Improving Public Health Preparedness

Strengthening Biosurveillance Systems for Enhanced Situational Awareness

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Introduction

This report is designed to aid state, territorial, tribal, and local public health leaders as they improve their capacity to achieve situational awareness during a public health emergency. We intend this report to serve as a concise reference work public health leaders can use to help design and manage biosurveillance systems to be used during an anticipated public health emergency. We hope public health staff will find it helpful in answering the question, "What information do I need to support decision making during a public health emergency and how do I get this information?" To address this question, we focused on information needs for situational awareness using three scenarios: a mass gathering, a natural disaster, or a large outbreak.

During these events, information on population health status, health risks, and health services must be readily available to those managing the public health response to the event (Figure 1). This report lists "core" information needed to effectively manage the public health aspects of an event such as an outbreak, a natural disaster, or a mass gathering. Furthermore, the report describes guiding principles and system capabilities that assure surveillance information systems meet relevant standards, while addressing the need for flexibility to adapt to unique and changing circumstances.

We intend for the report's findings and recommendations to be used by CDC grantees to prioritize activities related to the use of Public Health Emergency Preparedness (PHEP) funding (as well as funding from other CDC cooperative agreements) in the development, maintenance, and optimization of biosurveillance systems. In particular, we intend that our findings and recommendations will delineate specific action steps which will complement and supplement existing guidance contained in the recently developed PHEP capabilities.[1]

See page 13 for action steps and recommendations.

Methods

In fall 2012, the North Carolina Preparedness and Emergency Response Research Center (NCPERRC) in collaboration with the Public Health Informatics Institute (PHII), began this research project to learn the current landscape of biosurveillance in the United States and how it advances public health situational awareness. Drawing on various sources, from the published literature to in-depth interviews with leaders in the field, the NCPERRC and PHII teams have developed recommendations for state and local public health agencies to build or enhance their biosurveillance capabilities. This document is intended to inform the biosurveillance process, making it more useful and efficient in achieving situational awareness, with the goal of improved ability to anticipate and respond to health emergencies. It should be considered as a resource, along with current guidance, including the PHEP capabilities.

This project involved four interrelated sets of activities:

1. Extensive literature reviews
2. Key informant interviews
3. A workgroup meeting held May 21-23, 2013, which conducted:
    a) Review and refinement of biosurveillance business process matrices and task flows
    b) Development of guiding principles and system capabilities
    c) Listing of ancillary information resources

The literature review was performed to gain a better understanding of the current landscape of biosurveillance in the United States. We searched the published academic literature, as well as white papers and lessons learned documents from local, state, and federal public health departments, national public health organizations, and networks of public health professionals to learn about the

biosurveillance-related information systems that are in place around the country, what functions they serve, and how they advance situational awareness in their respective jurisdictions. This research informed the interview guide that was used in discussions with leading biosurveillance managers and thought leaders around the country. We asked for their personal insights into how biosurveillance is used in their jurisdictions to improve situational awareness, and about the key components necessary for their systems to operate. Following our background research, we identified core business processes and tasks involved in operating these systems. Subsequently, the team convened a workgroup of biosurveillance experts to review and refine these business processes and task flow diagrams which delineate the steps in biosurveillance processes. In addition, the group developed a set of priority core information needs and data sources, particularly those available electronically. Further, the team developed a set of guiding principles and best practices to guide system improvement.

Key Findings

Current Challenges for Biosurveillance Information

In this report, we focus primarily on core information needs, information sources, and information systems needed for **situational awareness**. By "core", we mean essential information needed by the **local event manager who is leading the public health response** to a public health emergency. That "local" manager could be employed by a local, state, tribal, or territorial health agency, depending on how management of a public health emergency is performed. We also acknowledge that the term "event" may be used to describe a planned occurrence, while "incident" is used to describe an unplanned event. In this report, we use the term "event" to include planned and unplanned events, or what is referred to as an "incident" in the National Incident Management System (NIMS).

Public health biosurveillance (Figure 1) has been defined as the collection, management, and integration of health-related data for the purpose of improving detection, characterization, prevention, and management of health hazards.[2–12] We emphasize that biosurveillance is a **process** such that no single information system is designed to address all the biosurveillance needs. Furthermore, information systems that support public health preparedness and response should be designed and maintained to provide information which is **directly relevant to public health action**, timely, specific, and as simple as possible. Recent research [2,5,12–16] described the purposes of biosurveillance systems as:

1. Early warning of health threats and early detection of potential health events;
2. Situational awareness; and
3. Consequence management.

The lack of preparedness and coordinated response after the 9/11 terrorist attacks sparked a national discussion about bioterrorism surveillance, and subsequently, disease surveillance, catalyzing the enhancement of surveillance systems in state and local health departments.[15,17–19] Various sources of biosurveillance information are now transmitted electronically using electronic health records (EHRs), electronic lab reporting (ELR), syndromic surveillance systems, notifiable disease reporting systems, poison control data, and environmental hazard data. These techniques now improve the efficiency of disease reporting compared to historical paper-based systems. Diseases can be reported more quickly, a higher percentage of cases are reported, and case data is more accurate and less subject to human error. Indeed, the majority of public health agencies have implemented disaster surveillance plans and much progress has been made.[20] However, there are some jurisdictions without such plans and additional progress is needed. Meaningful Use guidelines now lay the framework for effective electronic biosurveillance and provide incentive for more progress.[2,5–7,9–12]

Syndromic surveillance (SS) is now a popular new tool to improve situational awareness and encourage ongoing monitoring of public health emergencies. Common symptoms associated with notifiable and other important/emerging diseases are monitored and reported before receiving lab confirmation of pathogens. SS is faster than prior methods and very good at capturing chief complaint data, but its high sensitivity can lead to a low positive predictive value and may lead to "false alarms". Over recent years, syndromic surveillance systems have evolved and continue to evolve based on further exploration of their utility.[21–29]

Furthermore, information systems used by individual states and health departments are highly variable in scope and operation and not necessarily compatible. Interoperability is a key requirement for biosurveillance systems to be able to share and aggregate data at the state, regional, and national levels. Current challenges include updating systems to be interoperable without reinventing the wheel or draining resources, and describing a common language and parsing system for gathering and reporting data from case records.[30–32]

State and local biosurveillance systems have historically been developed piecemeal and not as part of a large, coordinated effort. As a result, they tend to have unique systems that serve functions very specific to that jurisdiction. State- and region-based systems have been well documented in the literature. Exemplary systems include: Massachusetts state, which uses two distinct surveillance systems for ambulatory and emergency care data; the Northwest Public Health Information Exchange, which serves the states of Washington, Oregon, Idaho, and Montana; the National Capital Region's ESSENCE biosurveillance system; North Carolina's NC EDSS and NC DETECT systems; and New York City's ED-based surveillance system.[33–50]

A number of preparedness and technological capabilities are necessary to implement a successful biosurveillance system. The ability to use data to assess a situation and coordinate a response is determined by how well-equipped biosurveillance staff are and how well biosurveillance systems respond to need.[1,51–53] Key characteristics of effective biosurveillance systems are timeliness of detection and reporting, accuracy of the data reported, completeness of the data reported, sensitivity and specificity of biosurveillance system detection algorithms for detecting disease, and correlation between different data sources for detecting disease.[13,54–71]

Building on these reports, CDC developed a biosurveillance "Concept Plan," which provided a framework for collaboration among key players in developing biosurveillance systems. Additionally, the US government recently developed a National Strategy for Biosurveillance, which promotes integration of biosurveillance efforts and identifies concrete goals for achieving useful biosurveillance.[72–74] Among other recommendations, these reports recommend that before launching a biosurveillance system, requirements for what the system will do, how it will operate, and who will be involved (both system staff and information sharing partners) must be established. Key requirement categories include IT needs, skills and capacity building, and system development and maintenance.[56,75,76]

As with all public health surveillance activities, the overarching consideration is to ensure that the objectives of these systems are driven by the need for information that will be used for program decision-making, [103] in this case; the program includes public health emergency preparedness and response decision makers.

