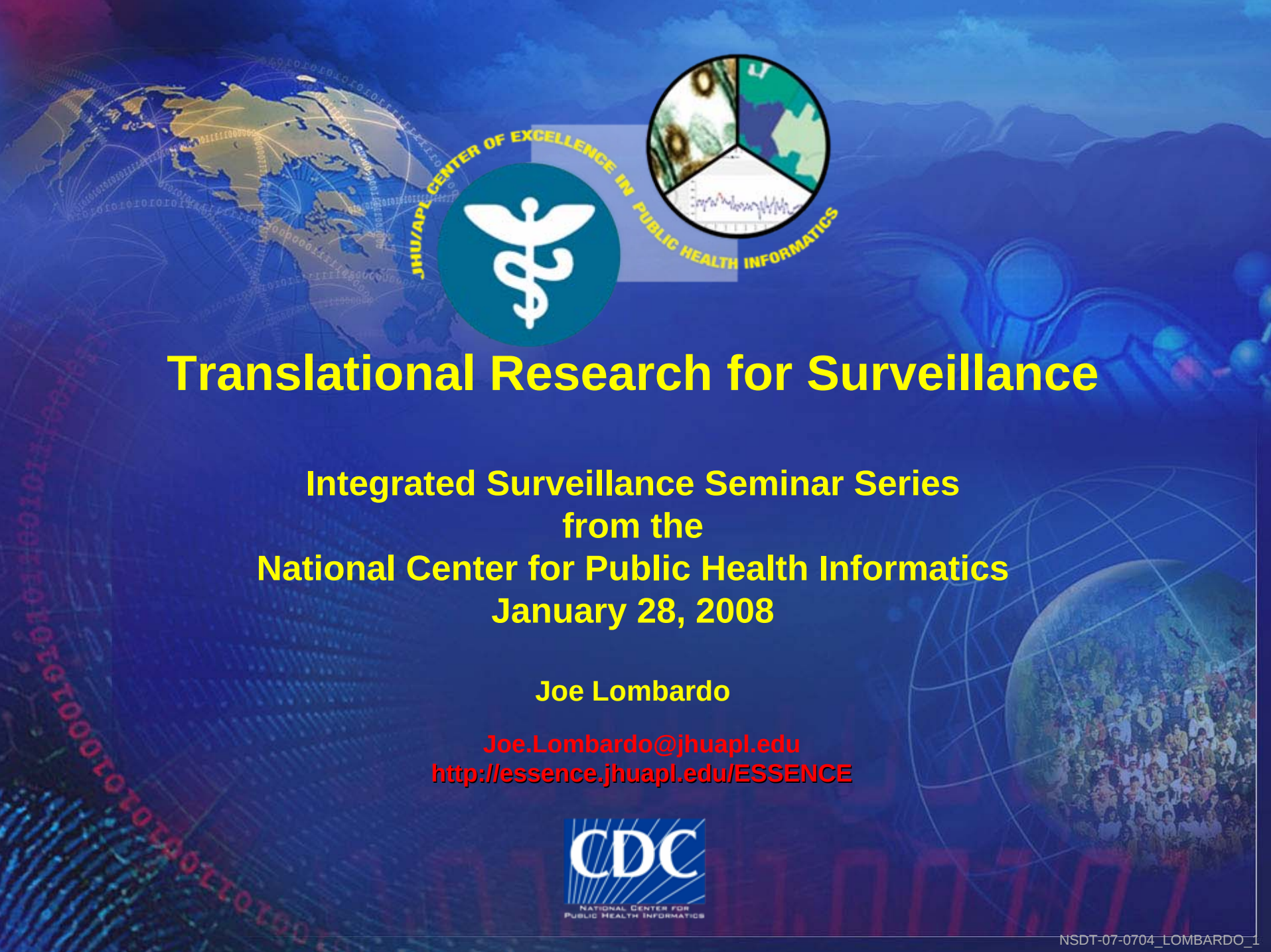


Translational Research for Surveillance

Integrated Surveillance Seminar Series
from the
National Center for Public Health Informatics
January 28, 2008

Joe Lombardo

Joe.Lombardo@jhuapl.edu
http://essence.jhuapl.edu/ESSENCE

CDC
National Center for Public Health Informatics

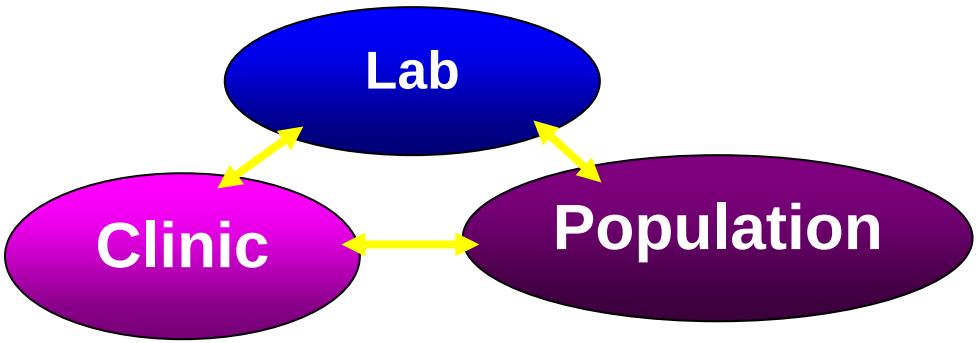
Outline

1. A definition of public health informatics translational research
2. Identify translational research opportunities in PHI needed to improve public health practice in surveillance
3. Introduce selected surveillance enhancement projects
   a. Advanced querying to rapidly create more productive and timely analysis groupings (moving from syndromic to case specific surveillance)
   b. Customizable alerting analytics
   c. Public health collaborations (overcoming data sharing obstacles)
4. Discussion

NCI Translational Research Defined

National Cancer Institute Technical Working Group Definition

"Translational research transforms scientific discoveries arising from laboratory, clinical, or population studies



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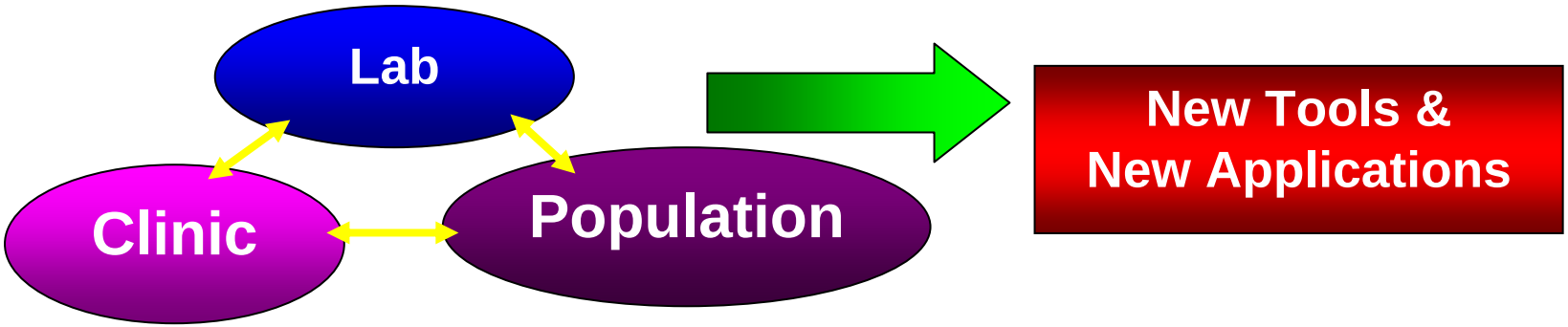
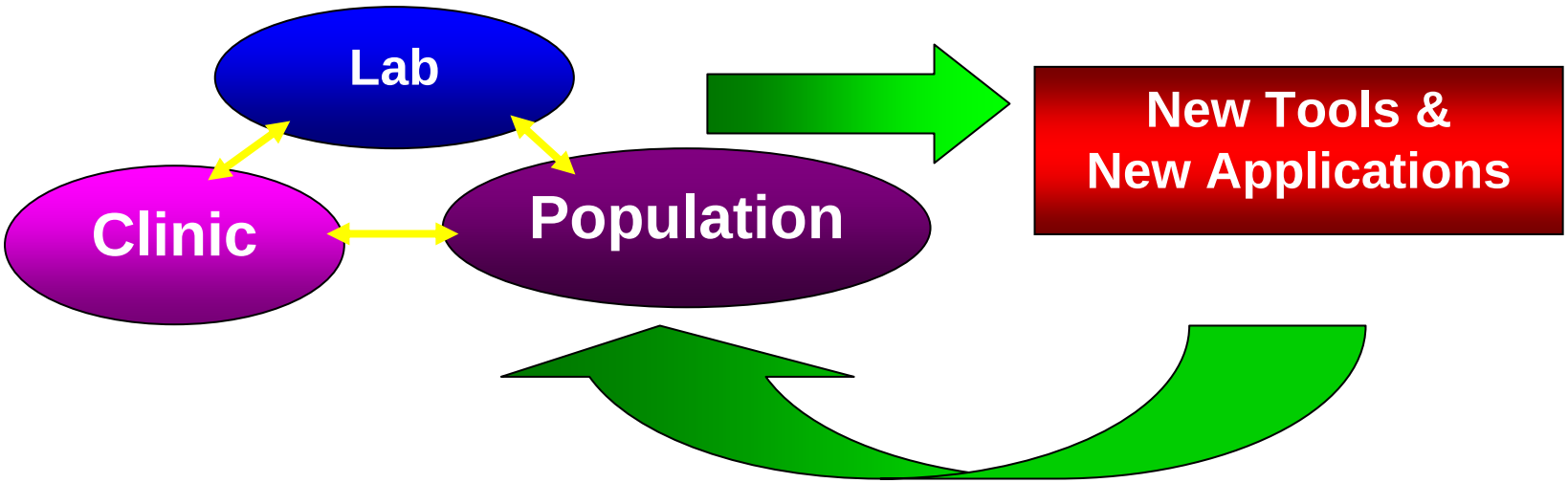
"Translational research transforms scientific discoveries arising from laboratory, clinical, or population studies into clinical applications



NCI Translational Research Defined

National Cancer Institute Technical Working Group Definition

"Translational research transforms scientific discoveries arising from laboratory, clinical, or population studies into clinical applications to reduce cancer incidence, morbidity, and mortality."



http://www.cancer.gov/trwg/TRWG-definition-and-TR-continuum

NCI's Translational Research Continuum

Basic Science Discovery

- Promising molecule or gene target
- Candidate protein biomarker
- Basic epidemiologic finding

Early Translation

- Partnerships and collaboration (academia, government, industry)
- Intervention development
- Phase III Trials

Late Translation

- Phase III Trials
- Regulatory approval
- Partnerships
- Production & commercialization
- Phase IV trials – approval for additional uses
- Payment mechanism(s) established to support adoption
- Health services research to support dissemination and adoption

Dissemination

(new drug assay, device, behavioral intervention education materials, training)

- To community health providers
- To patients and public

Adoption

- Adoption of advancement by providers, patients, public
- Payment mechanism(s) in place to enable adoption

From the President's Cancer Panel 2004-2005 Report *Translating Research into Cancer Care: Delivering on the Promise*

http://www.cancer.gov/trwg/TRWG-definition-and-TR-continuum

Translational Research Applied to Public Health Informatics

“Public Health Informatics has been defined as the systematic application of information and computer science and technology to public health practice.”

Yasnoff WA, O’Carrol PW, Koo D, Linkins RW, Kilbourne E. Public health informatics: Improving and transforming public health in the information age. J Public Health Management Practice. 2000: 6(6): 67-75.

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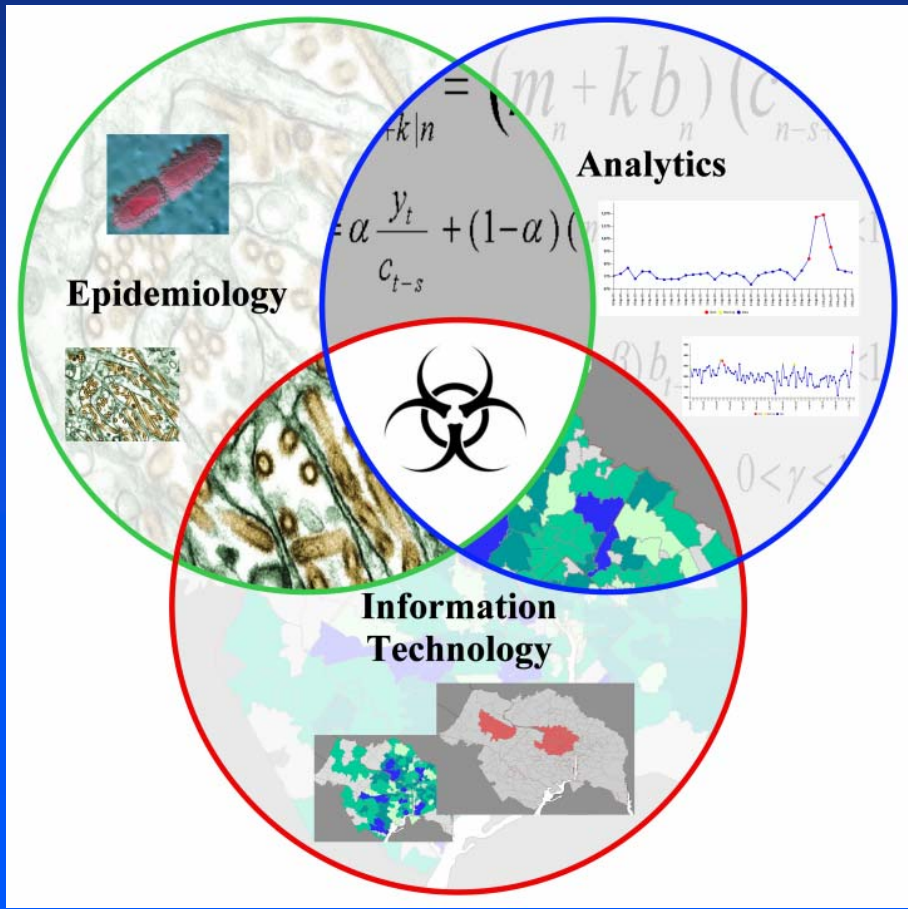
Proposed Definition for Translational Research for Public Health Informatics:

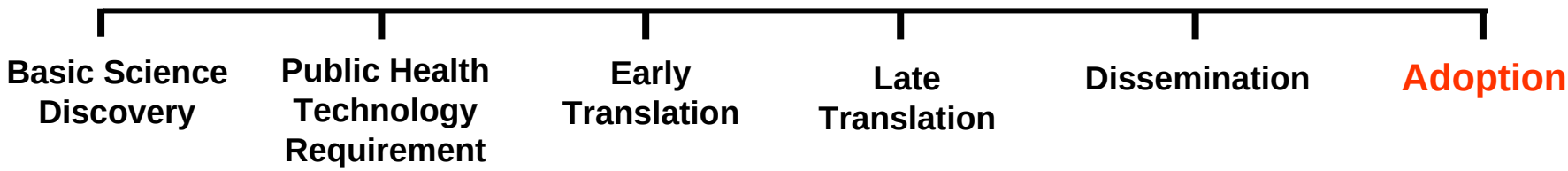
Translational research in public health informatics is the conversion of advancements made in information and computer science into tools and applications to **support public health practice**.

Alternative Definition of Translation Research For Public Health Informatics

Translational research in public health informatics is the translation of advancements made at the intersections of information technology, mathematics, and epidemiology into tools and applications to support public health practice.



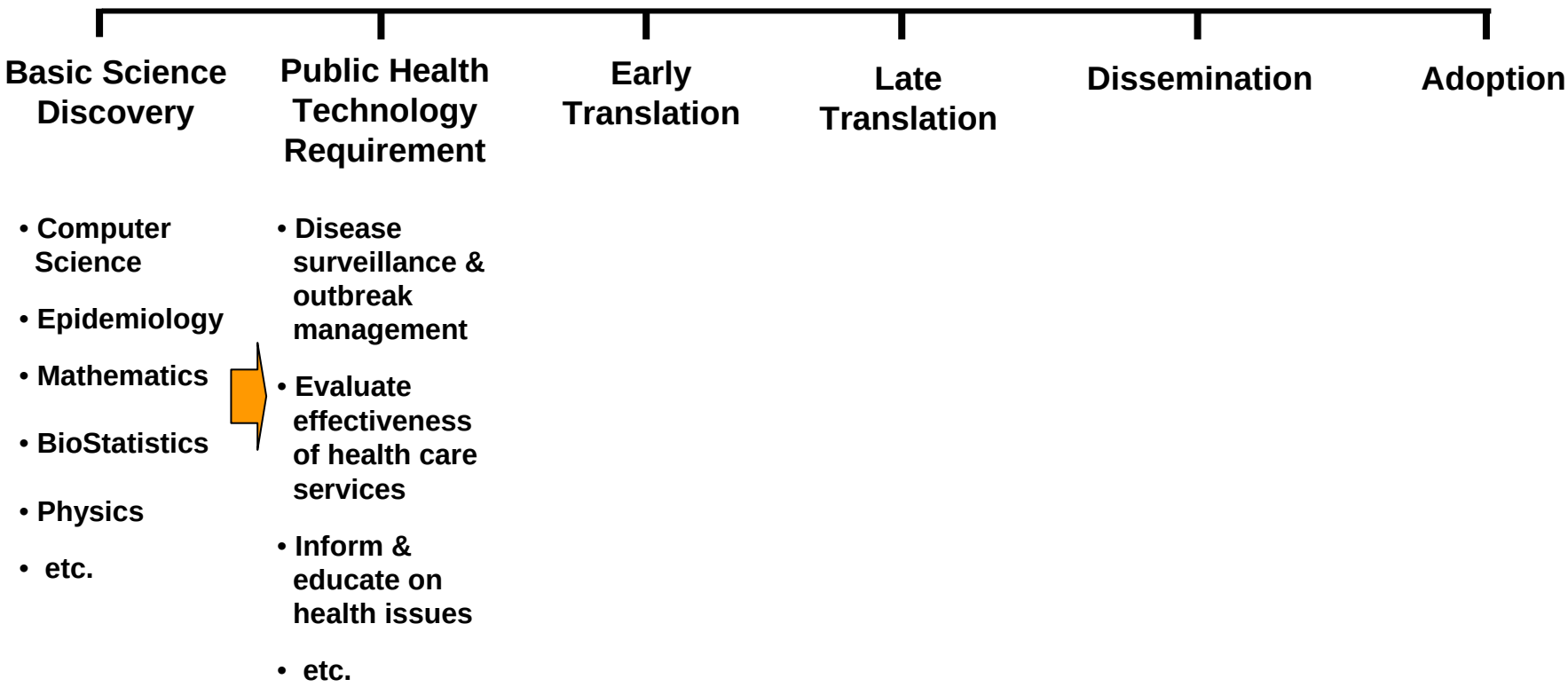
A (proposed) Public Health Informatics Translational Research Continuum



A Public Health Informatics Translational Research Continuum

- Computer Science
- Epidemiology
- Mathematics
- BioStatistics
- Physics
- etc.

