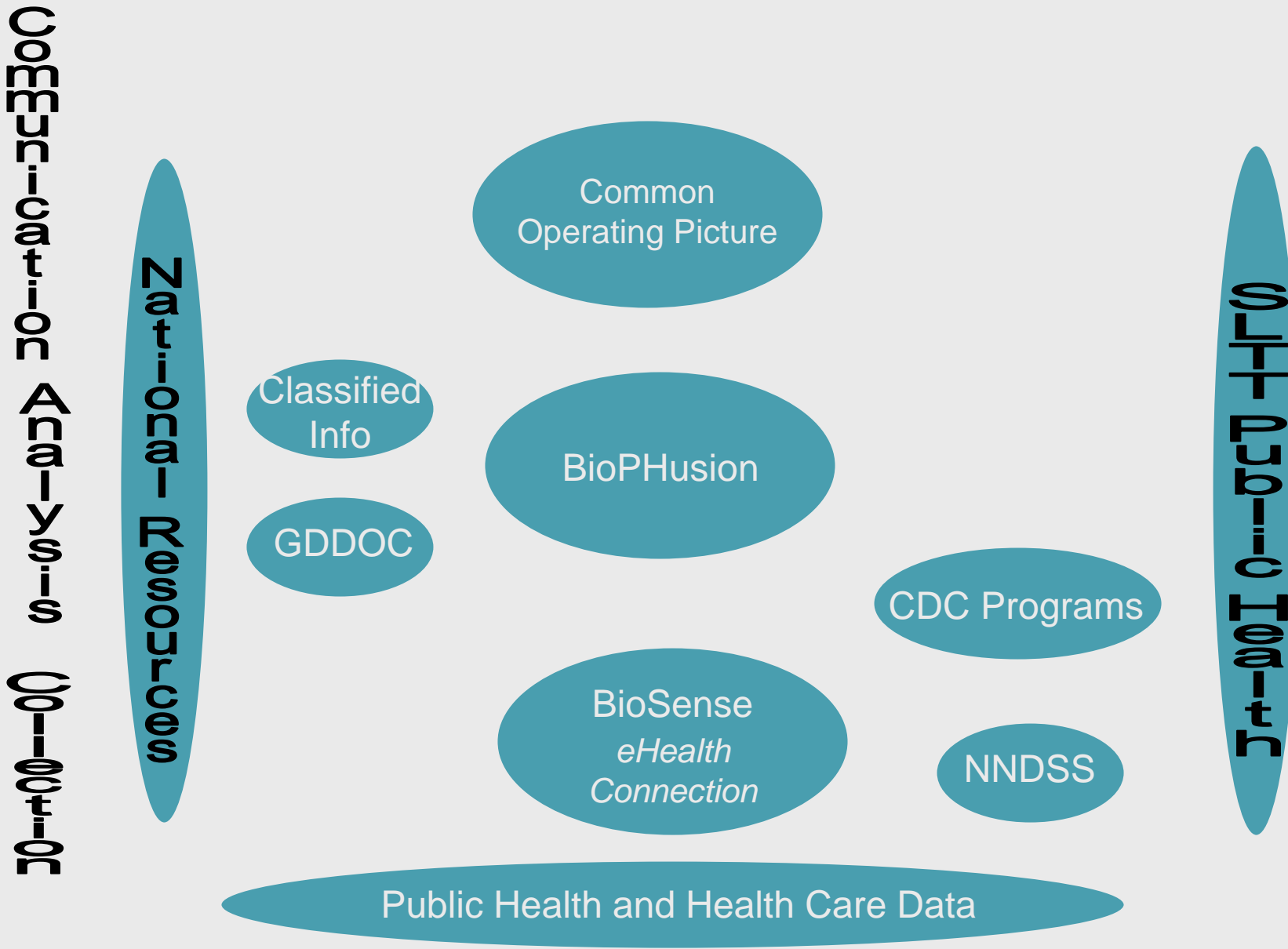




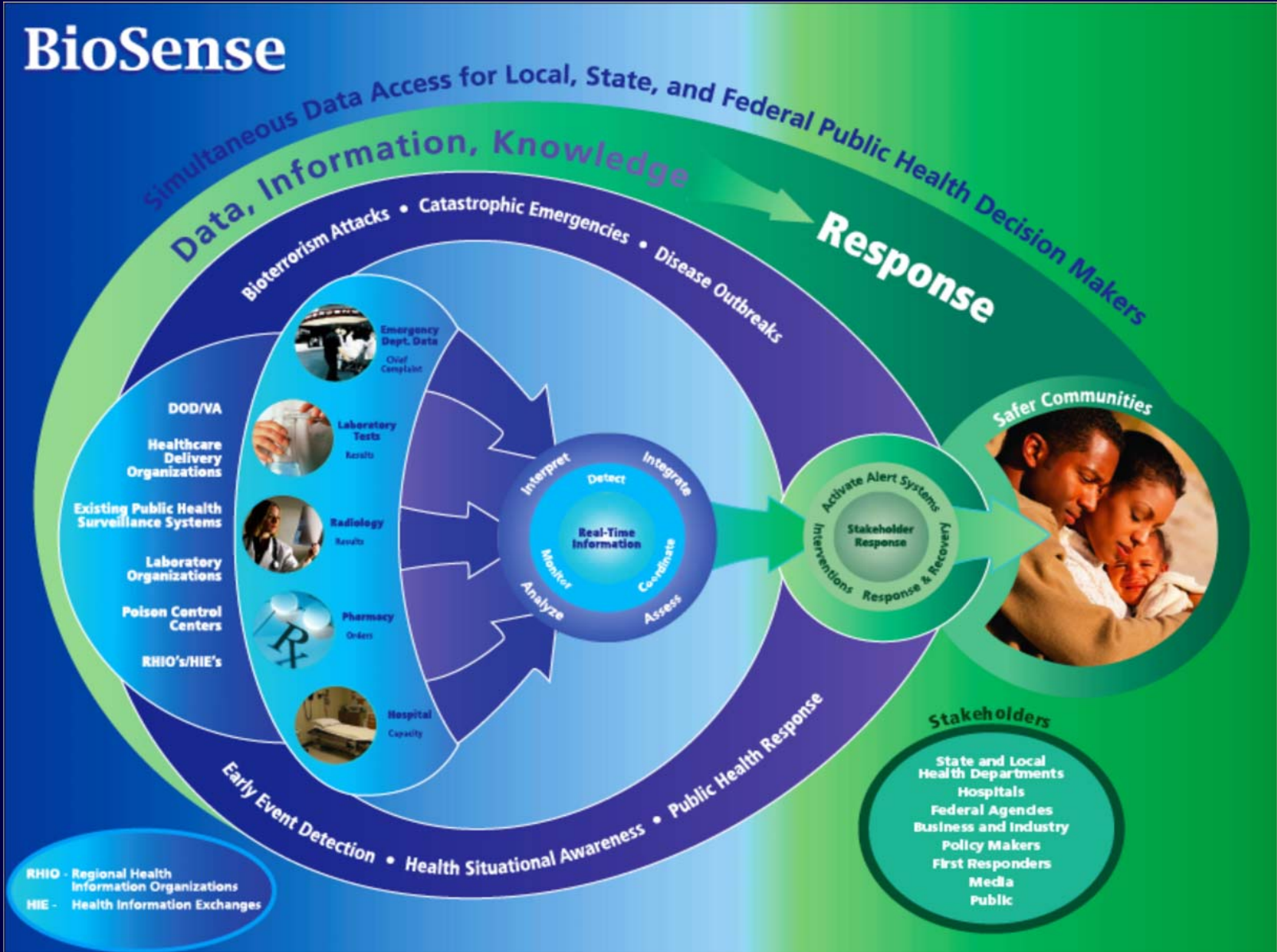
Real-time Biosurveillance: Strategy & Approach

Leslie Lenert, MD, MS
Director,
National Center for Public Health
Informatics

Human Biosurveillance at CDC: BSU



From a Conceptual Model to a System



Agenda

- I. Current Approach
- II. Advances and Lessons Learned
- III. New Approach
- IV. Timeline
- V. Benchmarking



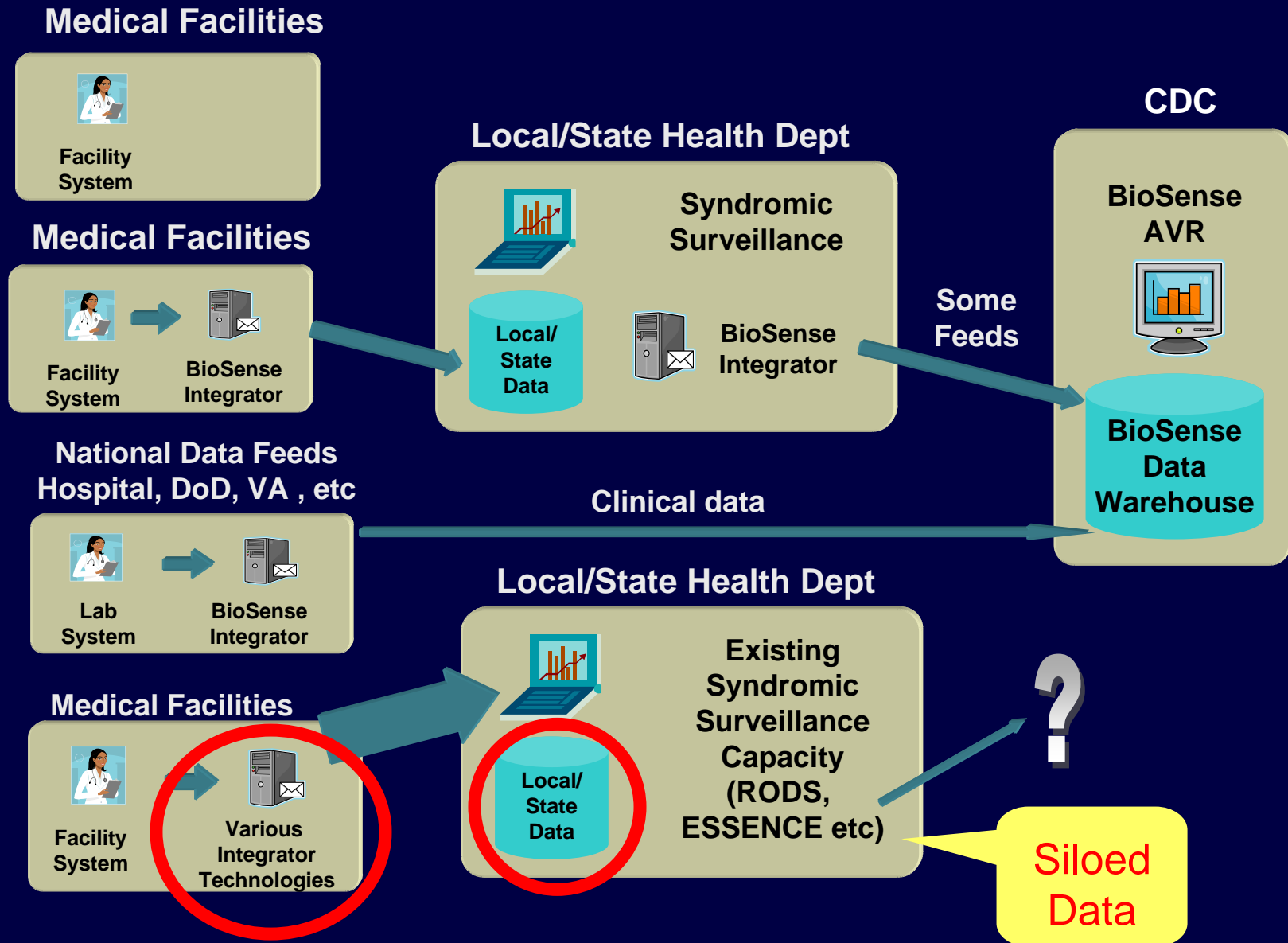


I. Current Approach

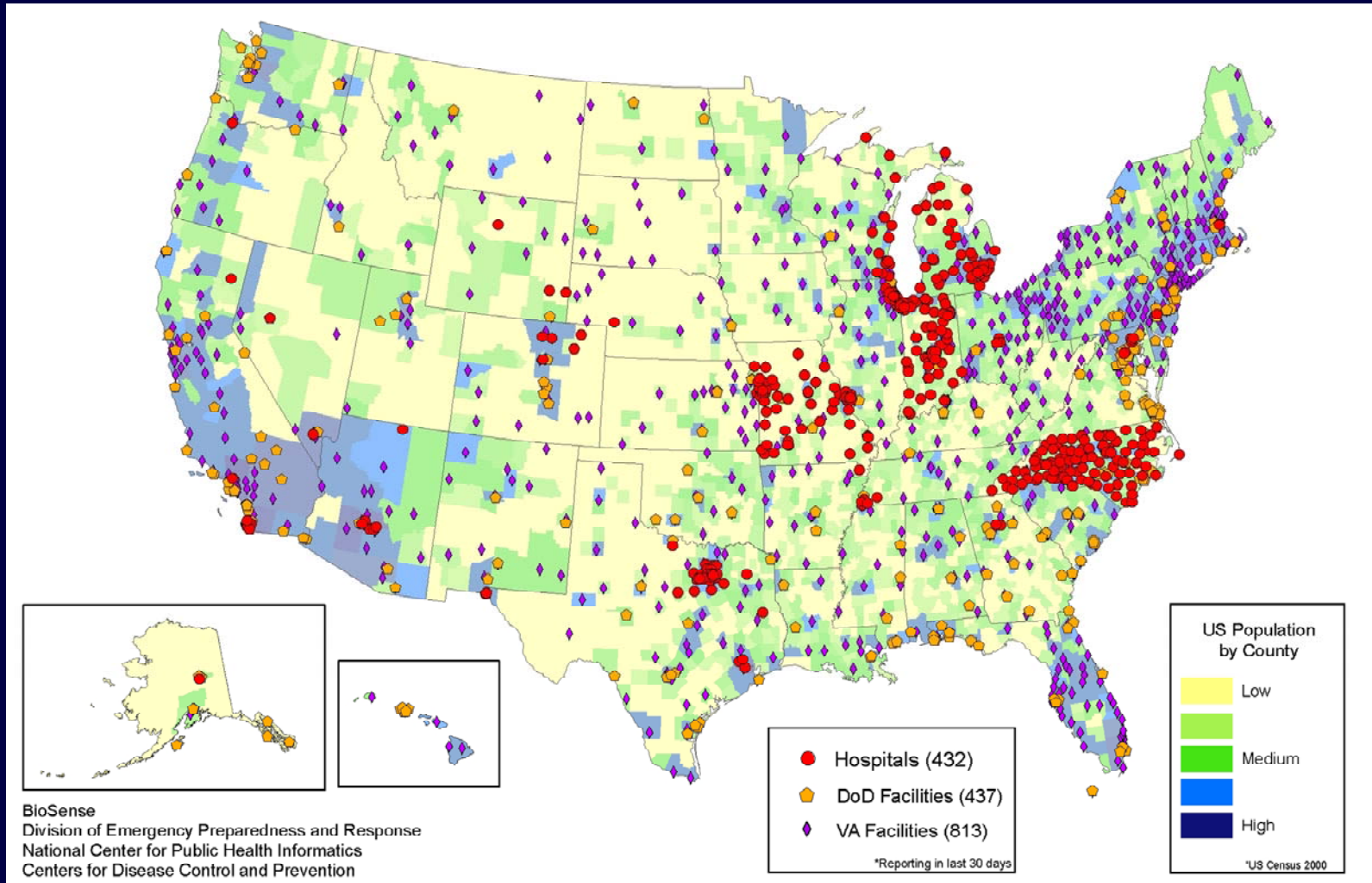
- Intensive data gathering from medical facilities, state & locals into a giant CDC owned data warehouse
- Heavy use of statistical algorithms to detect anomalies in the data and trigger investigations
- CDC centric approach developing in house software