Core Information Needs for Situational Awareness and Response Management

To address the core information needs for situational awareness and response management, we adopted the perspective of the state or local public health event manager, who is responsible for leading the public health response to an event. These managers may be the state epidemiologist, the state public health preparedness director, or a local health official in a large city. In many cases, incident command processes are in place to guide event coordination and management.

To focus our thinking, we selected three event scenarios which require public health preparedness and response:

1. A natural disaster (e.g., a hurricane or tornado)
2. A mass gathering (e.g., marathon race or national convention)
3. A disease outbreak (e.g., novel influenza)

A number of biosurveillance systems have been used to monitor health outcomes during a natural disaster, a public health emergency, or as a preventive measure during large, high-profile events (ad hoc or "drop-in" surveillance). Such events have included a salmonella outbreak, a tornado, a wildfire in Georgia, a flu outbreak, a hazardous exposure, wildfires in San Diego, the Kentucky Derby, the 2002 Winter Olympics, and the anthrax attacks of 2001.[13,14 77–79]

A specific example of the need for better disease surveillance following natural disasters was the lack of rapid and coordinated response to Hurricane Katrina. The response to Katrina has been well-documented, and the lessons learned have been used to improve current practices for better future preparedness. In the case of large-scale disasters that wipe out infrastructures and communications, more rudimentary systems can be implemented, such as those used in evacuation shelters in Houston.[80–83]

In another example, following the H1N1 pandemic, flu/influenza-like illness (ILI) surveillance efforts were intensified. Existing systems were supplemented with others specific to ILI surveillance (e.g., Aggregate Hospitalizations and Deaths Reporting Activity (AHDRA)), and alternate sources of data were considered (e.g., school absenteeism, OTC medicine sales).[64,84–93] When compared with lab-based surveillance information, emergency department flu/ILI surveillance information is about as accurate in identifying disease trends, and is more timely.[94–98]

To identify best practices and lessons learned regarding biosurveillance information needs and related information systems, we focused our key informant interviews on best practices in North Carolina, Florida, Georgia, and Boston. During our expert panel workshop, we also learned about best practices in New York state, Washington state and Indianapolis. From these sources, we found certain key themes that inform the recommendations in this report:

a) **Biosurveillance information needs and information flow**: In all of these states, managers reported needing information on health status, health risks, and health services to support decision making during a public health emergency. Specific types of information needed are detailed below. To provide this information in a timely way, various information systems in these jurisdictions routinely operate electronically to allow automatic transmission of health data at least every 24 hours, and sometimes more often (e.g., NC DETECT receives hospital emergency department data twice daily). These information systems can also be tailored to provide specific information for special occasions or in response to an event. Examples of ad hoc surveillance (or "drop in"

Illustrative Example: Ad-hoc Surveillance

During the 2012 Republican National Convention in Tampa, the Florida Department of Health modified its existing ESSENCE system to collect vital statistics and death records from medical tents established around the convention venue, allowing for increased frequency of data transmission to more closely monitor this event for illness or bioterrorism symptoms.

surveillance) include NC DETECT's role in a case finding following E. coli outbreaks at the Cleveland County Fair and the NC State Fair, GA SendSS' role in emergency surveillance following Hurricane Katrina, and FL ESSENCE's role during the 2012 Republican National Convention. All systems allowed for the addition of special monitoring components to the base systems for tailored surveillance during special events.

The level of data integration between information systems varies by jurisdiction. North Carolina uses NC DETECT for ED syndromic surveillance and NC EDSS for notifiable disease surveillance, but the two systems do not interact. The Boston Public Health Commission uses one system for surveillance during large-scale events (e.g., Boston Marathon) and another system for routine syndromic surveillance. Florida and Georgia have systems that integrate syndromic surveillance with notifiable disease surveillance, electronic laboratory reporting, and other ancillary functions.

b) **Essential elements of information systems:** These leading-edge states illustrate the operations of systems which serve the everyday needs of public health and also are central to addressing information needs during a public health emergency. Managers in these states rely primarily on electronically-provided reportable disease surveillance, electronic lab reporting, and near real-time feeds of emergency department data to address information needs during public health emergencies, such as outbreaks, mass gatherings, and natural disasters. Timeliness of reporting was the most frequently cited essential characteristic of biosurveillance information. Another important characteristic is the ability of a system to anticipate information needs in the event of a disaster and rapidly customize existing systems to address information needs during an event. For example, following Hurricane Katrina, Georgia managers modified their SendSS system to create surveillance forms to collect health data from evacuees in Atlanta shelters. This system modification was deployed within two days of the hurricane making landfall. System triangulation between the SendSS system, Grady Hospital, and the poison control center allowed coordination of care for sick evacuees. GA SendSS was also able to extend usage permissions to the CDC to receive the shelter surveillance data and hurricane-related mortality data.

Illustrative Example: Surveillance during a natural disaster

Following Hurricane Katrina, Georgia's SendSS system leveraged its built-in survey module to create surveillance forms to collect health data from evacuees in Atlanta shelters. System triangulation between SendSS, Grady Hospital, and poison control centers allowed coordination of care for sick evacuees.

c) **Barriers to success in biosurveillance**: Although our expert informants manage systems which exemplify best practices and innovative system design, they noted that barriers remain which limit the realization of the full potential of these systems to provide situational awareness in a public health emergency. Limitations include the lack of human resources to analyze and aggregate epidemiologically-useful information and manage the technical aspects of the system; lack of technological infrastructure to accommodate electronic transmission of data; and inconsistent standards for health information messaging and system capabilities across jurisdictions.

d) **Fiscal and personnel resources:** Crucial personnel for managing and designing these systems include epidemiologists, system administrators and analysts, developers, and other technical support to ensure that the system is responsive to user needs. Epidemiologists are particularly necessary to guide developers in designing a system that can answer key epidemiologic questions. The personnel resources required to run statewide information systems are highly variable, and depend on the degree of system autonomy and the technological needs (e.g., the need to detect events or the need to report and store information). Considerations for the assessment of fiscal and personnel resources include distinguishing between costs to develop, initialize, maintain, and upgrade systems.

e) **Data sources:** Public health preparedness professionals increasingly rely on 1) electronically-provided notifiable disease reports, 2) point-of-care data from emergency departments, urgent care centers, and primary care facilities, and 3) electronic laboratory data. For event management purposes, it is important to have data on health care utilization, in addition to illness data, to more fully manage preparedness activities and health communications. Over-the-counter and pharmaceutical sales data can be used to indicate outbreaks when there are increases in reported sales of medications. Pharmaceutical data can also help determine where medications are available or out of stock during an emergency. In a few jurisdictions, electronic reports of cause of death records have been useful.

   Novel web-based data sources like Google search records and social media are being investigated for their accuracy and timeliness in identifying illness events. Pilot studies have demonstrated some utility of Facebook and Twitter during emergencies, such as "tweeting" for help during natural disasters, but their potential for routine surveillance has yet to be determined.

