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HIT Summit

Leveraging HIT for Public Health Surveillance

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Public Health Information Infrastructure, the Public Health Information Network, and Disease Surveillance

Public Health Information Infrastructure

Public Health Information Network (PHIN)

- CDC's initiative to enable consistent exchange of response, health, and disease tracking data.
- Comprises five key functions…

  detection and monitoring, data analysis, knowledge management, alerting, and response;

  …with systems that enable…

  real-time data flow, computer assisted analysis, decision support, professional collaboration, and rapid dissemination of information.

phin

PUBLIC HEALTH INFORMATION NETWORK

Components of the PHIN

- **Standards** – PHIN Messaging and vocabulary standards
- **BioWatch, BioSense** – Accessing and analyzing diagnostic and pre-diagnostic health data
- **National Electronic Disease Surveillance System (NEDSS)** – disease surveillance, electronic laboratory reporting
- **Laboratory Response Network (LRN)** – diagnostic capacity and information delivery
- **Epidemiology Information Exchange (EPI-X)** – Secure, interactive communications
- **Outbreak Management System (OMS)** – Secure, distributed outbreak management
- **Health Alert Network (HAN)** – Internet connectivity, alerting and distance learning

Motivations for the PHIN

1. Health preparedness and response involves many organizations working together and exchanging information.
2. The information cycle is too long and frequently involves the manual exchange of data.
3. Decisions require rapid access to specific information.
4. Information systems need to operate reliably and securely during the worst situations.
5. The new realities of terrorism and disease trends require a new level of operation and coordination.

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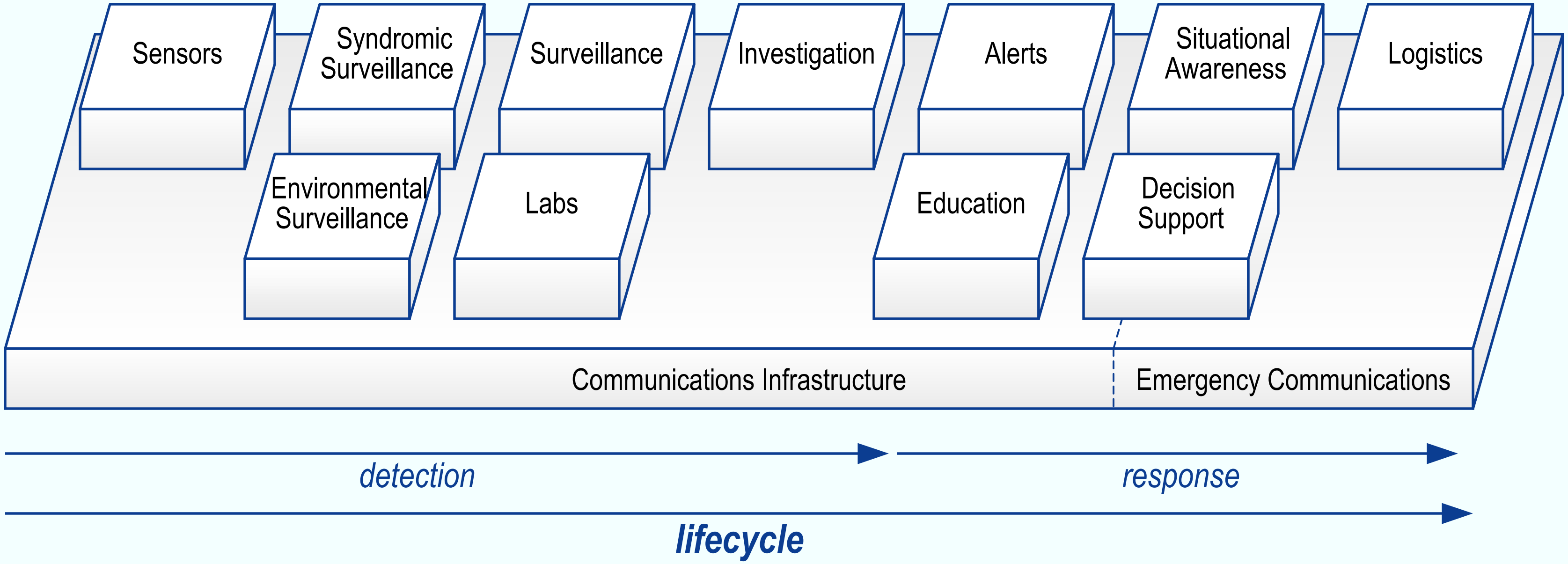
PUBLIC HEALTH INFORMATION NETWORK

