

- Developed to provide state level planners with “estimates of potential impact” specific to their localities
- Provides a range of “estimates of impact” in terms of deaths, hospitalizations and outpatient visits due to pandemic influenza
- Provides estimates of the total impact (i.e. after-the-event estimates)


FluAid 2.0: Estimating State Level Impact of Pandemic Influenza - [Population]
File
Screens
Reports
Utilities
About
Start New Process
Save
Calculate
Close
Previous
Next
CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION
Population by Age Group
Other
0-18 Yrs
0
19-64 Yrs
0
65+ Yrs
0
Total Population:
0
HINT: Default values are state specific estimates.
Reset default values
Page 2 of 9

FluAid 2.0 (cont'd)

- It is not an epidemiologic model
- It cannot describe when or how persons will become ill
- Multiple runs of the model, with changes, is recommended
- Requires input from health care providers, such as number of providers, number of beds, etc.
- High risk rates/low risk rates (data based on non-pandemic situations)

Flu Surge 2.0

- Takes epidemiologic data and tailors it to an individual hospital, based on its capacity
- User can alter the
  - . average length of stay
  - . ICU resource capacity
  - . total number of hospitalizations
- A spreadsheet is thereby created

CDC.gov

Flu Surge 2.0 (cont'd)

- These epidemiologic data are general and are not based on bedside clinical assessment

Bio Net

Funded by Department of Homeland Security

Integration of military and civilian capabilities

Early Aberration Reporting System (EARS)

Developed by the CDC

Consists of a class of quality control charts

1. Stewhart chart (P-chart)
2. Moving average (MA)
3. Variations of cumulative sum(CuSum)

World Health Organization

Inter-pandemic phase New virus in animals, no human cases	Low risk of human cases	1
	Higher risk of human cases	2
Pandemic alert New virus causes human cases	No or very limited human-to-human transmission	3
	Evidence of increased human-to-human transmission	4
	Evidence of significant human-to-human transmission	5
Pandemic	Efficient and sustained human-to-human transmission	6

Cumulative Number of Confirmed Human Cases of Avian Influenza A/(H5N1) Reported to WHO

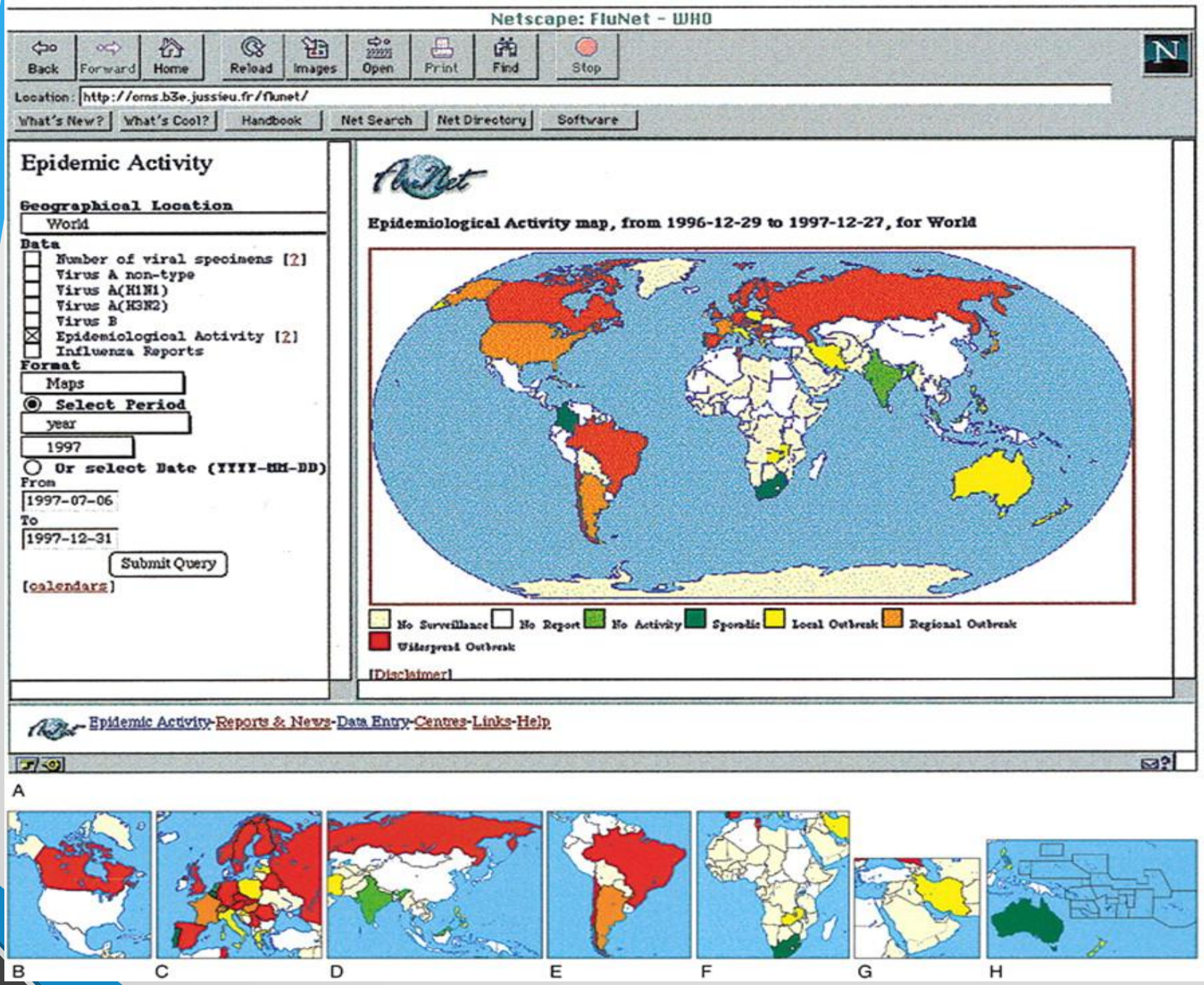
15 January 2007

Country	2003		2004		2005		2006		2007		Total	
	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths	cases	deaths
Azerbaijan	0	0	0	0	0	0	8	5	0	0	8	5
Cambodia	0	0	0	0	4	4	2	2	0	0	6	6
China	1	1	0	0	8	5	13	8	0	0	22	14
Djibouti	0	0	0	0	0	0	1	0	0	0	1	0
Egypt	0	0	0	0	0	0	18	10	0	0	18	10
Indonesia	0	0	0	0	19	12	56	46	4	3	79	61
Iraq	0	0	0	0	0	0	3	2	0	0	3	2
Thailand	0	0	17	12	5	2	3	3	0	0	25	17
Turkey	0	0	0	0	0	0	12	4	0	0	12	4
Viet Nam	3	3	29	20	61	19	0	0	0	0	93	42
Total	4	4	46	32	97	42	116	80	4	3	267	161

Total number of cases includes number of deaths.
WHO reports only laboratory-confirmed cases.
All dates refer to onset of illness.

Flu Net:
A Tool for Global Monitoring

- Developed by the World Health Organizations
- Internet based
- Allows each authorized center to enter data remotely and obtain full access to
  - real time epidemiological information
  - real time virological information



Flahault, A. et al. JAMA 1998;280:1330-1332.