In light of these trends, best practices, lessons learned, and reports of actual events, we considered the core information needed for achieving situational awareness during similar events. Although information often needs to be "rolled up" to the national level, we focused our attention on information needs **at the local level related to event response management.**

To determine core information needs, we applied four criteria:

1. **Utility to facilitate a local public health response**: In our research, interviews, and expert panel discussions, respondents repeatedly emphasized the need for useful information that can document health status, health risks, and health services in ways which can guide **local** event-related response efforts. At the local level, this means that information must be customized to specific geographic and situational realities unique to the public health jurisdiction, while maintaining consistency with regional, state, and national information needs to the greatest extent feasible. As a result, information systems must be designed in ways that permit flexibility as well as scalability. Further, since response measures often will be determined by health system capacity, biosurveillance systems in the current era must be designed not only to provide health status information but also to **provide health system utilization information** (e.g., emergency room utilization and EMS usage).

2. **Timeliness**: As a corollary to the need for utility in facilitating the public health response, data must be provided in a timely fashion. In the current era, there are expectations that public heath should move in the direction of "near real-time" data collection and transmission, using automated protocols. In some cases (e.g., ED syndromic surveillance data), daily or twice daily data transmission is occurring in a few states and localities. However, practices vary widely

across the nation with respect to scope and scale of timely reporting practices. Based on these considerations, we conclude that timeliness often dictates that **data be electronically transmitted, aggregated, and displayed in ways that can contribute directly to mobilization of public health's response.**

3. **Sensitivity, specificity, and predictive value**: Information which is specific to the disease or hazard of interest is preferable to information which is less specific and therefore less useful. As a result, laboratory results represent the high point of specificity in relation to certain health conditions, such as infectious diseases, lead poisoning, etc. Nevertheless, in some circumstances (e.g., chief complaint information from EDs or Urgent Care centers), information may still be valuable, although less specific to a particular disease, because it can be made available in a more timely manner than lab-confirmed case reports. Thus, sensitivity, specificity, and predictive value must be considered in defining information components of a biosurveillance system. In a literature review evaluating the timeliness of disease reporting, Jajosky et al estimate that electronic lab reports take between 10-19 days to be reported to the CDC from the date they were created.[63] Therefore, the timeliness criterion must be considered in concert with other criteria noted above. Tradeoffs exist between specificity, sensitivity, and timeliness, and these criteria are prioritized differently in different jurisdictions depending on their unique information needs. Further, the context (e.g., infectious disease outbreak vs. natural disaster) will influence the need for different types of information.

4. **Accessibility**: Over the past decade, the field of biosurveillance has become increasingly complex with the advent of sophisticated detection algorithms developed in concert with the explosion of new and rapidly evolving electronic health information systems. Further, new health policies, such as Meaningful Use, designed to stimulate innovation and adoption of these new approaches, provide added complexities. In light of these forces, accessibility by public health managers to core information should be considered in system design and in the selection of "core" components. We recognize that some information will be collected and managed by public health agencies, while other types of information will be managed by other health system organizations and entities outside the formal health system. In those situations where others "own" the information, access by public health officials to these information sources is often vital. As noted below, development of data use agreements **before** an event is crucial, if these sources are to be accessible during an actual event. We conclude that ease of use of core information should be a central consideration to assure that public health event managers get the information they need, in the way they need it, to make informed decisions.

Public health surveillance professionals and event managers need to be able to perform several tasks before and during an event:

1. Identify key partners and determine and establish key data, information available/needed, and communication channels
2. Identify and communicate a threat or incident affecting the health and safety of residents or a community
3. Identify, monitor, and/or manage availability of services and supplies necessary for the health and safety of residents and their communities
    a) Necessary routine medical care (e.g., dialysis, prescription refills)
    b) Emergency medical care (e.g., injury, countermeasures, mental health support)

   c) Public/commercial products (e.g., food, water supply and safety)
   d) Public/commercial services (e.g., power, roads, transportation)
4. Identify and care for vulnerable, at-risk, and affected populations
   a) Locate missing persons
   b) Determine, assist, and track health care and residential evacuations
   c) Identify and mobilize credentialed volunteers
   d) Establish and monitor the safety of shelters and temporary residences
5. Monitor the health impact on affected communities
   a) Conduct surveillance for primary and secondary illness, injury, and behavioral health needs during and post incident
6. Identify and monitor external influences
   a) Environmental conditions (e.g., ice, flooding, water sources and quality)
   b) Service providers (e.g., power suppliers, food distributors, DME/pharmaceutical suppliers)
7. Evaluate response and intervention
   a) Emergency services provided and needed

In light of these responsibilities, we applied the criteria noted above, along with our research findings, workshop findings, and interviews with key informants to conclude that three types of core information are needed and should be readily available to public agency event managers:

1. **Health status information**. Event managers need to have reliable information on:
   a) Notifiable and reportable diseases
   b) Syndromes of potential public health significance (e.g., influenza-like illness), including chief complaints from ED visits
   c) Laboratory results of potential public health significance
   d) Cause of death information (if available in a timely fashion)

2. **Health risks and hazards**. In certain situations, event managers need information on:
   a) Weather (especially in the event of a natural disaster)
   b) Environmental exposure to toxic agents (e.g., chemical spill or release)
   c) Zoonotic disease occurrence and vector populations

3. **Health services.** Since public health officials must understand and interact with the health care delivery system during an event with public health significance, they need information on:
   a) Hospital emergency room and hospital bed utilization
   b) Emergency medical services and other nonhospital outpatient ambulatory care services
   c) Pharmaceutical availability (e.g., availability of vaccines or antiviral drugs during an influenza outbreak)

In addition to these “core” information types, we identified examples of ancillary information that may be useful (see Appendix B for a listing of ancillary information). One benefit of ancillary information is to assess the vulnerability and resiliency of communities impacted by the event. Low resourced communities are more vulnerable to the impact of natural disasters and outbreaks; therefore, information which delineates factors related to vulnerability may assist the event manager in targeting interventions.

Sources of Core Information for Biosurveillance

To determine the most important sources of core information for biosurveillance, we applied the four criteria noted above. We gave priority to **information sources that are used on a day-to-day basis** for conducting routine public health surveillance. Ideally, an information source would be most useful during an event if it provided information on a daily basis, during normal operations, to the same public health staff that would use it during an emergency. This way, the staff is knowledgeable about accessing and processing the information. In addition, by building on the foundation of existing information sources, ad hoc surveillance systems, which are rapidly developed during an event to meet specific event needs, can also be very important, successful, and useful. We also gave priority to common information sources which are now or can soon be **transmitted electronically**, either using automated, standards-based protocols or through information system-enabled techniques.