Current State



Current State: BioSense Hospitals and US Population Density



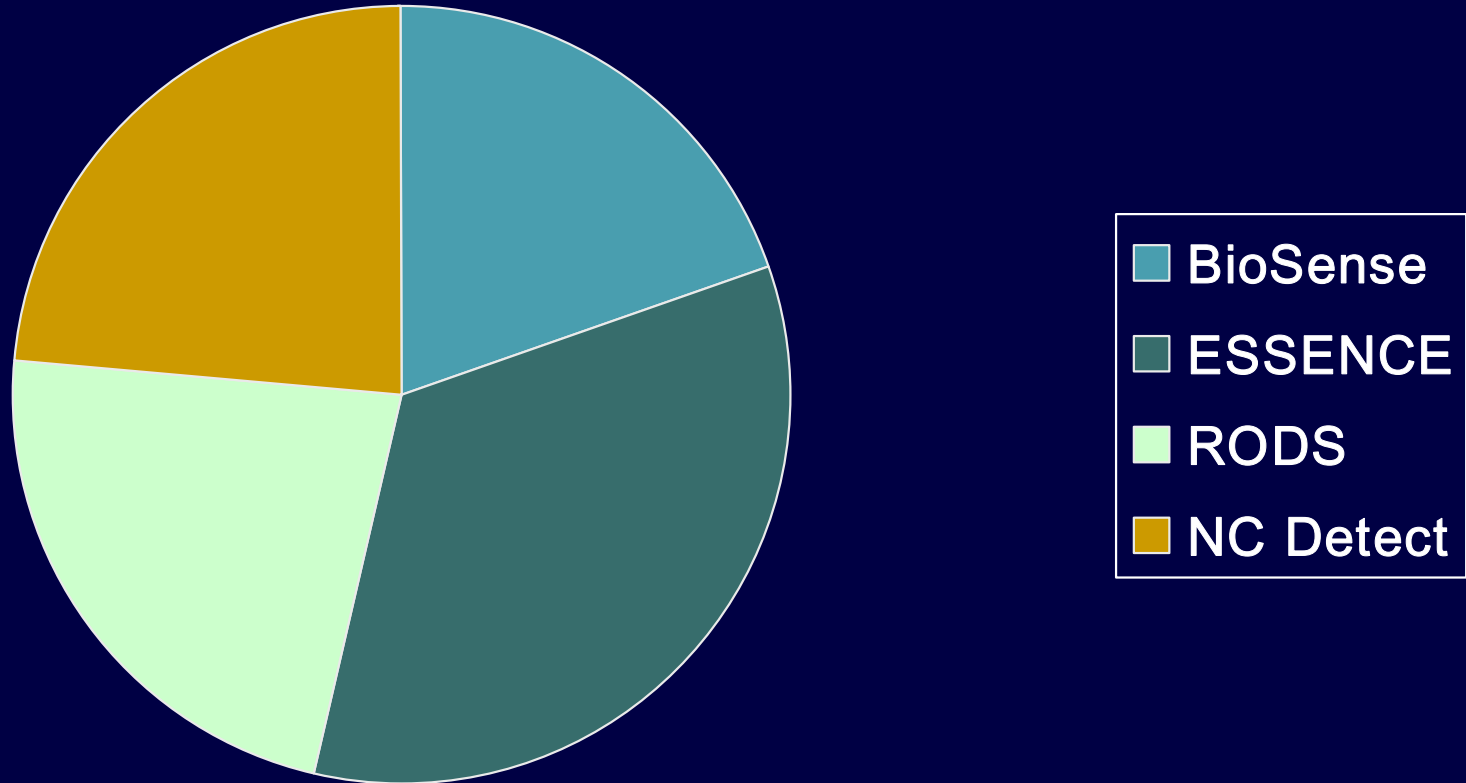
BioSense
Division of Emergency Preparedness and Response
National Center for Public Health Informatics
Centers for Disease Control and Prevention



Unique Capabilities of BioSense

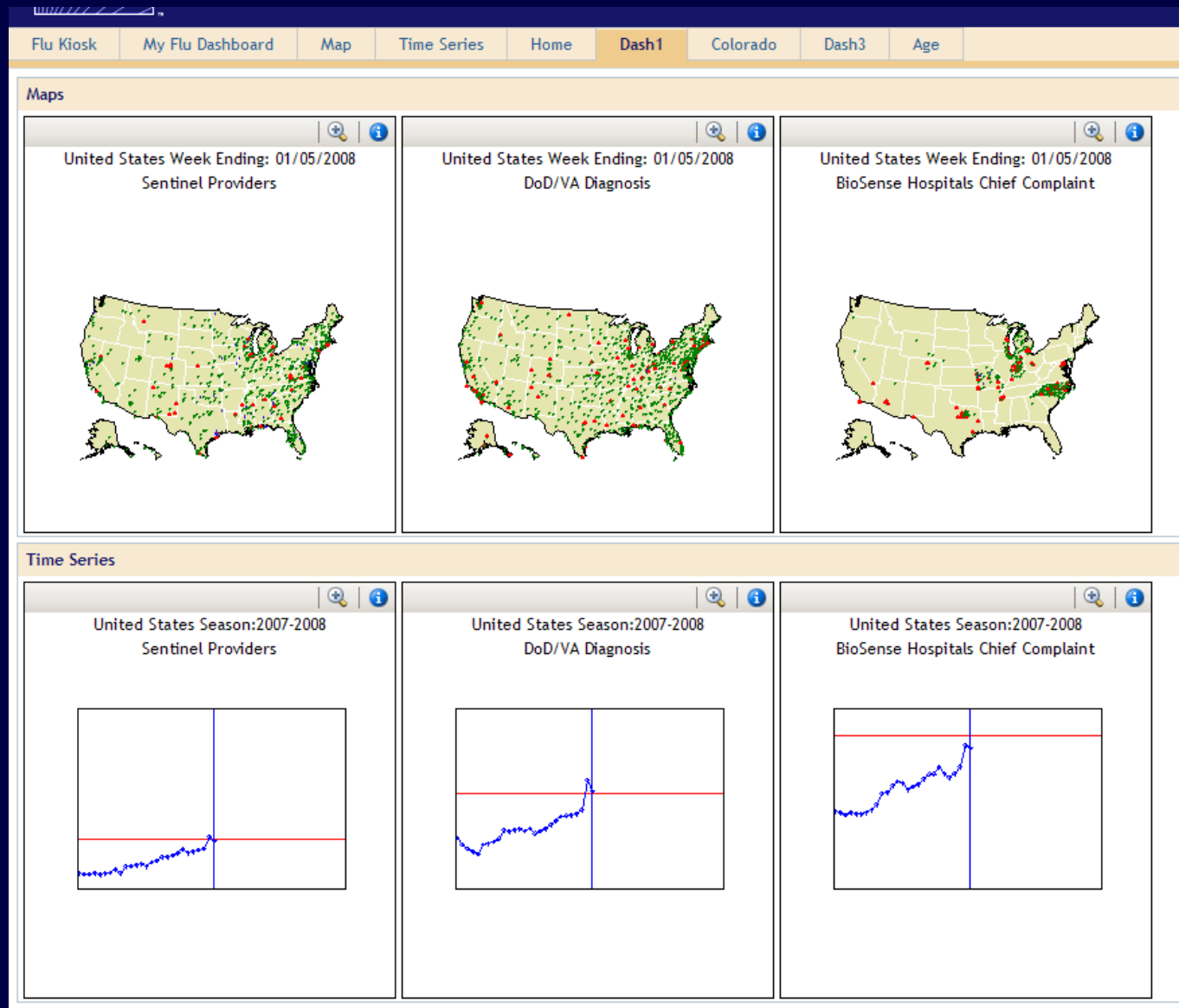
- Interoperability
- Capacity for secure large scale data management
- Custom tailoring of queries
- Integrated electronic laboratory reporting
- Individual level identifier

BioSense is an Interoperable System of Systems



Systems for data acquisition (n = 434)