JAMA

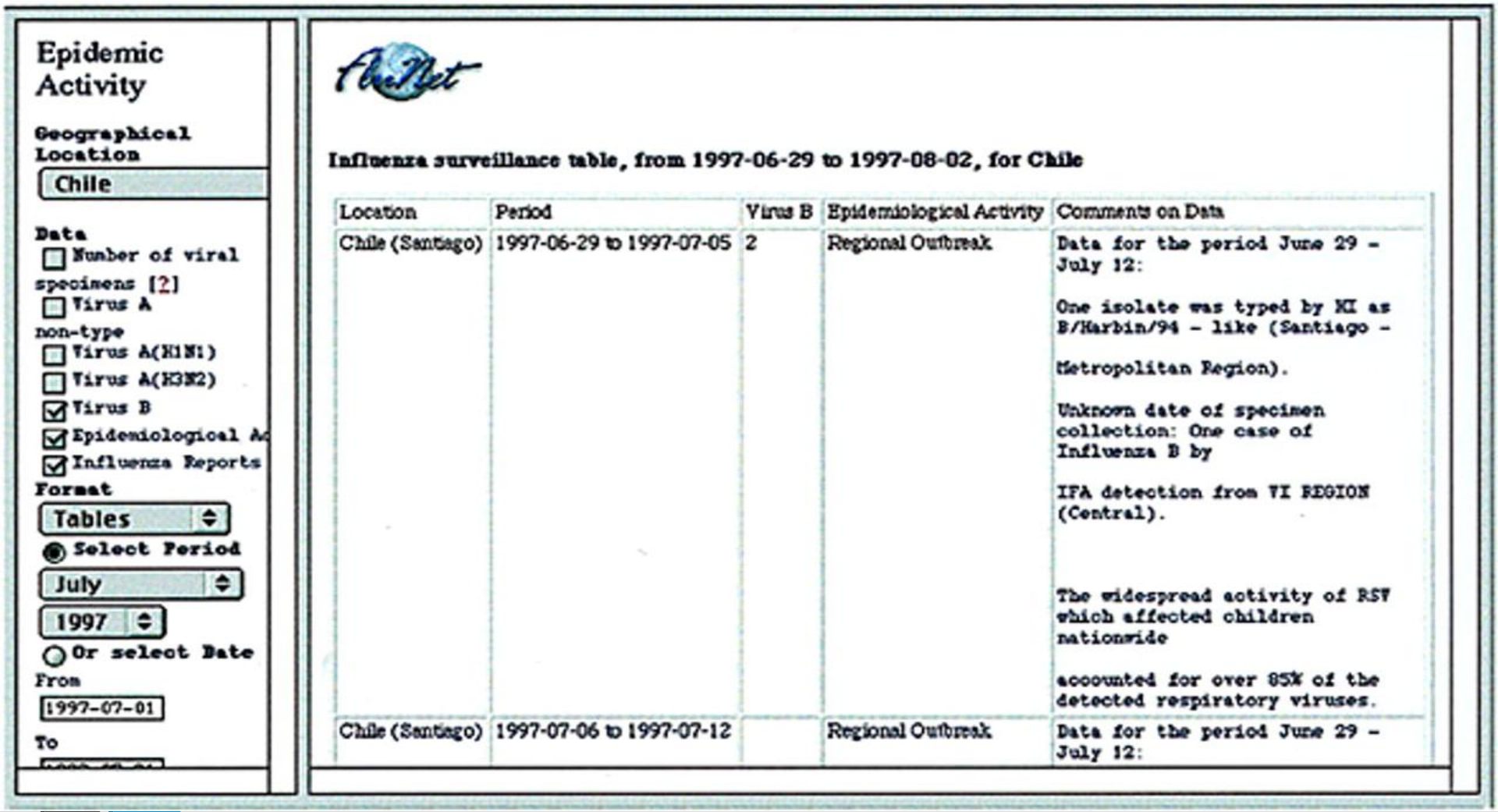
Flu Net

- Data outputs available in the form of graphs, maps, animations, tables, or text
- Additional reports, overviews
- Epidemiology:

  no activity → widespread

JAMA 1998

--Tables obtained "on the fly" when the FluNet end user requests from the Web interface a line listing containing a subset of entered data concerning a specific country (Chile) for a given period (July 1997)



Epidemic Activity

Geographical Location

Chile

Data

Number of viral specimens [2]

Virus A non-type

Virus A(H1N1)

Virus A(H3N2)

Virus B

Epidemiological Ac

Influenza Reports

Format

Tables

Select Period

July

1997

Or select Date

From

1997-07-01

To

FluNet

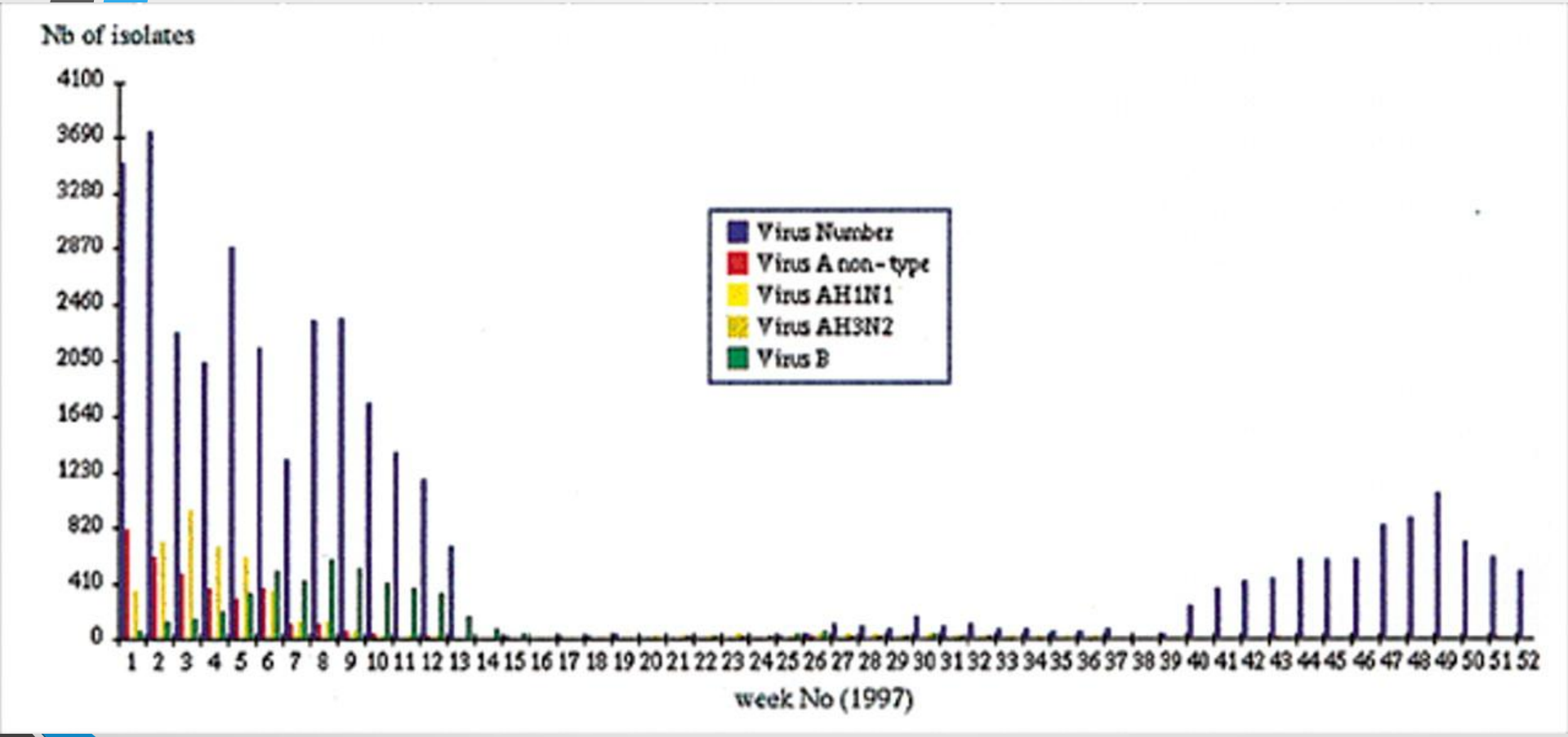
Influenza surveillance table, from 1997-06-29 to 1997-08-02, for Chile

Location	Period	Virus B	Epidemiological Activity	Comments on Data
Chile (Santiago)	1997-06-29 to 1997-07-05	2	Regional Outbreak	Data for the period June 29 - July 12: One isolate was typed by HI as B/Harbin/94 - like (Santiago - Metropolitan Region). Unknown date of specimen collection: One case of Influenza B by IFA detection from VI REGION (Central). The widespread activity of RSV which affected children nationwide accounted for over 85% of the detected respiratory viruses.
Chile (Santiago)	1997-07-06 to 1997-07-12		Regional Outbreak	Data for the period June 29 - July 12:

Flahault, A. et al. JAMA 1998;280:1330-1332.