1. Core information sources

Our research, expert panel discussions, and key informant interviews have consistently identified four priority core components for information systems needed to support event-related situational awareness. The relative value of these four sources varies depending on the type of public health emergency.

a) **Electronic lab reporting:** There is strikingly uniform agreement that a top priority for inclusion in core information systems is electronic lab reporting. This data source provides the specificity and timeliness needed to support the public health response and does so in a relatively simple and familiar fashion, recognizable to public health professionals. HL7 messaging standards must be used to assure conformity to existing data standards. Electronic lab reports should be obtained from public health labs, hospital labs, and commercial labs. Meaningful Use incentives and CDC funding will increase the extent of electronic lab reporting. Electronic lab reporting typically "feeds into" notifiable and reportable disease systems, which are described below.

b) **Emergency department (ED) reporting:** In many states, emergency department-based syndromic surveillance systems frequently provide ED information which can be timely and helpful in supporting a public health response. This information often provides chief complaint, diagnosis, and disposition information along with limited information to infer disease severity (such as information regarding whether an individual was admitted to hospital). To achieve maximum utility, the tasks of compiling and utilizing syndromic surveillance information require a high level of sophistication and experience. For example, in North Carolina, the NC DETECT system synthesizes data from 99% of the state's 122 hospital emergency departments, processing this information and transmitting it to public health agencies daily. This information proved useful in the recent H1N1 pandemic and during the 2012 Democratic National Convention in Charlotte. Currently, many states use syndromic surveillance information from hospital emergency departments on a regular basis. Recent Meaningful Use incentives should increase the use of syndromic surveillance information from emergency departments.[30,45,46,52,80,82,87,99]

c) **Electronic disease surveillance systems:** These systems, designed to automate collection, analysis, and reporting of notifiable and reportable diseases of public health significance, operate in all 50 states using a range of information systems and approaches.[2,11,29] Currently, 46 states, New York City, and Washington, D.C., use a compatible system with the National

Electronic Disease Surveillance System (NEDSS) to voluntarily and electronically send reportable conditions to CDC.[100] During an event, these systems are often central to management of surveillance information as they provide a way to receive, manage, process, and analyze disease-related data from multiple sources. For example, in Minnesota, public health officials use the state system, MEDSS, to review disease reports and conduct case investigations, or case follow-ups, within the state and with partners, including physicians and local public health agencies.[101]

d) **Health system utilization information:** Various approaches exist to provide public health managers with information on health service utilization related to care for individuals impacted by a public health emergency. In some states, syndromic surveillance systems have been adapted to provide this information. In other states, a dedicated system addresses this need. In each instance, the system should provide information on emergency and outpatient urgent care centers, along with hospital inpatient utilization. In some jurisdictions, emergency medical service (EMS) information may also be accessible and useful to public health event managers.

Illustrative Example: Health services utilization data

During the 2012-2013 flu season, Boston suffered a severe outbreak with over 10 times as many cases as in the previous season. As a result, the supply of Tamiflu® medication was exhausted in hard-hit parts of the city, and the Boston Public Health Commission began to collect pharmaceutical sales and health care utilization data to monitor the stock of Tamiflu®. Health care professionals were then able to refer sick persons to pharmacies and health centers where the drug was available.

2. Additional information sources

In addition to these sources, a wide range of additional information sources exist (see Appendix B) and are in current use. Some provide pre-event information needed to assess hazard levels (e.g., weather patterns related to a potential natural disaster), while others may contribute to early event identification (e.g., manual disease reporting from "alert" practitioners). Important work has been done to enhance automation of notifiable and reportable disease reporting using business process analysis and through development of algorithms needed to extract data from EHRs. Information systems that support public health's need for situational awareness must have the capability both to accept electronically-transmitted data and to integrate disparate sources of data.

Inpatient hospital and outpatient clinic information hold promise for biosurveillance purposes but are less developed than either electronic lab reporting or transmission of ED data. Recently developed guidance [102] from the International Society for Disease Surveillance (ISDS) should lead to advances in the use of electronically transmitted information from hospitals and outpatient facilities using EHRs.

The relative value of each information source varies depending on the nature of the event (see Appendix C). For example, in a disease outbreak of a novel influenza virus, laboratory information is of greater value than in other types of events.

Designing Event-Related Information Systems to Provide Situational Awareness Information

1. **Guiding principles**

    a) Systems to be used for situational awareness during an event should be built on the foundation of surveillance systems used day to day as part of normal operations.
    b) These systems require **ongoing investment** for maintenance and optimization.
    c) These surveillance systems must be designed **to support workflow at the local and state levels,** and also to provide regional and national understanding of the nature and extent of the event.
    d) **Formal business process, workflow analysis, and requirements development** should be performed to guide design and development of these systems. The "business" of public health should be considered analytically in the design of these systems.
    e) Systems must be designed to comply with **applicable standards** (e.g., messaging standards, data standards, etc.) in order to be scalable and interoperable.
    f) Systems must also be **sufficiently flexible** to adapt to local needs (e.g., tracking sub-jurisdictional data), particularly in the context of event response where system customization may be needed.
    g) Public health agencies should be **adequately staffed and resourced** to design, manage, and optimize core information system capabilities and to use information to support decision making during a public health emergency.

2. **Biosurveillance system capabilities**

    Systems designed to enhance public health event-related situational awareness ideally should have the capability to:

    a) Receive, aggregate, display, and report electronically-provided, accurate, and timely data for use in enhancing situational awareness.
    b) Receive a range of data formats (both electronically and manually) as needed by local and state public health professionals.
    c) Provide access to local public health professionals involved in event-related response mobilization.
    d) Aggregate and transmit information to state and national leaders involved in the deployment of response resources (e.g., Strategic National Stockpile) and in other mobilization and coordination efforts.
    e) Adapt to specific data needs for various types of situations, while simultaneously having scalability for aggregating and communicating information across jurisdictions.

Using Business Process Analysis to Improve the Design, Development, and Performance of Information Systems

All businesses perform business processes, a set of logically related activities combined to accomplish a business objective or produce something of value for the benefit of the business, organization, stakeholder, or customer. The business of public health is no different. For example, before, during, and after an event, public health departments seek to understand, contain, and resolve the health threat and prevent it from reoccurring. To do this, public health practitioners perform varied activities, standardized and unstandardized. Business process analysis helps to understand all of these activities in an effort to

identify the most efficient and effective process or best practice. Business process analysis is the technique used to understand an organization and its purpose while identifying the activities, participants, and information flows that enable the organization to do its work. Specifically, business process analysis provides an opportunity to focus on defining how the work is done and systematically document that work. From this documentation, all parties involved can be clear regarding the role information systems need to have in helping to accomplish the work in the best and most efficient way possible.

The output of the business process analysis is a set of current state documents which include diagrams and textual descriptions to be used for redesign of business processes. Business process redesign seeks to restructure tasks and workflows to be more effective and efficient. In many jurisdictions, state, tribal, local, and territorial health departments do things differently; however, they seek to accomplish the same goal of protecting the population's health. Some larger health departments are more technologically advanced than smaller health departments. Some health departments are more experienced in timely detection and resolution of certain public health situations. Analyzing how the successful health departments carry out respective business processes can aid other public health departments in improving their processes.

The purpose of business process analysis and redesign includes:

1. Operational performance improvement
2. Integration and automation
3. Cost reduction
4. Data, supply chain, and resource management
5. New business opportunities

Business process analysis can be used to improve design, and develop and improve performance of information systems by:

1. Analyzing and understanding how the work is currently done and how system operations and processes are carried out. (In this project, the "work" is biosurveillance related to providing situational awareness information to support decision making during a public health emergency.) In doing so, a clear picture of day-to-day activities and processes is provided.
2. Identifying areas that need improvement, inefficiencies in the process, and redundant tasks.
3. Improving the performance of an organization's business processes and increase customer satisfaction.
4. Organizing and standardizing processes to unify procedures across jurisdictions.
5. Defining the business activities that enable an organization to function.