BioSense Influenza Tool Merges Multiple Sources

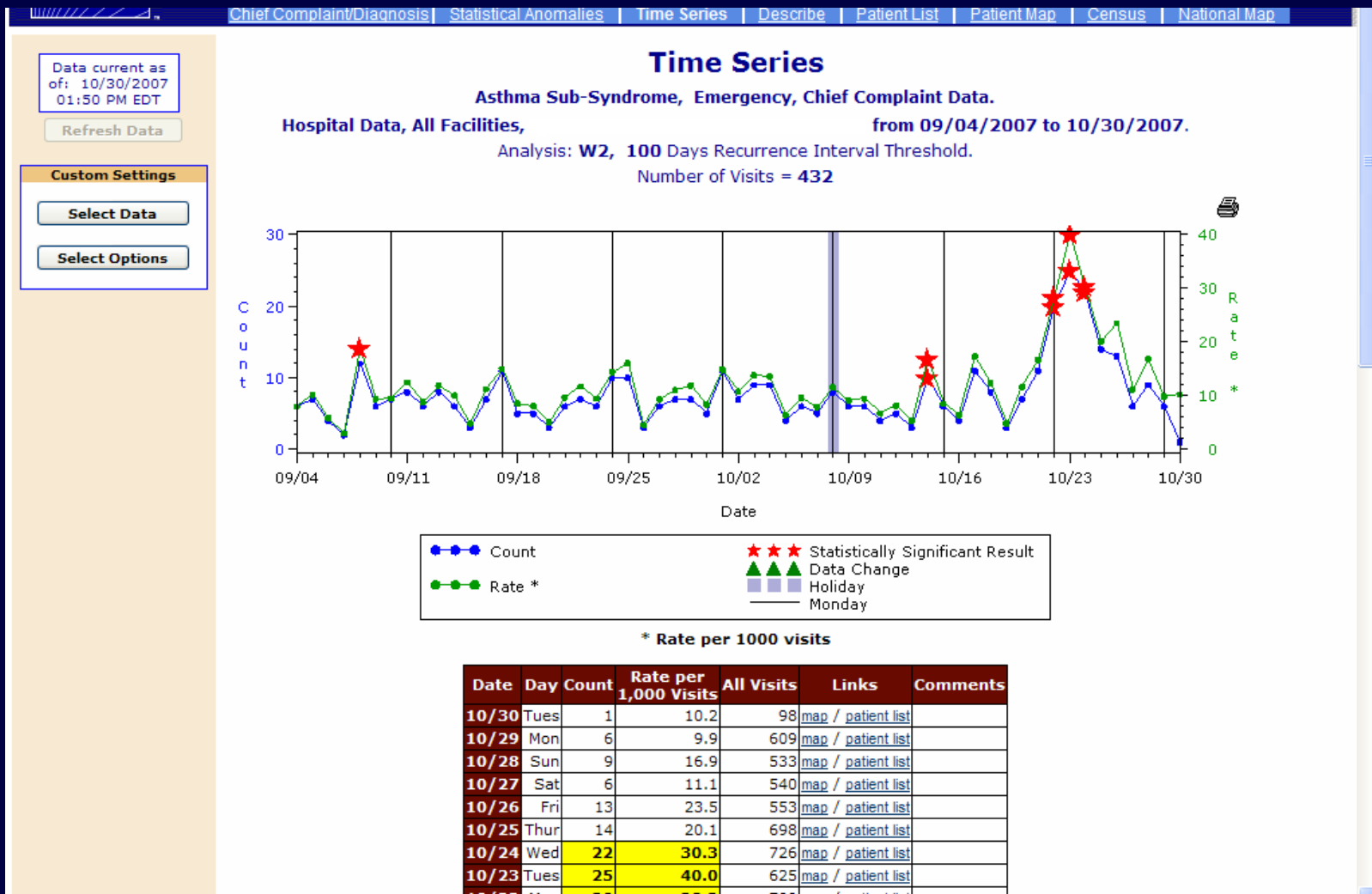


BioSense capabilities

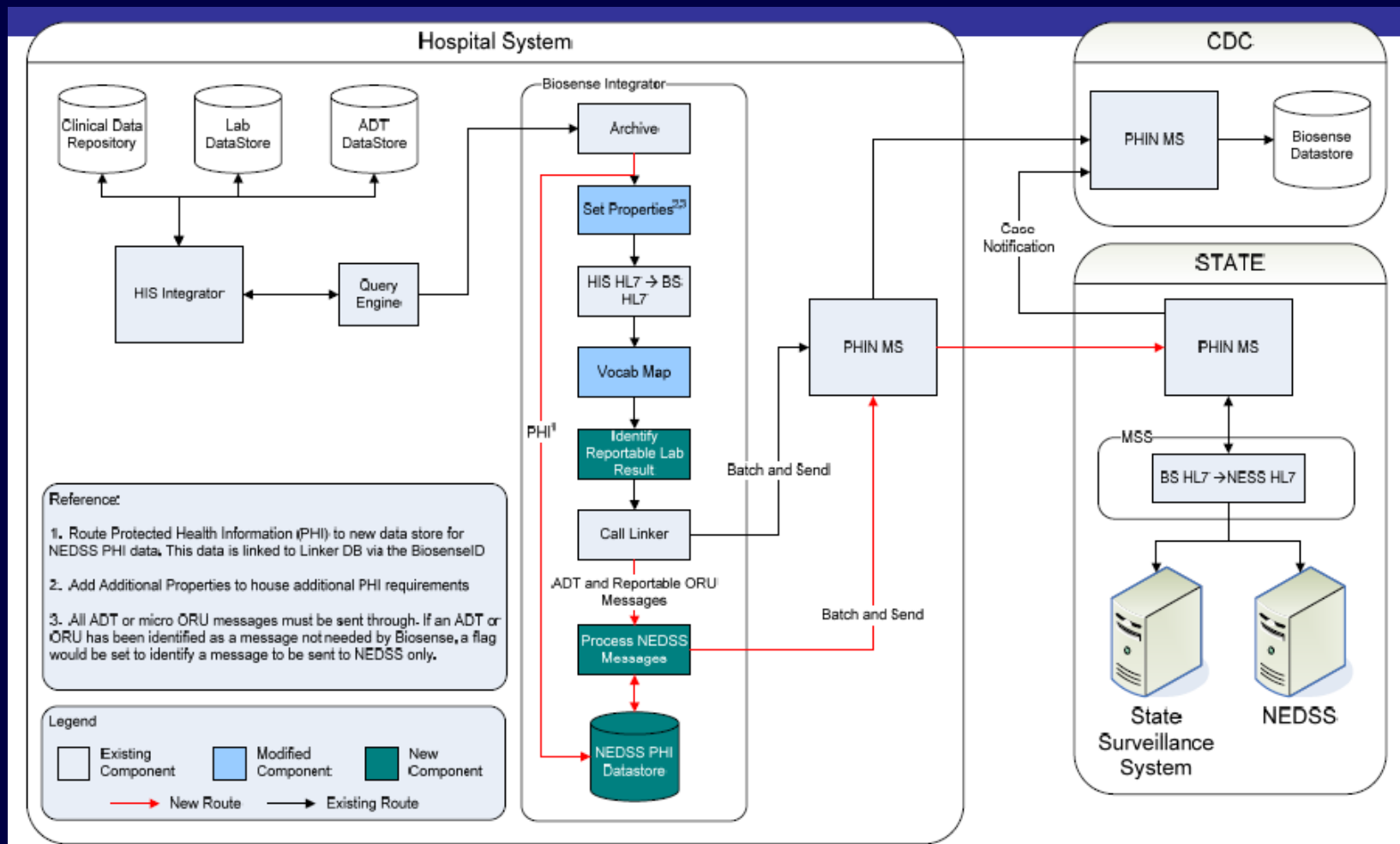




Tailored Query for Asthma



BioSense Integrates ELR Reporting



BioSense Individual Identifier

- Facility-level individual identifier
 - Improves specificity by preventing “double counting of lab results”
 - Preserves anonymity
 - Allows for combining data on an individual over time to create a complete clinical picture
 - Foundation of advanced “case recognition” technologies



Advances and Lessons Learned

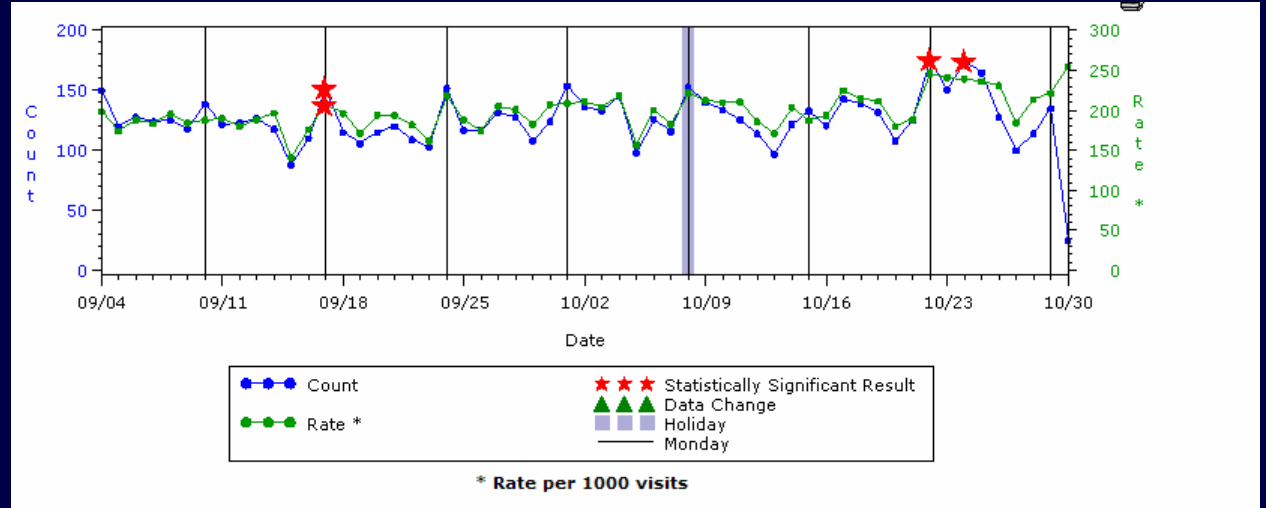
- Advances in understanding
 - Moving beyond syndromes to recognition of potential cases is necessary and feasible.
 - Evaluating the effects of installation of syndromic and other surveillance systems on national security requires a process view



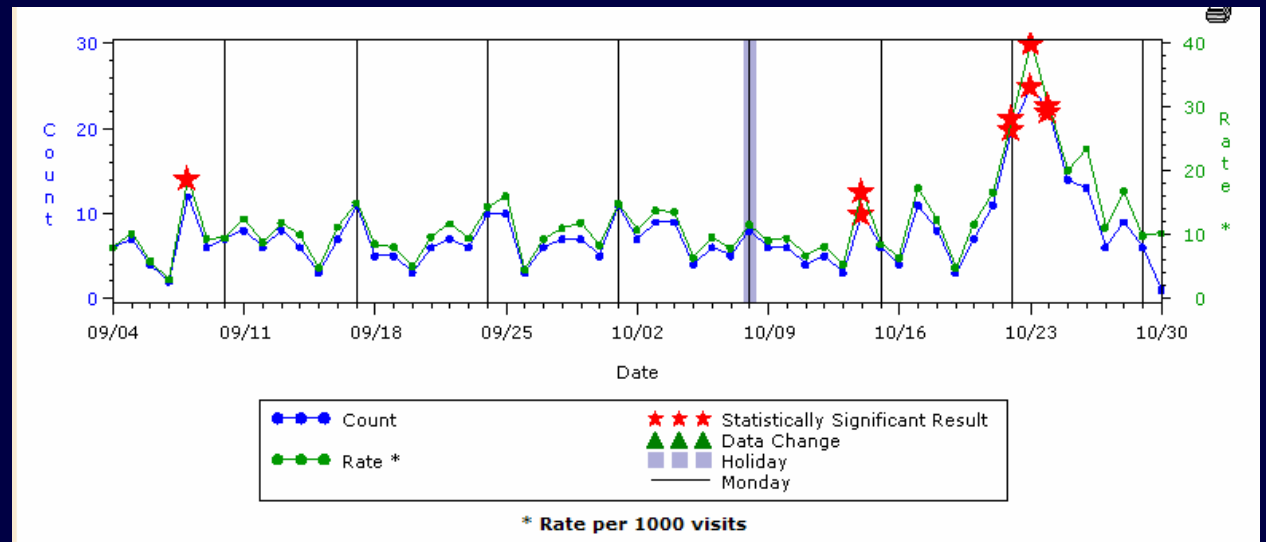
Why beyond syndromes



Respiratory syndrome



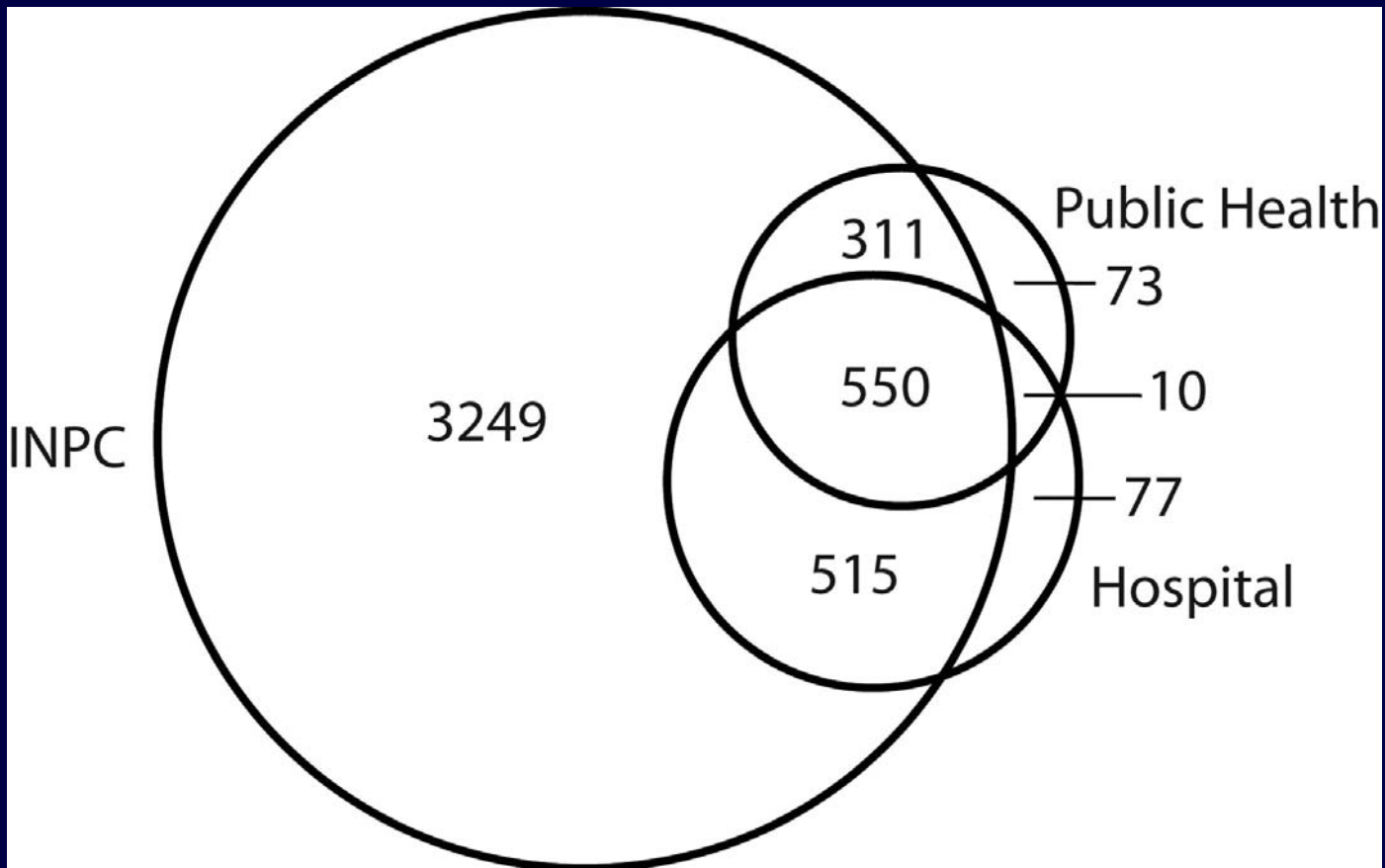
Asthma





Impact of lab reporting on case identification

Overlap in 4785 unique cases identified by electronic laboratory reporting (Indiana Network for Patient Care [INPC]) and passive surveillance methods (public health department and hospital laboratories): Indianapolis, Ind, 2001



Overhage, J. M. et al. Am J Public Health 2008;98:344-350





Gram-positive Rod Surveillance for Early Anthrax Detection

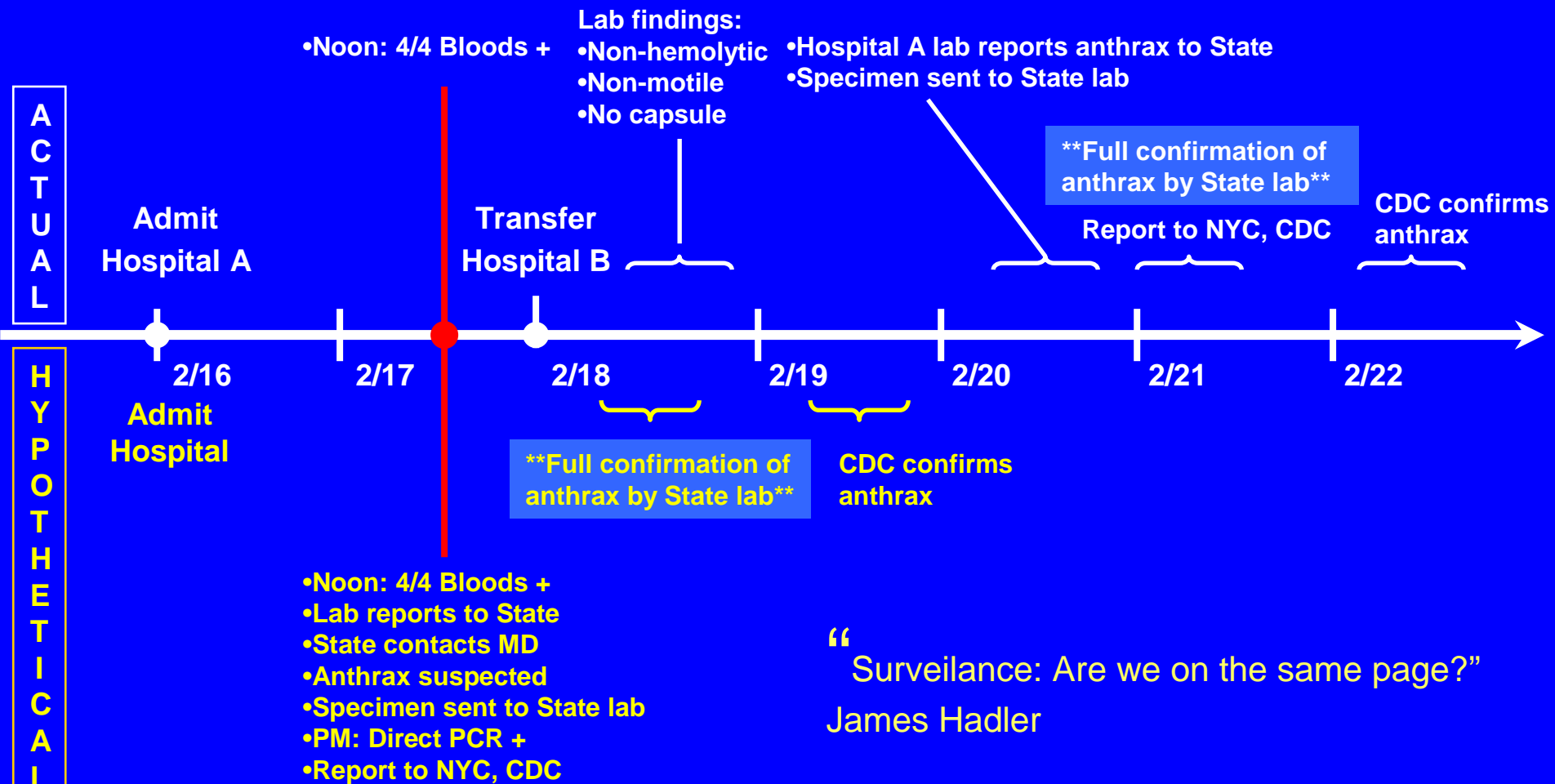
Elizabeth M. Begier,^{*†} Nancy L. Barrett,^{*}
Patricia A. Mshar,^{*} David G. Johnson,^{*}
James L. Hadler,^{*} and Connecticut Bioterrorism
Field Epidemiology Response Team^{*1}