A Public Health Informatics Translational Research Continuum



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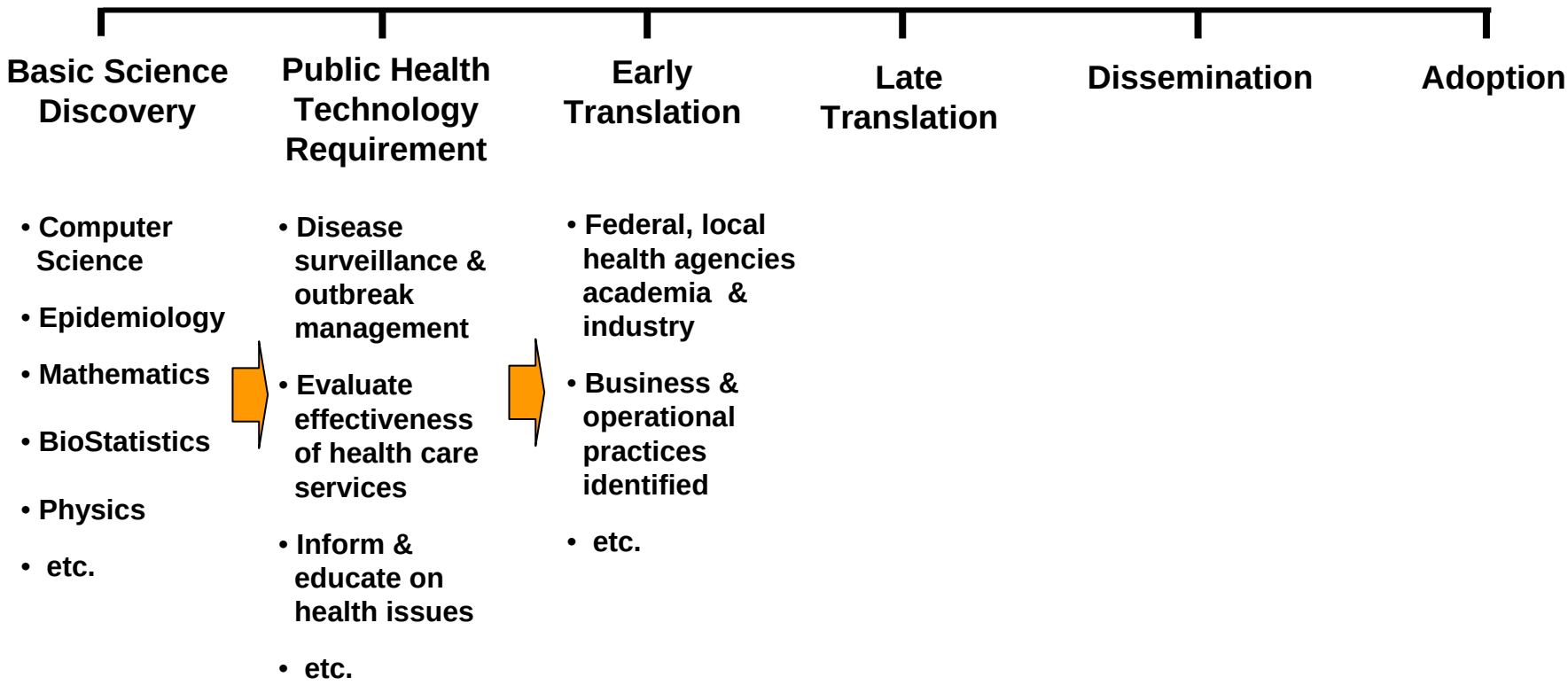

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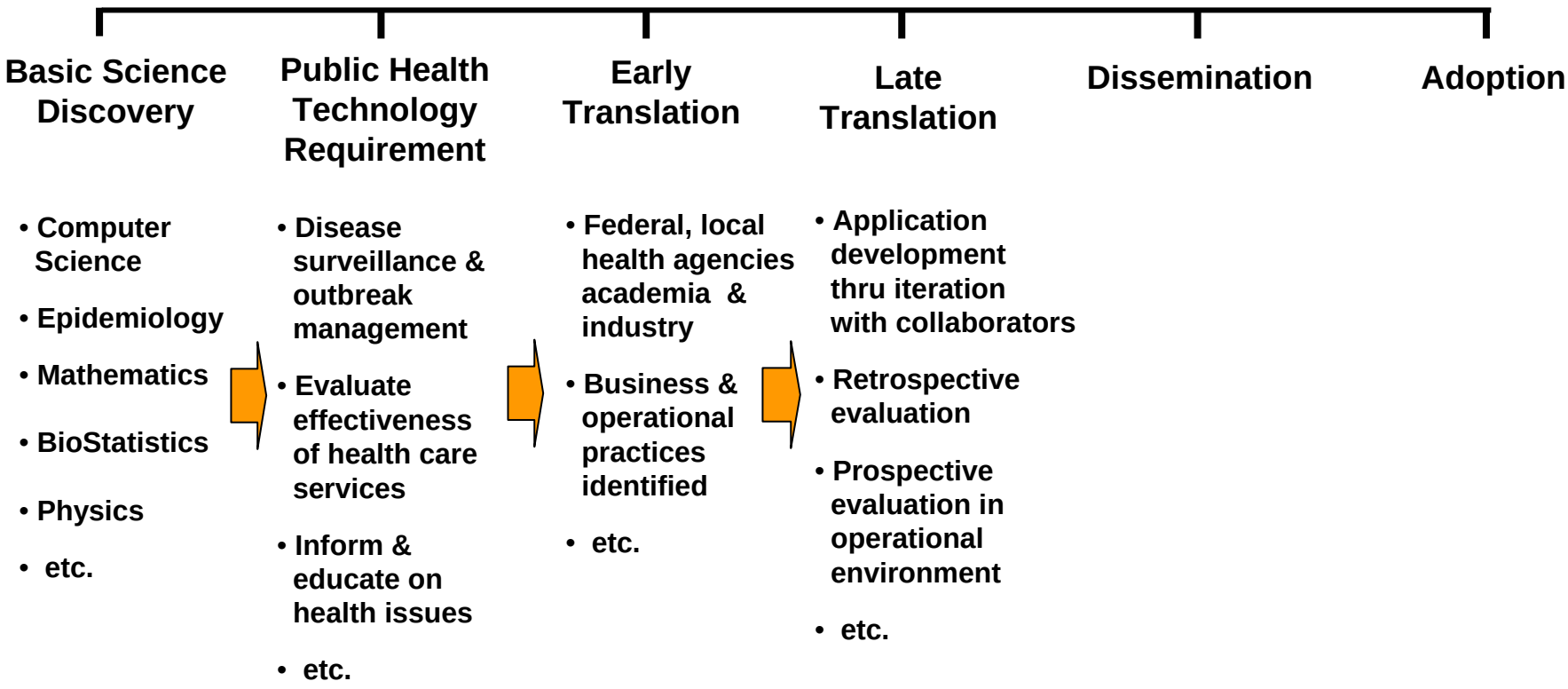
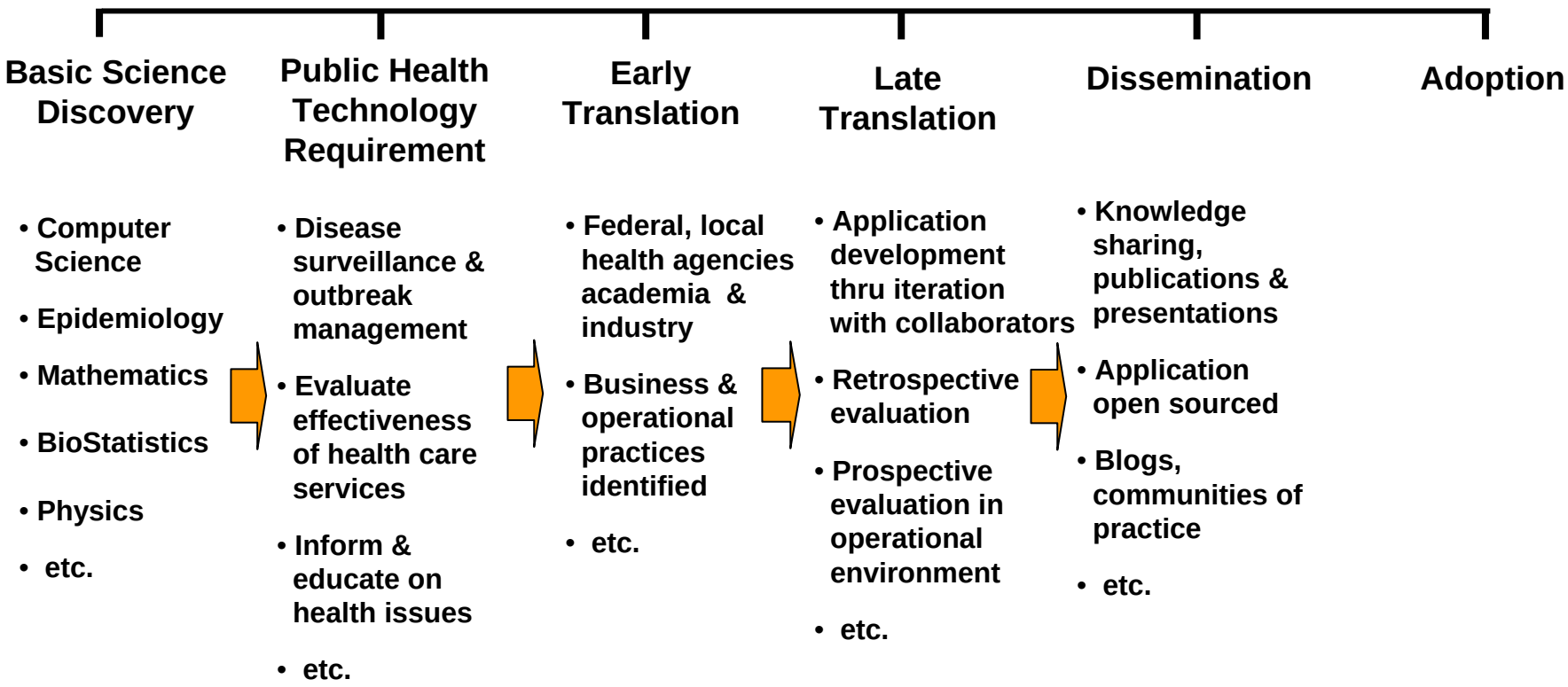


A Public Health Informatics Translational Research Continuum



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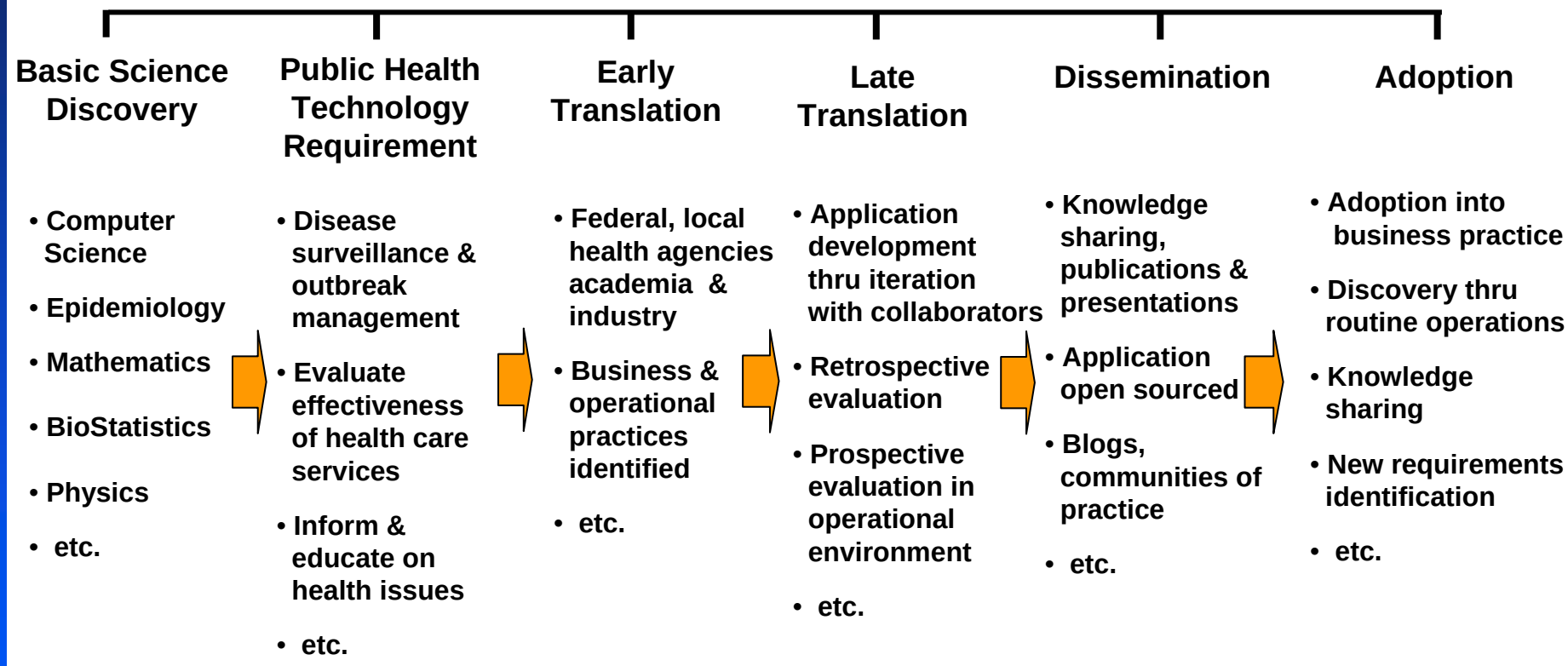
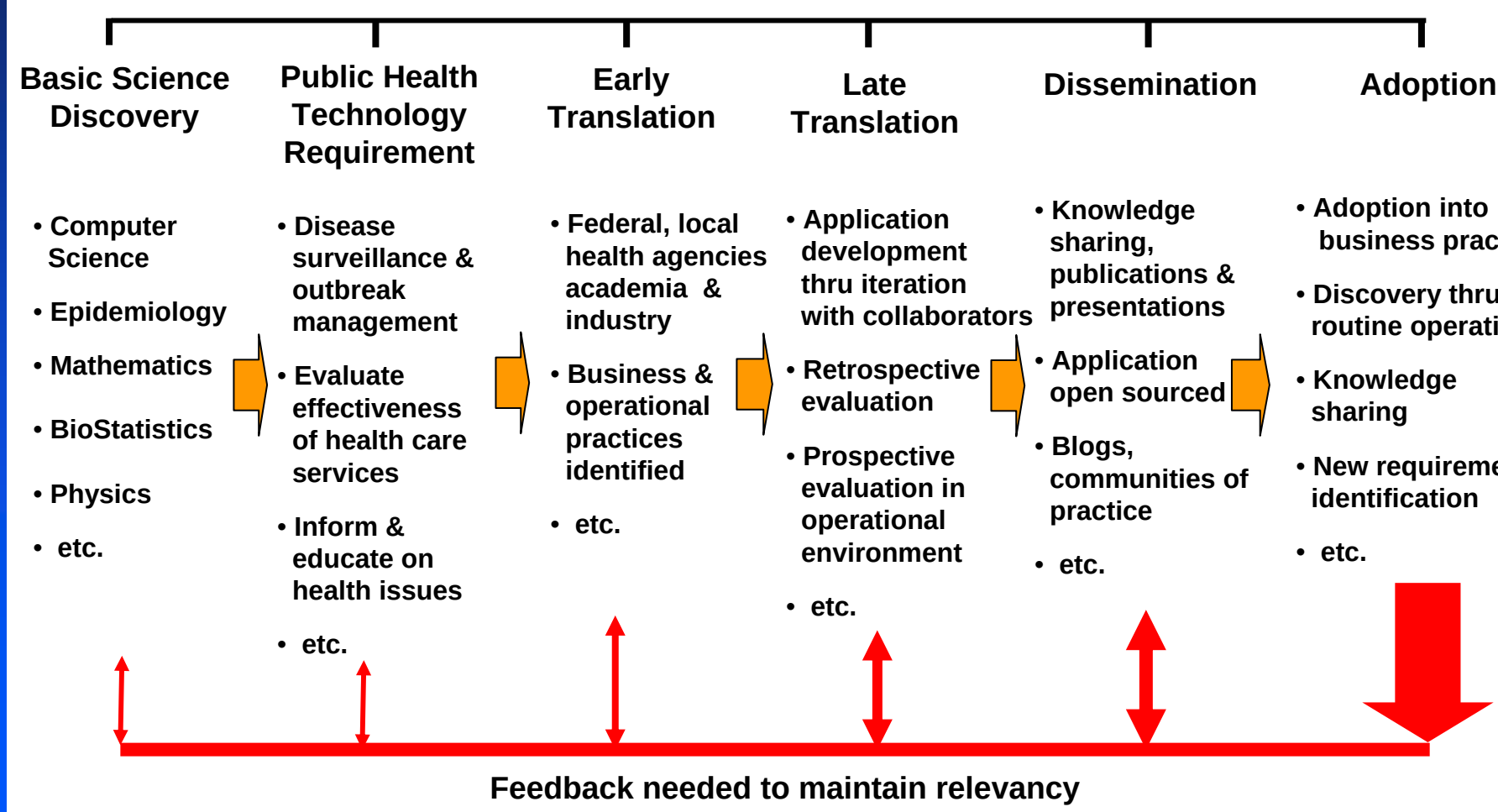