JAMA

--Graph produced "on the fly" when the FluNet end user requests total specimens and viral isolates positive for influenza virus A (not subtyped), A (H3N2), A (H1N1), and B within the network of 110 national influenza centers and 4 collaborating centers January 1997 through December 1997 centers



Flahault, A. et al. JAMA 1998;280:1330-1332.

JAMA

Problems

- “Pipe breaks” – slow access times
- Need redundant server systems/sufficient bandwidth
- Can detect antigenic shift in Influenza A, but it is not correlated to symptom variation (for greater lead time)

Conventional disease surveillance mechanisms that rely on passive reporting may be too slow or insensitive

JAMA 1998

State eHealth Initiative
Core Data Elements

- Demographic information
- Hospital labs
- Hospital dictated reports
- Radiology reports
- Allergies
- Retail pharmacy medications
- Ambulatory notes

*All other relevant clinical information hospitals can make available in electronic format

AHRQ/Tennessee: An Intervention Framework

		STEPS	EXAMPLES
INFRASTRUCTURE	OUTCOMES	Value	Adherence to best practices, reduce errors, reduce prescriptions, reduce redundant/overlapping testing, increase compliance
		Change in Practice	Systems that support safety, patient centered care, disease management, evidence based decisions
	INTERVENTIONS	Point of Care Systems	CPOE, e-Prescribing, medication administration, pharmacy, notification /escalation
		Data Interchange	Patient index, lab results, medication dispensing record
		Standards	Messaging, terminology, role based authorization

Next Steps

- Reconcile Memphis regional project with overall state strategy and other regional and TN-wide efforts
- Refinement of system and roll-out in all emergency departments
- Re-build infrastructure to be completely open-architecture and component-based. Integrate emerging standards
- Integrate with medication history and other sources of plan and laboratory information
- Build business model for a “utility” supporting all certified point-of-care systems in use in the region
- Expand use to public health, quality initiatives

http://www.volunteer-ehealth.org

Syndromic Surveillance in Public Health NYC

Data collected:

- age in years
- sex
- home zip code
- free-text chief complaint
- date and time of visit

Data sent within 12-24 hours to DOH

Emerging Inf. Dis.May 2004

Syndromic Surveillance in Public Health NYC (cont'd)

- Certain terms eliminated from consideration e.g. "nasal" "stuffy"
- Ratio of syndrome visits to nonsyndrome (other) visits is compared, over varying periods of time
- Children and their data not included for respiratory illnesses

Emerging Inf. Dis.
May 2004

Syndromic Surveillance in Public Health NYC (cont'd)

- A citywide signal was detected, which represented the earliest indication of community wide influenza activity that winter season
- This series of signals began 2 weeks before increases in positive influenza lab isolates
- Series of signals began 3 weeks before sentinel physician increases in influenza like illness

Emerging Inf. Dis.
May 2004

Syndromic Surveillance in Public Health NYC (cont'd)

- Yet, overall, about 1/3 of signals did not occur during periods of influenza activity
- All signals require personnel for follow-up

Authors comment:

- Analytic methods and investigation protocols must be designed so they do not overburden public health agencies
- Syndromic surveillance systems are essentially "smoke detectors" which do not replace traditional systems

Westchester County Department of Health MMWR 2004

- 59 signals over 9 months
- 8 syndrome categories
- 34/59 merited further investigation
- Of the 34 investigated, no incidents of public health significance were identified that would have been missed by traditional processes

Another Syndromic Surveillance System

NSW, Australia

- Data added as a “free text presenting problem” in addition to ICD-0 classification
- “Cleaned” free text is assigned to categories representing syndrome groups
- Text with highest correlation with eventual diagnosis was symptom or sign based