Connecticut established telephone-based gram-positive rod (GPR) reporting primarily to detect inhalational anthrax cases more quickly. From March to December

Important to evaluate surveillance systems

Emerging Infectious Diseases 2004;11:1483-6

Timeline of Actual (PA) vs. Hypothetical (CT) Diagnosis of Anthrax February 2006



Evaluating Detection of an Inhalational Anthrax Outbreak

David L. Buckeridge,* Douglas K. Owens,†‡ Paul Switzer,‡ John Frank,§ and Mark A. Musen‡

Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 12, No. 12, December 2006

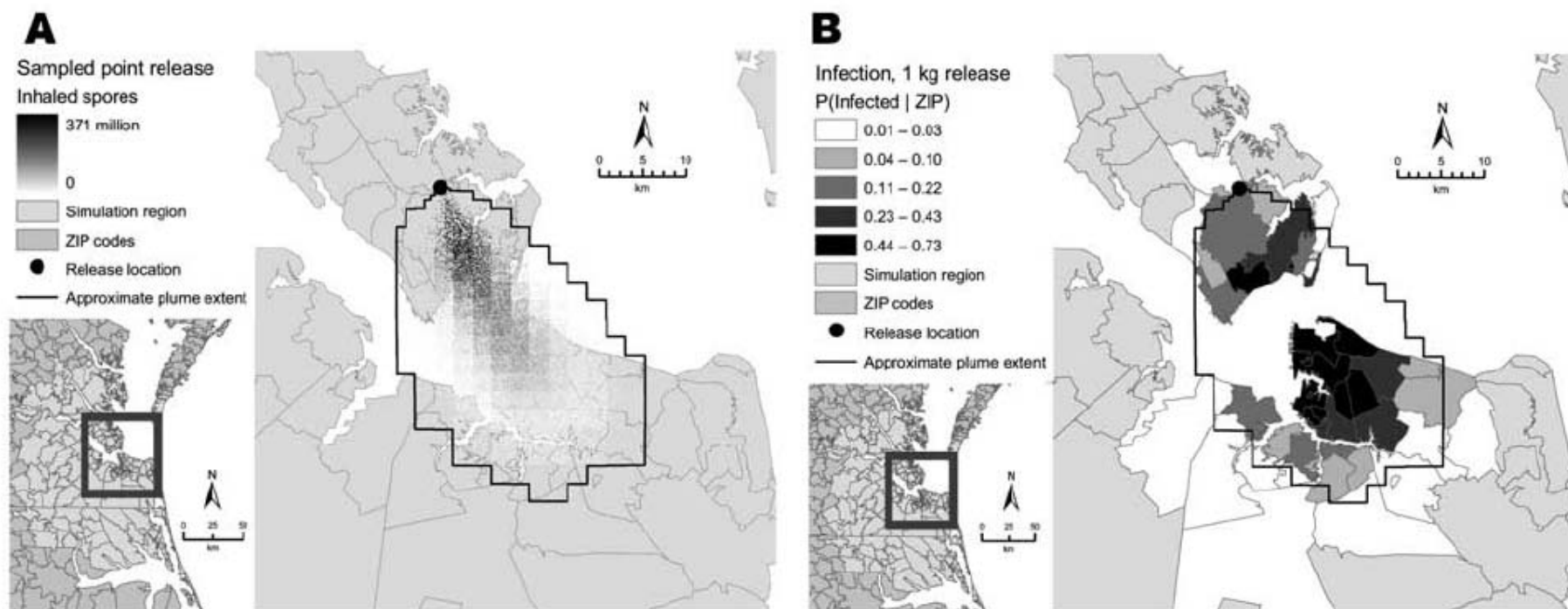
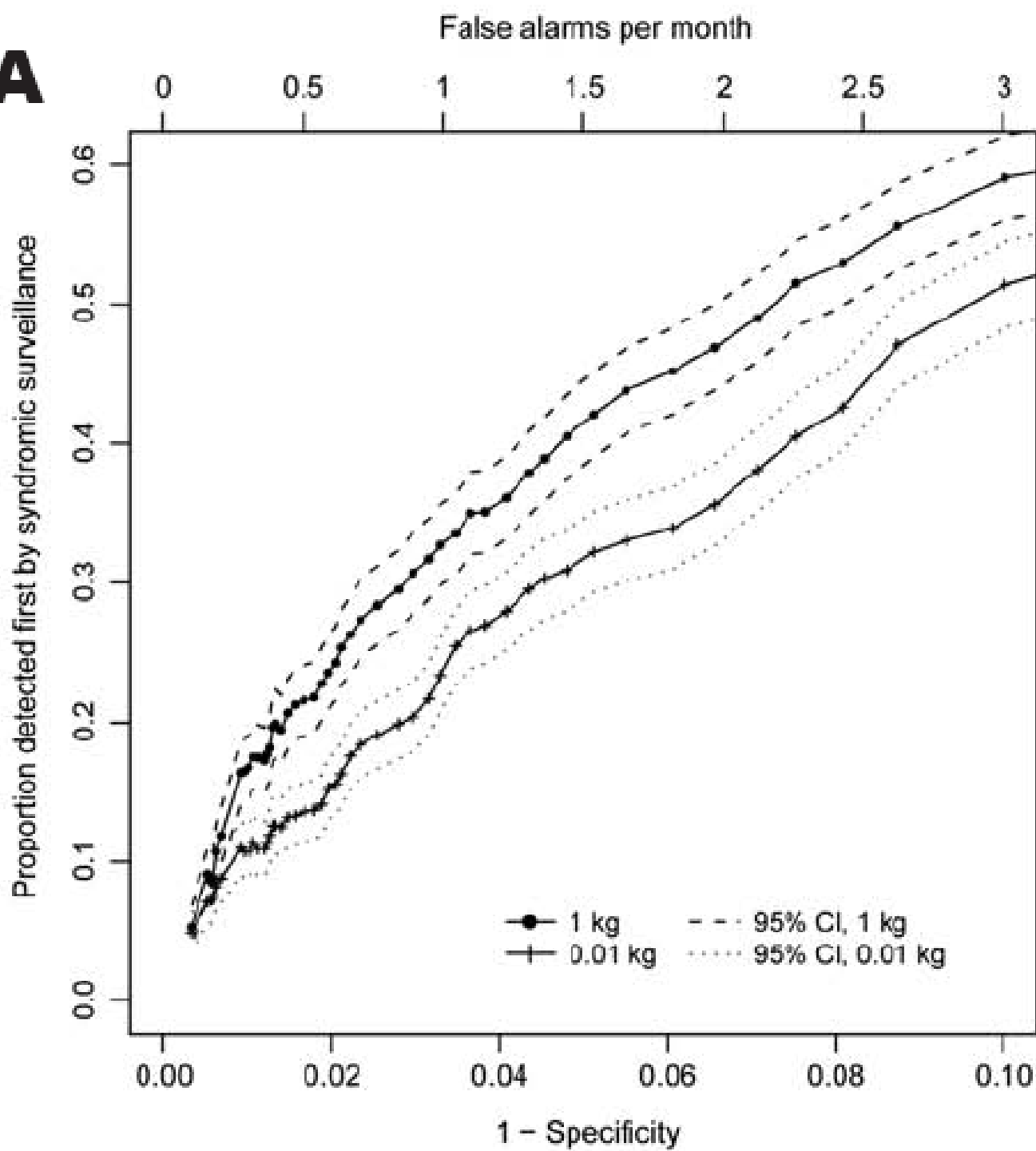


Figure 1. Maps showing output from dispersion (A) and infection (B) components of the simulation model. The dispersion component simulates geographic distribution of anthrax spores after an aerosol release. The infection component simulates infection of persons exposed to spores.

A



System performance is 3-dimensional

Assessing surveillance using sensitivity, specificity and timeliness

Ken P Kleinman and Allyson M Abrams Department of Ambulatory Care and Prevention, Harvard Medical School and Harvard Pilgrim Health Care, Boston, MA, USA

Statistical Methods in Medical Research 2006; **15**: 445–464

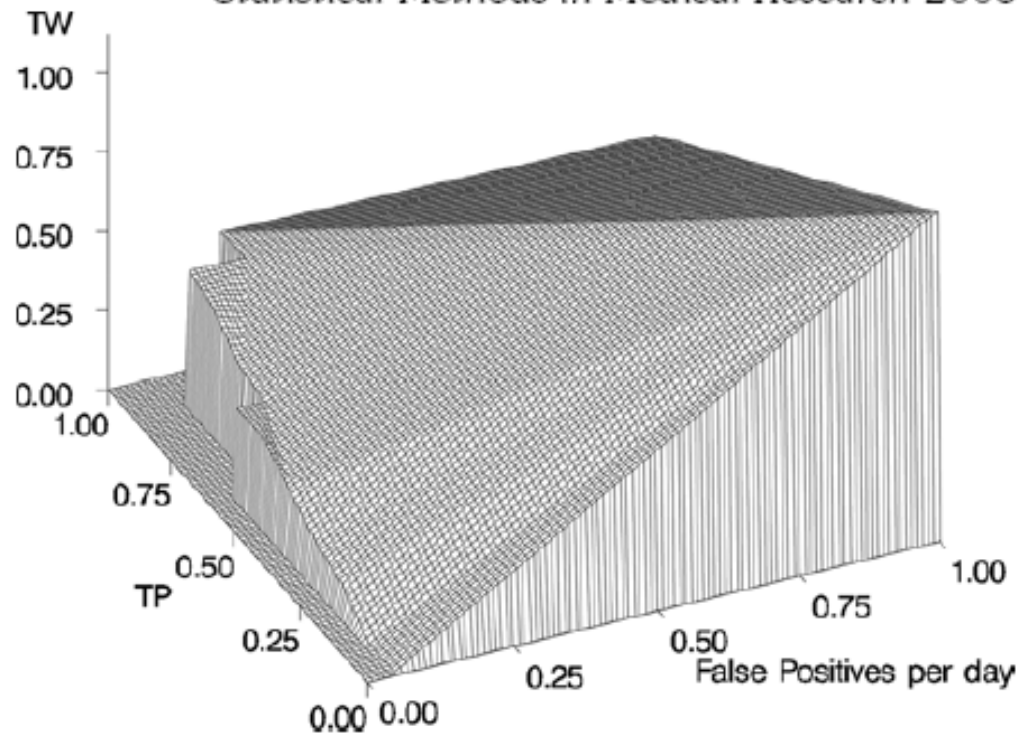


Figure 5 Timeliness-ROC surface corresponding to the data in Tables 1 and 2; vertical dimension is the timeliness weight.



II. Lessons Learned

- Politics of control of data has been the primary obstacle to formation of a national system
- Much existing data remains siloed at the Local/ State level
- Building systems non collaboratively leads to low adoption rates
- Getting data direct from medical facilities is challenging, facilities have limited IT resources

III. New Approach

Mission

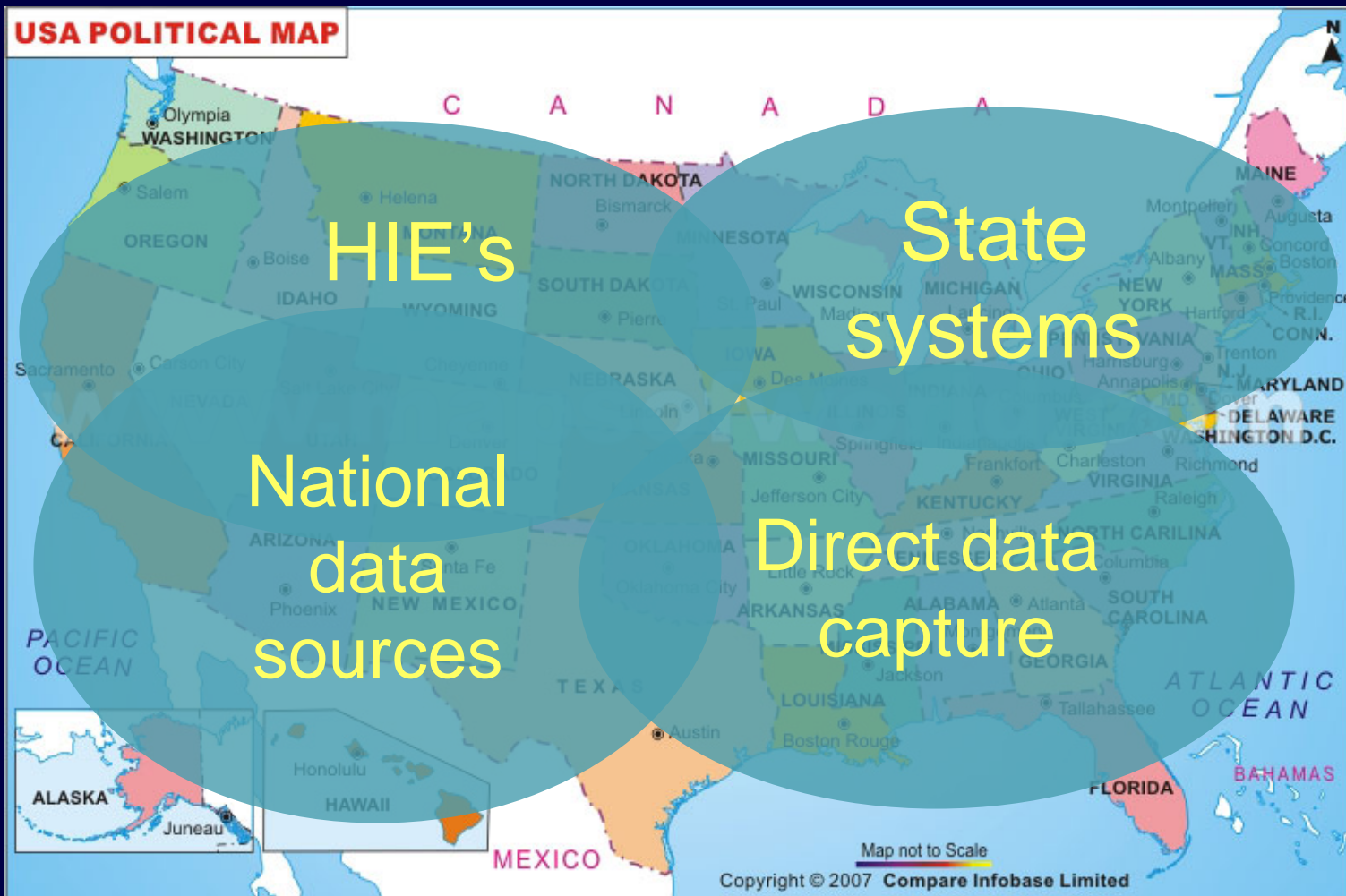
A system that comprehensively monitors the healthcare system of the United States for evidence of acute health threats to the public.