A Public Health Informatics Translational Research Continuum



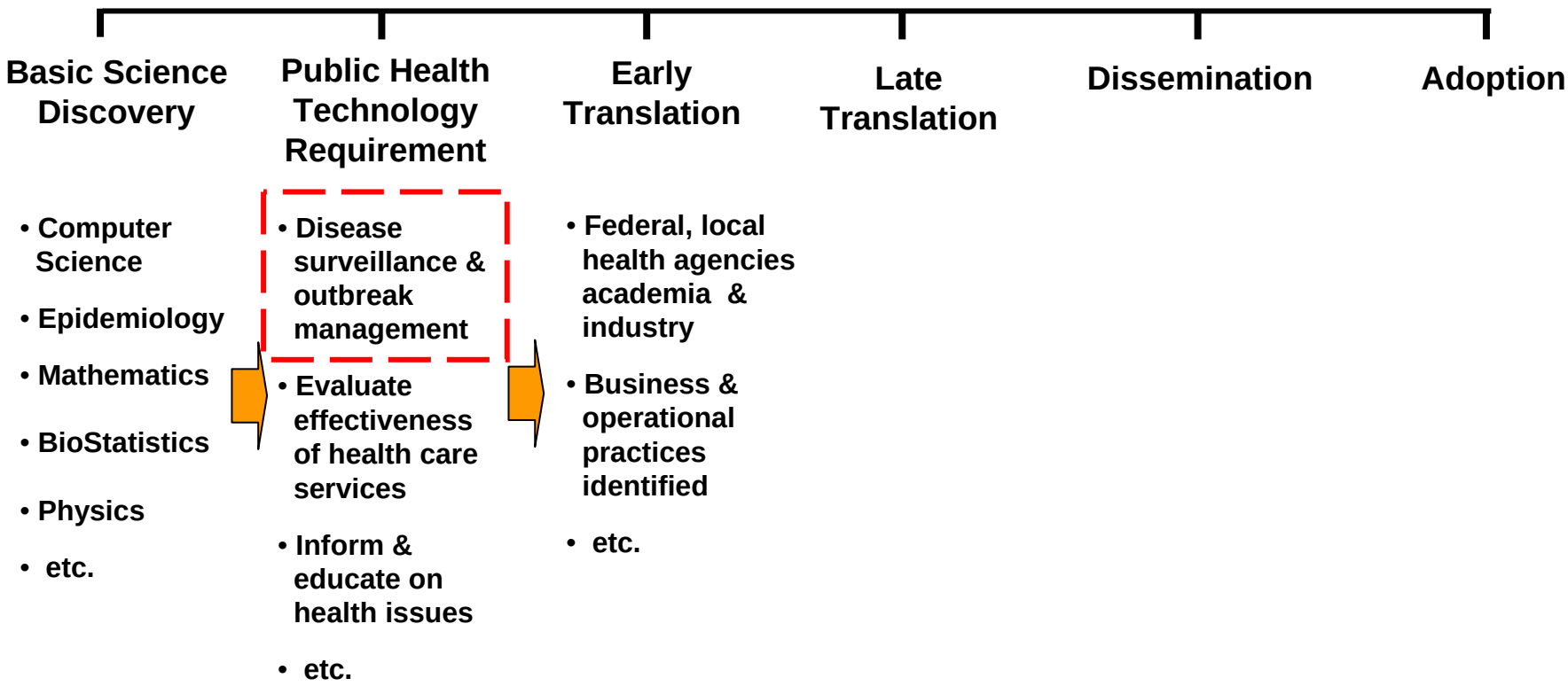
JHU/APL COE Translational Research in Disease Surveillance

1. Background of the Surveillance Informatics Program at JHU/APL

2. Some Basis for Additional Surveillance Research & Development

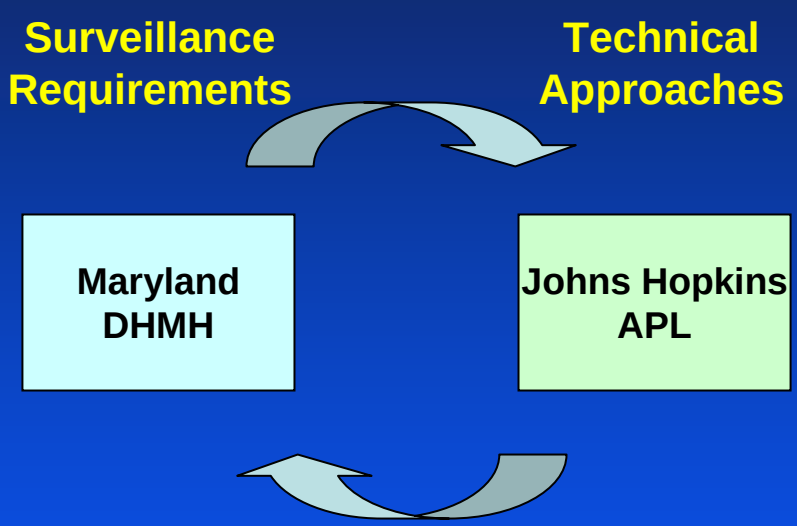
3. Center of Excellence Sample Projects

Surveillance Project Beginnings at JHU/APL

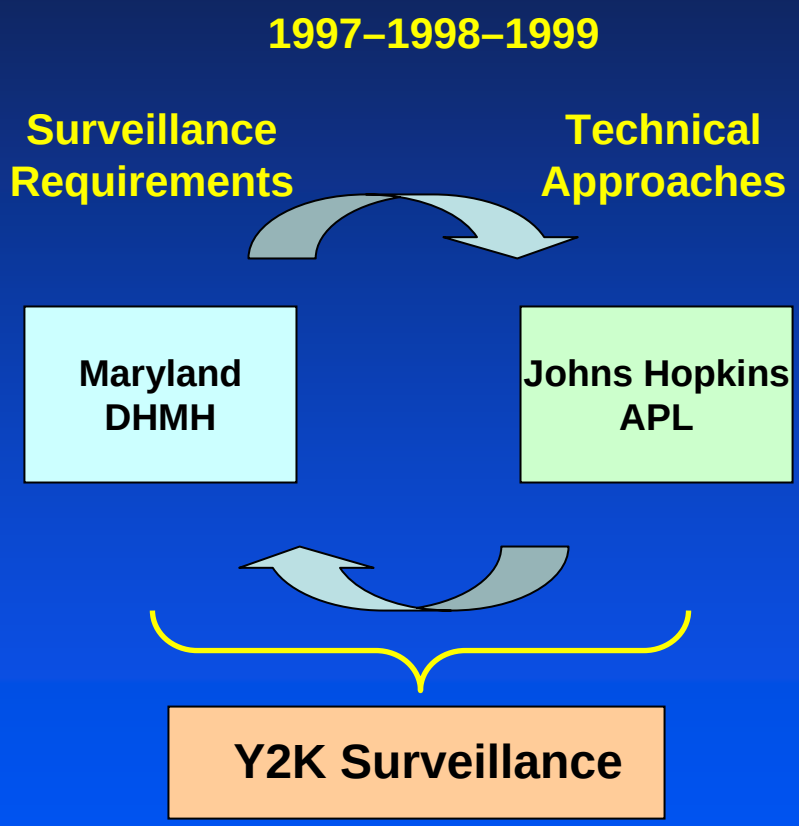


Identification of a Requirements for a Public Health Informatics Solution for Automating Disease Surveillance