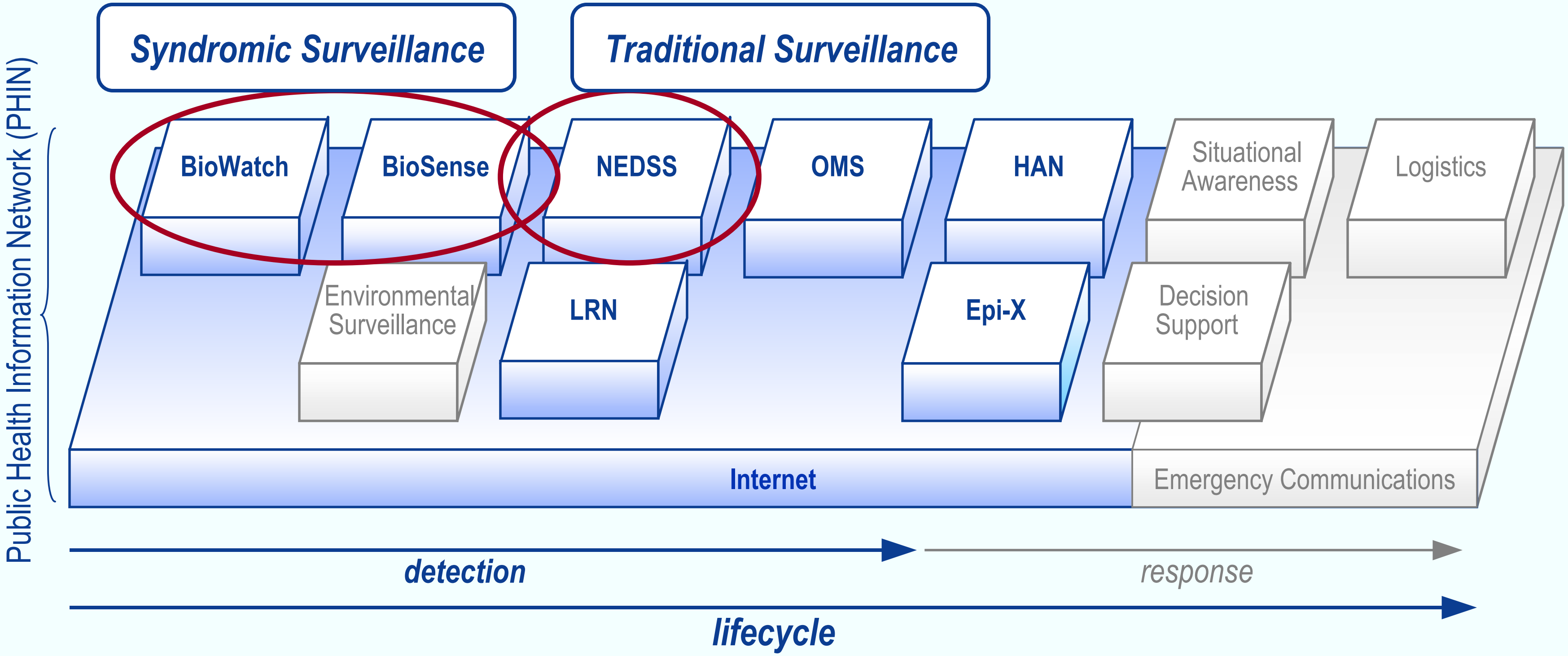
Surveillance

Components of Disease Surveillance and Response



Surveillance

PHIN Components for Disease Surveillance



Syndromic Surveillance Defined

Surveillance:	The close monitoring of a normal person or population for signs of disease.
Syndrome:	A group of related symptoms and signs of a disease or disorder, without a known underlying cause or diagnosis.
Syndromic Surveillance:	In public health, the monitoring of signs and symptoms in a population, often through non-traditional data sources, as a sign of disease.

Motivated by need to detect bioterrorism events.
Leveraged to detect naturally-occurring outbreaks

Surveillance Approaches

Traditional Surveillance	*Syndromic Surveillance*
Use data from death records, reportable cases, and confirming diagnostic tests.	Use data from non-traditional sources such as 911 calls, nurse-line calls, ED complaints, drug sales.
Rely on confirmed diagnoses.	Rely on syndromes, before a diagnosis is available.
Traditional function of public health.	Emerging function of public health.