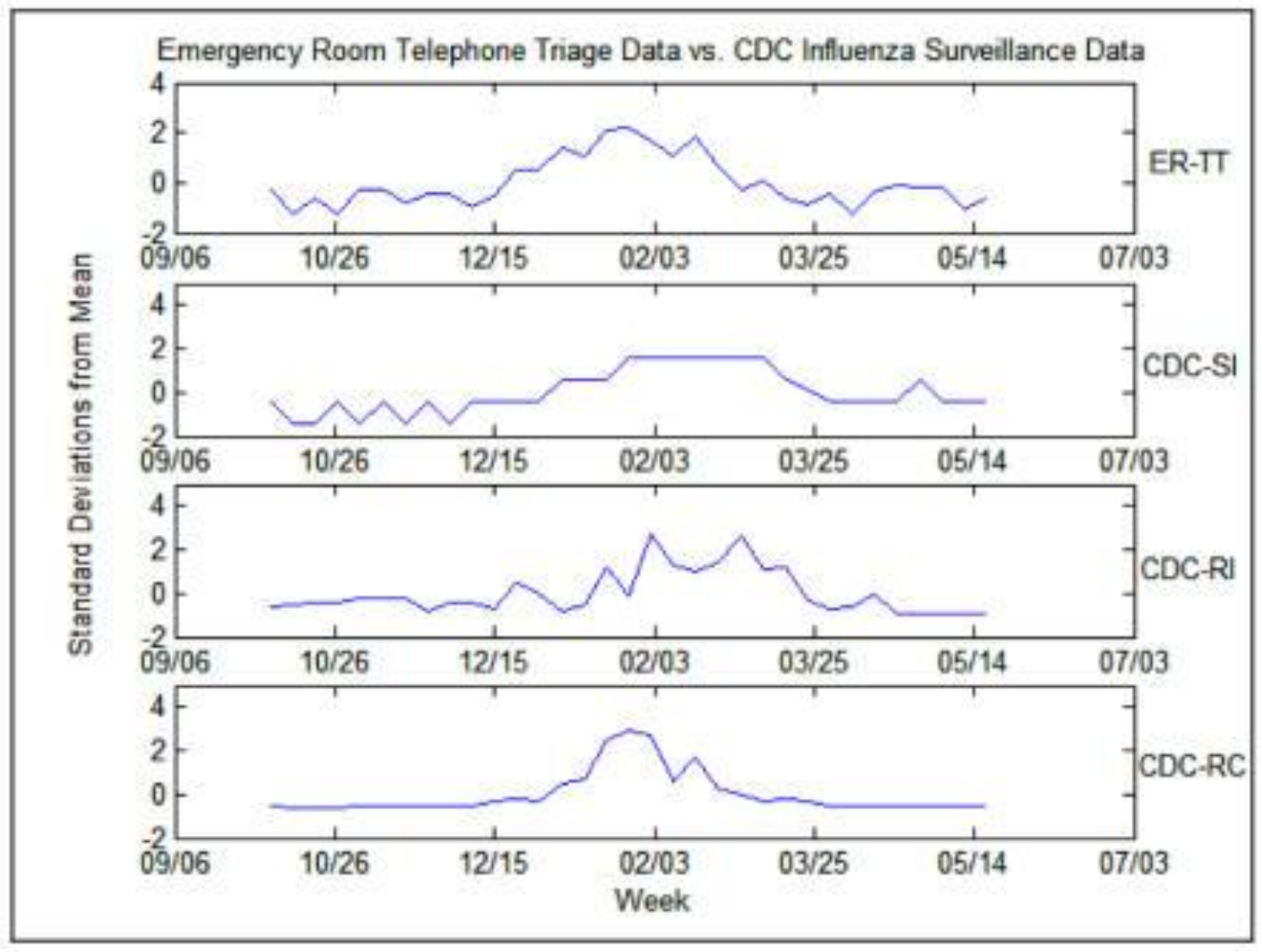
BMC Public Health
December 2005

Problems

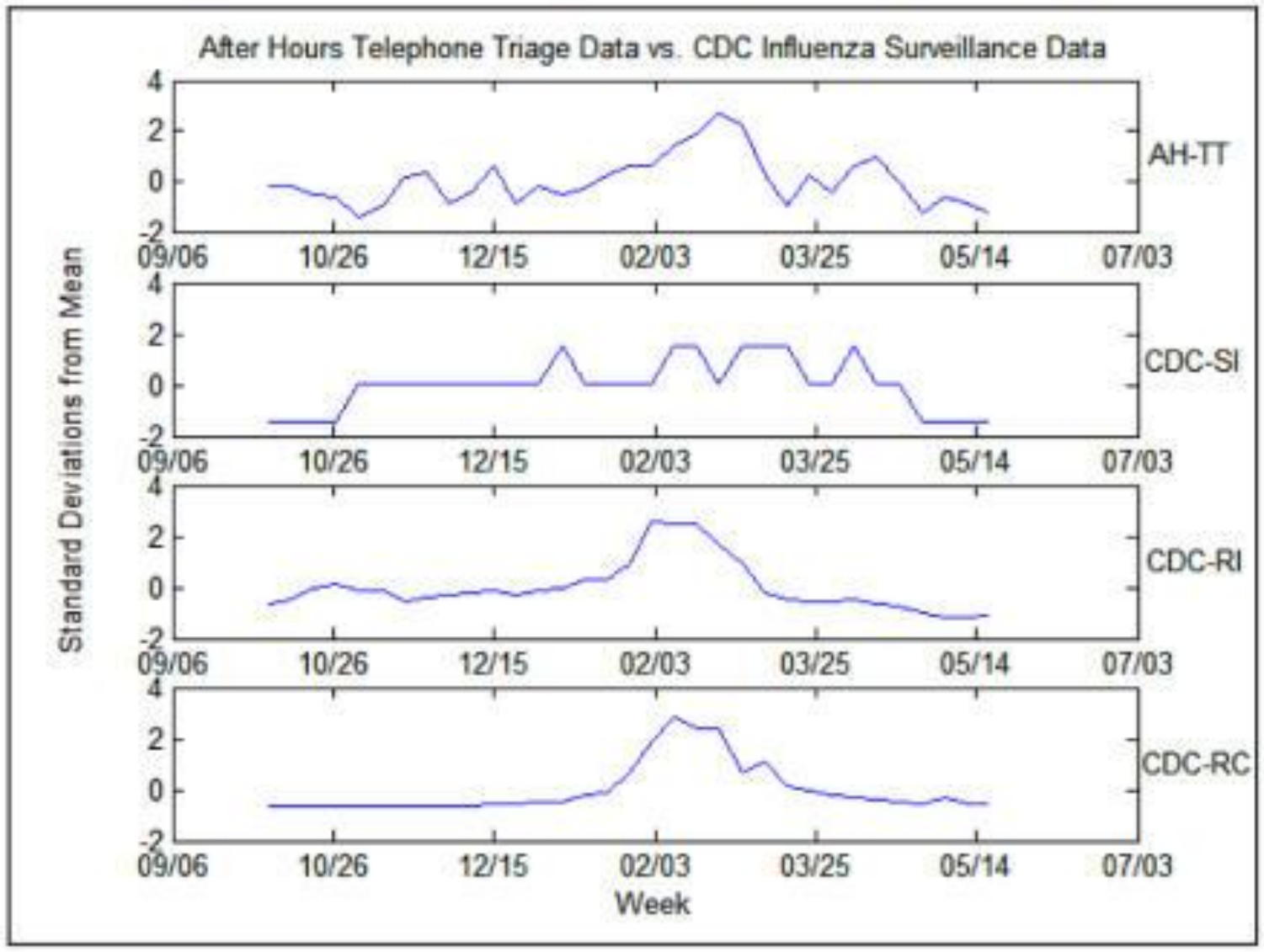
- Patient may be assigned to more than one category for a single ED visit
- Free text words are edited, e.g.

  No nausea or vomiting → no vomiting
- Importance/significance of category assigned besides “top match” not explored
- If text which was most effective was symptom/sign based, then a symptom/sign based system may be an advantage

Telephone Triage



Telephone Triage



Flu Aid 2.0

Ann Epidemiol 2004

"adding bells and whistles" Alberta, Canada

- Added age and age set specific data for local regions
- Developed trending data during interpandemic years as well as pandemic years, for better overall predictability

The Validity of chief complaint and discharge diagnosis in emergency dept-based syndromic surveillance

National Center for Infectious Disease

CDC

Acad Emerg Med 2004 Dec

- Each patient visit was assigned one of ten clinical syndromes or “none” after medical record review, and recorded on a surveillance form

CDC Study (cont'd)

Results:

Utilizing Kappa statistics:

. Agreement between surveillance forms and ED discharge dx Kappa = 0.55

. Agreement between surveillance forms and chief complaints Kappa = .48

CAN WE DO BETTER?

Classification of Chief Complaints into Syndromes

Pennsylvania & Utah

Results for respiratory: Sensitivity: 63%

Conclusion:

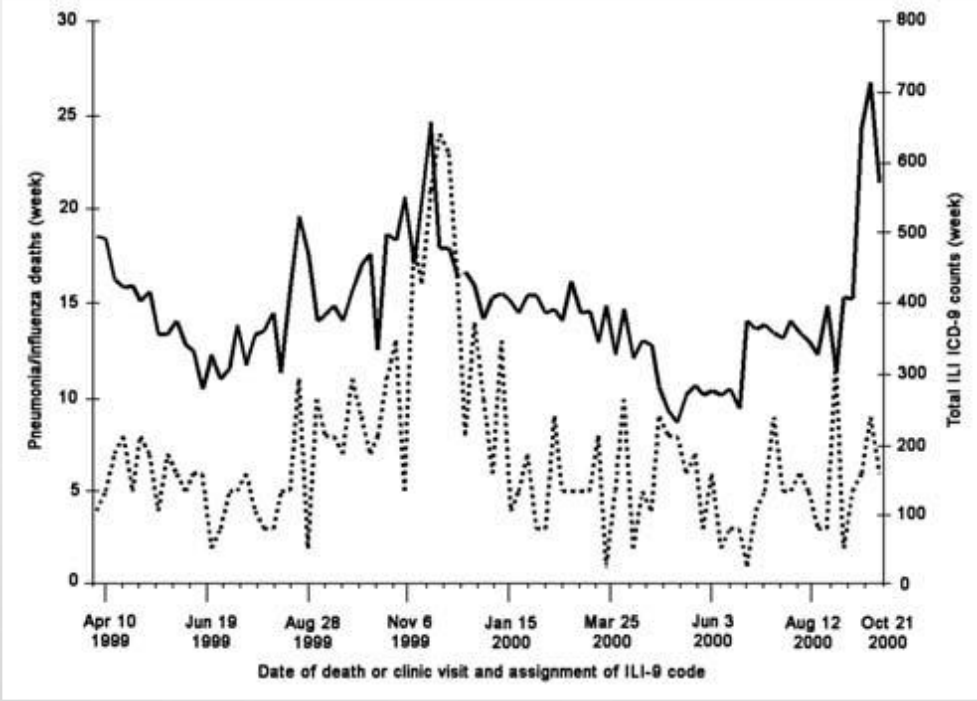
Chief complaint classification might be useful for detecting moderate to widespread outbreaks; however, to increase sensitivity the techniques should be extended to other clinical information sources, including chest radiograph and emergency department reports.

MMWR Aug 26, 2005

Syndromic Surveillance Systems Disadvantages

- Formal calculations of sensitivity and specificity, and positive predictive value generally not conducted
- Visual comparison of surveillance curves with validating data, such as death from influenza/pneumonia over same time period, may alone not be sufficient proof of efficacy

Figure 1. Weekly totals of HealthPartners Medical Group influenza like illness ICD-9 counts (solid line) and Minneapolis-St. Paul metropolitan area weekly influenza and pneumonia deaths (broken line) April 10, 1999, through December 29, 2000.



Syndromic Surveillance Systems

- Assessing validity is difficult because the system attempts to identify disease outbreaks before a definitive diagnosis is made
- The actual cause of many signals (statistical aberration) generated by a system is never known (??)
- Baseline historical data – What should be used?
- Not effective for individual patients
- Changes in syndrome presentation not easily detectable

What Can Be Learned?