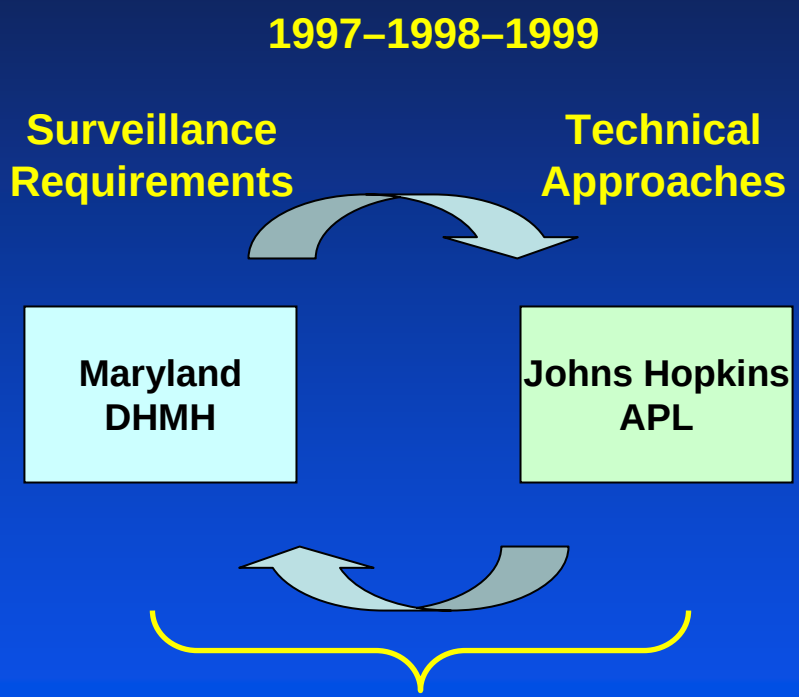
1997–1998



Event Driven Requirement for an Operational Prototype

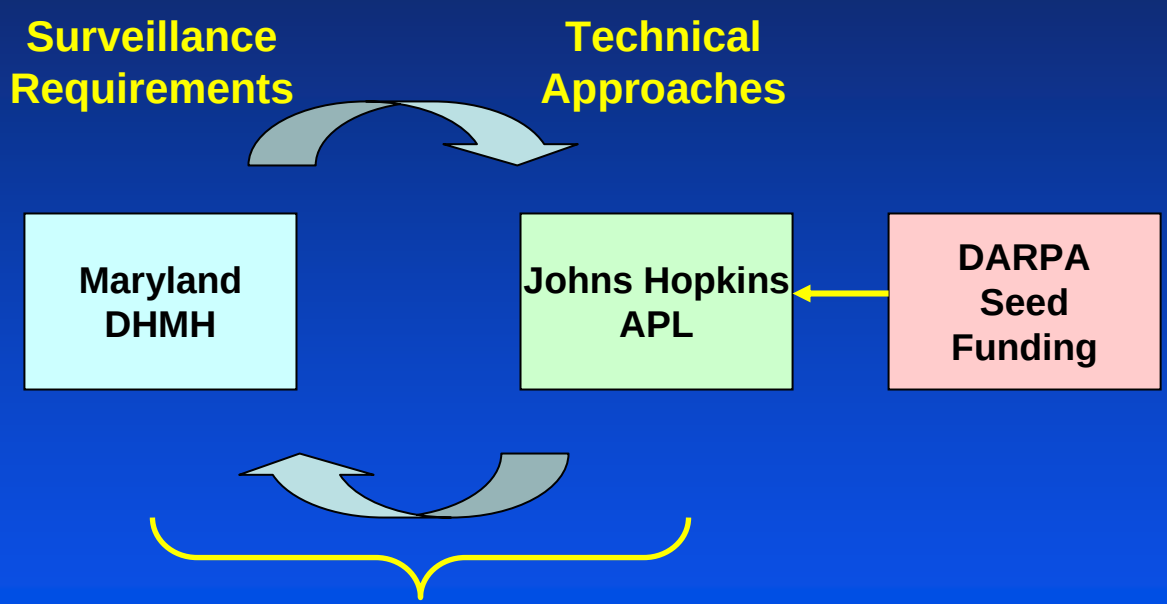


Early Indicators Used for Automated Surveillance



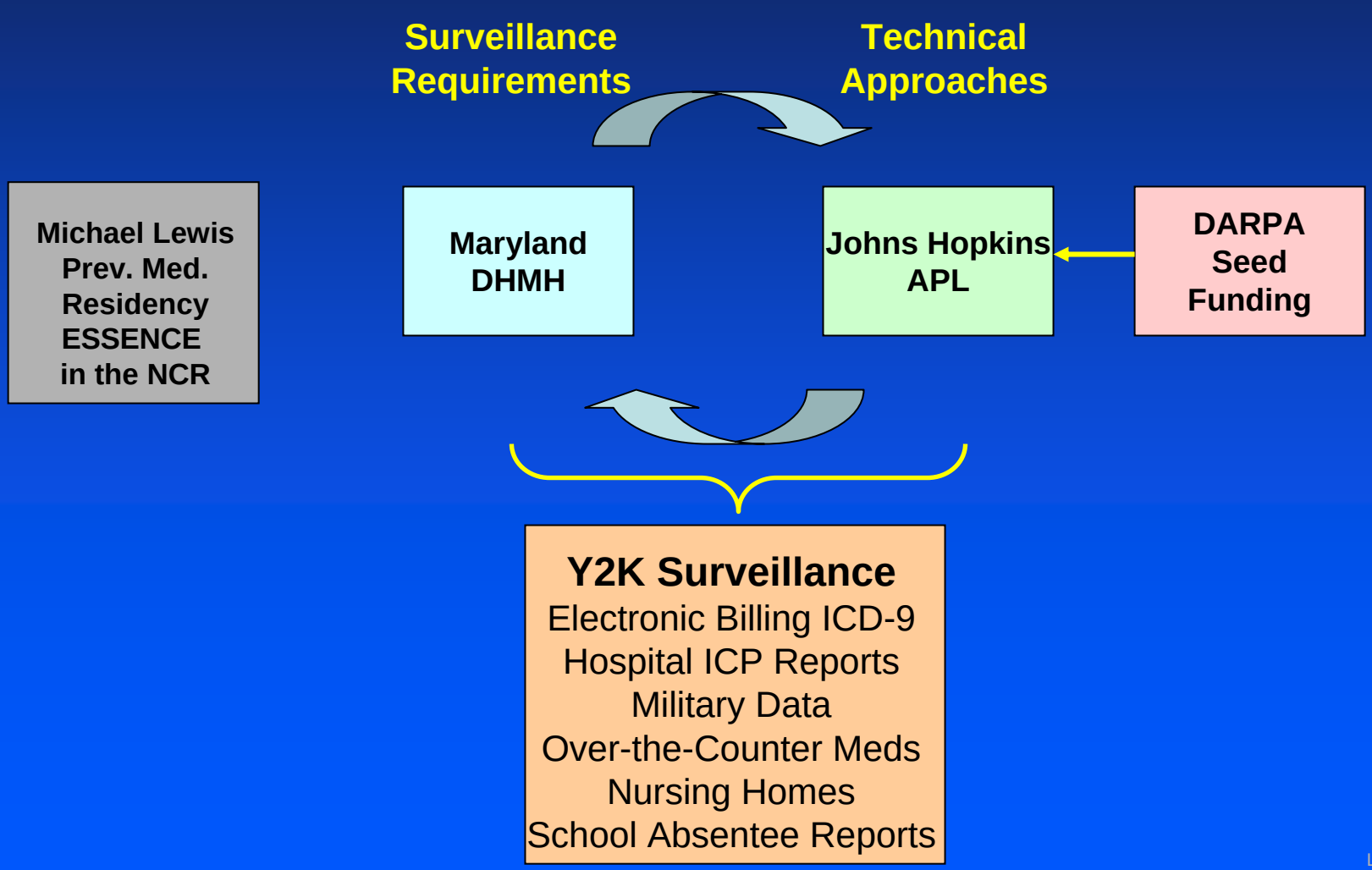
Y2K Sponsorship

1997–1998–1999



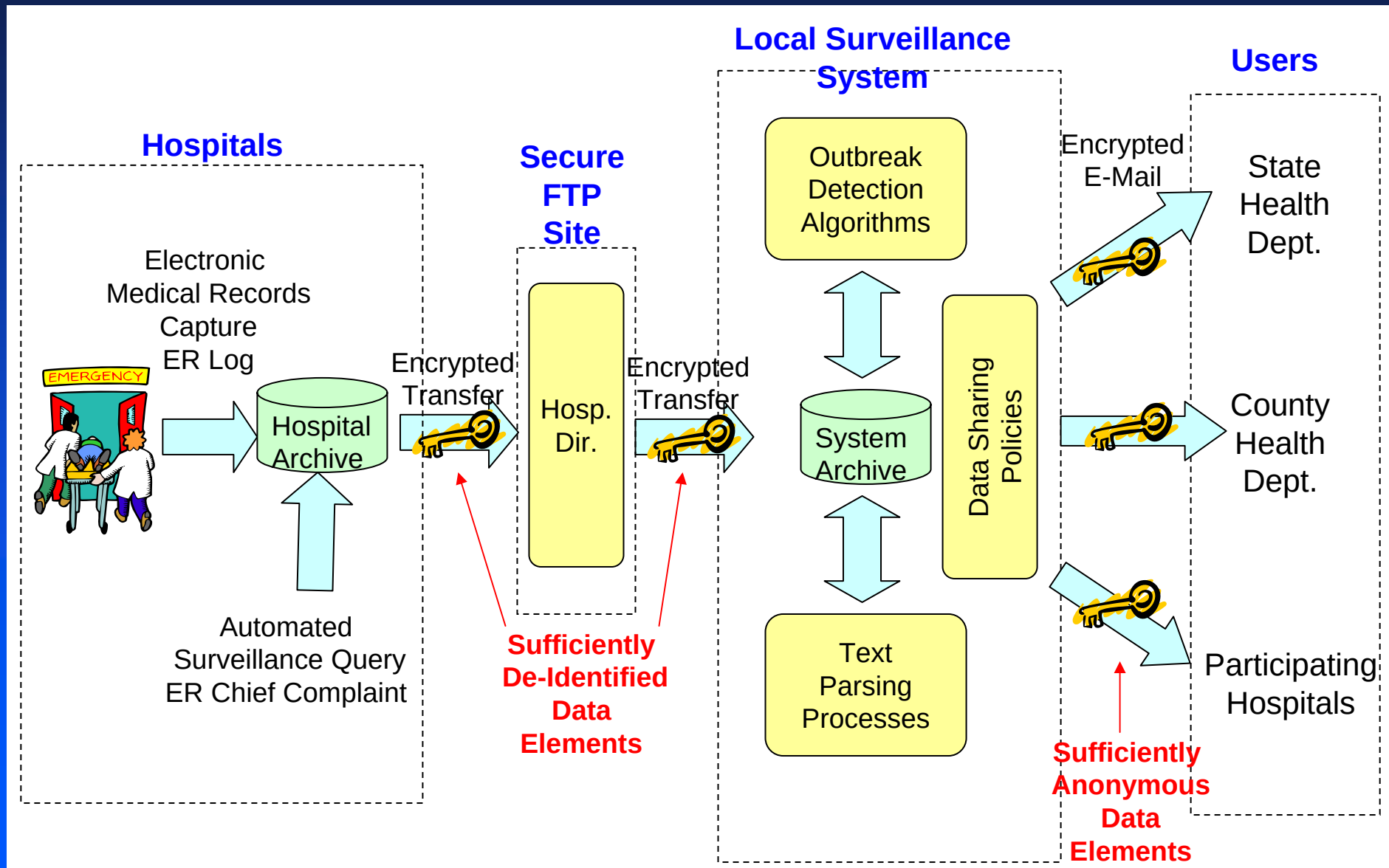
Expanded Collaborations

1997–1998–1999

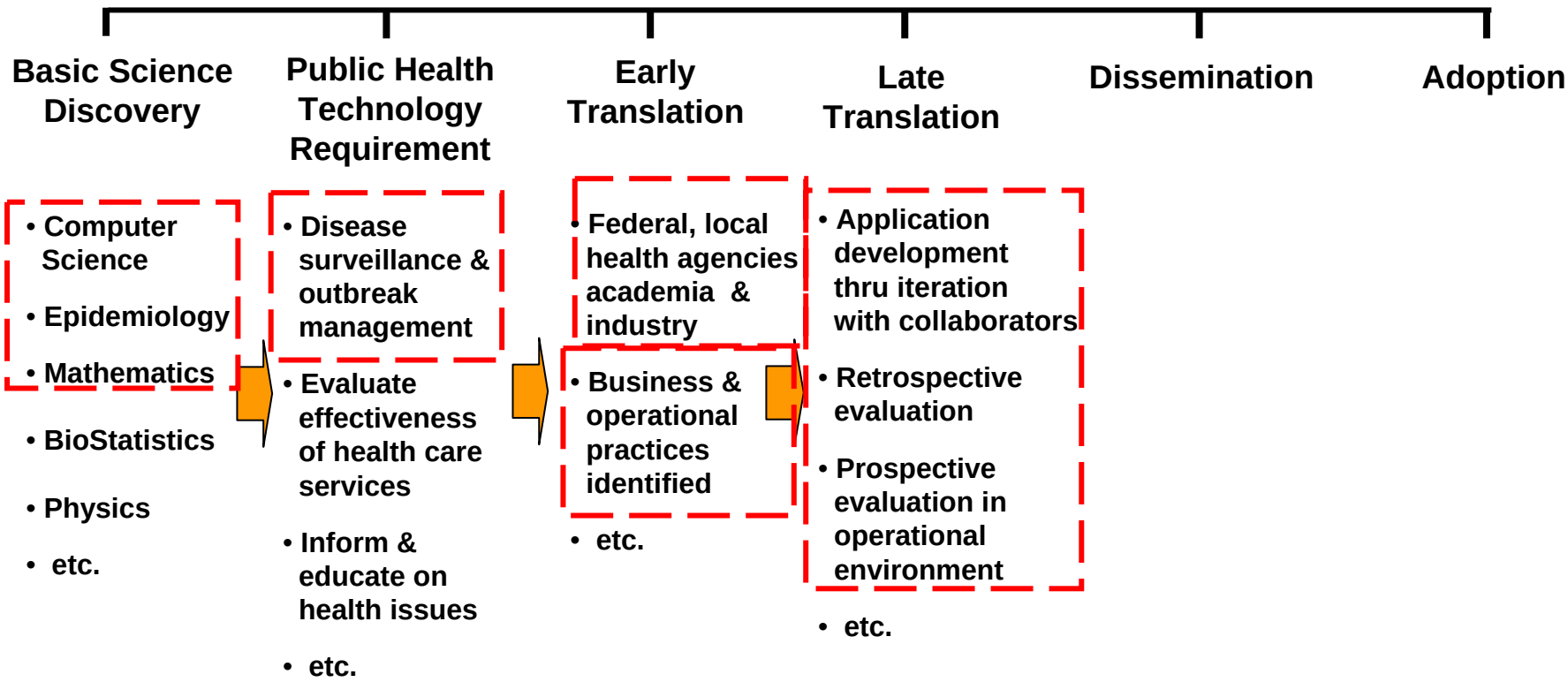


Early ESSENCE Architecture

Electronic Surveillance System for the Early Notification of Community-based Epidemics



A Public Health Informatics Translational Research Continuum



Surveillance Collaborations Provide Adoption & Basis for New Surveillance Functionality

Seedling

BioAlirt

Maryland DHMH

Maryland DHMH

Virginia DOH

DC DOH

DoD GEIS/WRAIR

Moving Across the Continuum Through Operational Experiences During 9/11 and the Anthrax Letters

Y2K

Regional Surveillance

Surveillance Collaborations Provide Adoption & Basis for New Surveillance Functionality

Seedling

BioAlirt

JSIPP

Maryland DHMH

Maryland DHMH

Virginia DOH

DC DOH

DoD GEIS/WRAIR

Camp Lejeune, NC

Pope AFB, NC

Barksdale AFB, LA

Ft. Campbell, KY

Ft. Gordon, GA

San Diego, CA

Ft. Lewis, WA

Dahlgren, VA

Robins AFB, GA

Operational Experiences for the Continuum

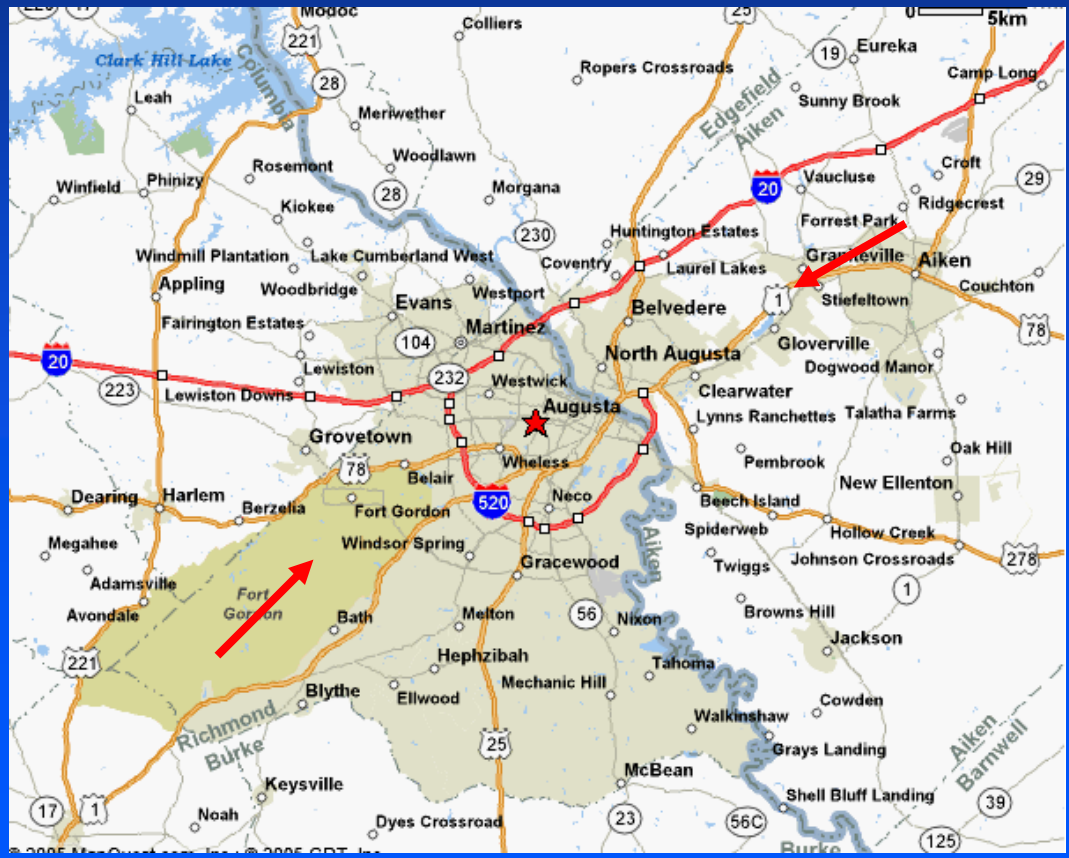
Y2K

Regional Surveillance

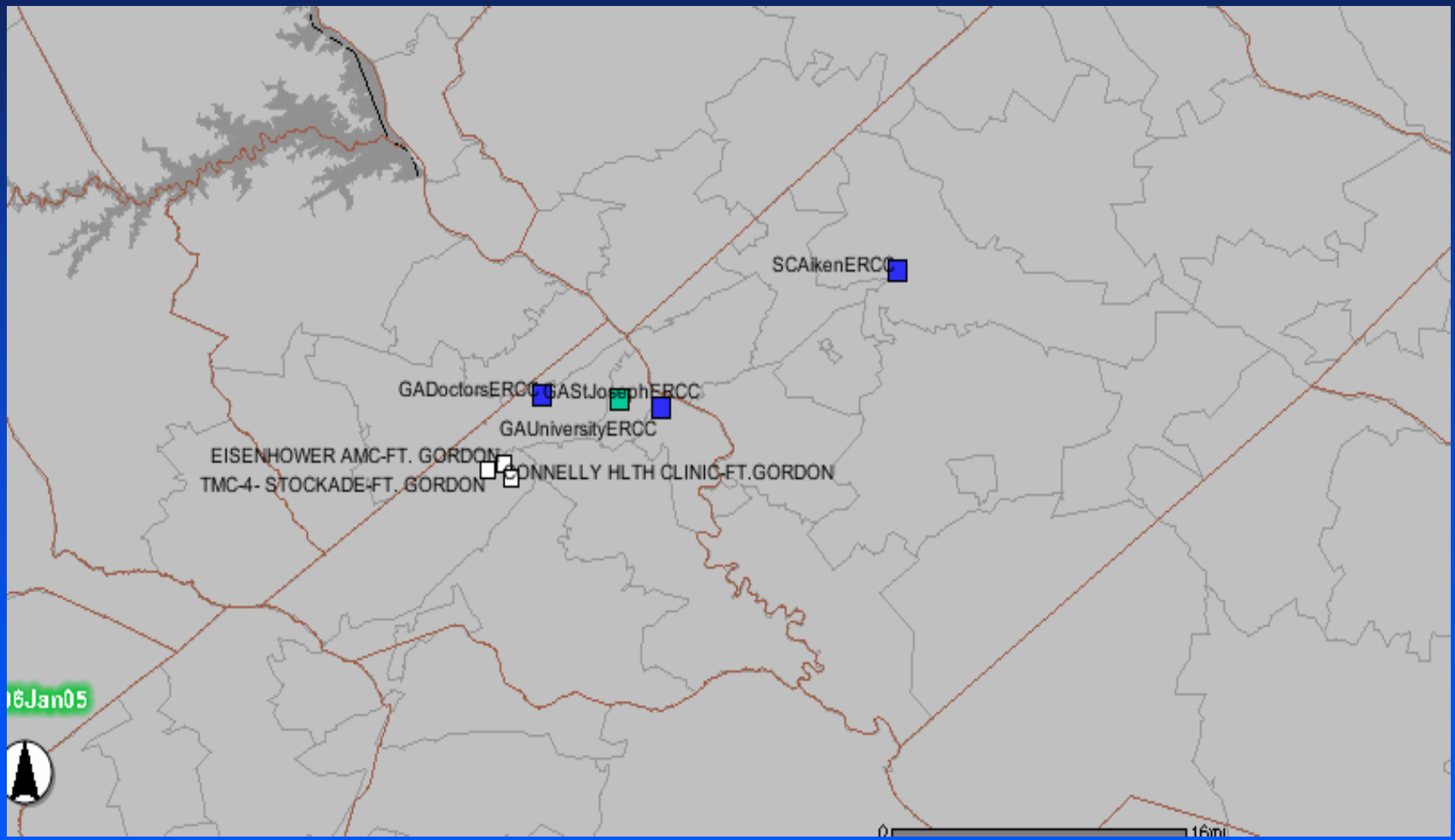
Regional Collaborations

Train Accident Near Ft. Gordon

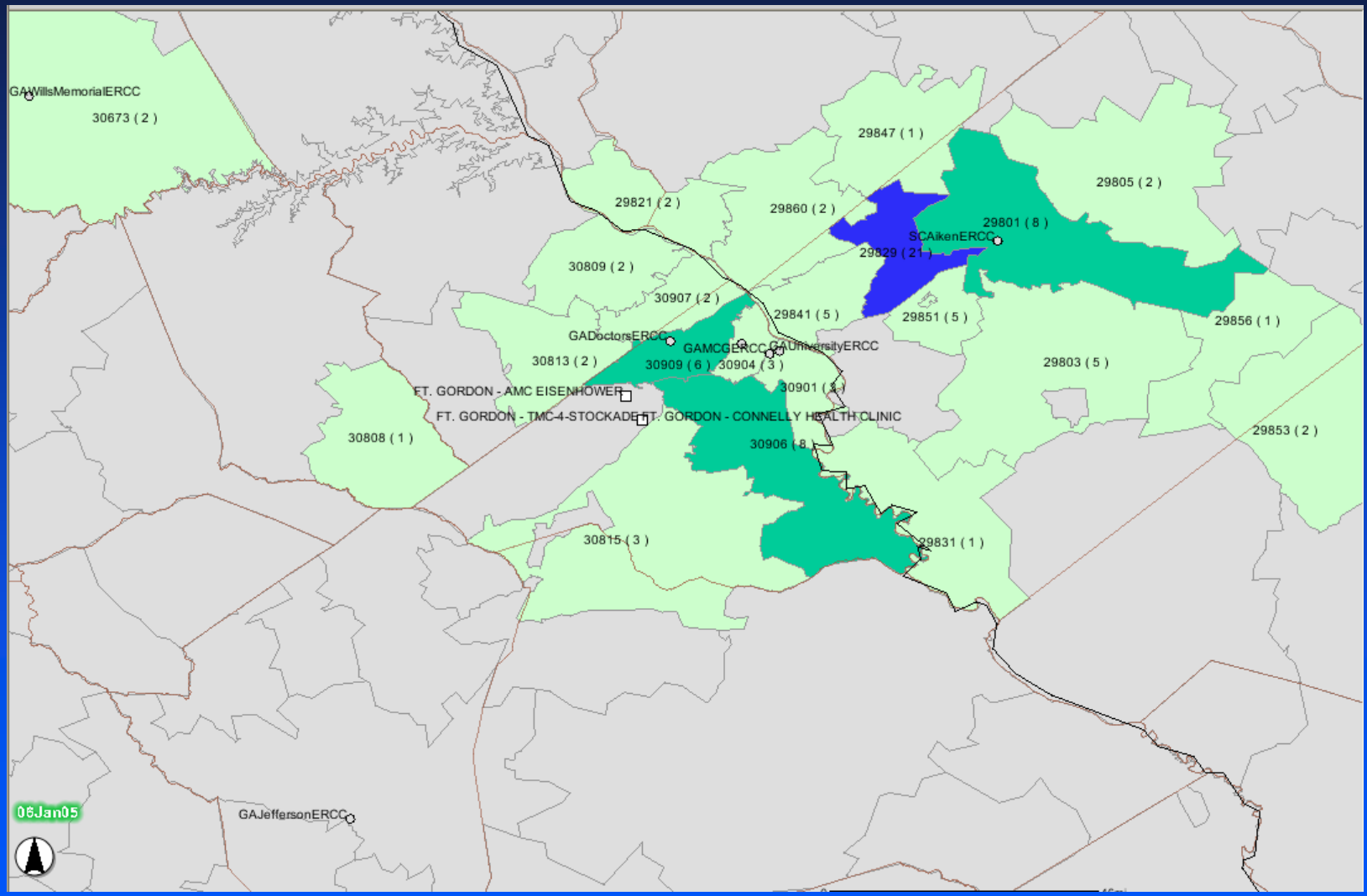
On January 6, 2005, two freight trains collided in Graniteville, South Carolina (approximately 10 miles northeast of Augusta, Georgia), releasing an estimated 11,500 gallons of chlorine gas, which caused nine deaths and sent at least 529 persons seeking medical treatment for possible chlorine exposure.