In this project, we developed business process matrices for each of the three components of the biosurveillance process depicted in Figure 1. Based on our analysis of these three business processes, we developed task flow diagrams depicting the key steps and activities in each process (see Appendix A for business process matrices and task flows). The three business processes are:

1. Collect and receive health status information
2. Analyze and synthesize disparate public health surveillance information
3. Disseminate timely public health surveillance information

These matrices and flow diagrams are designed for use by state/territorial/local health leaders as tools to review their current systems and identify approaches to improve biosurveillance processes and the information systems which support them. For further guidance regarding the use of these tools, please

consult the PHII website, **www.phii.org**. This process was used to create the *Common Ground: Public Health Preparedness Business Process Interdependencies* (Figure 2).

This diagram was developed by PHII's Common Ground Preparedness Workgroup. For further information, please visit http://www.phii.org/sites/default/files/resource/pdfs/CG%20Prep%20Requirements-FINAL.pdf.

Action Steps to Enhance the Ability of Biosurveillance Systems in the Next 12-24 Months

1. Commit to full implementation of electronic lab reporting by assuring that all hospital, commercial, and public health labs develop capacity to transmit lab results of public health significance electronically. The appropriate public health agency assures their own capability to receive and manage this information.
2. Commit to electronic acquisition of emergency department data from emergency rooms in the public health agency's jurisdiction and assure the health department's capacity to receive and manage this information.
3. Commit to enhancement of the National Notifiable Disease Surveillance System (NNDSS), including addressing barriers identified in the NEDSS assessment survey and specific suggestions for improvement in the Council of State and Territorial Epidemiologists report.[20]
4. Commit to increasing the use of business process analyses to analyze local surveillance system workflow and, as a result, optimize design, development, and performance of biosurveillance information systems.

Other Recommendations to Enhance Situational Awareness

1. Create a peer assistance network consisting of expert practitioners who are willing and able to share lessons learned and consult with others who are developing or expanding biosurveillance systems. This network can be designed as an information sharing resource to enhance system capabilities by linking expertise in system design and operations with those engaged in system improvement.
2. Create a repository of best practices in biosurveillance for major national events (e.g., national conventions, marathons, etc.).
3. Assure that CDC labs commit to using ELR to report results to state health agencies to enhance speed and efficiency of lab reporting.
4. Establish relationships and develop information sharing agreements with key partners outside the public health system before an event occurs.
5. Conduct careful evaluation of surveillance activities following disasters to discern weaknesses or problems that need to be addressed in preparation for future emergencies.

Recent Reports Providing Recommendations for Enhancing Systems for Event-Related Situational Awareness

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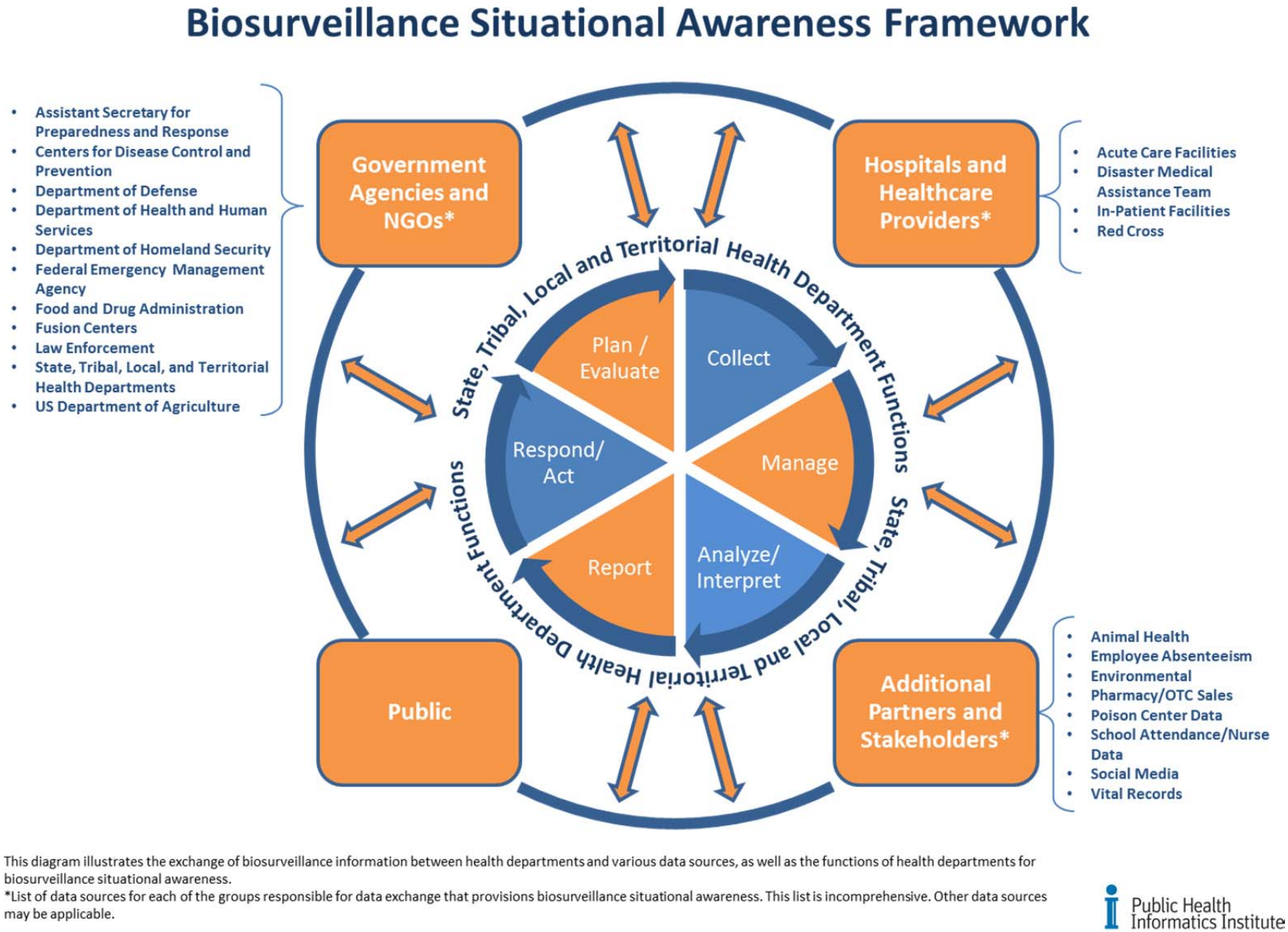
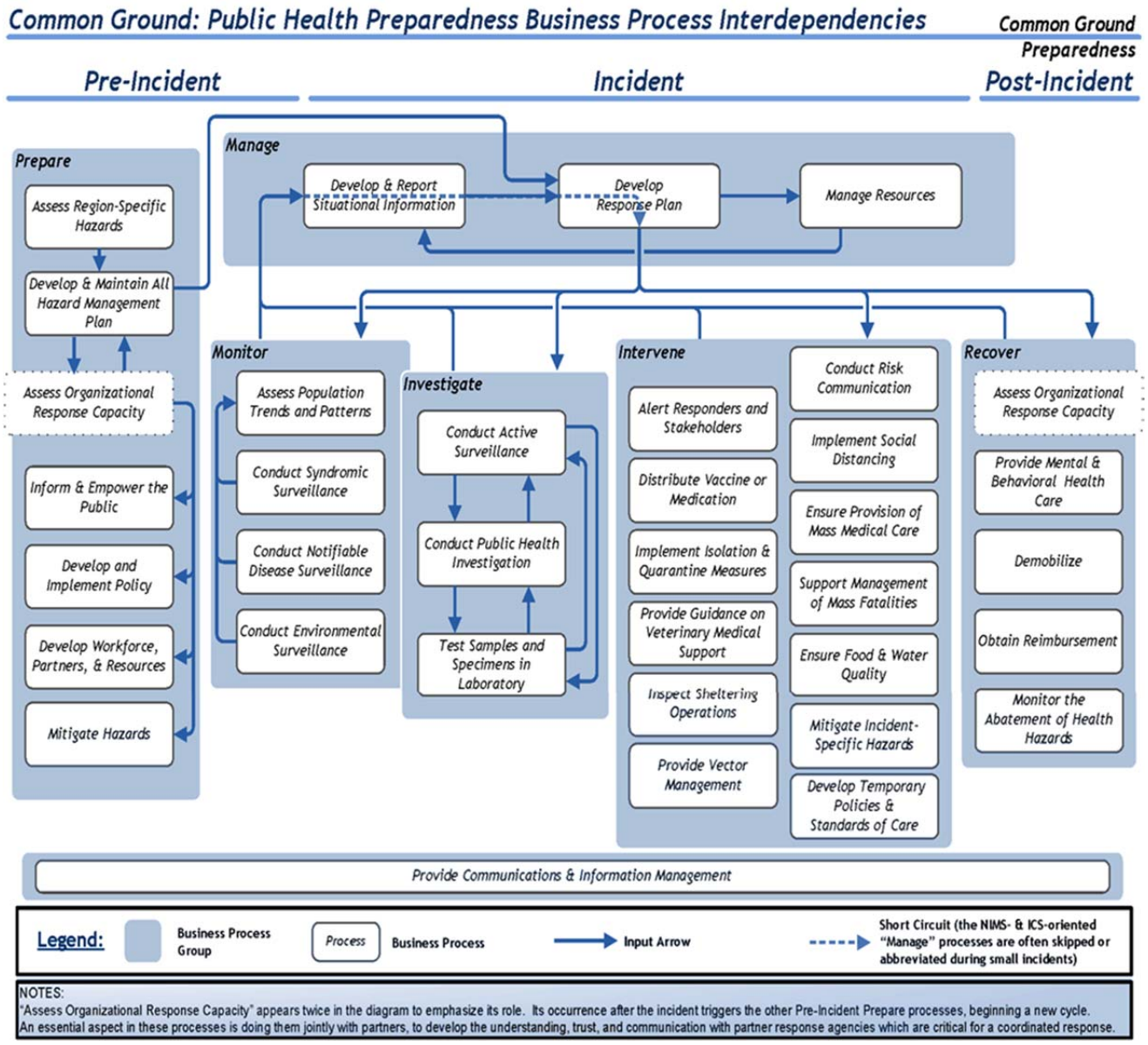
Figure 1. Biosurveillance Situational Awareness Framework