Vision

“The health of the nation *today* and the health of its healthcare system”



Biosense Evolution: Covering the United States



III. Strategy

1. Regional Collaboratives
 - Organize the work of surveillance
2. Federated Data Sources
 - Leverage existing capacity for real-time surveillance
3. National Health Status Portal
 - Provides views of real-time health data
4. Regional/national collaboration tools enhance information exchange and situational awareness
 - Leverage investments in DEOC management software
5. Health information exchanges
 - Provide rich data sources
6. National data sources brokered through BioSense
 - Leverage existing BioSense infrastructure
7. Case Detection Technology
 - Leverages investments in BioSense
8. Open Source Collaborative Development
 - State, local and CDC efforts advance together

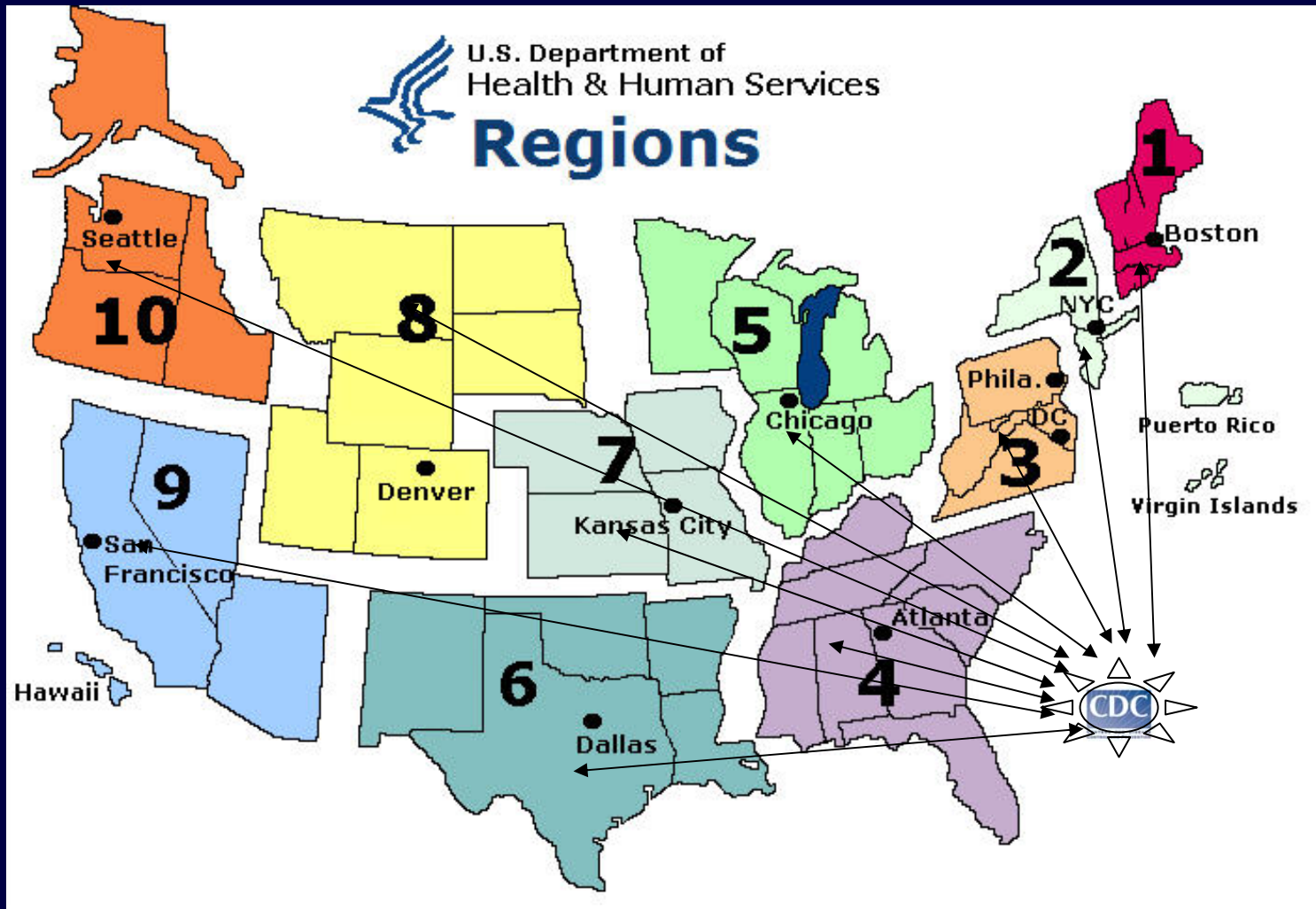
System

Data acquisition

Technology



1. Regional Collaboratives



Regional Collaboratives ...

- Are virtual centers—groups of states connected by grid technologies and group work software
 - One state would have management responsibilities
- Are self organized—some states may chose not to participate
- Plan and execute routine surveillance for the region from real time links to healthcare
- Work from a common regional operating picture created in partnership with CDC/BioPHusion
- Have CDC participation as partner in surveillance
 - Fills gaps within regions
 - Supports cross regional analyses and national analyses
- Are funded by contracts or cooperative agreements



How This Plan Leverages Existing Capacity

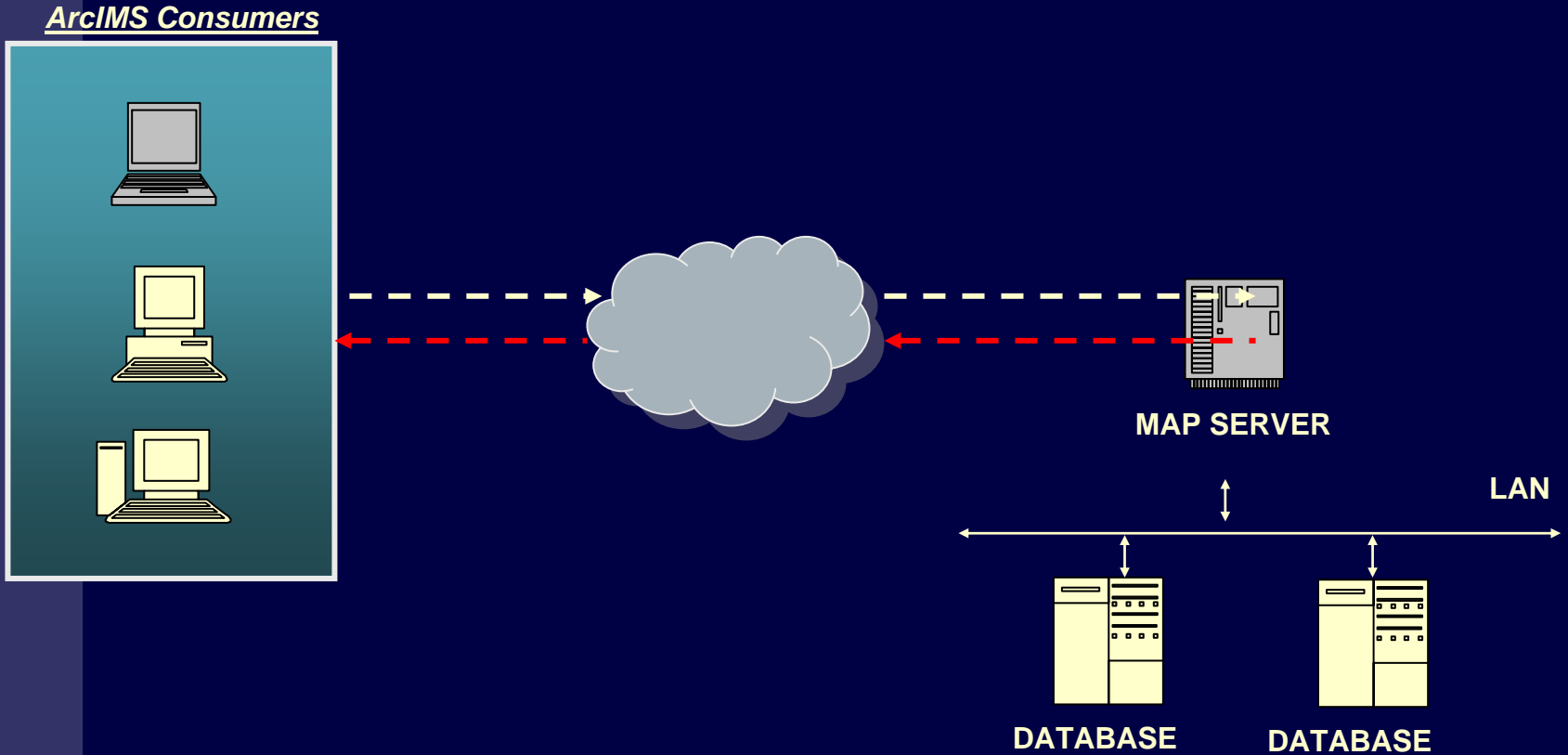
- Leverage Existing Data Integration
 - Locals/States/EHIO Data acquisition efforts
- Leverage Existing Data
 - State Surveillance Data
- Leverage Existing Technology
 - Integration Engine: Mirth Data Integrator, PHINMS
 - Biosurveillance Application: BioSense, RODS, ESSENCE, AEGIS
 - Federated Data Model: GLOBUS, SPIN, DGINet, CaBIG





2. Federated Systems:

Traditional Client-Server



Correspondence

Open Access

Distributed data processing for public health surveillance

Ross Lazarus*¹, Katherine Yih² and Richard Platt^{1,2}

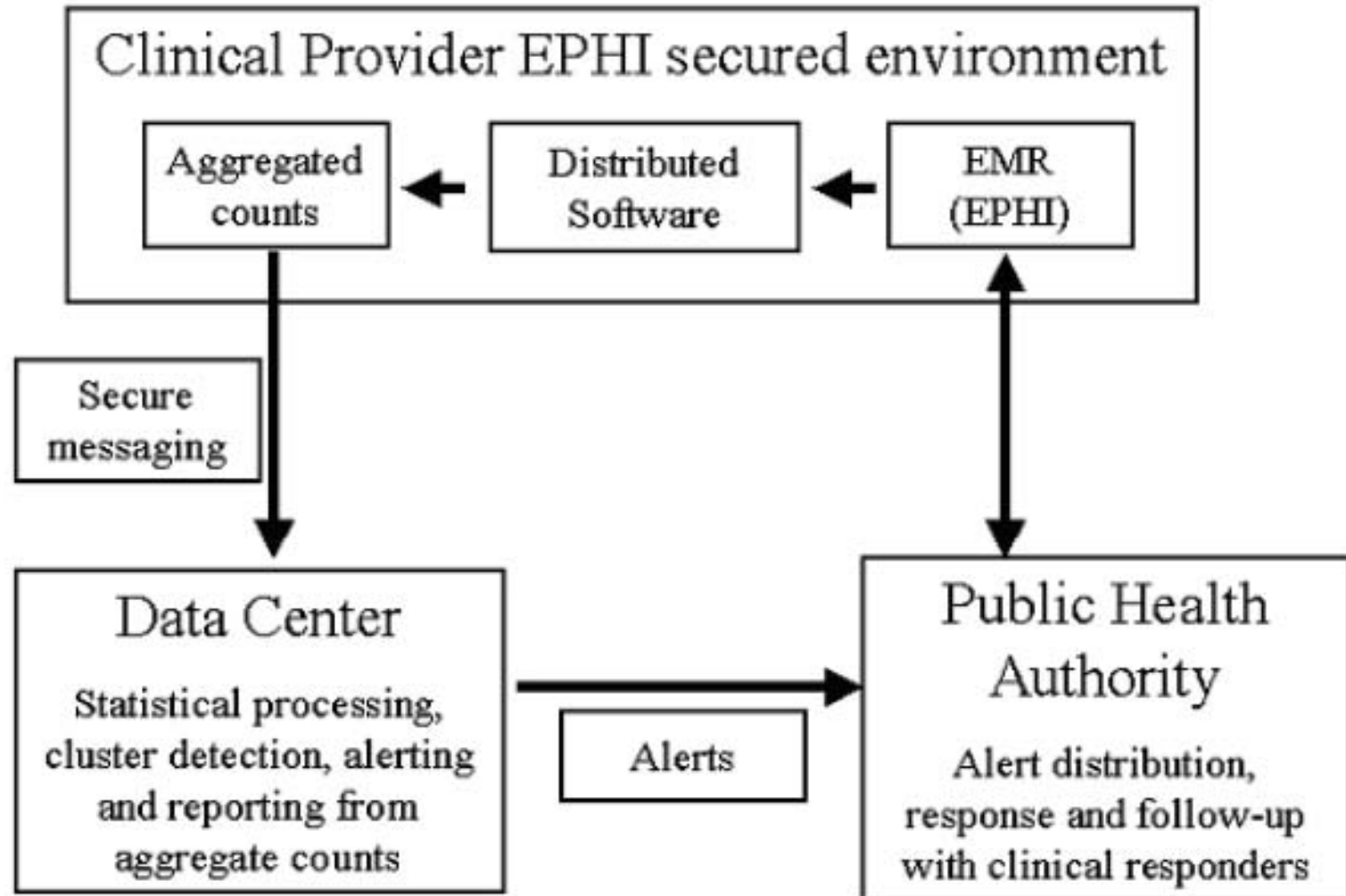
Published: 19 September 2006

BMC Public Health 2006, 6:235 doi:10.1186/1471-2458-6-235

Received: 23 March 2006

Accepted: 19 September 2006

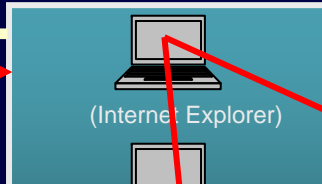
This article is available from: <http://www.biomedcentral.com/1471-2458/6/235>





Federated System: PH-DGInet

Consumers



Address: http://dginedemo2.esri.com/portal/portal/_nsj_ns:YTEwfGMwFGQwFGY_media-type/html/user/jsack/page/default.psm?js_peid/P-1061943751b-10028