- How much better than an “astute clinician” are syndromic surveillance systems?
- Patient use patterns and seasonality have a considerable effect on the distribution of the data set
- Certain holidays may generate lower than usual counts due to day of week
- The issues above may be remedied by a prospective, real time, web accessible model with actual bedside clinical data on-line collected via a template. Endpoint is not simply presence or absence of a syndrome, but a DDx.

What Can Be Learned?

- Such decision making requires evidence-based data at the site of origin
- Bedside signs and symptoms that are common aspects of any health record, rather than “prefab” terms and codes hold greater promise to represent such data
- Aggregation, assembly and interpretation of such data in real-time at the clinical site would be ideal

What can be learned?

- An astute clinician in an ED is the strongest asset in detection of a series of unusual cases
- What may be less intuitive to a clinician are nuances in presentation to the ED that may play a role in later treatment and management

Using ICD-9 Codes as Basic Data Set

Drawbacks

- Entered by staff in ED generally unaccustomed to coding – accuracy may vary
- Diagnoses are not generated in real time, but at end of ED stay
- Diagnosis entered may reflect a symptom or a specific diagnosis, but not both
- A code may represent only a portion of the presenting complaints

BMC Public Health
December 2005

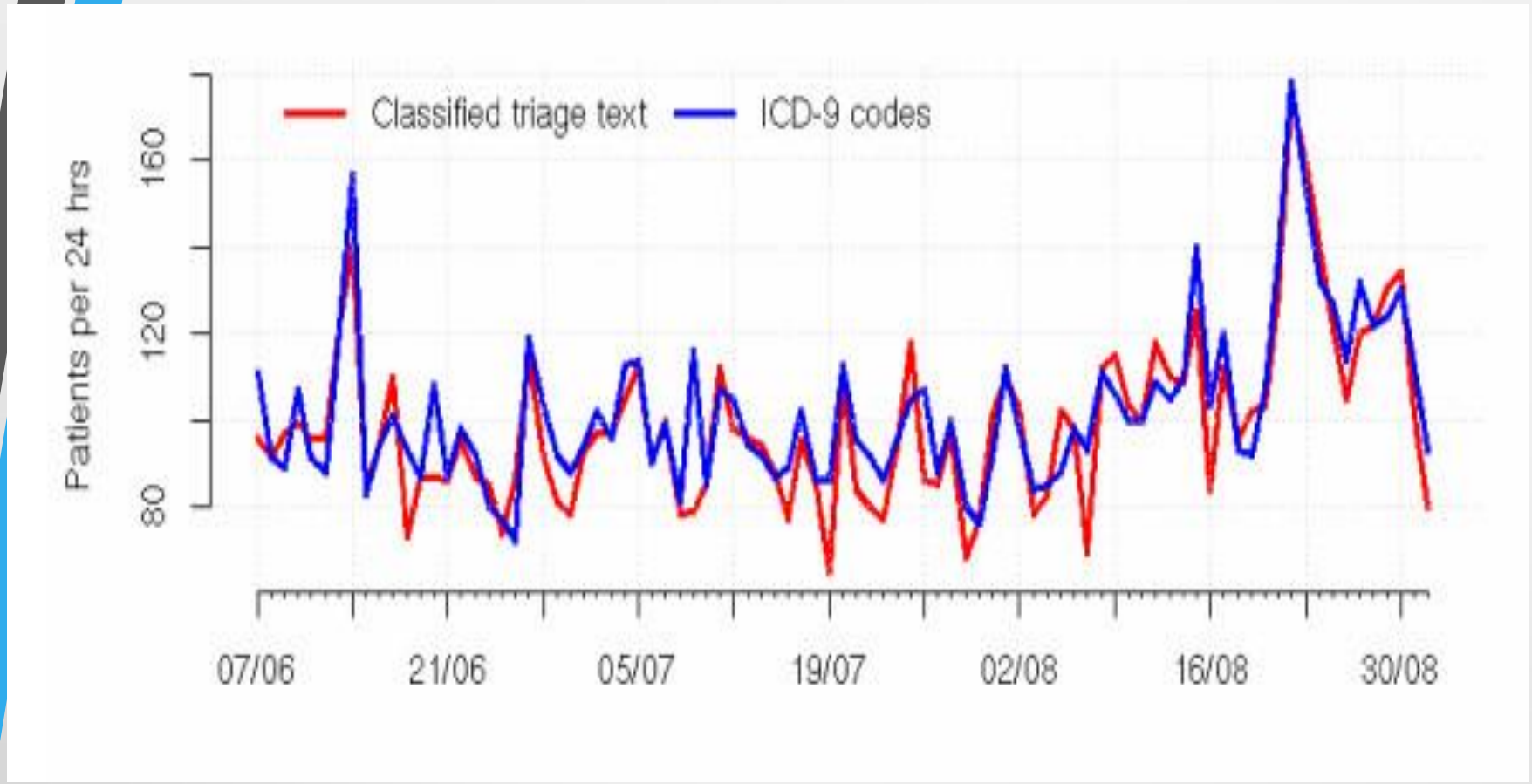


Figure 3

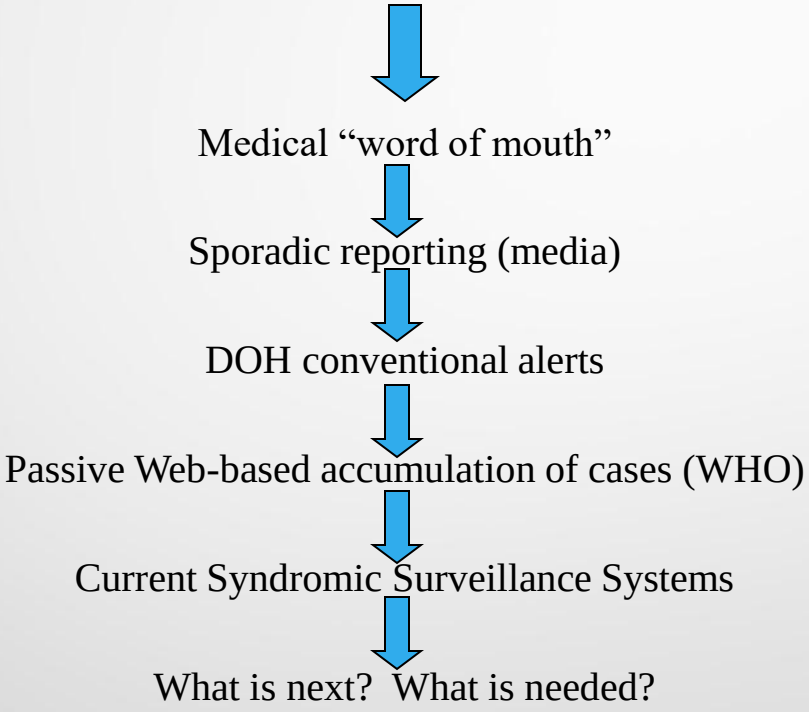
Comparison of daily counts of ED visits for the 'All respiratory' syndrome classified both automatically from triage nurse text and from the coded provisional ED diagnoses, for the period 7 June to 1 September 2004. Includes only ED visits that have a provisional diagnosis recorded

BMC Public Health 2005, **5**:141

An alternative approach:

Specific signs and symptoms may be more illustrative than ICD-9 classification and syndromic labeling.

PANDEMIC/EPIDEMIC DETECTION



Current Needs and Opportunities

- Machine learning from vast data collections [“rapid learning”]

. For diagnosis, prognosis, and therapy

- Revisiting symbolic, knowledge, and model-based methods once the low-hanging fruit are picked
- Understanding, modeling, and integrating with workflows

Peter Szolvits
MIT AI Lab

Clinical Data are Mostly Text

- Need Text Understanding

  . Discharge summaries

  . Clinical notes

  . Reports

  . Letters

- Standardized templates with appropriate questions and answer options available

Peter Szolvits
MIT AI Lab

“Solutions: The Next Generation”

Clinical data, which influence bedside decision making, when aggregated from a number of individuals within a prescribed geographic area, help determine public health initiatives.