Location of Medical Facilities Collecting Data for JSIPP During the Accident



Residence of Patients Seen at Local Hospitals In the Respiratory Syndrome



Learning Opportunities and Feedback into the Continuum

Surveillance Collaborations Provide Adoption & Basis for New Surveillance Functionality

Seedling	BioAlirt	JSIPP	BioWatch
		Camp Lejeune, NC	Veterans Health Admin.
	Maryland DHMH	Pope AFB, NC	Washington DoH
	Virginia DOH	Barksdale AFB, LA	Santa Clara DoH
Maryland DHMH	DC DOH	Ft. Campbell, KY	Missouri DoH
	DoD GEISWRAIR	Ft. Gordon, GA	Marion Co. DoH
		San Diego, CA	LA County DoH
		Ft. Lewis, WA	Cook Co. DoH
		Dahlgren, VA	Tarrant Co. DoH
		Robins AFB, GA	Miami DoH
			Milwaukee DoH

Y2K

Regional Surveillance

Regional Collaborations

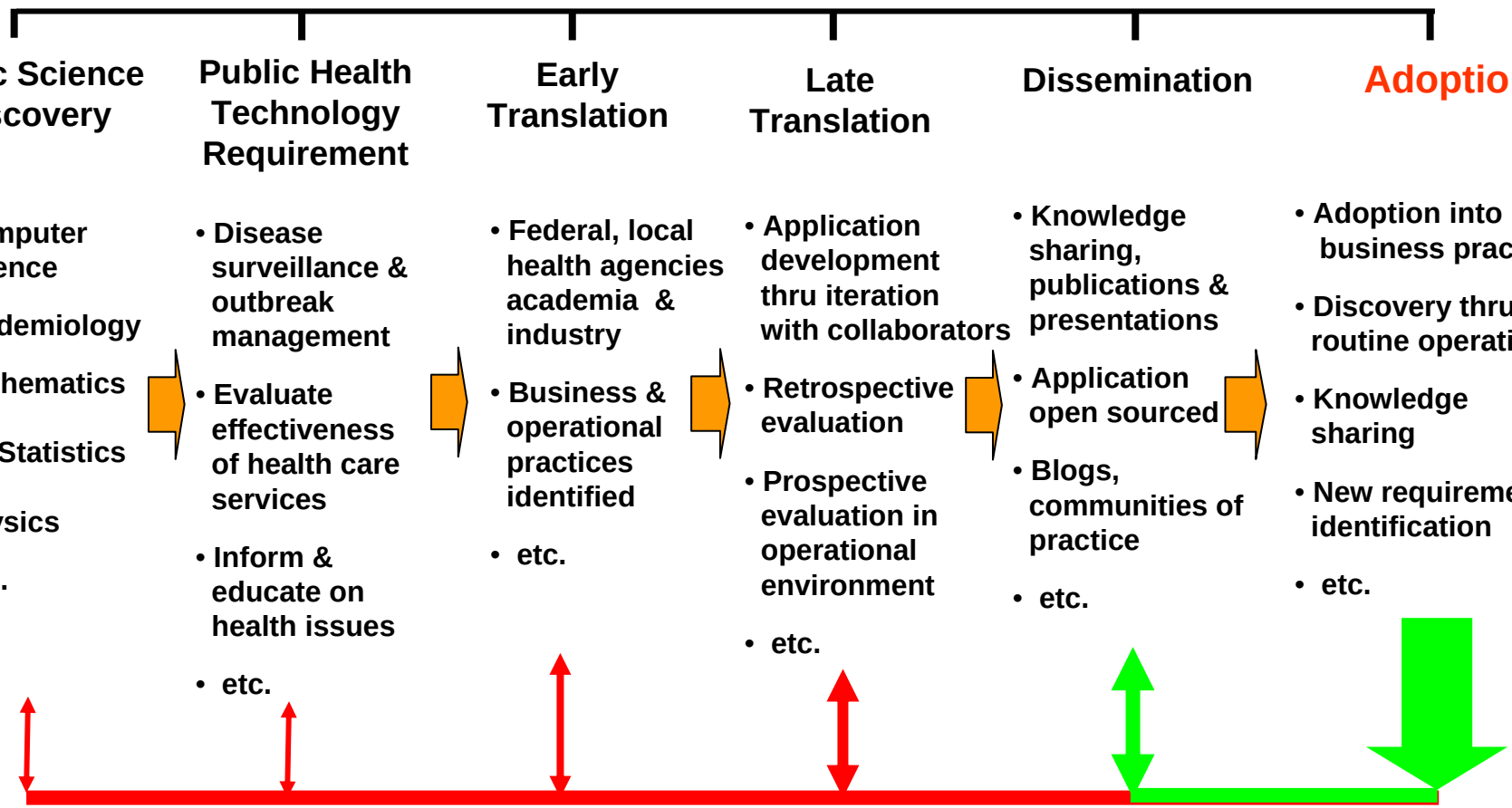
Wealth of Feedback

Feedback into the Continuum from Presentations or Posters on Studies Supported by the ESSENCE Application

Syndromic Surveillance Conference 2008, December 3-5, 2008

1. Improvement in Performance of Ngram Classifiers with Frequency Updates, P. Brown et al.
2. Evaluation of Body Temperature to Classify Influenza-Like Illness (ILI) in a Syndromic Surveillance System, M. Atherton, et al.
3. Comparison of influenza-like Illness Syndrome Classification Between Two Syndromic Surveillance Systems, T. Azarian, et al.
4. Monitoring *Staphylococcus* Infection Trends with Biosurveillance Data, A. Baer, et al.
5. How Bad Is It? Using Biosurveillance Data to Monitor the Severity of Seasonal Flu, A. Baer, et al.
6. Socio-demographic and temporal patterns of Emergency Department patients who do not reside in Miami-Dade County, 2007, R. Borroto, et al.
7. Enhancing Syndromic Surveillance through Cross-border Data Sharing, B. Fowler, et al.
8. Early Identification of *Salmonella* Cases Using Syndromic Surveillance, H. Brown, et al.
9. Support Vector Machines for Syndromic Surveillance, A. Buczak, et al.
10. Evaluation of Alerting Sparse-Data Streams of Population Healthcare-Seeking Data, H. Burkom, et al.
11. Use of Syndromic Surveillance of Emergency Room Chief Complaints for Enhanced Situational Awareness during Wildfires, Florida, 2008, A. Kite-Powell et al.
12. North Texas School Health Surveillance: First-Year Progress and Next Steps, T. Powell, et al.
13. Utilizing Emergency Department Data to Evaluate Primary Care Clinic Hours, J. Lincoln, et al.
14. Application of Nonlinear Data Analysis Methods to Locating Disease Clusters, L. Moniz, et al.
15. Innovative Uses for ESSENCE to Improve Standard Communicable Disease Reporting Practices in Miami-Dade County, E. O'Connell, et al.
16. Substance Abuse Among Youth in Miami-Dade County, 2005-2007, E. O'Connell, et al.
17. ESSENCE Version 2.0: The Department of Defense's World-wide Syndromic Surveillance System Receives Several Enhancements, D. Pattie, et al.
18. Framework for the Development of Response Protocols for Public Health Syndromic Surveillance Systems, L. Uscher-Pines, et al.
19. A Survey of Usage and Response Protocols of Syndromic Surveillance Systems by State Public Health Departments in the United States, L. Uscher Pines, et al.
20. Amplification of Syndromic Surveillance's Role in Miami-Dade County, G. Zhang, et al.
21. Using ESSENCE to Track a Gastrointestinal Outbreak in a Homeless Shelter in Miami-Dade County, 2008, G. Zhang, et al.

Feedback into the Continuum Through Operational Experiences

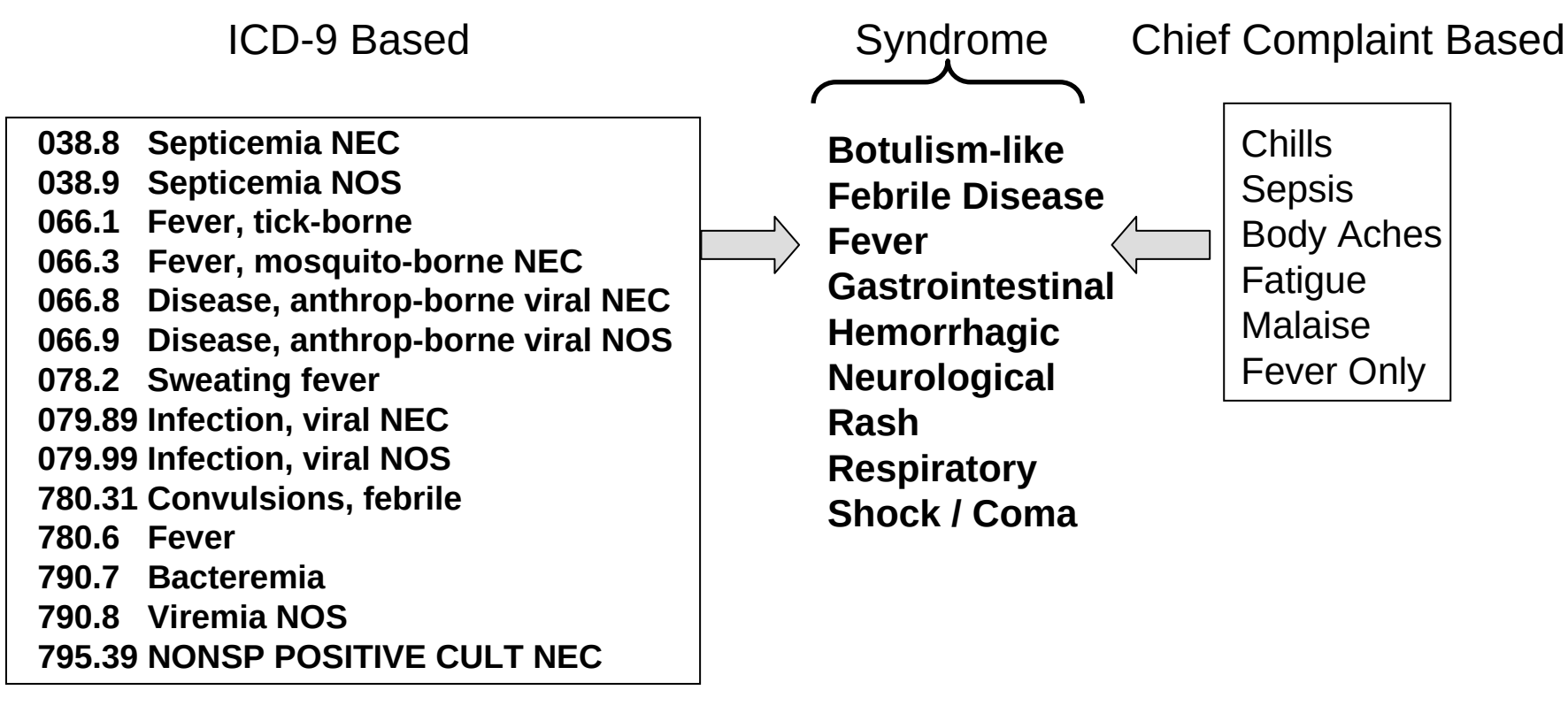


Feedback into the Continuum
Limitations of Existing Syndromic Surveillance

1) Syndromic groupings create performance constraints

Feedback into the Continuum
Limitations of Existing Syndromic Surveillance

1) Are syndrome groupings the best way to perform surveillance?



Feedback into the Continuum
Limitations of Existing Syndromic Surveillance

1) Syndromic groupings create performance limitations

Feedback into the Continuum
Limitations of Existing Syndromic Surveillance

1) Syndromic groupings create performance limitations
   - Large groups create a noisy background level

Feedback into the Continuum
Limitations of Existing Syndromic Surveillance

1) Syndromic groupings create performance limitations

- Large groups create a noisy background level
- **Signals must be strong enough to be distinguished above the background**

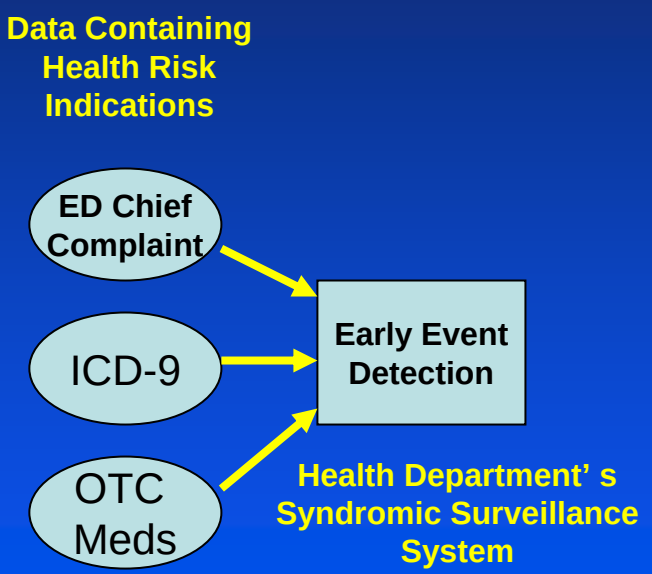
Feedback into the Continuum
Limitations of Existing Syndromic Surveillance

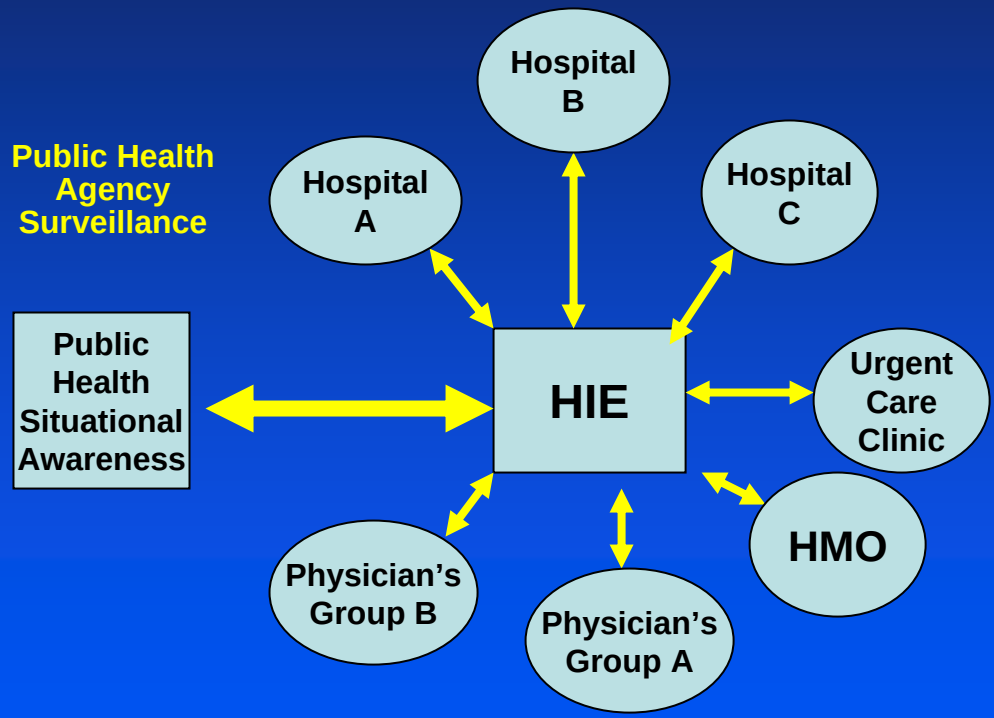
1) Syndromic groupings create performance limitations

- Large groups create a noisy background level
- Signals must be strong enough to be distinguished above the background
- **Fixed number of predefined syndromes limit system usefulness for discovery of immediate health risk**

Changing Environment for Public Health Surveillance & Its impact on Performance

Existing Surveillance Focus → **Health Information Exchanges**





Non Specific Data Sources → **Electronic Medical Records**

Accessing Linked Medical Records for Public Health Situational Awareness

Informed Alerting

Disease Identification

Outbreak Management

Emerging Risks

Effective use of the Electronic Medical Record Enables Situational Awareness

Feedback into the Continuum
Limitations of Existing Syndromic Surveillance

1) **Syndromic groupings create performance limitations**
   - Large groups create a noisy background level
   - Signals must be strong enough to be distinguished above the background
   - Fixed number of predefined syndromes limit system usefulness for discovery of immediate health risk
2) **Effective utilization of multiple data streams**

Current Disease Surveillance Analytics Approach

ED Chief Complaints

OTC Medication Sales

Lab Requests / Results

Detection of Abnormal Levels for a Syndrome

Temporal Algorithms
Spatial Algorithms

Temporal Algorithms
Spatial Algorithms

Temporal Algorithms
Spatial Algorithms

Alerting & Notification for a Syndrome or Disease

Alerting

Adding data sources increases the statistical false positives

Current Disease Surveillance Analytics Approach

ED Chief Complaints

OTC Medication Sales

Lab Requests / Results

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- Temporal Algorithms
- Spatial Algorithms
- Temporal Algorithms
- Spatial Algorithms
- Temporal Algorithms
- Spatial Algorithms

Alerting & Notification for a Syndrome or Disease

Alerting

Alert Fatigue

Adding data sources increases the statistical false positives

Feedback into the Continuum
Limitations of Existing Syndromic Surveillance

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   - Signals must be strong enough to be distinguished above the background
   - Fixed number of predefined syndromes limit system usefulness for discovery of immediate health risk
2) **Effective utilization of multiple data streams**
   - **Clinical findings are most relevant on the individual patient level**

Feedback into the Continuum
Limitations of Existing Syndromic Surveillance

1) Syndromic groupings create performance limitations

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2) Effective utilization of multiple data streams

- Clinical findings are most relevant on the individual patient level
- **Creates additional false positives if the *relationships among the data streams aren't known and included in the algorithms***

Feedback into the Continuum
Limitations of Existing Syndromic Surveillance

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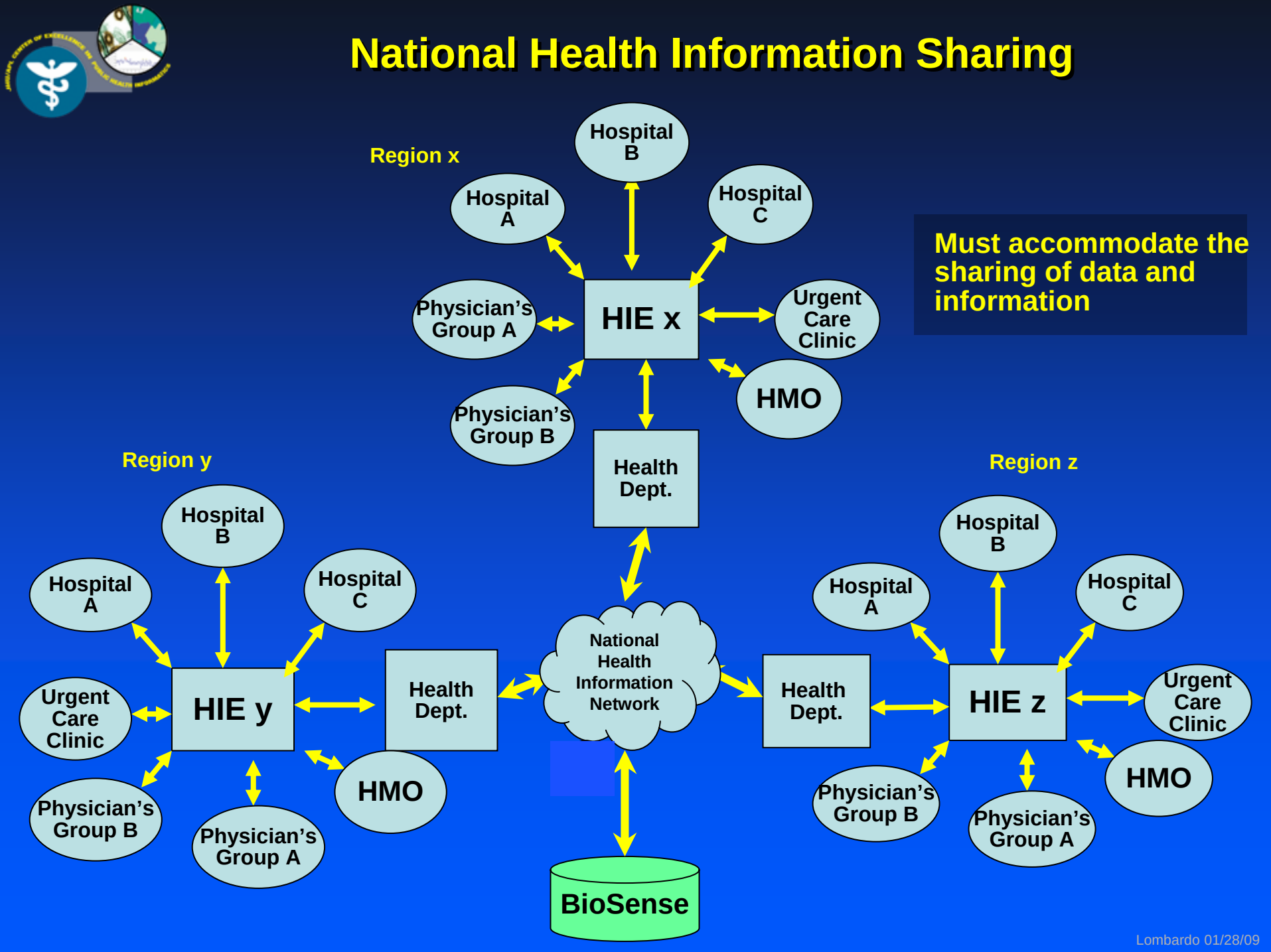
2) Effective utilization of multiple data streams