Promise of Syndromic Surveillance

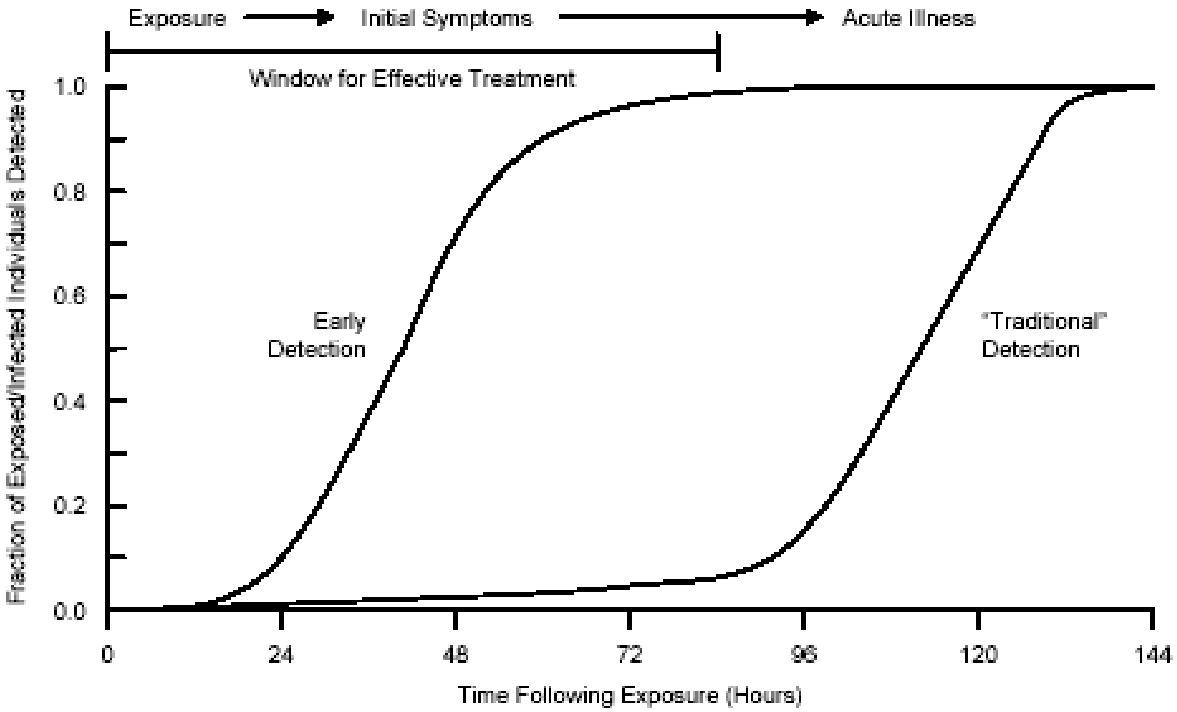
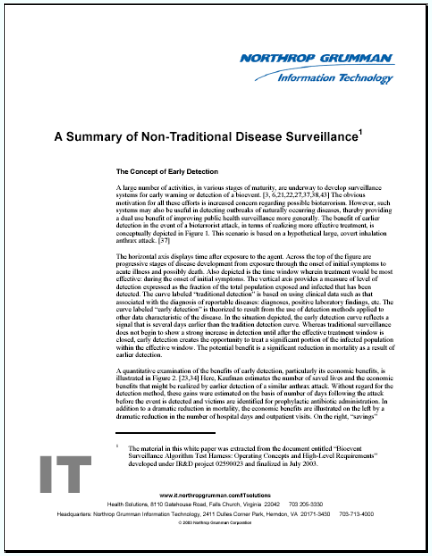


Figure 1. Benefit of early detection of a large, covert inhalation anthrax attack (adapted from a DARPA presentation).



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A Summary of Non-Traditional Disease Surveillance[1]

The Concept of Early Detection

A large number of activities, in various stages of maturity, are underway to develop surveillance systems for early warning or detection of a bioevent. [3, 6,21,22,27,37,38,43] The obvious motivation for all these efforts is increased concern regarding possible bioterrorism. However, such systems may also be useful in detecting outbreaks of naturally occurring diseases, thereby providing a dual use benefit of improving public health surveillance more generally. The benefit of earlier detection in the event of a bioterrorist attack, in terms of realizing more effective treatment, is conceptually depicted in Figure 1. This scenario is based on a hypothetical large, covert inhalation anthrax attack. [37]

The horizontal axis displays time after exposure to the agent. Across the top of the figure are progressive stages of disease development from exposure through the onset of initial symptoms to acute illness and possibly death. Also depicted is the time window wherein treatment would be most effective: during the onset of initial symptoms. The vertical axis provides a measure of level of detection expressed as the fraction of the total population exposed and infected that has been detected. The curve labeled "traditional detection" is based on using clinical data such as that associated with the diagnosis of reportable diseases: diagnoses, positive laboratory findings, etc. The curve labeled "early detection" is theorized to result from the use of detection methods applied to other data characteristic of the disease. In the situation depicted, the early detection curve reflects a signal that is several days earlier than the tradition detection curve. Whereas traditional surveillance does not begin to show a strong increase in detection until after the effective treatment window is closed, early detection creates the opportunity to treat a significant portion of the infected population within the effective window. The potential benefit is a significant reduction in mortality as a result of earlier detection.

A quantitative examination of the benefits of early detection, particularly its economic benefits, is illustrated in Figure 2. [23,34] Here, Kaufman estimates the number of saved lives and the economic benefits that might be realized by earlier detection of a similar anthrax attack. Without regard for the detection method, these gains were estimated on the basis of number of days following the attack before the event is detected and victims are identified for prophylactic antibiotic administration. In addition to a dramatic reduction in mortality, the economic benefits are illustrated on the left by a dramatic reduction in the number of hospital days and outpatient visits. On the right, "savings"

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[1] The material in this white paper was extracted from the document entitled "Bioevent Surveillance Algorithm Test Harness: Operating Concepts and High-Level Requirements" developed under IR&D project 02590023 and finalized in July 2003.