This diagram illustrates the exchange of biosurveillance information between health departments and various data sources, as well as the functions of health departments for biosurveillance situational awareness.
*List of data sources for each of the groups responsible for data exchange that provisions biosurveillance situational awareness. This list is incomprehensive. Other data sources may be applicable.

Public Health Informatics Institute

Figure 2. Preparedness Program Business Process Interdependencies



Appendix A: Biosurveillance Situational Awareness Business Process Matrices and Task Flows

The following pages contain biosurveillance situational awareness business process matrices and task flows.

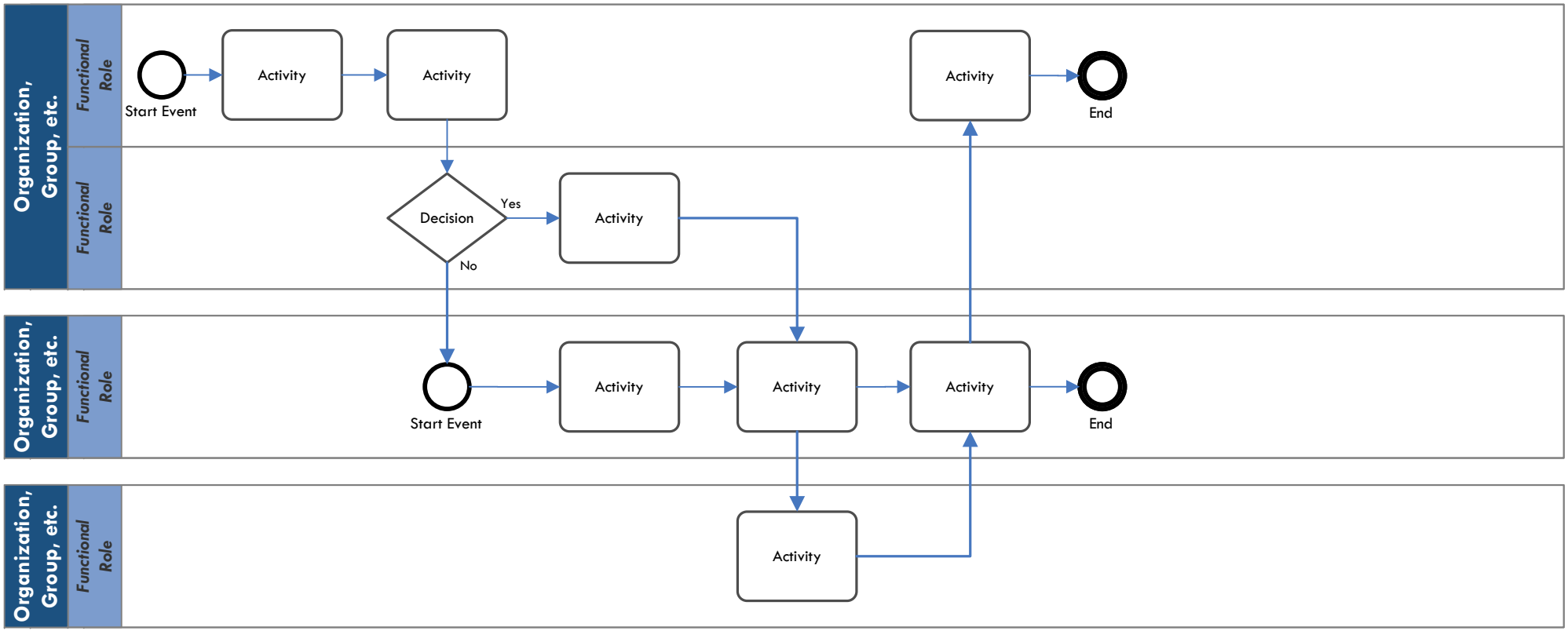
Project Name

Business Process Matrix Template

Business Process Name

OBJECTIVES	BUSINESS RULES	TRIGGERS	TASK SET	INPUTS	OUTPUTS	MEASURABLE OUTCOMES
A concrete statement describing what the business process seeks to achieve. A well-worded objective will be SMART: Specific, Measurable, Attainable/Achiev-able, Realistic, and Time bound.	A set of criteria that defines or constrains some aspect of the business process. Business rules are intended to assert business structure or to control or influence the behavior. Examples in healthcare and public health include laws, standards, and guidelines.	An event, action, or state that indicates the first course of action in a business process. In some cases, a trigger is also an input.	The key set of activities that are carried out in a business process.	Information received by the business process from external sources. Inputs are not generated within the process.	Information transferred out from a process. The information may have been the resulting transformation of an input, or it may have been information created within the business process.	The resulting transaction of a business process that indicates the objectives have been met.