“Solutions: The Next Generation”

Getting on the same page:

Clinical/bedside  Epidemiology/

Medical care public health

A new perspective:

Microclinical  macroclinical

Clinical Medicine and Public Health

"When Worlds Collide"

Thailand 2005

Disease documented in 2 family members resulting from person-to-person transmission of a lethal avian influenza virus during unprotected exposure to a critically ill index patient

New England Journal Of Medicine 2005

Solutions: The Next Generation

The process of proceeding from one to the other requires:

- Aggregation and assembly of data in a rigorous prospective fashion
- Placement of data within an automated infrastructure located wi/legacy processes
- Access to e-infrastructure from multiple sites

Solutions: The Next Generation

- Interpretation of data by metrics that evolve with time
- Communicability of interpretation so that it is relevant on both micro and macro levels
- Real time execution

Only bedside models can accomplish these objectives

Excellent Suitability of Avian Flu for an IT Solution: microclinical & macroclinical

Why are we aiming beyond CuSum (pattern variance)?

The Clinical Problem

Respiratory illness caused by influenza is difficult to distinguish from illness caused by other respiratory pathogens on the basis of symptoms alone.

CDC 2005

- Speaks for all contributing data to be placed in a format that facilitates diagnosis
- Can we perhaps, uncover “nuances of diagnosis”?

Why is this important?

Clinical Medicine and Public Health

If formatted data includes:

. Age

. Vaccination status

. Concurrent illnesses

. Definitive diagnosis

. Patient disposition

. CXR appearance

relative risks may be stratified

“The Next Generation”

- Can then establish threshold of probability of diagnosis for triage decision making
- An effective tool, until immediate confirmatory testing with high predictive value becomes universally available
- Still has management capabilities based on trend analysis between certain signs and symptoms and outcomes (discharge, admit)

Syndromic Surveillance: The Next Generation

Data obtained is signs and symptoms, rather than codes, or categorized “free terminology” in real time at the bedside for on-line entry

The “Value-Added”

- By doing so, one may detect a syndrome that may have as unusual constellation of symptoms/signs

or

- A known syndrome/diagnosis that is changing in presentation (mutation)

Why?

- Better data capture/better data
- Better representation of the true clinical picture (micro & macro) and spectrum of disease

“The Next Generation”

A series of carefully selected, standardized H&P questions, with multiple choice selections clearly demarcated for answers

All questions to be answered, then the data base is completed

Only then will data be processed

Clinical Signs and Symptoms

Factors that impact on bedside decision making (“micro-clinical”)

and

Epidemiologic decision making (“macro-clinical”)

Test Characteristics of Clinical Findings, by Study

Table 3. Test Characteristics of Clinical Findings, by Study

Symptoms, Authors	Sensitivity	Specificity	Positive LR (95% CI)*	Negative LR (95% CI)*	DOR (95% CI)*
Sore throat					
No age restriction					
Monto et al	0.84	0.16	1.0 (0.97-1.0)	1.0 (0.85-1.2)	1.0 (0.8-1.2)
Hulson et al	0.75	0.28	1.0 (0.91-1.2)	0.89 (0.62-1.3)	1.2 (0.72-2.0)
van Elden et al	0.80	0.33	1.2 (0.91-1.6)	0.61 (0.28-1.3)	1.9 (0.69-5.3)
Summary			1.0 (0.98-1.0)	0.96 (0.83-1.1)	1.1 (0.87-1.3)†
Only patients ≥60 y					
Nicholson et al	0.58	0.36	0.91 (0.61-1.4)	1.2 (0.66-2.1)	0.8 (0.3-2.1)
Govaert et al	0.40	0.81	2.1 (1.7-2.7)	0.74 (0.64-0.85)	2.9 (2.0-4.3)
Summary			1.4 (0.81-2.5)	0.77 (0.66-0.89)	1.8 (0.81-4.0)
Sneezing					
No age restriction					
Carrat et al	0.50	0.59	1.2 (1.0-1.5)	0.85 (0.71-1.0)	1.4 (1.0-2.1)
van Elden et al	0.33	0.69	1.1 (0.55-2.0)	0.97 (0.71-1.3)	1.1 (0.42-2.8)
Summary			1.2 (1.0-1.5)	0.87 (0.75-1.0)	1.3 (0.95-1.9)†
Only patients ≥60 y					
Nicholson et al	0.32	0.33	0.47 (0.24-0.92)	2.1 (1.4-3.1)	0.2 (0.1-0.6)
Nasal congestion					
No age restriction					
Monto et al	0.91	0.19	1.1 (1.1-1.2)	0.47 (0.40-0.56)	2.4 (2.0-2.9)
van Elden et al	0.68	0.41	1.1 (0.81-1.6)	0.79 (0.44-1.4)	1.4 (0.58-3.6)
Summary			1.1 (1.1-1.2)	0.49 (0.42-0.59)	2.3 (1.9-2.8)†
Only patients ≥60 y					
Nicholson et al	0.47	0.50	0.95 (0.57-1.6)	1.0 (0.67-1.7)	0.9 (0.3-2.4)
Chills					
No age restriction					
Carrat et al	0.83	0.25	1.1 (1.0-1.2)	0.68 (0.46-0.99)	1.6 (1.0-3.0)
Only patients ≥60 y					
Govaert et al	0.46	0.82	2.6 (2.0-3.2)	0.66 (0.55-0.77)	3.9 (2.7-5.7)
Vaccine history					
No age restriction					
Hulson et al	0.12	0.83	0.71 (0.41-1.2)	1.1 (0.96-1.2)	0.69 (0.37-1.3)
van Elden et al	0.02	0.82	0.11 (0.01-1.1)	1.2 (0.02-1.4)	0.12 (0.01-1.0)
Summary			0.63 (0.37-1.1)	1.1 (1.0-1.2)	0.60 (0.33-1.1)†
Fever and cough					
No age restriction					
Monto et al	0.64	0.67	1.9 (1.8-2.1)	0.54 (0.50-0.57)	3.6 (3.1-4.2)
Only patients ≥60 y					
Govaert et al	0.30	0.94	5.0 (3.5-6.9)	0.75 (0.66-0.84)	6.6 (4.2-10.0)
Fever and cough and acute onset					
No age restriction					
Monto et al	0.63	0.68	2.0 (1.8-2.1)	0.54 (0.51-0.58)	3.6 (3.1-4.1)
Only patients ≥60 y					
Govaert et al	0.27	0.95	5.4 (3.8-7.7)	0.77 (0.68-0.85)	7.1 (4.5-11.0)

Abbreviations: CI, confidence interval; DOR, diagnostic odds ratio; LR, likelihood ratio.
*Positive LR is the LR when the finding is present; negative LR is the LR when the finding is absent; DOR is an indicator of the test's overall accuracy.
†Homogeneous DOR ($P>.05$). When the DOR was heterogeneous, we assessed for homogeneity separately for the positive and negative LRs.

Call, S. A. et al. JAMA 2005;293:987-997.

JAMA

Does this patient have influenza?

No independent sign(s) and/or symptom(s) in all age groups overall raised likelihood of influenza

In >60 age group . . .	LR
fever, cough, and acute onset	5.4
fever and cough	5.0
fever alone	3.8
malaise	2.6

JAMA 2005

Does this patient have influenza? (cont'd)

To decrease the likelihood of influenza . . .

	LR
absence of fever	.40
cough	.42
nasal congestion	.49

JAMA 2005

Does this patient have influenza? (cont'd)

Author's conclusions:

- Clinical findings identify patients with influenza like illness but are not particularly useful for confirming or excluding the diagnosis of influenza
- Clinicians should use

  - timely epidemiologic data to either

    treat empirically or rapid test then treat

JAMA 2005

Emerging/Changing Spectrum of Disease

"Atypical Avian Influenza"

Thailand 2004

Emerging Inf Diseases 2004

. Fever
. Diarrhea
. No respiratory symptoms
. Exposure to poultry

ICD-9 Coding – based tools??