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Earlier Detection

↓

More Effective Intervention

Surveillance Algorithms

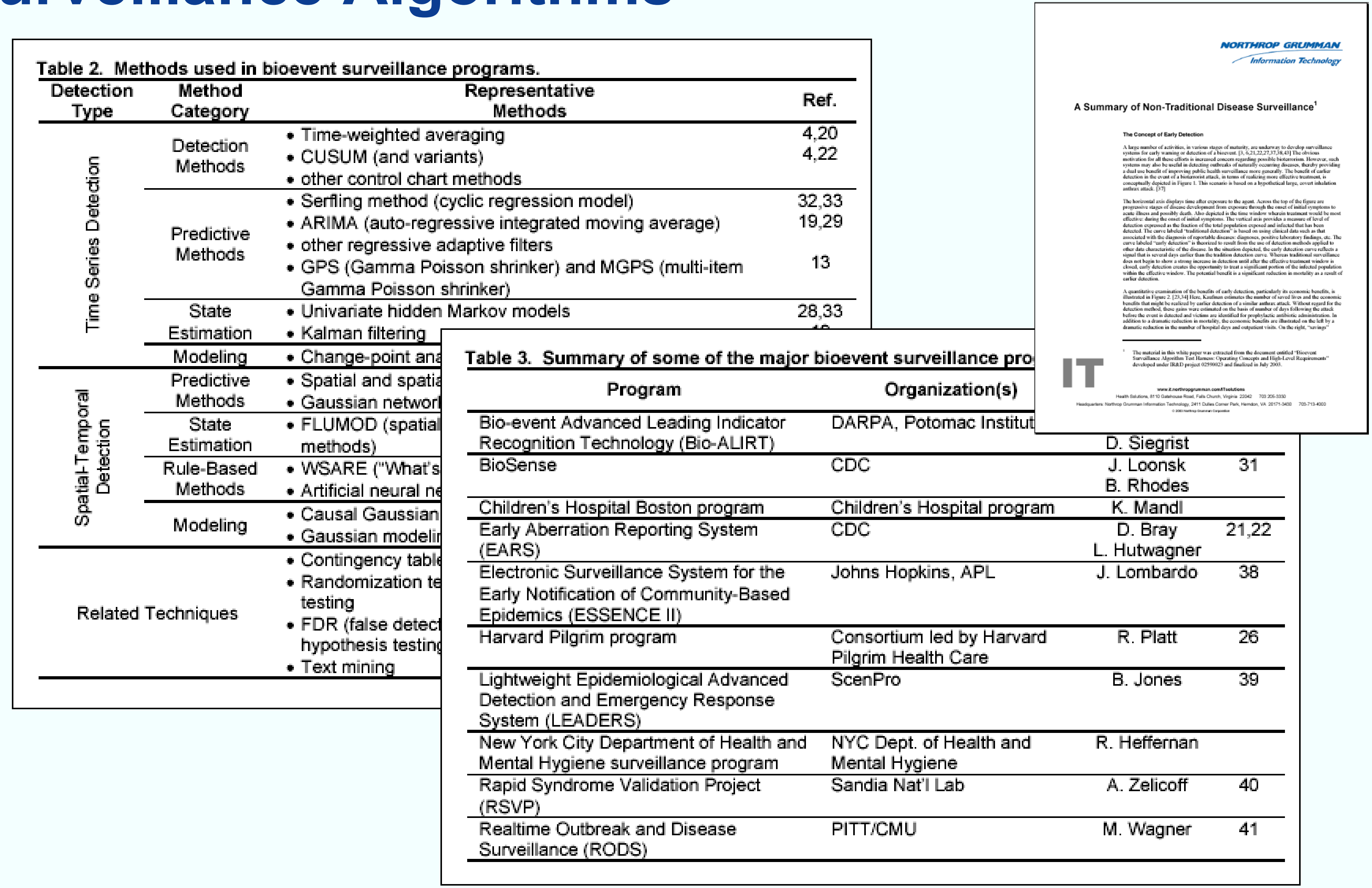

Table 2. Methods used in bioevent surveillance programs.

Detection Type	Method Category	Representative Methods	Ref.
Time Series Detection	Detection Methods	• Time-weighted averaging	4,20
		• CUSUM (and variants)	4,22
		• other control chart methods	
	Predictive Methods	• Serfling method (cyclic regression model)	32,33
		• ARIMA (auto-regressive integrated moving average)	19,29
		• other regressive adaptive filters	
		• GPS (Gamma Poisson shrinker) and MGPS (multi-item Gamma Poisson shrinker)	13
	State Estimation	• Univariate hidden Markov models	28,33
		• Kalman filtering	
	Modeling	• Change-point ana	
Spatial-Temporal Detection	Predictive Methods	• Spatial and spatia	
		• Gaussian networ	
	State Estimation	• FLUMOD (spatial methods)	
	Rule-Based Methods	• WSARE ("What's	
		• Artificial neural ne	
	Modeling	• Causal Gaussian	
		• Gaussian modelir	
Related Techniques		• Contingency table	
		• Randomization te testing	
		• FDR (false detect hypothesis testing	
		• Text mining	