Business Process Name



General Process Notes

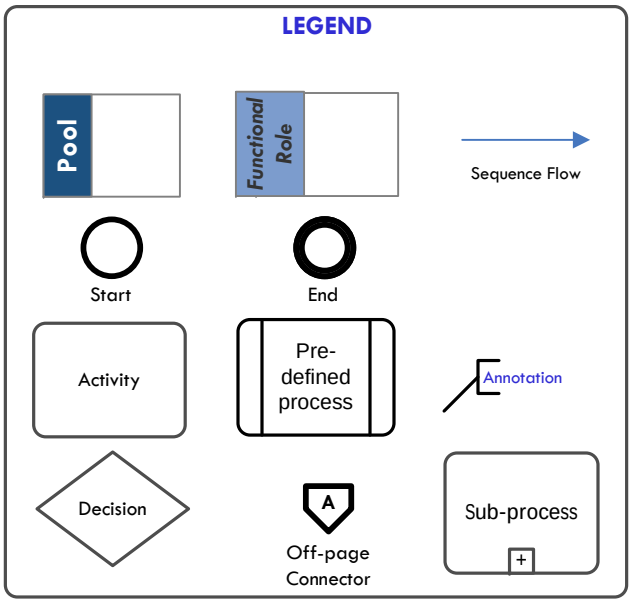
0 General notes regarding the task flow.

1. Identify Business Need for Data

- Details

2. Identify Potential Data Requirements

- Details



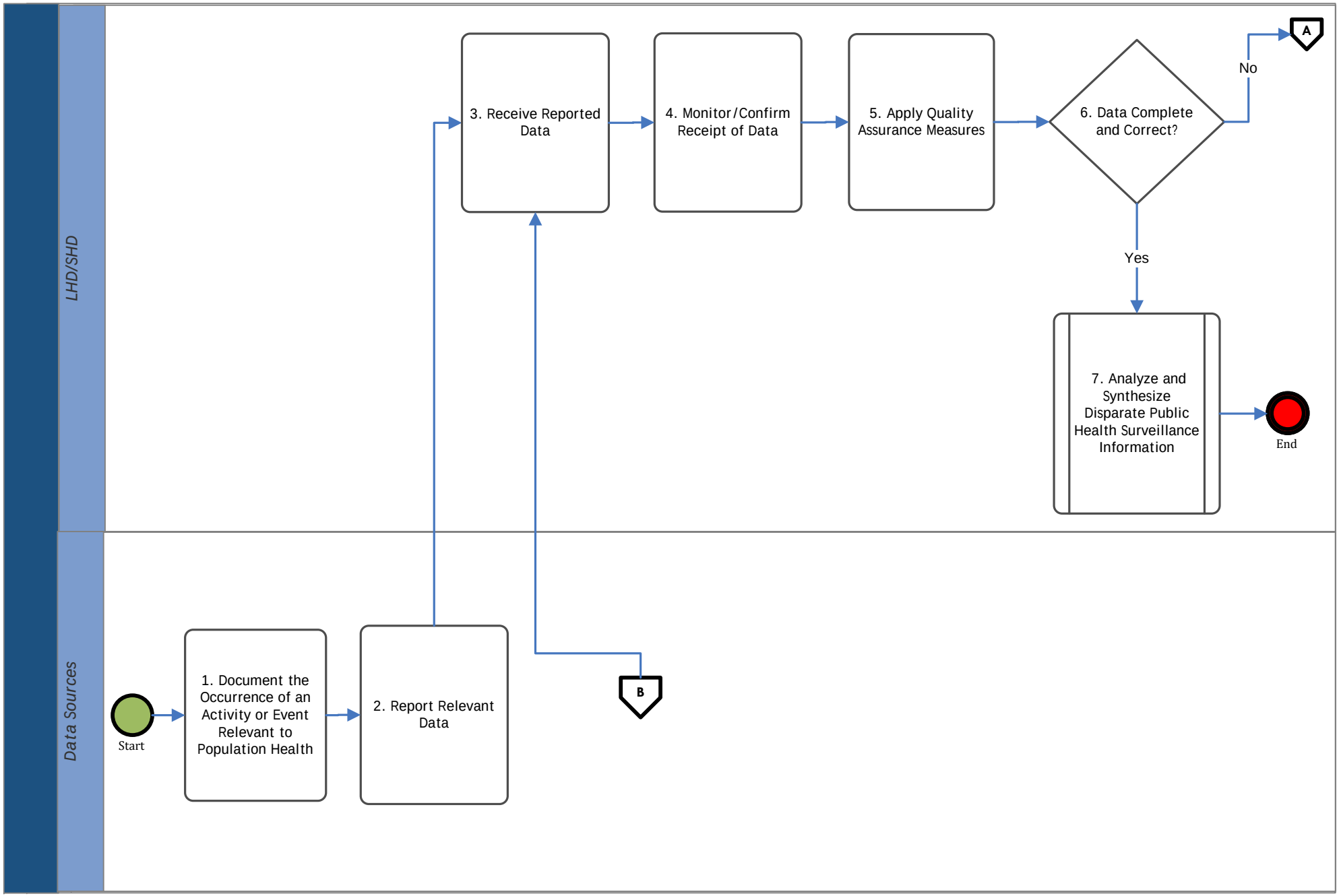
Biosurveillance Situational Awareness

Business Process Matrix

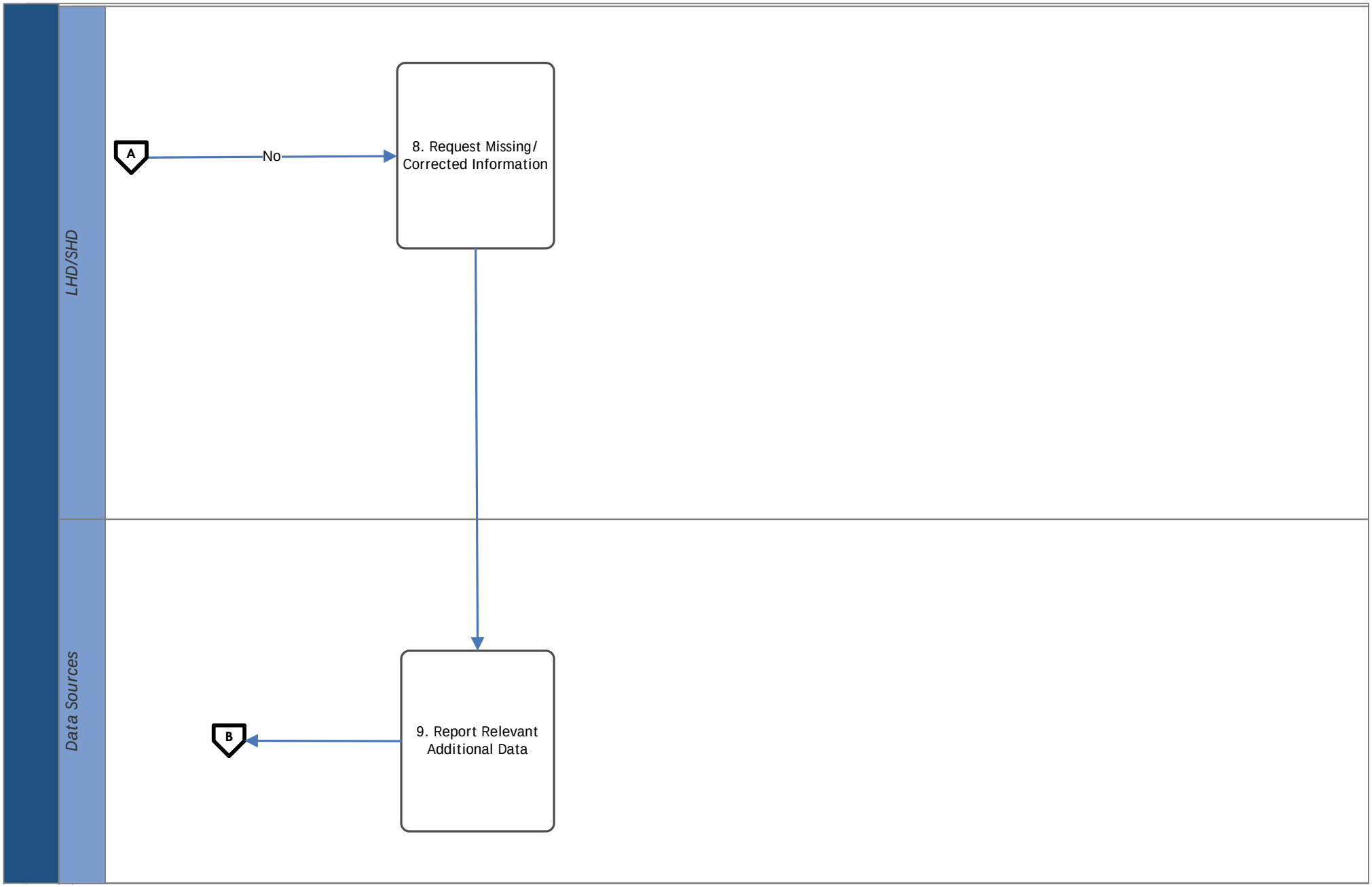
Collect and Receive Health Status Information