"Assessing the Impact of Airline Travel on the Geographic Spread of

Pandemic Influenza"

- Epidemic model: recognition in focal city spread concurrently to both northern and southern hemispheres
- Time lag very short

Eur J. Epidemiol
2003

Chest X-Ray Findings

Predictors of Mortality:

. Multifocal and focal consolidation

. Pleural effusions

. Cavitation

. Lymphadenopathy

. Collapse

. Pneumothorax

Radiologic Society of North America
2006 Annual Meeting

Figure. Chest x-ray of a patient who died from avian flu, showing extensive bilateal lung consolidation.

Virologic Factors

Possibility of reassortment of viral factors, such as gene segments, with currently circulating human viruses requires tracking of clinical and subtype variables

Rapid Testing (30 minutes-1 hour)

The Laboratory Problem

FDA Caution:

"Test sensitivities and specificities cannot necessarily be compared across package inserts as these studies were done"

. With different patient groups

. With different levels of influenza activity

. At different times post onset of symptoms

. With different specimen types

. Under different laboratory conditions

MMWR 2/3/06

RT – PCR Assay

Testing indicated when a patient has

. Severe respiratory illness

. Risk for exposure

MMWR 2/3/06

RT – PCR Assay

Test results take hours to days (DOH labs only)

. Clinical decision making needs to be rigorous

. Improvement in clinical decision making when results are added to IT tool

(Rapid Learning)

MMWR 2/3/06

The Laboratory Problem

Particularly at the beginning of the season or outbreak,

negative results may not be relied upon to guide management or treatment decisions

CDC 2005

Question: "So many cases, so little knowledge"

Answer: All clinical data needs to be captured, aggregated, and assembled

"Show me the Data"

Influenza Virus Cultures

MMWR 2/3/06

- Nasopharyngeal aspirates within three days of onset of symptoms
- Greater sensitivity in children (higher virus shedding)
- Sensitivity/specificity ranges may be different for different subtypes

Are there other variables, yet unknown?

Influenza Virus Cultures

Positive and Negative Predictive Values (sensitivity and specificity) are highly dependent on

MMWR 2/3/06

Prevalence

Bayes Theorem

All percentages related to a disease (sign, symptom, test result) are dependent on the prevalence of that disease in the population tested

CoInfections with H9N2 Isolates

Iran

Mycoplasma

Escherichia coli

Ornithobacterium rhinotracheale

Acta Virol 2006

ED DATA

Clinical Signs and Symptoms

(not codes, not terms)

Travel history/High risk co-morbidities

Contacts

Vaccination history

Chest X-ray

VARIABLES

Viral Culture

Other cultures

(coinfections)

Rapid-Testing for Influenza

(true +/true -)

(false +/false -)

~~RT-PCR~~

Disposition

Discharge from ED

Admission: med-surg bed

ICU

OUTCOMES/ALTERNATIVES: **Inf A, Inf B, HSNI, H7/H9, noninfluenza**

A Romanian police officer helps cull a flock of domestic ducks with Avian flu. In October the flu also hit fowl in Russia and Turkey, Croatia and Greece.

CMAJ • November 22, 2005 • 173(11) |

Physician, nurse, and patient factors:

Influence on ambulance diversion

Annals Emerg Med 2003

Covariates: patient volume

assessment time

boarding time

Conclusion: Diversion increased with:

- number of admitted patients boarded in ED
- number of admitted
- boarding time

Reducing volume of walk-in patients not a determinant

Demographic Factors during Influenza Season

↓

Increased ED utilization by patients >65 years

↓

Major respiratory illnesses

Increased admissions

FOCUS ON ELDERS

Acad Emerg Med 2005

Demographic Factors:

Influence on medical admission rates

Age

Deprivation Status

Bv J Gen Pract 2002

Does this patient have influenza? (cont'd)

JAMA 2005

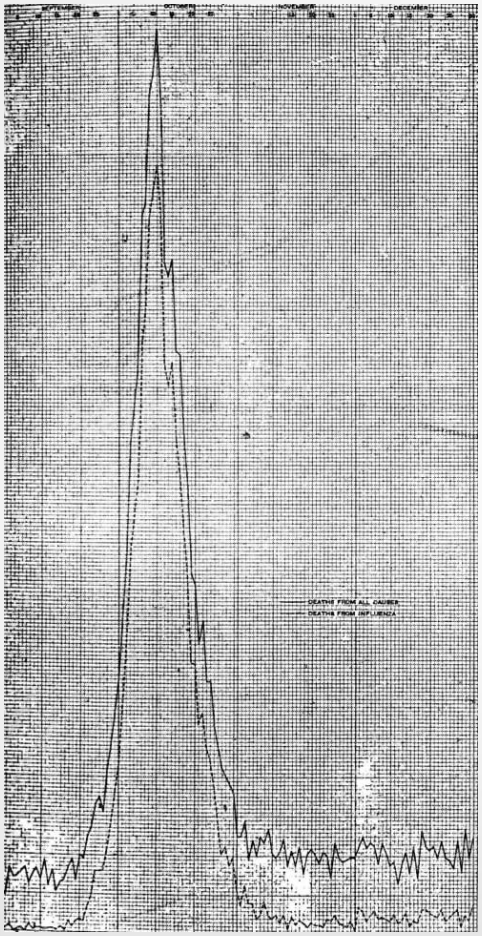
An IT approach:

- Incorporation of data into a template
- Addition of diagnostic data when available
- Larger amounts of data may detect clinical patterns not previously ascertainable

Result:

- Management decisions better evidence-based

The Massive Mortality Due to the Influenza



The massive mortality due to the influenza epidemic in October of 1918 in Kansas. This is representative of what happened in every state in the nation.Last revised: January 12, 2006 Pandemic Flu.gov

Management issues (cont'd)

In setting of critical shortages of certain resources, such as tamivir, determination of priority can be made, e.g.:

- Unvaccinated patients
- High risk vaccinated patients
- Stable low risk vaccinated patients w/+ rapid test
- All "ill-appearing" individuals w/respiratory illness regardless of risk, vaccination, or test status
- High risk close contacts of documented patient
- Healthcare personnel

The Solution

A real-time, web-based, standardized template with likelihood ratio based metrics

“From Patient to Policy”

Bedside Clinical Data helps to create policy useful for population based decision making

How do we do this?

- Signs and symptoms, real time obtained, (history, physical, CXR, demographics, epidemiology)
- 100% capture at triage level
- Standardized accepted medical terms in a constructed template on-line “a true electronic medical record”
- Bayesian based modeling
- Outcomes (diagnoses) are verified, placed in the template along with their signs and symptoms (variables), prospectively acquired

- Functionalized template data aggregated from multiple sites of access (local, regional, etc.) serves as a predictive tool
- Tool effective for clinical management of the single patient, as well as detection of nuances in change of disease pattern/presentation

Why?

- The predictive tool rank, probabilities of all potential diagnoses, not simply the syndrome in question

- Thus, the probability of a unique, atypical diagnosis (or atypical presentation of a typical diagnosis) is discernable at a level which will signal an alert, once a certain number of like cases occur
- Previous applications of the tool has show valid predictability with a short “ramp-up” period (# of required cases for validity) because of the number of pieces of data collected per encounter – each piece of data a weighted variable that impacts on each outcome

Use of the tool within standard clinical processes does not require additional personnel

One template multiple applications

Multiple management decisions

Data: What can we do with it? Change processes

All determinants (variables) are weighted with respect to all alternatives

Examples:

- Empiric treatment with antiviral meds
- Decisions regarding ambulance diversion
- Type of bed needed if admitted
- Projected utilization and death rates from clinical (bedside) evaluation, not region-wide estimates

GRANTING THE HOSPITAL ADMINISTRATOR'S IT "WISH LIST"