Table 3. Summary of some of the major bioevent surveillance pro

Program	Organization(s)		
Bio-event Advanced Leading Indicator Recognition Technology (Bio-ALIRT)	DARPA, Potomac Institut	D. Siegrist	
BioSense	CDC	J. Loonsk B. Rhodes	31
Children's Hospital Boston program	Children's Hospital program	K. Mandl	
Early Aberration Reporting System (EARS)	CDC	D. Bray L. Hutwagner	21,22
Electronic Surveillance System for the Early Notification of Community-Based Epidemics (ESSENCE II)	Johns Hopkins, APL	J. Lombardo	38
Harvard Pilgrim program	Consortium led by Harvard Pilgrim Health Care	R. Platt	26
Lightweight Epidemiological Advanced Detection and Emergency Response System (LEADERS)	ScenPro	B. Jones	39
New York City Department of Health and Mental Hygiene surveillance program	NYC Dept. of Health and Mental Hygiene	R. Heffernan	
Rapid Syndrome Validation Project (RSVP)	Sandia Nat'l Lab	A. Zelicoff	40
Realtime Outbreak and Disease Surveillance (RODS)	PITT/CMU	M. Wagner	41

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Sources of Data

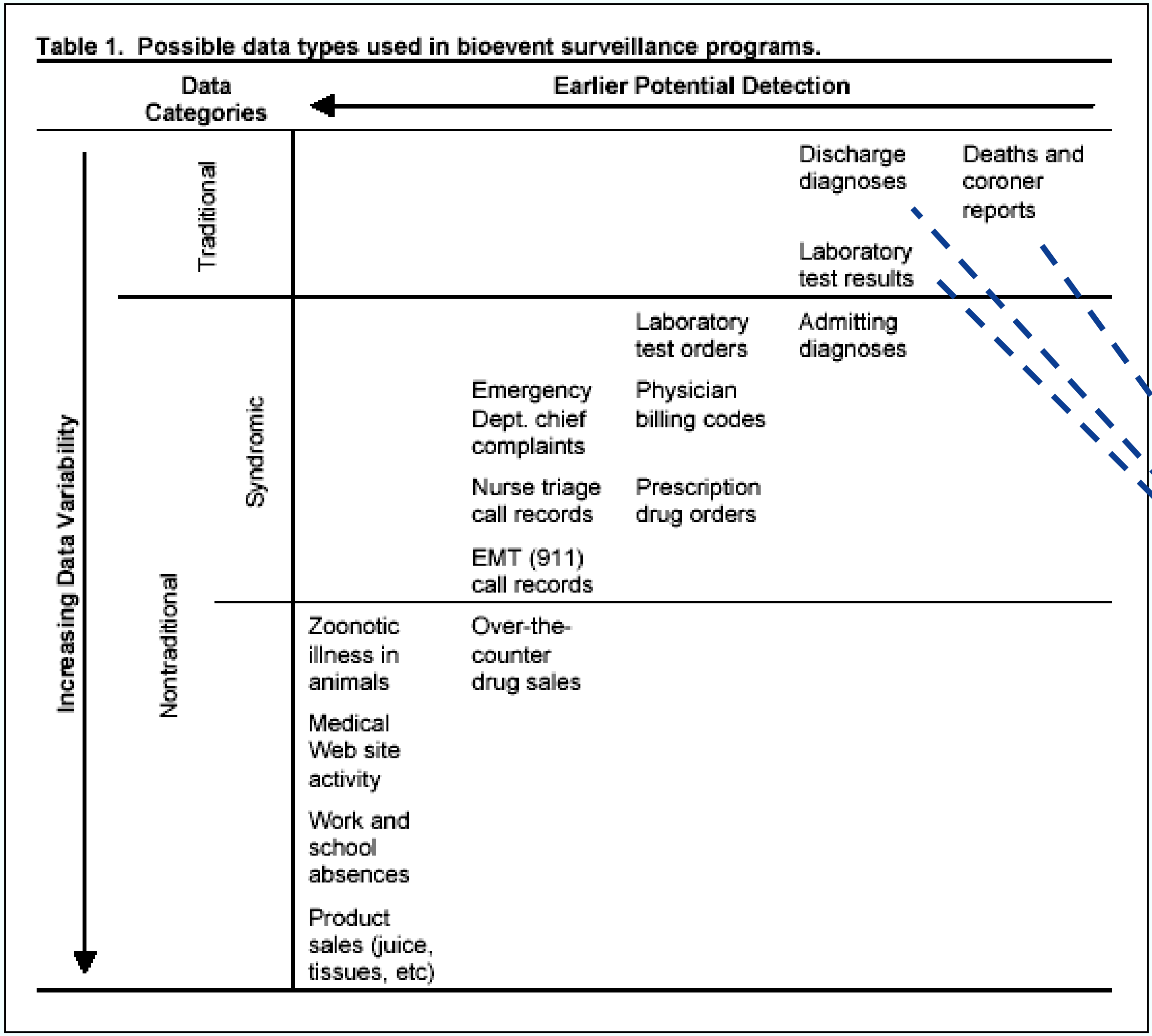
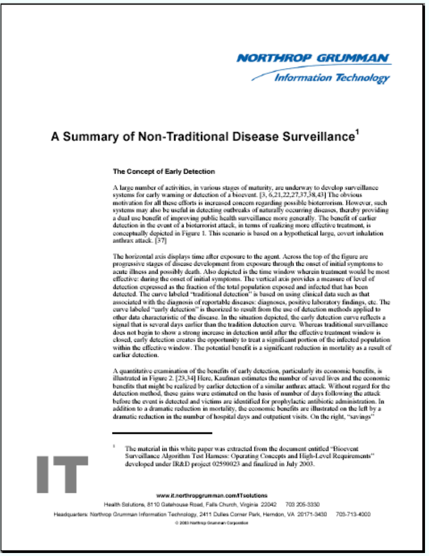


Table 1. Possible data types used in bioevent surveillance programs.