- Clinical findings are most relevant on the individual patient level
- Creates additional false positives *if the relationships among the data streams aren't known and included in the algorithms*

3) Data and information sharing

National Health Information Sharing



Must accommodate the sharing of data and information

Feedback into the Continuum
Limitations of Existing Syndromic Surveillance

1) Syndromic groupings create performance limitations

- Large groups create a noisy background level
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2) Effective utilization of multiple data streams

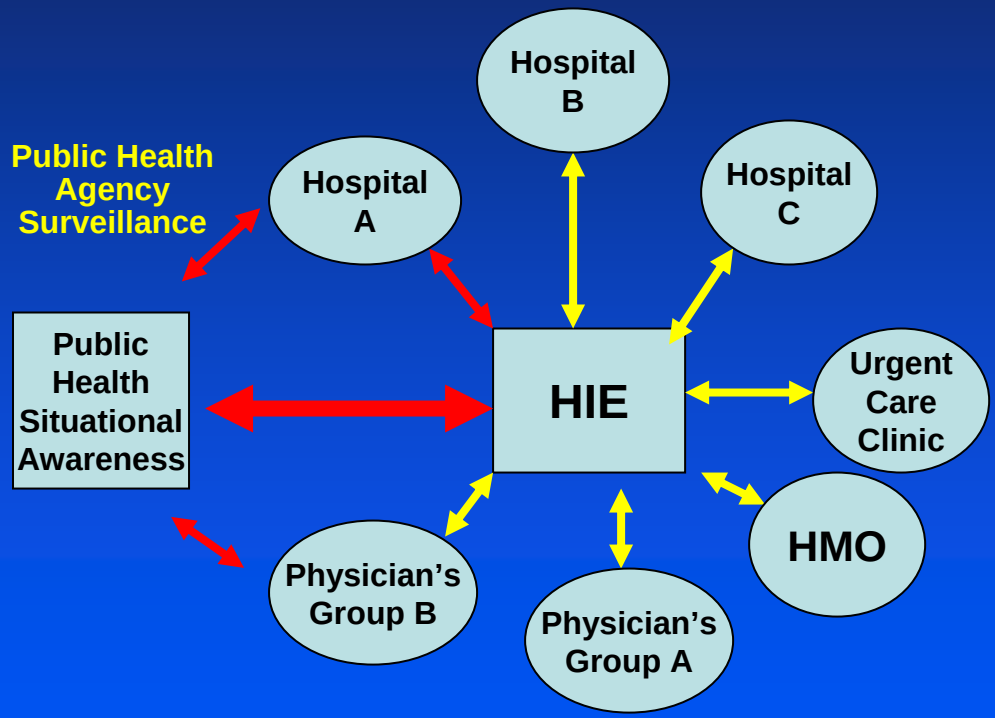
- Clinical findings are most relevant on the individual patient level
- Creates additional false positives if the relationships among the data streams aren't known and included in the algorithms

3) Data and information sharing

- HIPAA and identity theft have placed limitations on data sharing among public health agencies
- **State laws restrict sending data captured for surveillance purposes outside state boundaries**

Information Must Be Shared Among Public Health and Health Care Systems

Health Information Exchanges



Electronic Medical Records

Feedback into the Continuum
Limitations of Existing Syndromic Surveillance

1) Syndromic groupings create performance limitations

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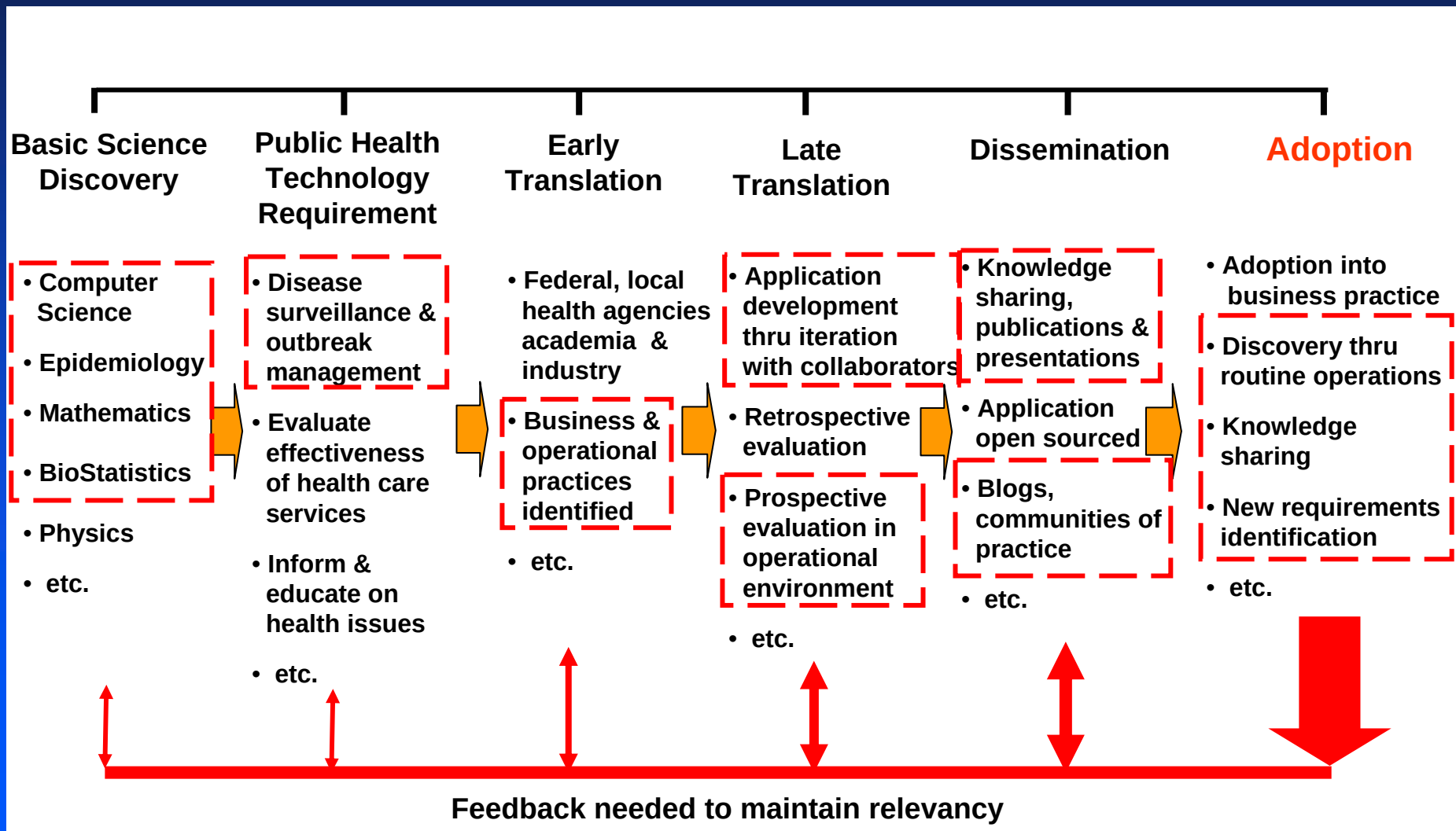
3) Data and information sharing

- HIPAA and identity theft have placed limitations on data sharing among public health agencies
- State laws restrict sending data captured for surveillance purposes outside state boundaries
- Healthcare delivery must be aware of public health concerns
- **Information to support public health surveillance information should be obtained during patient encounters**

Current Feedback Paths Into the Translational Research Continuum



Requirements Iteration Obtained Through Adoption

Operationally Identified Surveillance Requirement:

1) Ability to perform surveillance for specific populations by performing advanced queries on linked clinical data from medical records

2) Ability to create rules to customize the detectors for the specific populations or events being monitored

3) Informatics tools are needed that permit epidemiologists and disease monitors to create new surveillance objects without enlisting the support of IT system specialists

4) Health risks must be shared between health care and other public health agencies

Current Disease Surveillance Analytics Approach

ED Chief Complaints

OTC Medication Sales

Lab Requests / Results

Detection of Abnormal Levels for a Syndrome

Temporal Algorithms
Spatial Algorithms

Temporal Algorithms
Spatial Algorithms

Temporal Algorithms
Spatial Algorithms

Alerting & Notification for a Syndrome or Disease

Alerting

Alert Fatigue

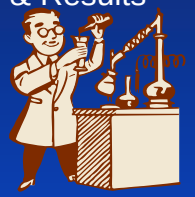
Adding data sources increases the statistical false positives

Moving from Syndromic to Case Specific Surveillance in a Collaborative Environment

Patient Care Delivery

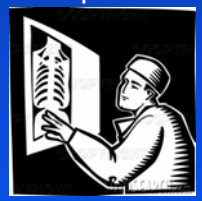
Phone Triage

Lab Requests & Results

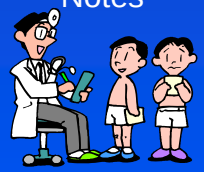


Chief Complaint

Radiology Requests & Reports



Clinic Notes



ICD-9 & CPT Codes

Medications

Medical Record

EMR

HIE

Health Information Exchange

Local Public Health Agency

Newer Version of an Automated Surveillance System

- Information Sharing
- Flexible Alert Criteria
- Advanced Query Tool or Filter

Epidemiologist Initiated Modifications

Health Care & Other PH Agencies

Collaborative Sharing of Surveillance Results

Population Specific Analysis

Sample Project 1: *Advanced Query Tool, AQT*
Analysis of user defined subpopulations

Query 1: Syndrome based

Query 1 = **Syndrome Respiratory**

Query 2: Chief complaint (CC) free-text

Query 2 = **CC *cough*** + **CC *fever***

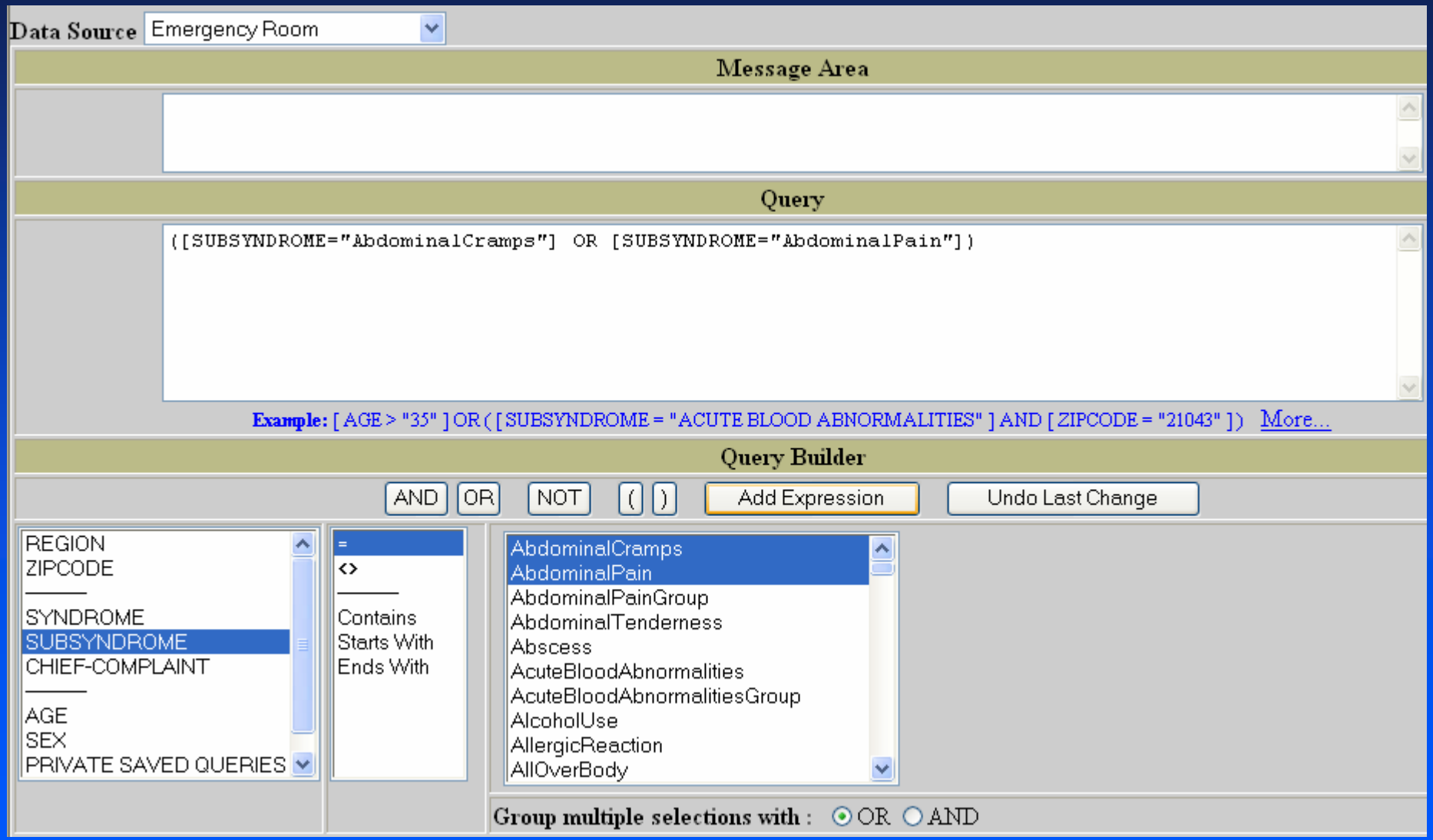
Query 3: Logical combinations that mix all stratifications (chief complaint, syndrome, etc)

Advanced Query 3 = (**Age 0 - 4** + (**Syndrome GI** or **CC *cough***)) + (**Age 18 - 64** + **Lab Confirmed Flu**)

Advanced Query Tool Project

- Ability to include all the data elements that are available to the surveillance system in the query
- Hide the complexity of the underlying data models and query languages
- Allow users to build on-the-fly case definitions using any data element available.

Advanced Query Tool



Further Information on *AQT*

1. Advanced Querying Features for Disease Surveillance Systems, M. Hashemian, et al., Spring 2007 AMIA Conf., May 2007.

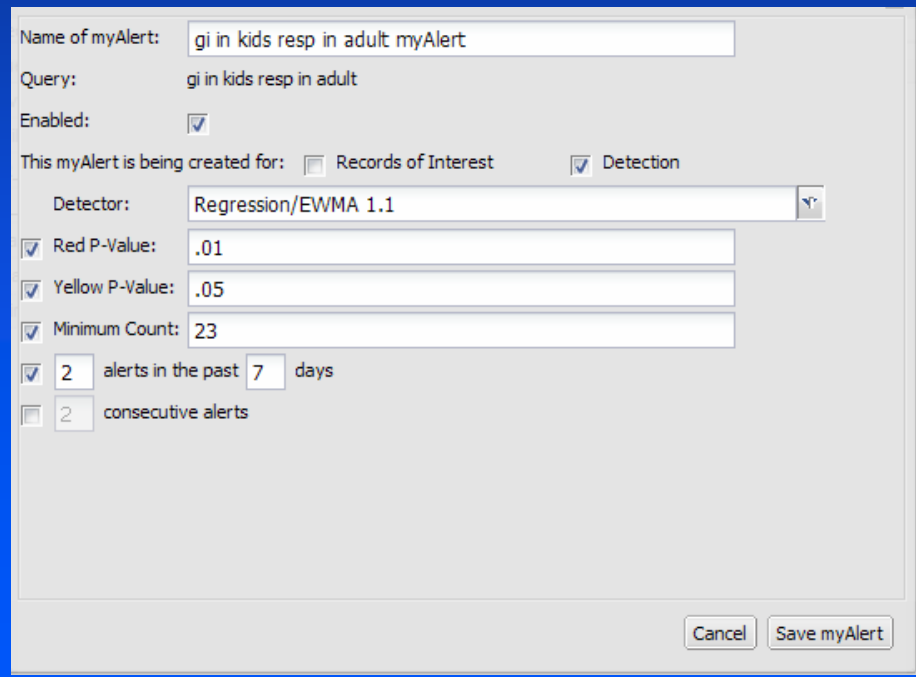
2. Advanced Querying Features for Disease Surveillance Systems, M. Hashemian, et al., 2007 PHIN Conf., Aug. 2007.