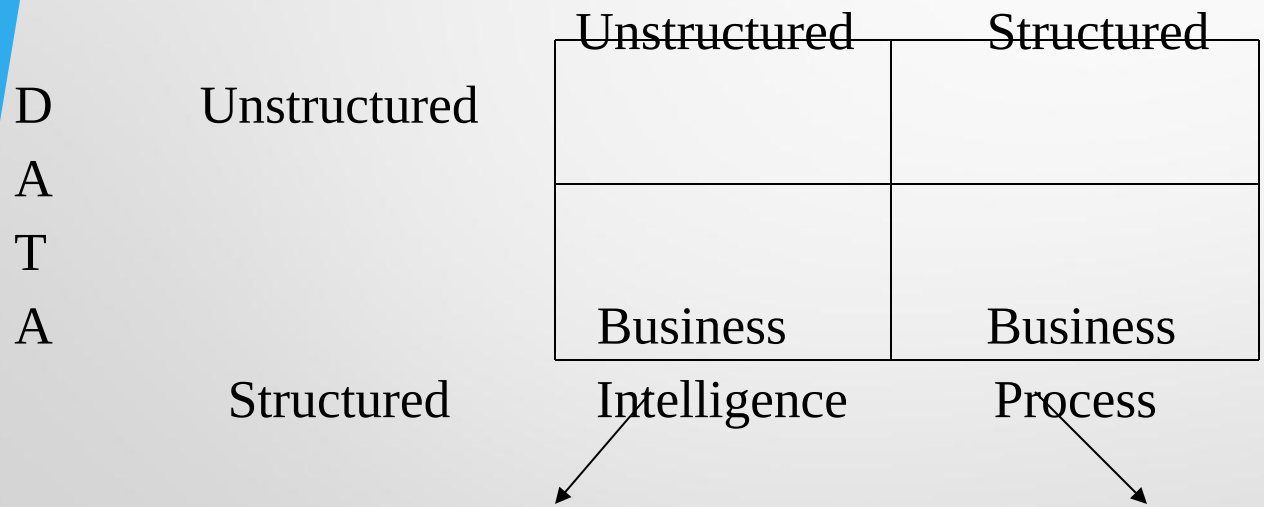
- Non rules-based techniques
- More intuitive tools
- Advantages of real time acquisition of data
- Data management
- Data mining – process of automating the extractive predictive information from large databases
- Applications in patient diagnosis, treatment patterns, and risk stratification

J HealthCare Information Management May 2004

Take Home Point:

All data in single format (EHR) aggregated and interpreted for maximum benefit to patient → policy creation

INTERACTION



Current IT tools

"Next Generation" IT Tools

The Solution
Radio Communication: Jan. 23, 2008 11:35 PM (1335)

EMS Dispatch: Hello, ED 2?

Admin, Hospital ED: Yes, EMS, Go ahead

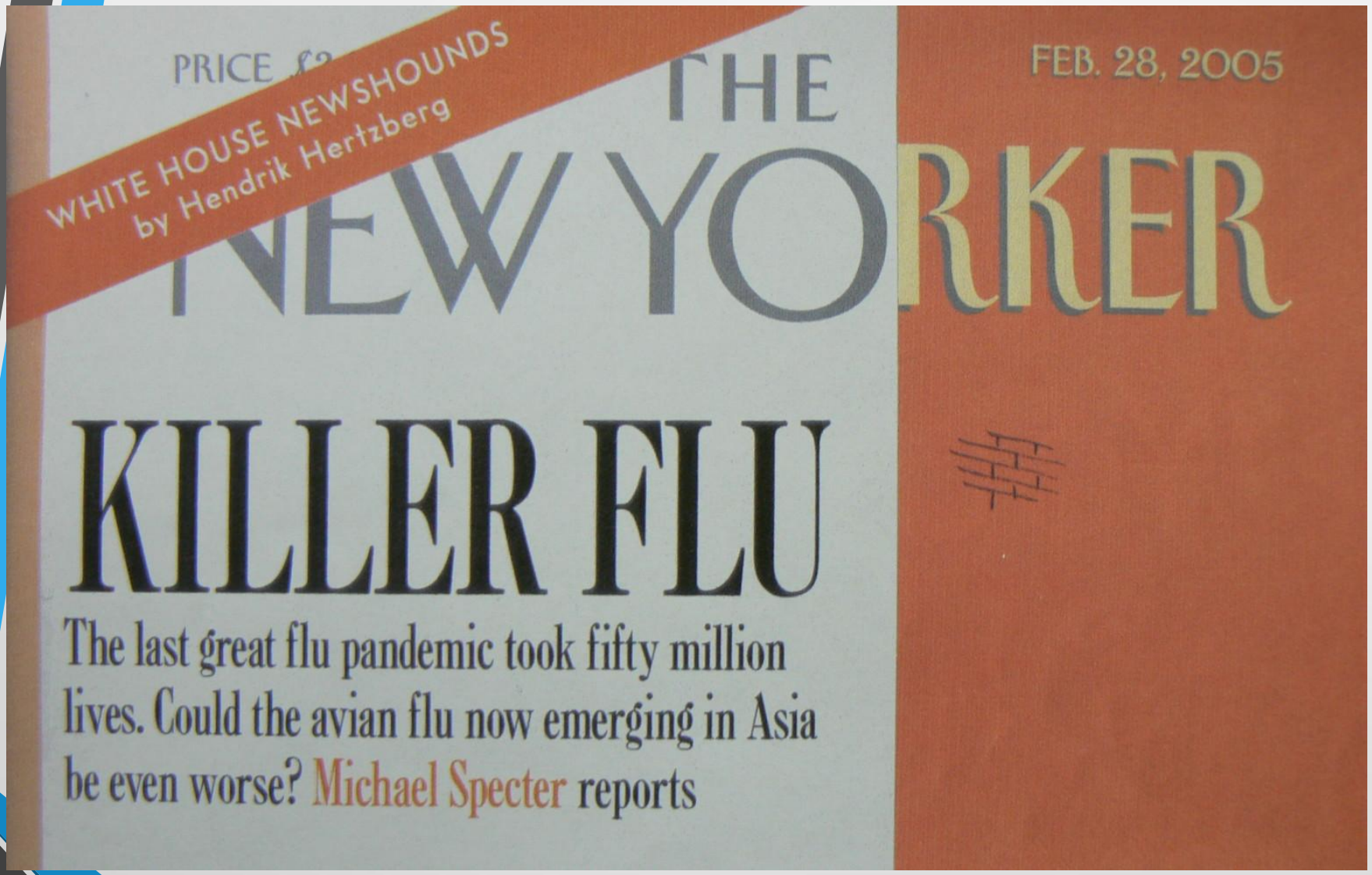
EMS Dispatch: Are you still on ambulance diversion?

Admin: Yes, we are

EMS: We have a suspected outbreak in a NH . . . 34 elderly patients-require transfer to an emergency facility. Can you accept any?

Admin: (Logs on, check triage complaints (standardized) of waiting patients; checks mode of entry (walk-in or ambulance), checks high risk vs low risk status, checks likelihood of admission among patients in ED bed, calculates automatically number of open beds likely in 15 min/30/60)

"*Can accept 10 in 15 min/total 20 in 30 min*"


PRICE
WHITE HOUSE NEWSHOUNDS
by Hendrik Hertzberg
THE NEW YORKER
FEB. 28, 2005
KILLER FLU
The last great flu pandemic took fifty million lives. Could the avian flu now emerging in Asia be even worse? Michael Specter reports

Web Sites of Interest

Information Technology and Avian Influenza

Federal Initiatives

HHS site includes all ONC initiatives

www.hhs.gov/healthit

American Health Information Community links available to Biosurveillance Workgroup and to Nationwide Health Information Network

www.hhs.gov/healthit/ahic/index.html

CDC

www.cdc.gov/biosense

www.cdc.gov/flu/pandemic/flusurge_fluaid_qa.htm

www.cdc.gov/flu/tools/fluaid/index.htm

www.cdc.gov/flu/tools/flusurge

www.cdc.gov/flu/professionals/labdiagnosis.htm

www.pandemicflu.gov H5N1 flu

www.hhs.gov/nvpo/pandemic National Vaccine program Office

WHO

www.who.int/en/

Click on right hand link Avian Influenza "Full Coverage"

World Health Organization Epidemic and Pandemic Alert and Response (EPR)


May they touch snowflakes, not flu bugs
NEW!
Now in stores!
CLOROX
CLOROX
CLOROX
CLOROX
Use these disinfecting products to kill germs that can make kids sick.