Increasing Data Variability

Data Categories		Earlier Potential Detection				
Traditional					Discharge diagnoses Laboratory test results	Deaths and coroner reports
Nontraditional	Syndromic		Emergency Dept. chief complaints Nurse triage call records EMT (911) call records	Laboratory test orders Physician billing codes Prescription drug orders	Admitting diagnoses	
		Zoonotic illness in animals Medical Web site activity Work and school absences Product sales (juice, tissues, etc)	Over-the-counter drug sales			



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A Summary of Non-Traditional Disease Surveillance[1]

The Concept of Early Detection

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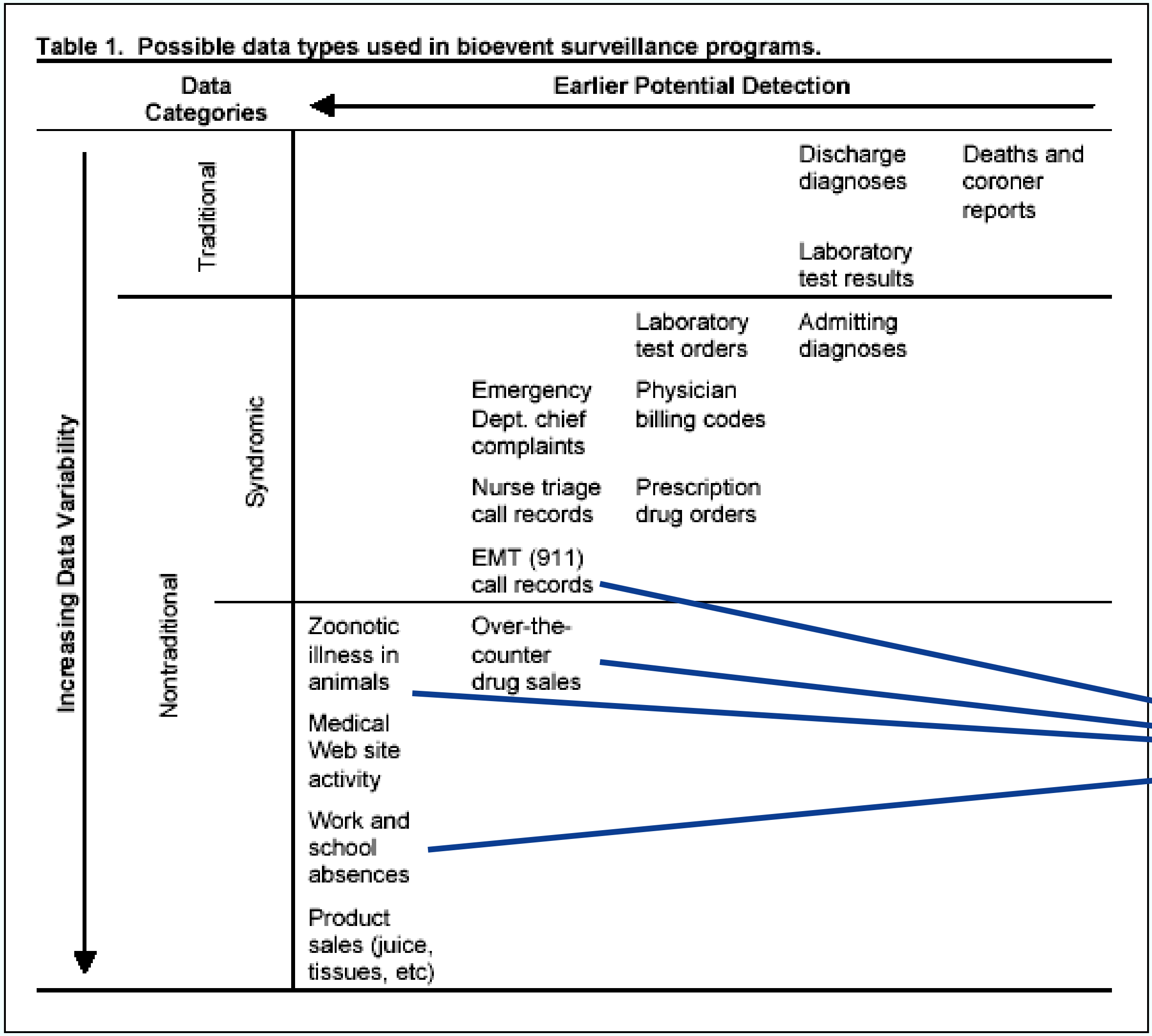
Traditional Surveillance

Specific
Manual
Not Timely

Sources of Data



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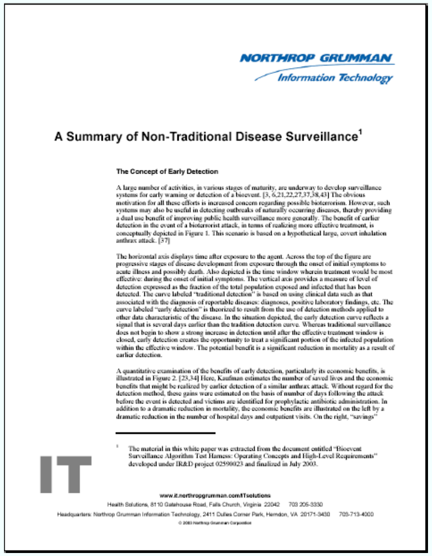
Increasing Data Variability

Syndromic Surveillance

Non-Specific
Already Electronic
Early Warning?