DGInet Security Policy

DGInet Overview Map

DGInet Directory

Search:

Search Results:

Metadata Layer

- (U) Imagery metadata**
Description: Some medium resolution imagery (16 meter) over the San Diego area
Author/Producer: other
Publish date: 01/01/2004
Product Security Marking: UNCLASSIFIED
- (U) Imagery metadata**
Description: Some high resolution imagery (1 meter and 3 inch) over the San Diego area
Author/Producer: other
Publish date: 01/01/2004
Product Security Marking: UNCLASSIFIED
- (U) Imagery metadata**
Description: Some medium resolution imagery (16 meter) over the San Diego area
Author/Producer: other
Publish date: 2004/01/01
Product Security Marking: UNCLASSIFIED
- (U) Imagery metadata**
Description: Some high resolution imagery (1 meter and 3 inch) over the San Diego area
Author/Producer: other
Publish date: 2004/01/01
Product Security Marking: UNCLASSIFIED
- (U) Electrical Power (EP)**
Description: Electrical Transmission, San Diego, Fishnet, FishNet, network, AC Power Line...
Author/Producer: other
Publish date: 1/2/2003
Product Security Marking: UNCLASSIFIED

DGInet Map

UNCLASSIFIED

center coordinates: lat = 32°49'0"N lon = 117°10'0"W UNCLASSIFIED

DGInet Annotation

Layout View

Layout View Options

Cross Hair Lat-Lon Border Scale Bar North Arrow MGRS GRID

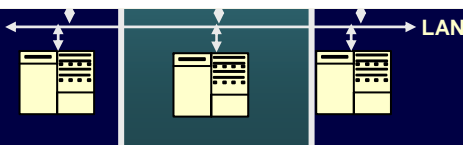
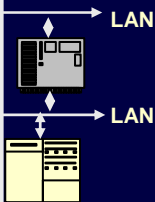
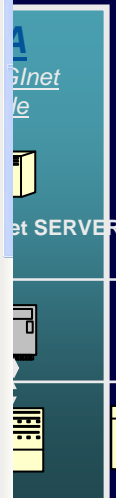
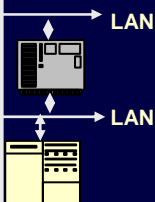
DGInet Find Location

Find

Find your location by:

US States and Territories
City:
State:

International (includes US States and Territories)
City:
Country:

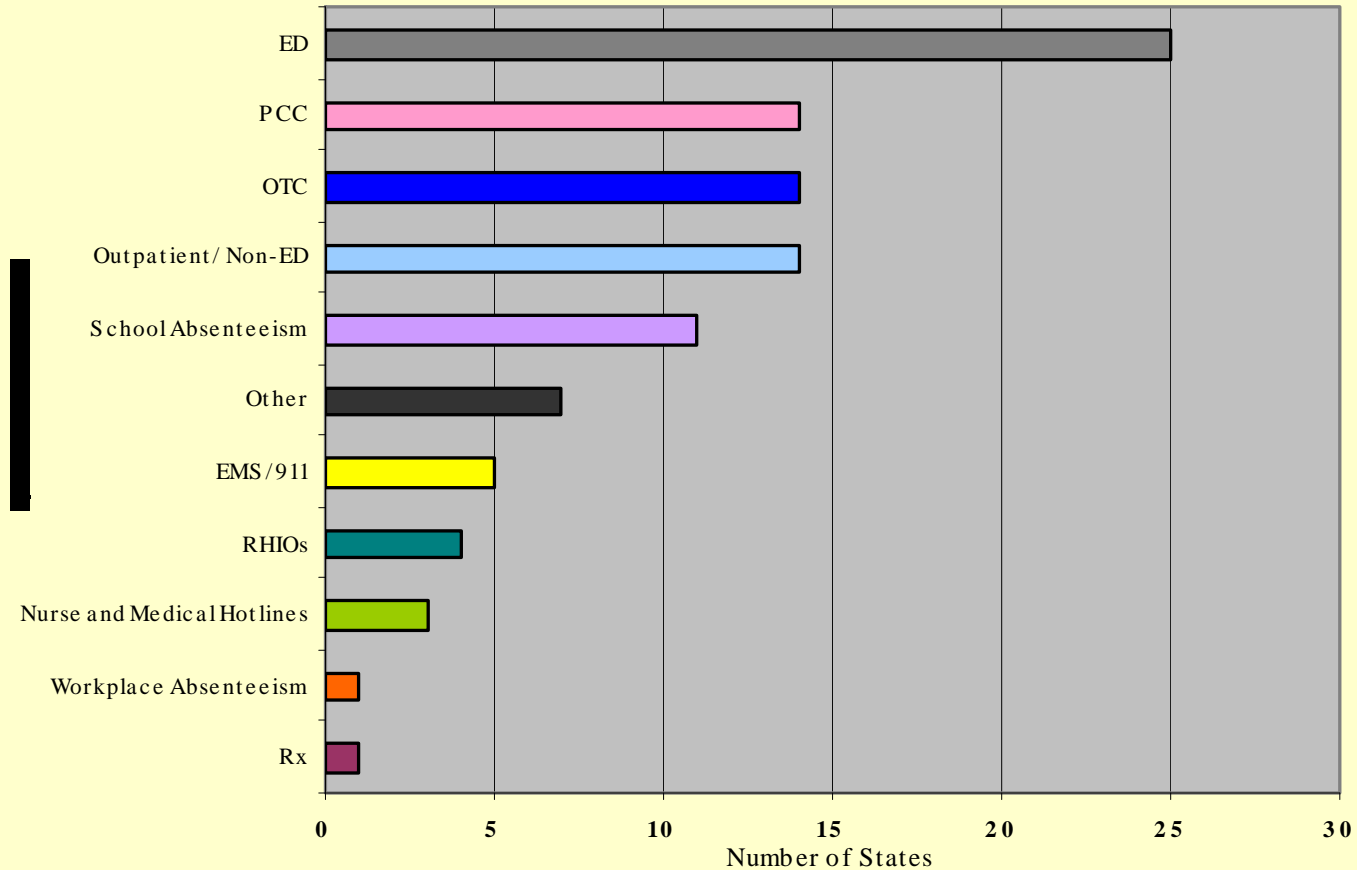


CSTE/ISDS State Syndromic Surveillance Use Survey

41 Respondents- 33 Use Syndromic Surveillance



Number of States Utilizing Specific Syndromic Surveillance Data Sources



3. National Health Status Portal



CDC COTPER/DEOC DIRECTOR'S EMERGENCY OPERATIONS CENTER

Situation for Friday, February 15, 2008

Sign In |

Common Operating Picture - Public Health Around the Globe

Home | Weather | Pandemic Influenza | Global Disease Detection

View All Site Content

Documents

- Shared Documents

Lists

- Calendar
- Tasks
- Daily Activities

Events

Exercises

- Pandemic Influenza

Sites

- Weather
- Global Disease Detection
- Deployments

Discussions

- Team Discussion

People and Groups

Public Health Around the Globe

Daily Activities - Click map to access interactive view

Daily Report

Title:
Category: Push Packages and Federal Medical Status Status
Activity:
20 of 20 FMSs are deployable; Eight (8) of the 20 deployable FMSs are currently pre-staged for future deployments.

Center: No Center
Sub Category:
Country:
State/Province:
ID: 23
Modified: 12/13/2007 10:18:54 AM

Push Packages and Federal Medical Stations

- 12 of 12 Push Packages are at deployable status.
- 20 of 20 FMSs are deployable; Eight(8) of the 20 deployable FMSs are currently pre-staged for future deployments.

Links

- ATACS
- DEOC Tools
- DEOC Resources
- Contact DEO
- Employee Tools
- CITGO

CDC Emergency Preparedness

CDC Emergency Preparedness and Response: News and Announcements

- Learn more about hydrazine, the rocket fuel found on the satellite expected to fall to the earth in early March.** 1/1/0001
- Preliminary Findings on Air Quality in FEMA-supplied Mobile Homes and Trailers** 1/1/0001
- Research Priorities in Emergency Preparedness & Response Report** 1/1/0001

Adapted from DEOC tool suite

End State



Local/State Health Dept



Syndromic Surveillance
Existing Capacity



Syndromic Data

Federated Data Grid

Case Data



Disease Surveillance



Local/State Health Dept

CDC

BioPhusion Portal



National Health Surveillance Portal



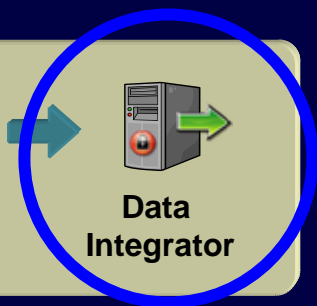
NBIS Portal

DHS

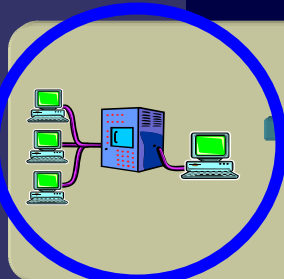
Facility



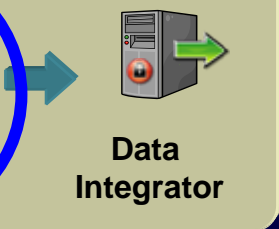
Facility System



Data Integrator



RHIO/HIE



Data Integrator

4. Regional/National Collaboration Tools



CDC COTPER/DEOC DIRECTOR'S EMERGENCY OPERATIONS CENTER

Situation for Friday, February 15, 2008

Pandemic Influenza -

Home Weather **Pandemic Influenza** Global Disease Detection

View All Site Content

Documents

- Director's Briefings
- IAPs

Data Collections

- General Situation - Levels & Declarations
- Epi/Surveillance - Demographics (Domestic)
- Epi/Surveillance - Demographics (International)
- Epi/Surveillance - Country
- Epi/Surveillance - State
- Epi/Surveillance - Seasonal
- Laboratory
- Medical Countermeasures & Non-Pharmaceutical Interventions
- Healthcare Delivery
- Pan Flu Deployments
- JIC - Communications
- JIC - Communication Surveillance and Objectives

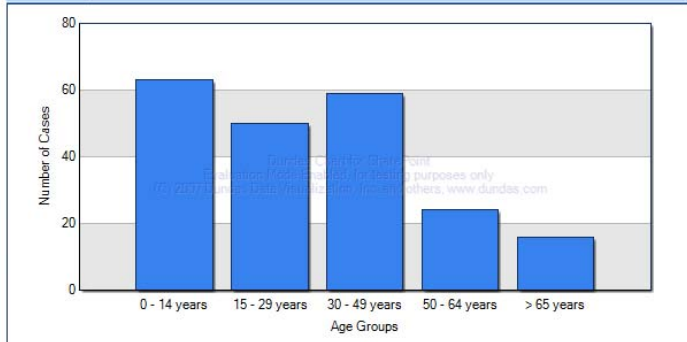
Video Wall

Common Operating Picture > Pandemic Influenza

JIC - Media/Inquiry Activity

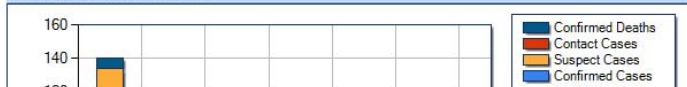
Influenza Domestic Demographics (EXERCISE EXERCISE EXERCISE)

Wizard List... Advanced Properties Help



Influenza Cases - United States (EXERCISE EXERCISE EXERCISE)

Wizard List... Advanced Properties Help



CDC COTPER/DEOC DIRECTOR'S EMERGENCY OPERATIONS CENTER

Situation for Friday, February 15, 2008

Welcome Combs, Jason (CDC/CHES/ACPHD) [...]

Pandemic Influenza -

Home Weather **Pandemic Influenza** Global Disease Detection

View All Site Content

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- Pan Flu Deployments
- JIC - Communications
- JIC - Communication Surveillance and Objectives

Epi/Surveillance - State

Common Operating Picture > Pandemic Influenza > Epi/Surveillance - State

Home Weather **Pandemic Influenza** Global Disease Detection

View All Site Content

State/Territory Interval Confirmed Cases Suspect Cases Contact Cases Confirmed Deaths Demographic Risk/Characteristics of Confirmed Cases

State/Territory	Interval	Confirmed Cases	Suspect Cases	Contact Cases	Confirmed Deaths	Demographic Risk/Characteristics of Confirmed Cases
Arkansas	Acceleration	Sum = 276	Sum = 68		Sum = 28	
Arizona		72	62		6	
District of Columbia		6	0		0	
Florida		32	0		6	
Georgia		6	0		0	
Hawaii		9	0		0	
Illinois		4	3		0	
Maryland	Recognition	2	0		1	
Michigan		3	0		1	
New York	Acceleration	100	0		5	
Ohio		3	0		1	
Guam		15	2		1	
		24	1		7	

Event	Status	Number of Tasks
CDC November Pan Flu Drill	Closed	5
CDC November Pan Flu Drill	Opened	9