3. Advanced Querying Features for Disease Surveillance Systems, M. Hashemian, *Advances in Disease Surveillance 2007;4:97 Available at: http://www.isdsjournal.org/article/view/1993/1547*

Sample Project 2: *My Alerts*

- The ability for a user to generate on-the-fly case definitions lead to the need for those dynamic queries to become part of the health department's day-to-day detection system.
- In addition, because these very specific streams are well understood, specific detection criteria may be required for each individual query.

- myAlerts allows users to save any query, and define exact requirements for an alert to be generated. This may be temporal detection related (threshold for red/yellow alerts, minimum count, # of consecutive days alerting, etc), or can also be flagged
- as "Records of Interest" in which case any patient seen that matches the query will be alerted on.



myAlert Results

Detection based myAlerts

Records of Interest Messages

Manage Alert Definitions

Alerts | Records of Interest

Alert Definition	Date	Data Source	Detector	Level	Count	Expected	Timeseries
chills chiefcomplaint	03Oct06	ER by Patient	Regression/EWMA 1.2	0.049	16	9.86	Timeseries
chills chiefcomplaint	04Oct06	ER by Patient	Regression/EWMA 1.2	0.039	13	9.64	Timeseries
chills chiefcomplaint	06Oct06	ER by Patient	Regression/EWMA 1.2	0.044	16	9.86	Timeseries
fever plus subsyndrome	04Oct06	ER by Patient	Regression/EWMA 1.2	0.039	571	515.46	Timeseries
fever plus subsyndrome	05Oct06	ER by Patient	Regression/EWMA 1.2	0.016	568	516.89	Timeseries
fever syndrome	04Oct06	ER by Patient	Regression/EWMA 1.2	0.005	420	363.36	Timeseries
fever syndrome	05Oct06	ER by Patient	Regression/EWMA 1.2	0.000	424	363.96	Timeseries
fever syndrome	07Oct06	ER by Patient	Regression/EWMA 1.2	0.013	415	366.39	Timeseries
fever syndrome	08Oct06	ER by Patient	Regression/EWMA 1.2	0.006	419	368.32	Timeseries
fever syndrome	10Oct06	ER by Patient	Regression/EWMA 1.2	0.029	415	371.36	Timeseries

Records of Interest based myAlerts

Records of Interest Messages

Manage Alert Definitions

Alerts | Records of Interest

Alert Definition	Date	Geography	Facility	Medical Grouping	Age Group	Sex	Data Details
fever and blood chiefcomplaint	10Oct06	OTHER_REGION		FEVER LOW BLOOD PRESSURE	45-64	Female	Data Details
fever and blood chiefcomplaint	09Oct06	PRINCE GEORGES		CHEST PAIN FEVER BLOOD VMT	18-44	Female	Data Details
fever and blood chiefcomplaint	08Oct06	PRINCE WILLIAM		COUGHING BLOOD FEVER	5-17	Female	Data Details
fever and blood chiefcomplaint	07Oct06	OTHER_REGION		FEVER LOW BLOOD PRESSURE	45-64	Female	Data Details
fever and blood chiefcomplaint	06Oct06	PRINCE GEORGES		CHEST PAIN FEVER BLOOD VMT	18-44	Female	Data Details
fever and blood chiefcomplaint	05Oct06	PRINCE WILLIAM		COUGHING BLOOD FEVER	5-17	Female	Data Details
fever and blood chiefcomplaint	05Oct06	WASHINGTON		FEVER SPITTING BLOOD	65+	Male	Data Details
fever and blood chiefcomplaint	05Oct06	WASHINGTON		FEVER SPITTING BLOOD	65+	Male	Data Details
fever and blood chiefcomplaint	04Oct06	OTHER_REGION		FEVER LOW BLOOD PRESSURE	45-64	Female	Data Details
fever and blood chiefcomplaint	03Oct06	PRINCE GEORGES		CHEST PAIN FEVER BLOOD VMT	18-44	Female	Data Details

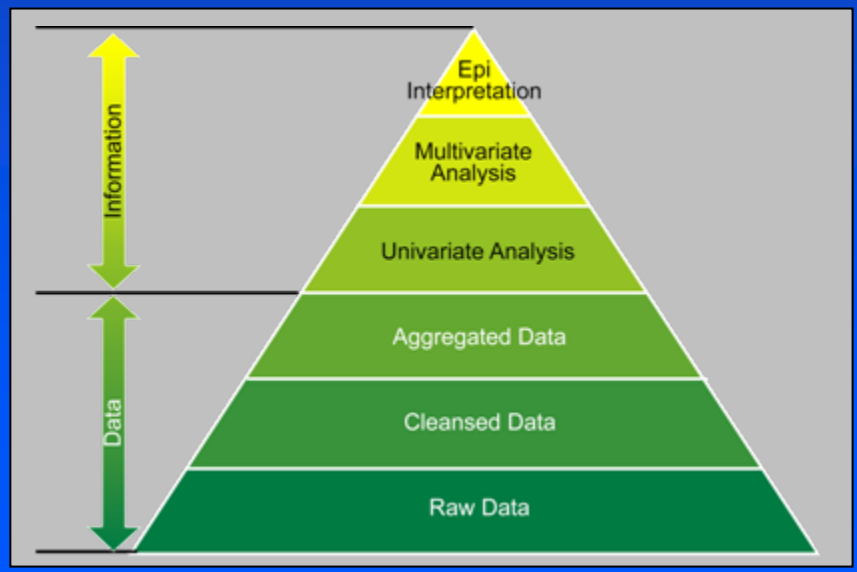
Additional information on *My Alerts*

1. Resolving the 'Boy Who Cried Wolf' Syndrome, M. Coletta, et al., 2006 ISDS Conference, Oct. 2006, *Advances in Disease Surveillance 2007;2:99. Available at: http://www.isdsjournal.org/article/view/2112/1668*

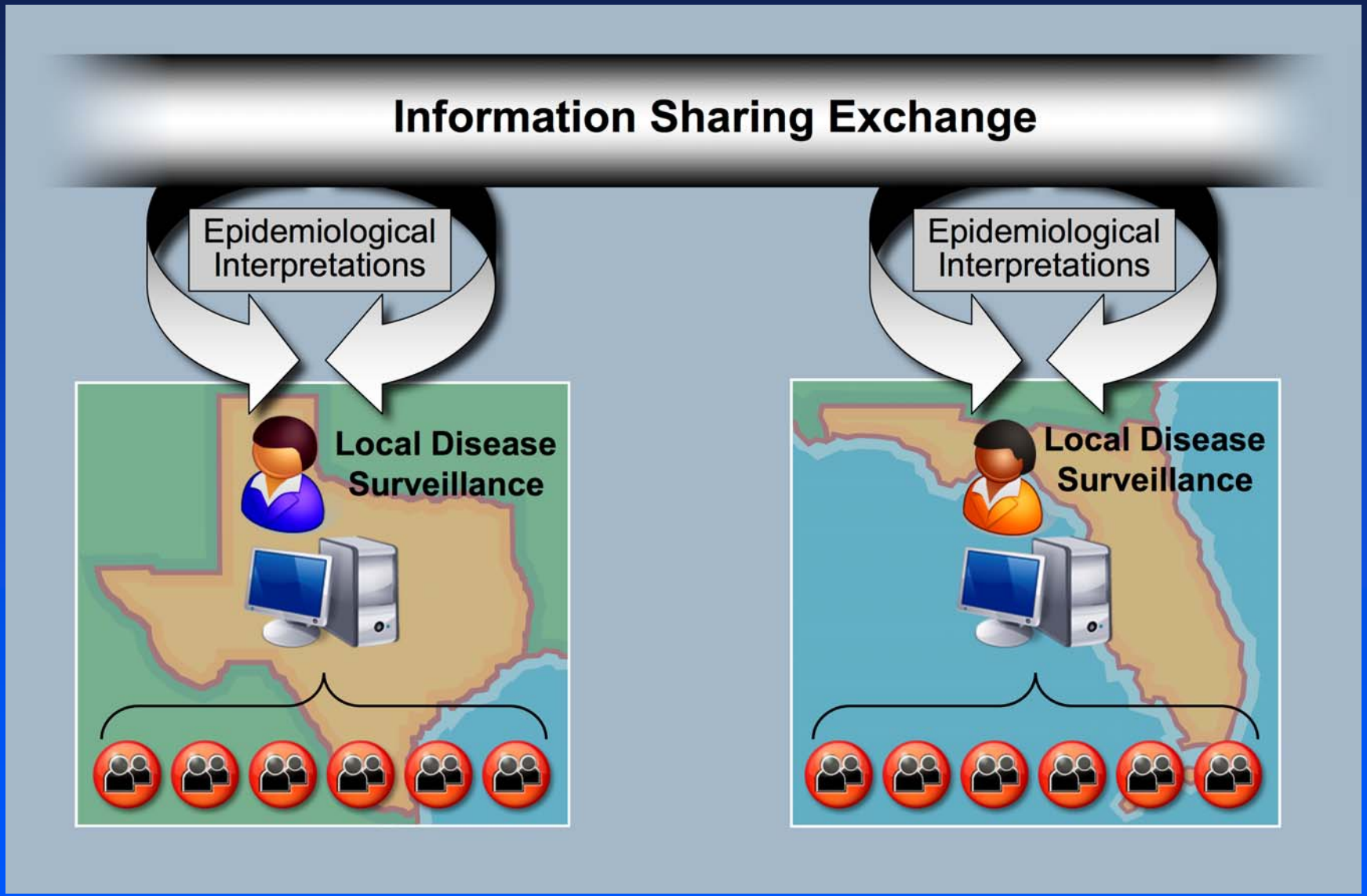
2. *myAlerts*: User-Defined Detection in Disease Surveillance Systems, W. Loschen, et al., Submitted for Presentation at the 2009 Spring AMIA Conference.

Sample Project 3: *Infoshare*
Overcoming Data Sharing Obstacles

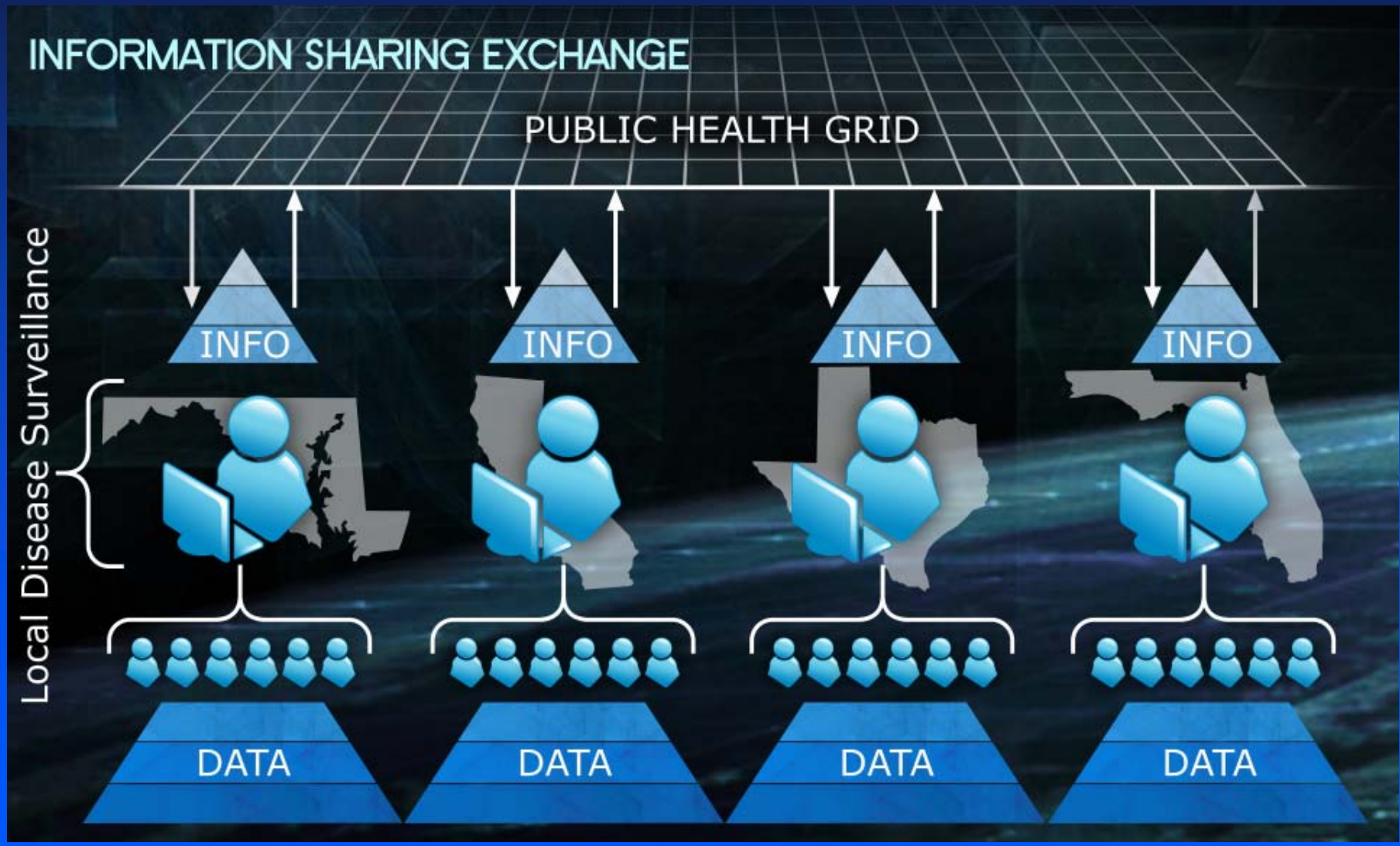
Epi Interpretation	Epi: “Respiratory outbreak we are currently investigating”
Multivariate Analysis	Fusion Detector: Respiratory has a Red Alert across 3 of 5 sources
Univariate Analysis	Detector: ER Respiratory visits are 4 times the normal rate
Aggregated Data	247 ER Respiratory visits, 1647 OTC Respiratory products sold
Cleansed Data	John Doe, 26, M, Sore Throat Jane Doe, 20, F, Shortness of Breath ...
Raw Data	John Doe, 26, M, Sore Throat John Doe, 26, M, Sore Throat Jane Doe, 1987, Female, SoB ...