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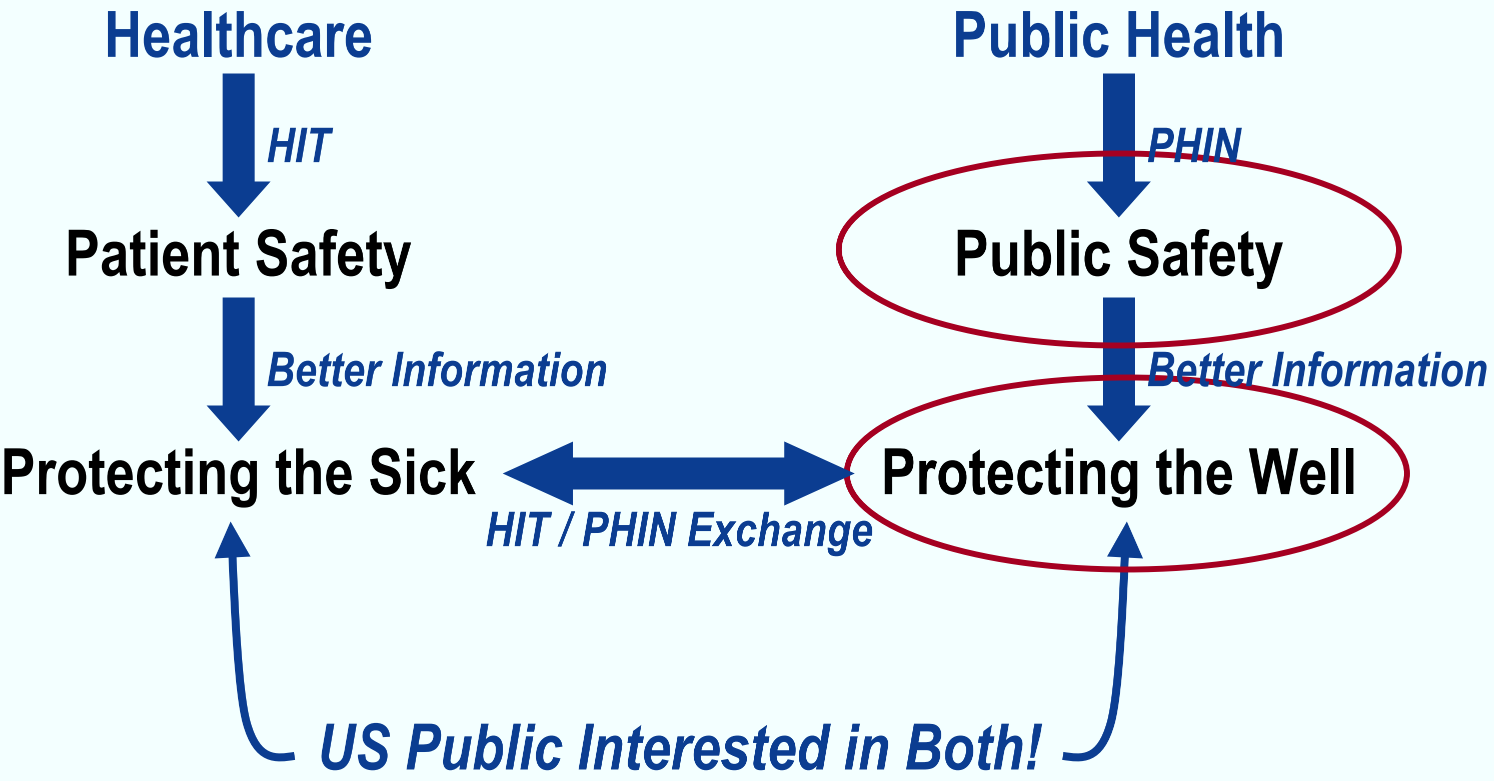
So what about HIT and the EHR?

Motivation: Parallel of Safety



Healthcare

HIT

Patient Safety

Better Information

Protecting the Sick

Public Health

PHIN

Public Safety

Better Information

Protecting the Well

HIT / PHIN Exchange

US Public Interested in Both!