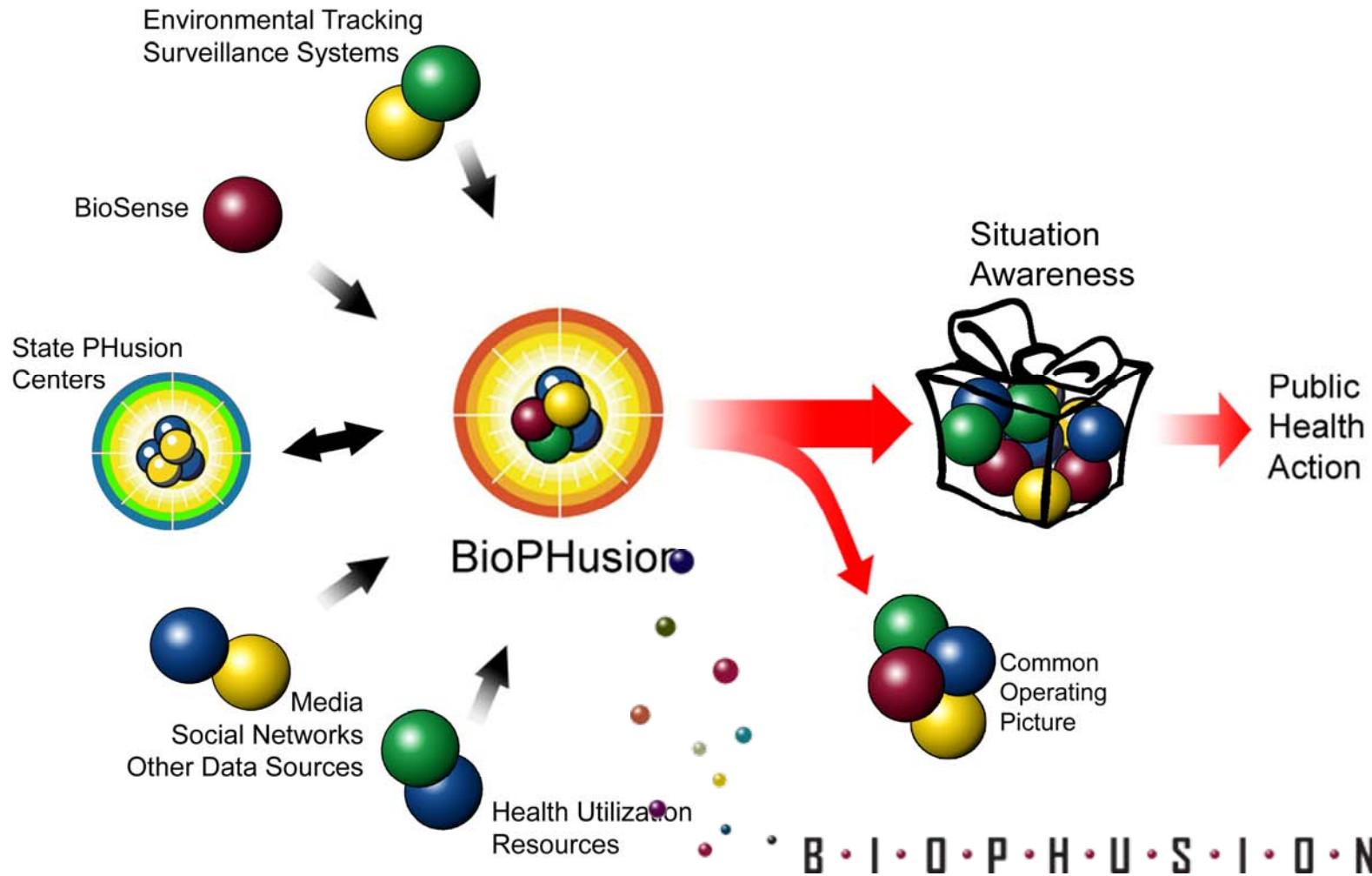
Pandemic Influenza RSS

PandemicFlu.gov RSS Feed for News Releases

HHS Secretary Leavitt Signs Agreement With Canada To Improve Indigenous Health Care Delivery and Access 1/1/0001

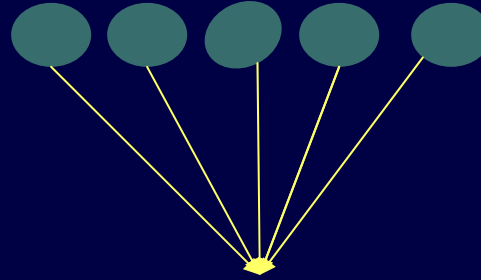
Task Work Space Provide Tools to Document and Share Analyses

Integration with BioPHusion



BioSense-BioPHusion within the CDC

News reports,
Other CIOs
BioPHusion.net



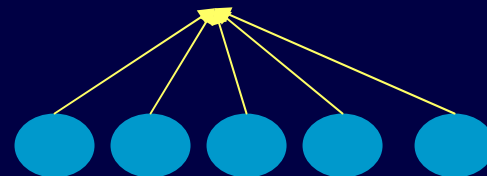
BioPHusion

Daily
National
COP

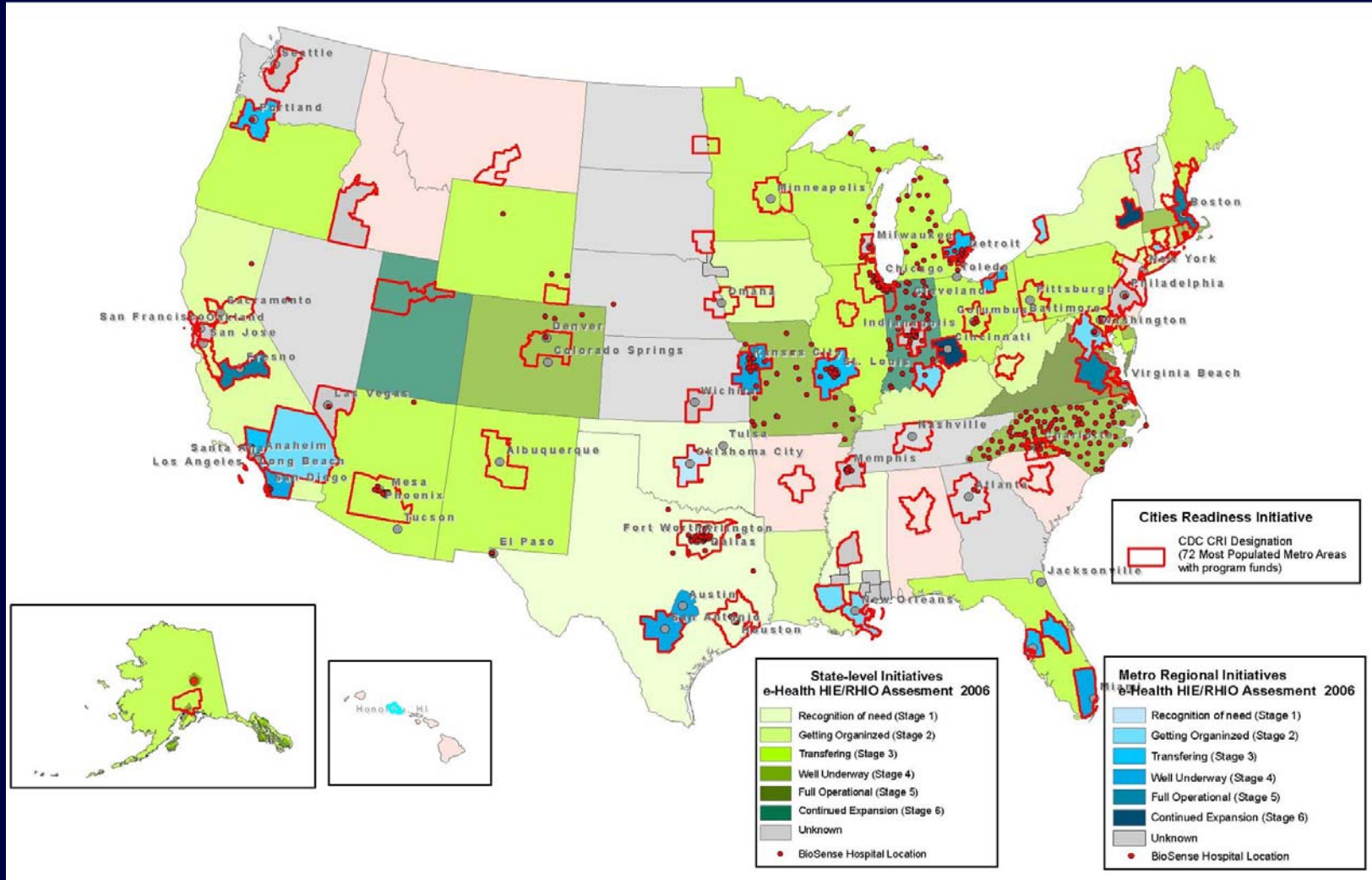
Daily
National
Health
Picture

BioSense

Clinical data sources



5. Use HIE Infrastructure to Support Data Acquisition

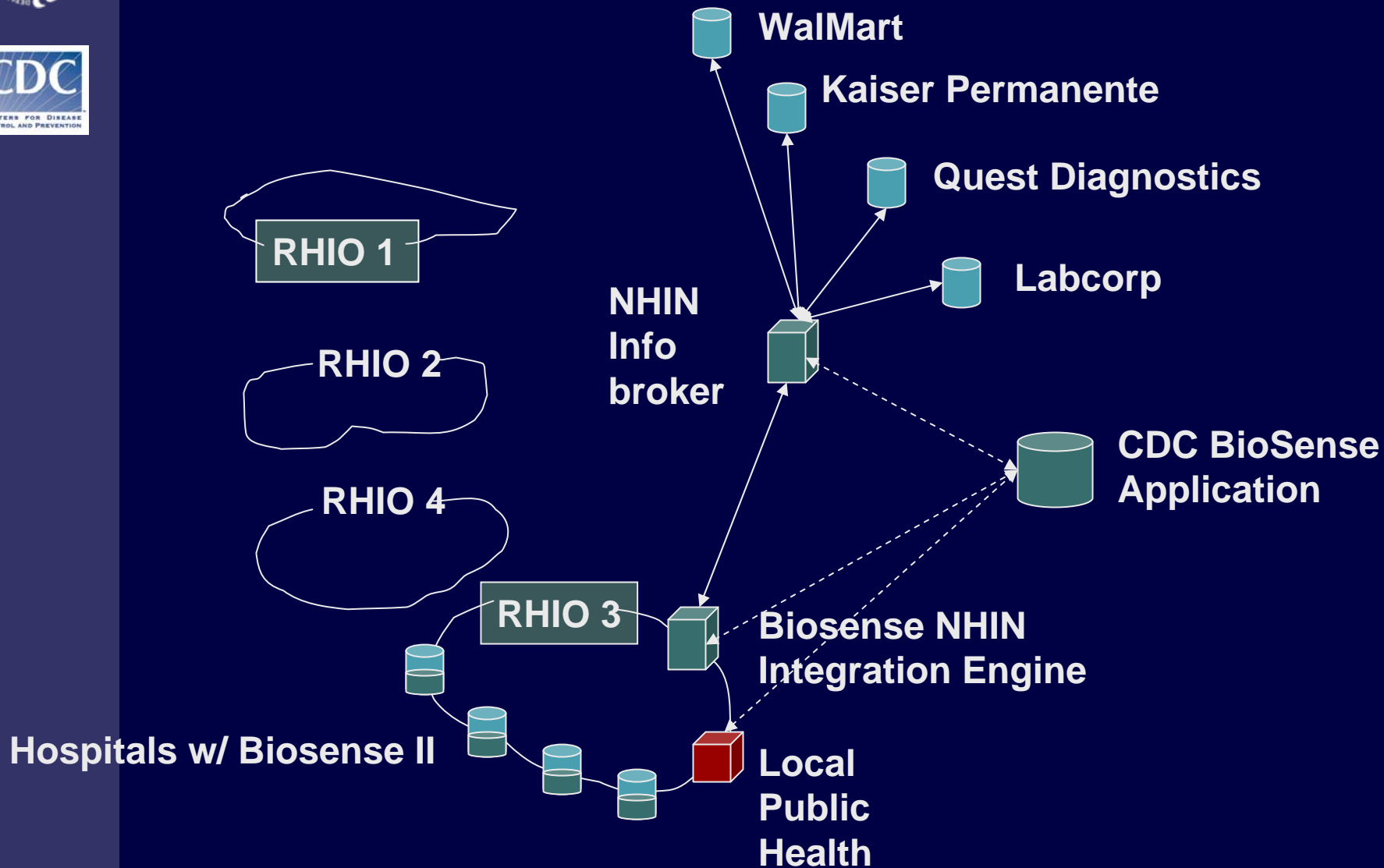


BioSense Health Information Exchange Initiative



- Links HIE's with state and local public health and the CDC
- Focuses on case identification and reporting
- Focuses on two way communications
- Awardees (8M annual program)
 - State of New York
 - State of Indiana
 - Eastern Washington/Western Idaho