Information Exchange Concept

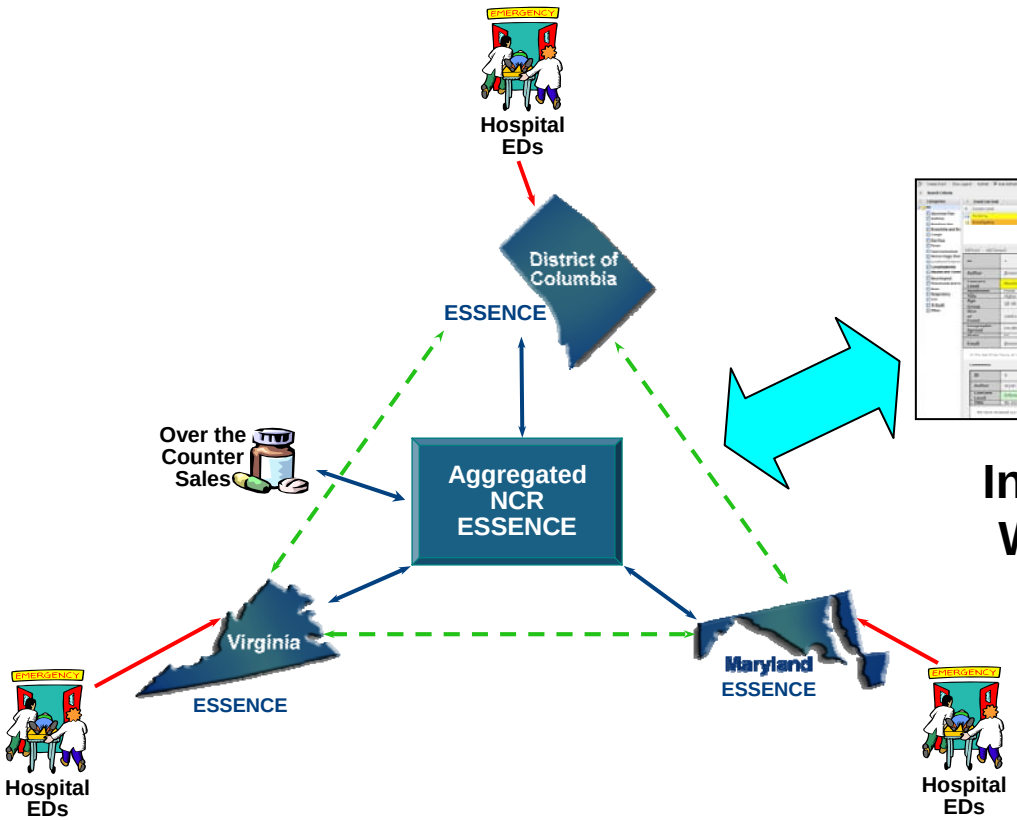


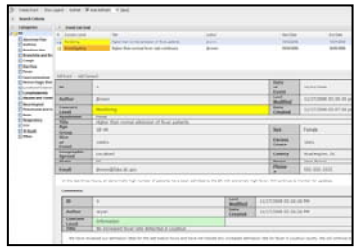
Information Sharing on the Grid



Infoshare Used for the Inaugural NCR Regional Collaboration

NCR Disease Surveillance Network

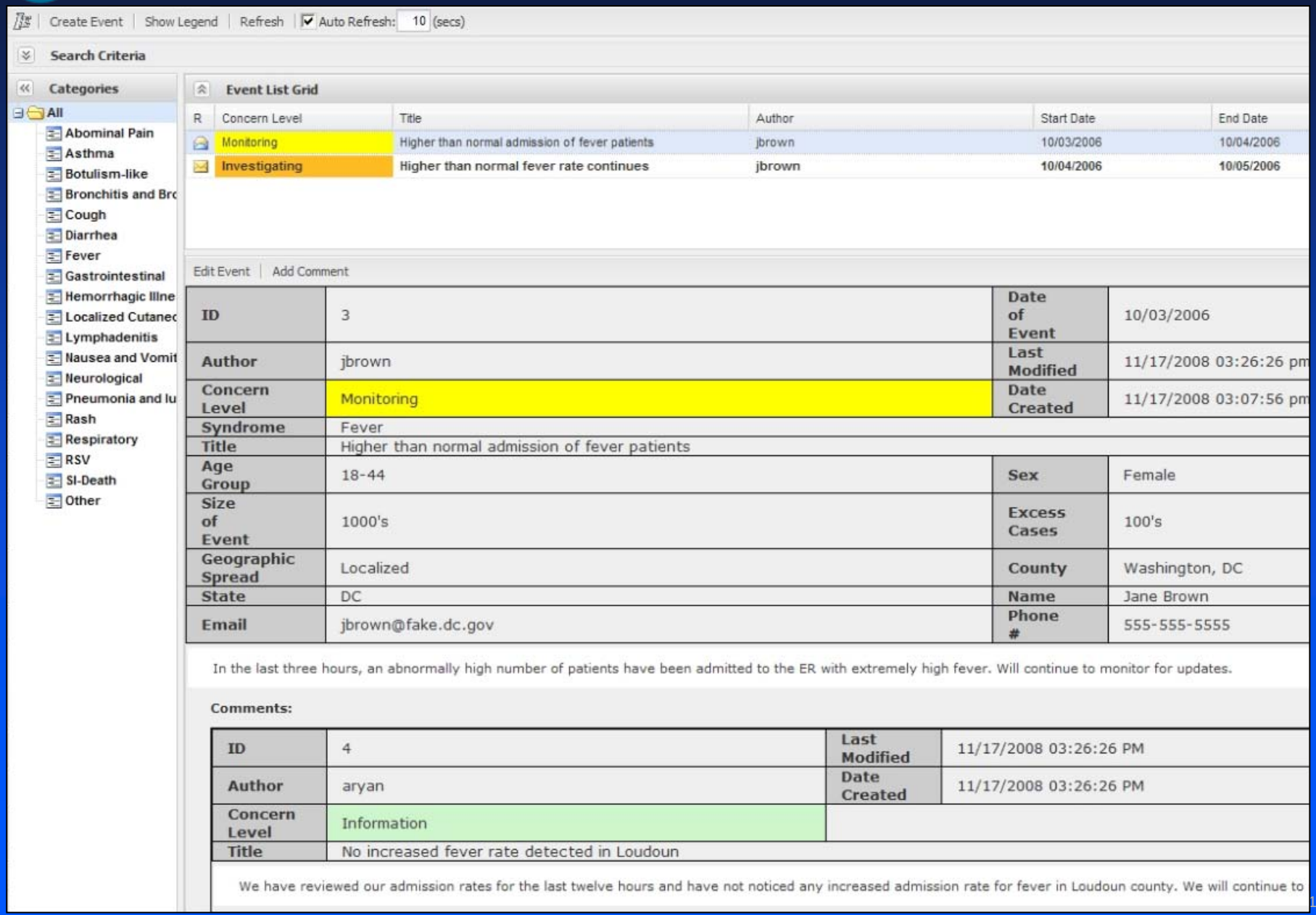




Infoshare Website

Bio Intelligence Center

Inaugural *Infoshare* Site



Create Event | Show Legend | Refresh | Auto Refresh: 10 (secs)

Search Criteria

Categories

- All
  - Abominal Pain
  - Asthma
  - Botulism-like
  - Bronchitis and Bro
  - Cough
  - Diarrhea
  - Fever
  - Gastrointestinal
  - Hemorrhagic Illne
  - Localized Cutaneo
  - Lymphadenitis
  - Nausea and Vomit
  - Neurological
  - Pneumonia and lu
  - Rash
  - Respiratory
  - RSV
  - SI-Death
  - Other

Event List Grid

R	Concern Level	Title	Author	Start Date	End Date
	Monitoring	Higher than normal admission of fever patients	jbrown	10/03/2006	10/04/2006
	Investigating	Higher than normal fever rate continues	jbrown	10/04/2006	10/05/2006

Edit Event | Add Comment

ID	3	**Date of Event**	10/03/2006
Author	jbrown	**Last Modified**	11/17/2008 03:26:26 pm
Concern Level	Monitoring	**Date Created**	11/17/2008 03:07:56 pm
Syndrome	Fever		
Title	Higher than normal admission of fever patients		
Age Group	18-44	**Sex**	Female
Size of Event	1000's	**Excess Cases**	100's
Geographic Spread	Localized	**County**	Washington, DC
State	DC	**Name**	Jane Brown
Email	jbrown@fake.dc.gov	**Phone #**	555-555-5555

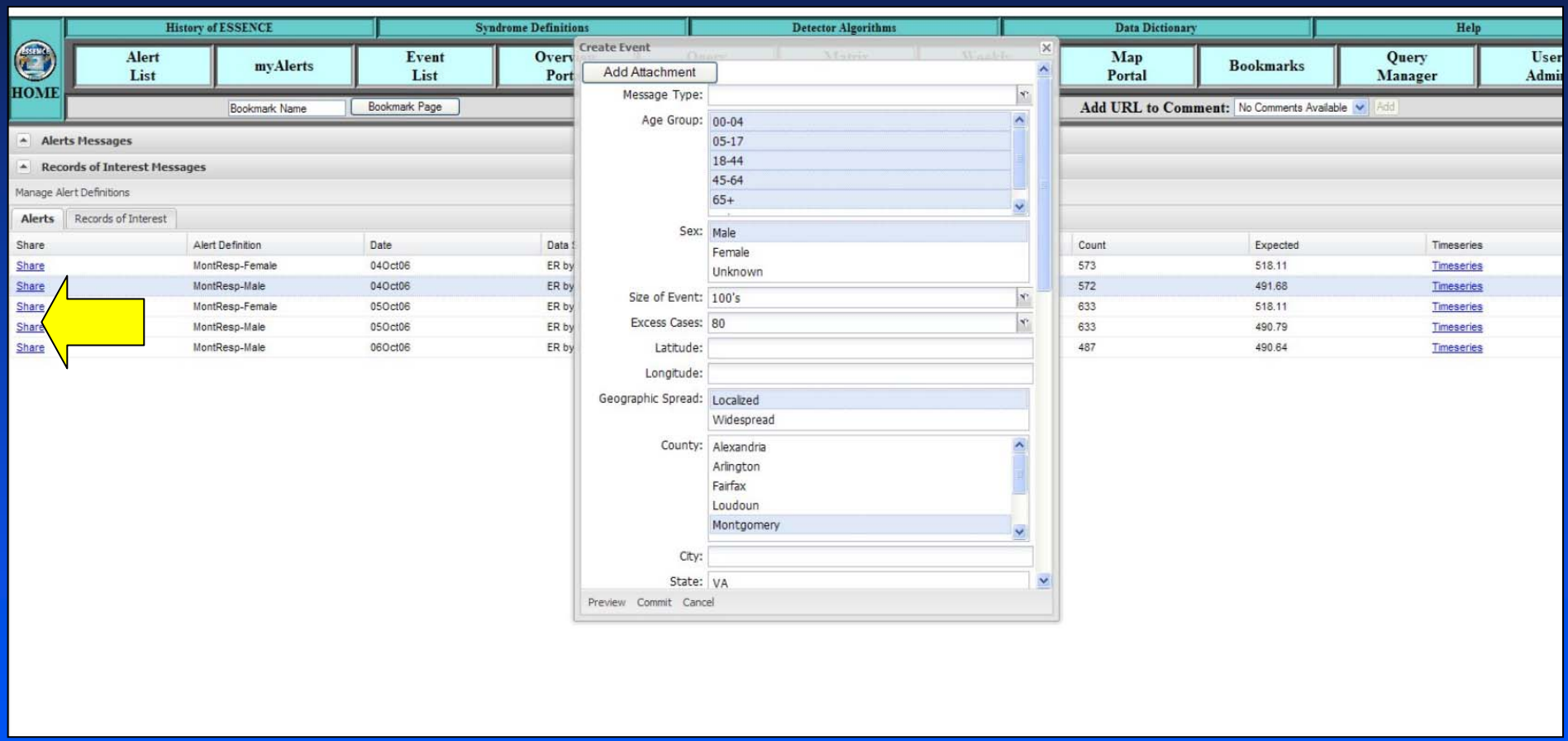
In the last three hours, an abnormally high number of patients have been admitted to the ER with extremely high fever. Will continue to monitor for updates.

Comments:

ID	4	**Last Modified**	11/17/2008 03:26:26 PM
Author	aryan	**Date Created**	11/17/2008 03:26:26 PM
Concern Level	Information		
Title	No increased fever rate detected in Loudoun		

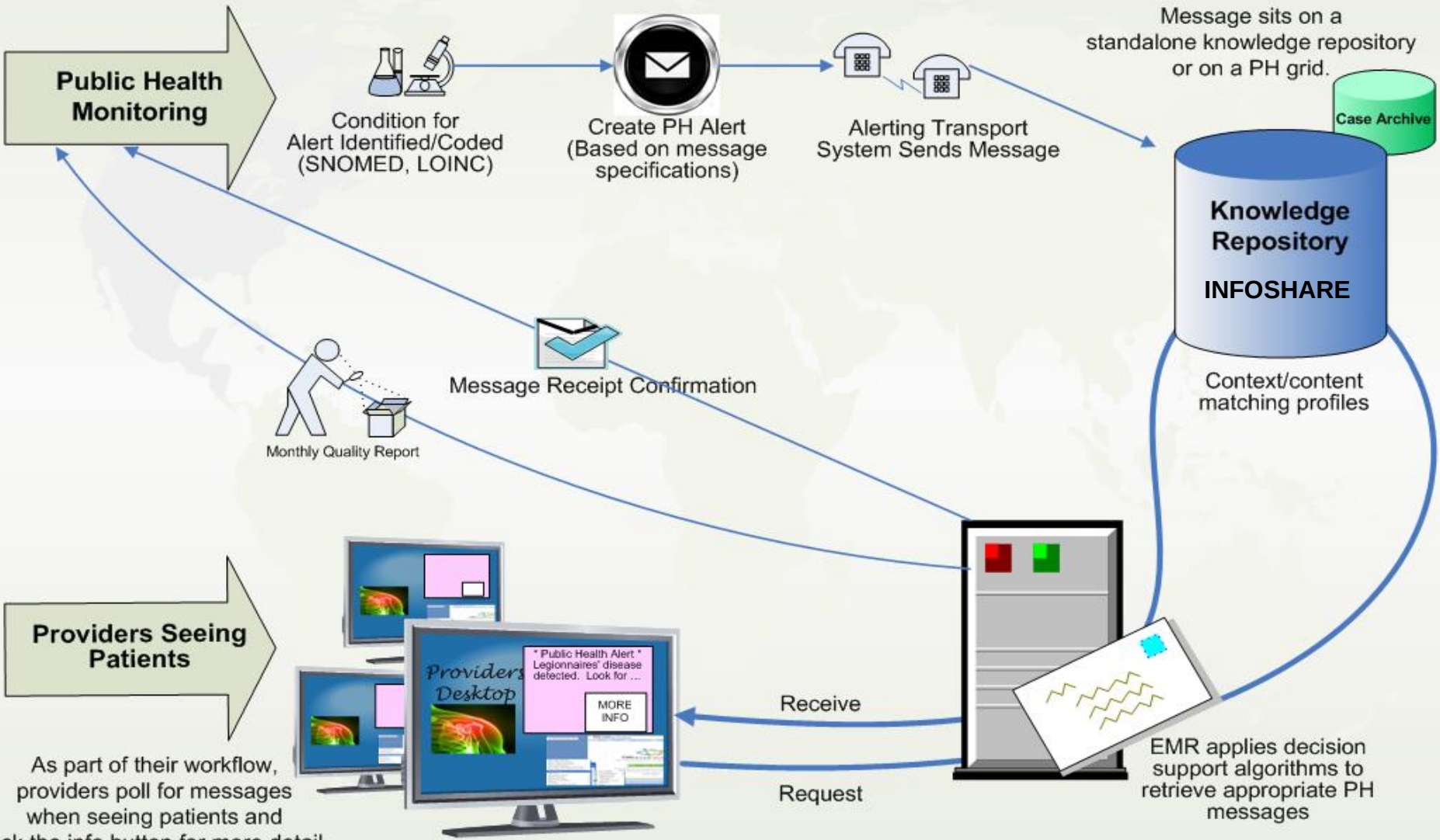
We have reviewed our admission rates for the last twelve hours and have not noticed any increased admission rate for fever in Loudoun county. We will continue to

Linkage within ESSENCE to *Infoshare*



New Share Button added to myAlerts.
This allows users to create InfoShare messages directly from ESSENCE with most message fields pre-filled out.

CDC EMR Alerting Concept Diagram Alerting Data Flow v15
DRAFT



Courtesy Nedra Garrett, CDC

Additional Information on *InfoShare*

1. Moving Data to Information Sharing in Disease Surveillance Systems, W. Loschen, et al., Spring 2007 AMIA Conference, May 2007.

2. Event Communications in a Regional Disease Surveillance System, W. Loschen, et al. AMIA 2007 Annual Symposium, Nov. 12, 2007.

3. Enhancing Event Communication in Disease Surveillance: ECC 2.0,N. Tabernero, et al., 2007 PHIN Conference, Aug. 2007.

4. Enhancing Event Communication in Disease Surveillance: ECC 2.0, N. Tabernero, el al., Advances in Disease Surveillance 2007;4:197. Available online at: http://www.isdsjournal.org/article/view/2112/1668

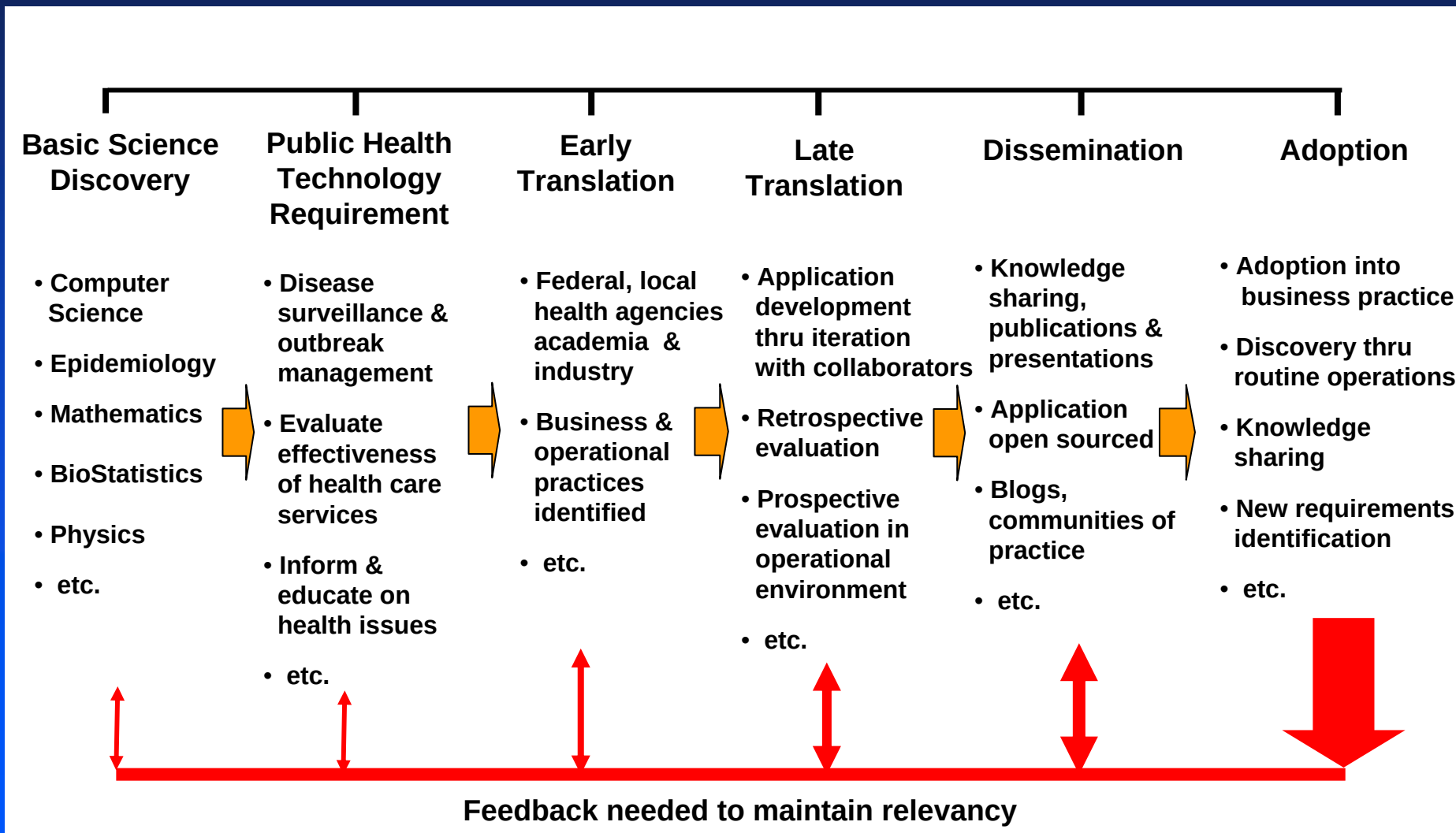
5. Super Bowl Surveillance: A Practical Exercise in Inter-Jurisdictional Public Health Information Sharing, C. Sniegoski, *Advances in Disease Surveillance 2007;4:195.* Available online at: http://www.isdsjournal.org/article/view/2106/1666

6. Structured Information Sharing in Disease Surveillance Systems, W. Loschen, et al., *Advances in Disease Surveillance 2007;4:101.* Available online at: http://www.isdsjournal.org/article/view/1997/1552

7. Disease Surveillance Information Sharing , N. Tabernero, et al., 2008 PHIN Conference, Aug. 2008.

8. Methods for Information Sharing to Support Health Monitoring, W. Loschen, APL Technical Digest. 2008; 27(4): 340-346. Available online at: http://techdigest.jhuapl.edu/td2704/loschen.pdf

Is this the Correct Translational Research Continuum for Public Health Informatics?



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Prince George's County Department of Health
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Charley Magruder

University of Utah

Catherine Staes

Matthew Samore

General Electric Healthcare

Keith Boone

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Discussion

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