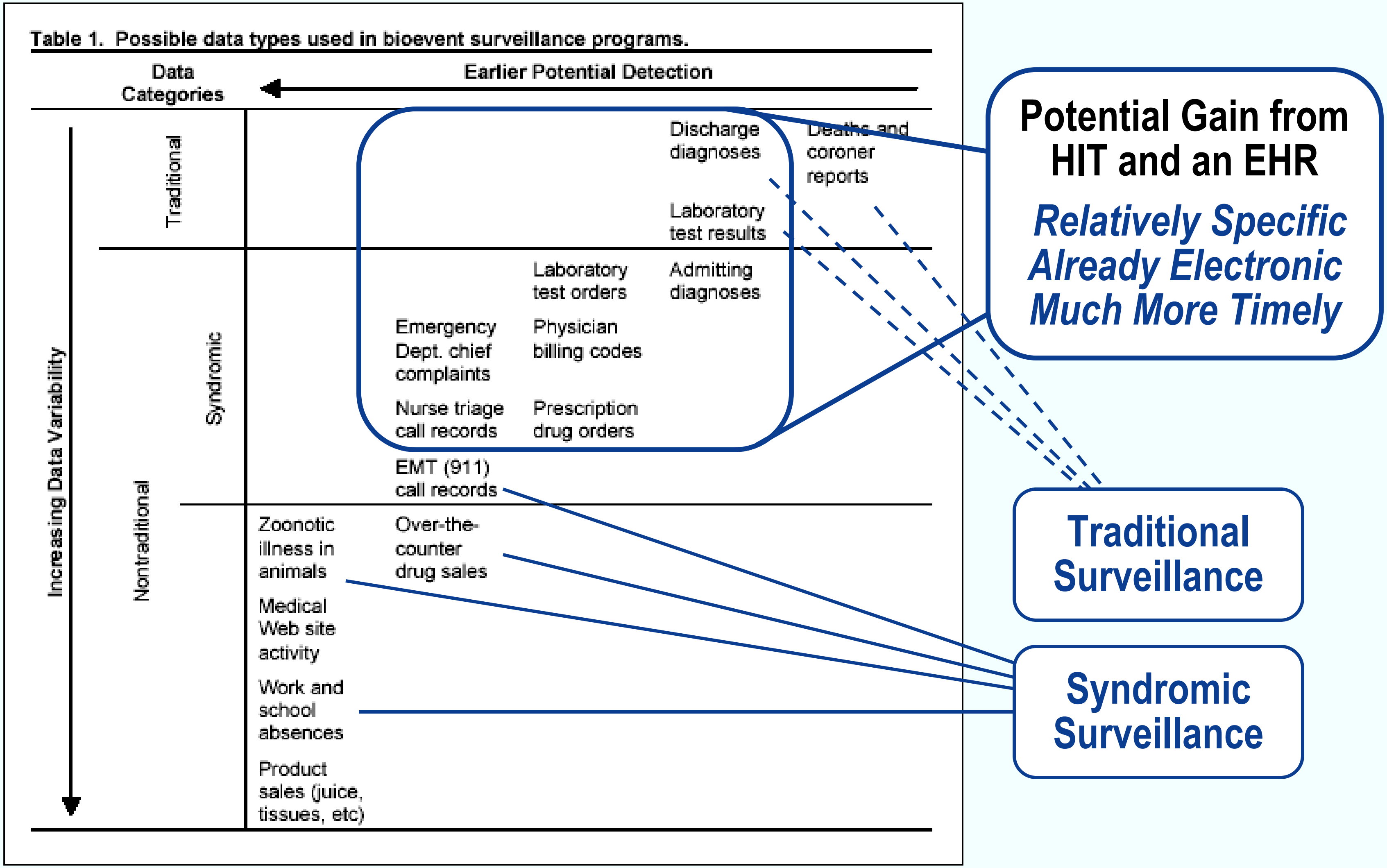
HIT as a Source of Public Health Information

- HIT and the EHR fundamentally change the availability of clinical information for public health.
  - Timely access to specific information.
  - Electronic access that is a byproduct of standard clinical practice.
- Utility of HIT is dependent upon the availability of that information nationally and globally.

Must maintain patient privacy.

Must provide incentives for healthcare to take part.

Sources of Data



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			EMT (911) call records			
		Zoonotic illness in animals	Over-the-counter drug sales			
		Medical Web site activity				
		Work and school absences				
		Product sales (juice, tissues, etc)				

Potential Gain from HIT and an EHR

Relatively Specific
Already Electronic
Much More Timely

Traditional Surveillance

Syndromic Surveillance

More Than Information

- Public health and disease surveillance provides a larger picture for the utility of HIT and the EHR.
  - …more than patient access to health information…
  - …more that physician access to patient records standards…
  - …more than electronic capture of patient information…
  - …more than a facilitator for clinical research and evidence-based medicine…
  - …more than an enabler of provider efficiency…
  - …more than an enabler of plans and communities…
- Success is fundamentally about *Infrastructure, Interoperability, Information Availability, and Information Exchange*.

HIT & Public Health

- Public Health is both a potential provider and a potential consumer of information.
- The PHIN is an example of a national health information infrastructure, designed for public health information exchange.

But the potential of HIT can only be realized if…

- HIT and the EHR are designed and implemented with standards and data exchange in mind.
- Public Health engages during the conceptualization of HIT and the EHR to ensure that PHIN can take advantage of information.