6. Use BioSense as Broker for National Resources

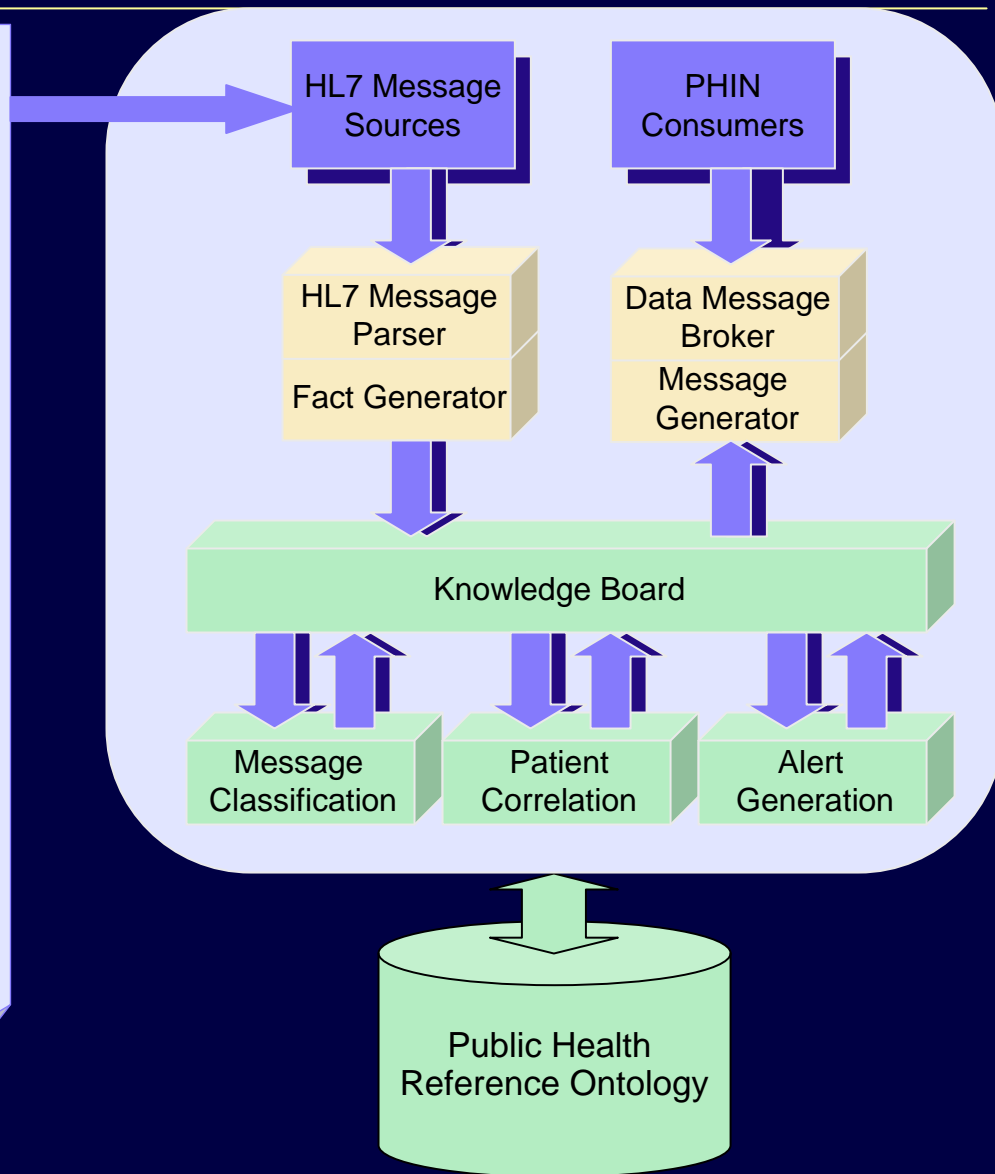


7. Case Recognition

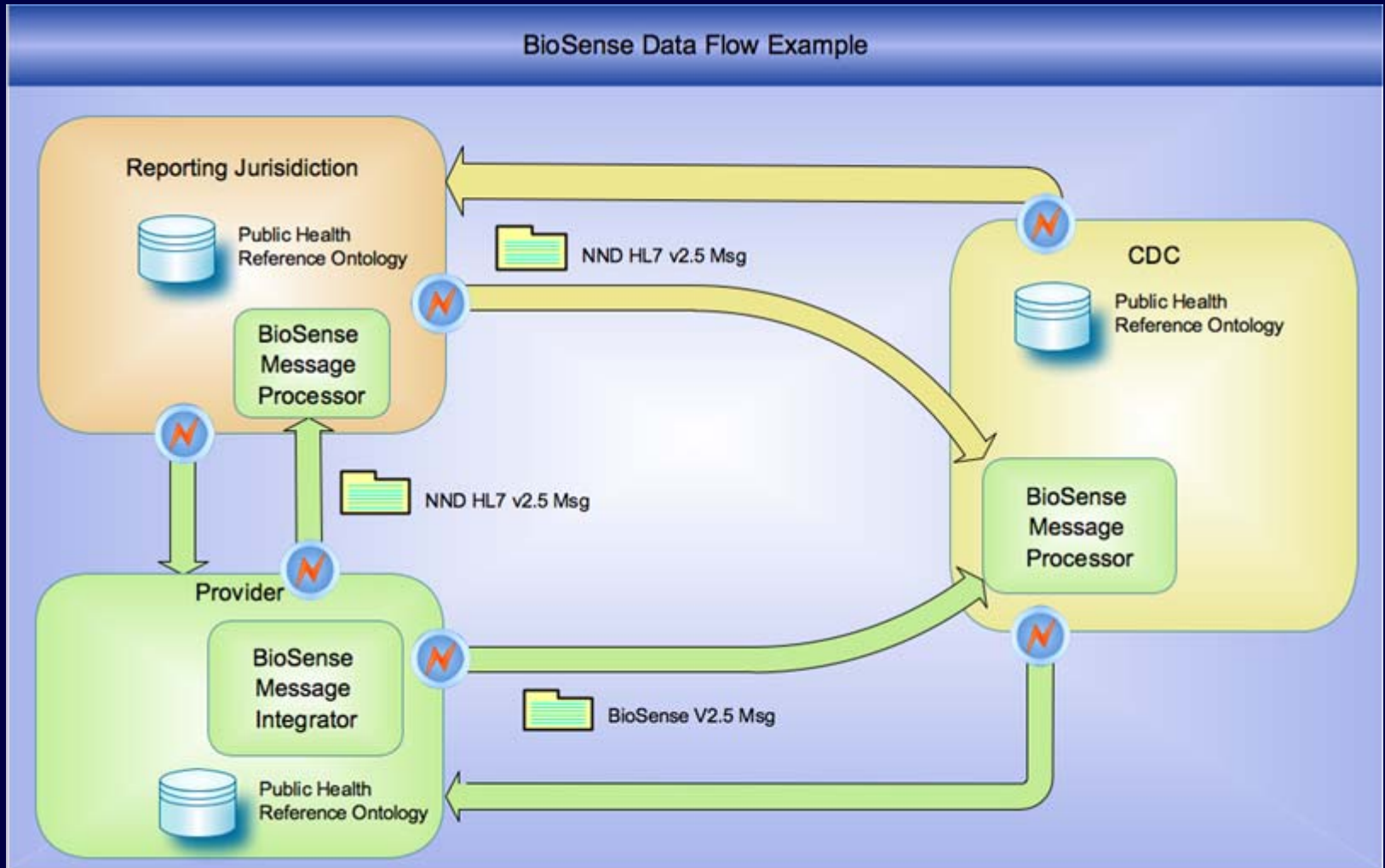


HL7 2.5 Source Message

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- <ORU_R01>
+ <MSH>
- <ORU_R01.PATIENT_RESULT>
+ <ORU_R01.PATIENT>
- <ORU_R01.ORDER_OBSERVATION>
- <OBR>
+ <OBR.1>1</OBR.1>
+ <OBR.2>
+ <OBR.3>
- <OBR.4>
+ <CE.4>CSF protein</CE.4>
+ <CE.5>CSF protein</CE.5>
</OBR.4>
+ <OBR.7>
+ <OBR.8>
+ <OBR.14>
- <OBR.15>
- <SPS.1>
+ <CWE.4>Spinal Fluid</CWE.4>
</SPS.1>
</OBR.15>
+ <OBR.22>
+ <OBR.24>LA</OBR.24>
+ <OBR.25>F</OBR.25>
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- <OBX>
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+ <CE.5>CSF protein mg%</CE.5>
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- <OBX.5>
+ <NM.1>34</NM.1>
</OBX.5>
- <OBX.6>
+ <CE.1>mg/dL</CE.1>
</OBX.6>
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Remotely programmable for use in emerging infectious diseases



Case Recognition: Integration with Regional HIE's

- Case detection occurs at the institutional level
- Suspected case forwarded to HIE
- HIE's searches other clinical data sources in region for relevant data for suspected case and retrieves this data
 - Suspect case can be confirmed or rejected
- Composite case forward to state and local public health and CDC (when indicated)

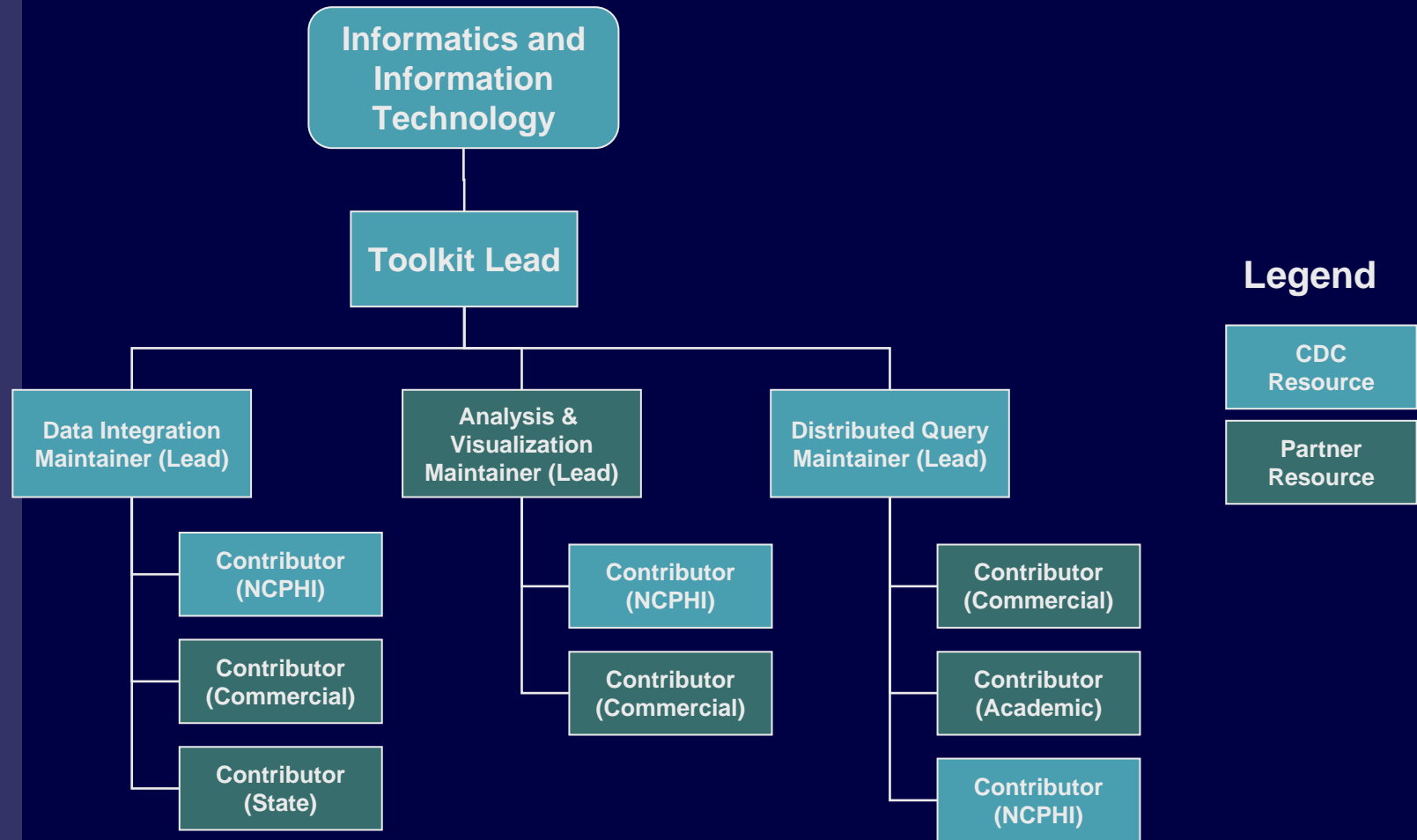


8. Open Source Collaborative Development

- Lead a Public Health Informatics Community
 - Community determines technology efforts
 - Community collaborates on strategy
- Use Open Source Methods
 - Anyone can use the software
 - Anyone can copy & modify the software
 - Only trusted contributors can provide enhancements to the base product



Open Source Initiative Back By Organizational Change



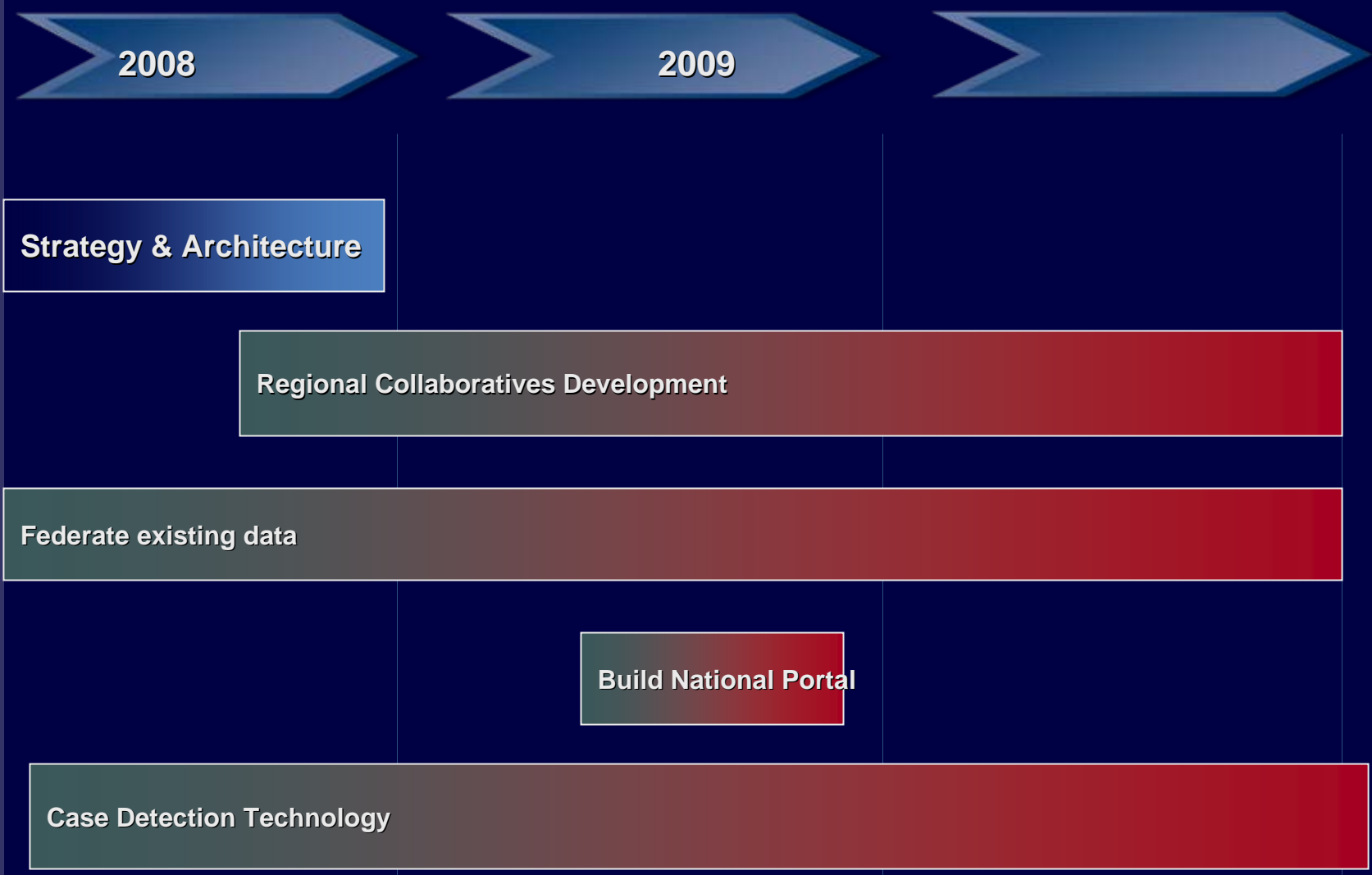
Draft organizational structure for Open Source development

Other Supportive Programs

- NEDSS
 - Targeted to merge with this activity
- BioSense HIE Initiative
- NHIN
- Centers of Excellence in Public Health Informatics
- R01 program in automated surveillance technologies
- Cooperative agreement program in evaluation of the impact real-time surveillance technologies



IV. Timeline



Benchmarking: Estimated System Performance



Category	Facilities		Days	Volume	Vol, %
	No.	%			
1. Nonfederal hospitals, manual data collection	3780				
<100 beds	1852	49.0%	5	92610	9.8%
100-199 beds	869	23.0%	5	130410	13.8%
200-499 beds	869	23.0%	5	260820	27.7%
>=500 beds	189	5.0%	5	113400	12.0%
2. State SS*, no automated feed to CDC	700				
<100 beds	343	49.0%	4	17150	1.8%
100-199 beds	161	23.0%	4	24150	2.6%
200-499 beds	161	23.0%	4	48300	5.1%
>=500 beds	35	5.0%	4	21000	2.2%