OBJECTIVES	BUSINESS RULES	TRIGGERS	TASK SET	INPUTS	OUTPUTS	MEASURABLE OUTCOMES
• To rapidly collect valid and relevant data for the early detection of potential outbreaks or other adverse events that have significant impact on public health • To receive information from various sources in all formats available (e.g., ELRs, telephone, fax, system interface, text messages, paper, etc.) in a timely and usable manner	• HIPAA privacy rules • Office of National Coordinator (ONC) for Health Information Technology standards for the electronic exchange of health information (e.g., Meaningful Use) • Public Health Information Network (PHIN) standards • Data Use Agreements (DUA) • Data transmission business rules • State, local, tribal mandates around collection and receipt of data	• Occurrence of an activity that generates data to be transmitted to the biosurveillance data system on a routine basis • Data is requested	1. Document the Occurrence of an Activity or Event Relevant to Population Health 2. Report Relevant Data 3. Receive Reported Data 4. Monitor/ Confirm Receipt of Data 5. Apply Quality Assurance Measures 6. Data Complete and Correct? 7. Analyze and Synthesize Disparate Public Health Surveillance Information 8. Request Missing/ Corrected Information	• Data from: Electronic Medical Records (EMRs)/ Electronic Health Records (EHRs); Electronic Lab Reports (ELRs); chief complaint reports/ syndromic reports; veterinary (zoonotic) information; social media data; pharmacy/ prescription sales data; over-the-counter medication sales data, etc. • Reportable	• List of data providers (sender details) • Data feed into analytical functions • Data completeness report • Data quality reports • Meta data report • Receipt confirmation message	• Data sources (e.g., physicians, hospitals, etc.) provide health status data in a timely manner • Number of reporters of data (sender details) • Number of received reports (receipt details)

OBJECTIVES	BUSINESS RULES	TRIGGERS	TASK SET	INPUTS	OUTPUTS	MEASURABLE OUTCOMES
	• Family Educational Rights and Privacy Act (FERPA) rules and regulations		9. Report Relevant Additional Data	condition information • Notifiable disease information • Health Information Enterprises (HIEs) • Health Information Service Providers (HISPs)		


LHD/SHD
Data Sources
3. Receive Reported Data
4. Monitor/Confirm Receipt of Data
5. Apply Quality Assurance Measures
6. Data Complete and Correct?
No
A
Yes
7. Analyze and Synthesize Disparate Public Health Surveillance Information
End
Start
1. Document the Occurrence of an Activity or Event Relevant to Population Health
2. Report Relevant Data
B

2 of 3


LHD/SHD
Data Sources
A
No
8. Request Missing/ Corrected Information
B
9. Report Relevant Additional Data

Activity Details / Narrative

General Process Notes

Objectives:

- To rapidly collect valid and relevant data for the early detection of potential outbreaks or other adverse events that have significant impact on public health
- To receive the information from various sources in all formats available (e.g., ELRs, telephone, fax, system interface, text messages, paper, etc.) in a timely and usable manner

Measurable Outcomes:

- Data sources (e.g., physicians, hospitals, etc.) provide health status data in a timely manner
- Number of reporters of data (sender details)
- Number of received reports (receipt details)

General Notes:

- Project scenarios: mass gatherings, natural disasters, and disease and food borne outbreaks
- Actors in this process need to have an understanding of how health providers document during an emergency event in time of stress. The amount and quality of data may vary for health providers as their primary role is to take care of patients, not to collect data for public health
- Public health is typically not the lead during a public emergency and depends on various disparate data sources for information needed to take action

Activity Description:

1. Document the Occurrence of an Activity or Event Relevant to Population Health

- An activity occurs that is reportable or relevant to public health agencies

2. Report Relevant Data

- Health status data is made accessible to public health via electronic or manual transmission from multiple data sources
- Health status information is submitted using various secure mechanisms (e.g., PHIN messaging system, HL7 messaging, SFTP, electronic reporting, phone call, fax, SMS text messaging, etc.)
- Data sources submit revised/corrected data and/or additional information requested by health department
- **Note:** Prior to this step, health information data exchange training and planning must be conducted by the providers and public health agencies
- For additional information on this activity reference: *International Society for Disease Surveillance, Electronic Syndromic Surveillance Using Hospital Inpatient and Ambulatory Clinical Care Electronic Health Record Data: Recommendations from the ISDS Meaningful Use Workgroup, 2012. Available online: http://www.syndromic.org/meaningfuluse/IAData/Recommendations*

3. Receive Reported Data

- LHD/SHD receives the health status information
- Based on jurisdictions, LHD/SHD receives health status data via various data transmission mechanisms (e.g., PHIN messaging system, HL7 messaging, SFTP, electronic reporting, phone call, fax, SMS text messaging, etc.)

4. Monitor/Confirm Receipt of Data

- LHD/SHD monitors the data
- A confirmation receipt of data is not always provided

5. Apply Quality Assurance Measures

- LHD/SHD program subject matter experts assess the quality of the data
- Data is monitored regularly for each data submission for timeliness, accuracy, and completeness
- Timeliness and completeness of data can be defined by the comparison of expected vs. received transmission/exchange of data, volume, and data elements
- State/agency, jurisdiction, or user-defined parameters are used to filter data and identify conditions of interest for further evaluation
- This task may occur at multiple locations in the process, for example, the information technology department may test the validity of a message for structure (i.e., valid message and format) but not content

6. Data Complete and Correct?

- LHD/SHD utilizes electronic and/or manual decision making processes to determine if additional information is needed
- Any errors or problems with the data are corrected, including checking with data senders as needed
- May produce exception report for missing information which will be shared with a data analyst

7. Analyze and Synthesize Disparate Public Health Surveillance Information

- **Predefined process**

8. Request Missing/Corrected Information

- LHD/SHD requests missing information from reporting source. Analysis of the data will continue while waiting for additional information. Do not wait for missing data

9. Report Relevant Additional Data

- The data sources submit specific, additional information requested by the LHD/SHD (e.g., name, contact information, final diagnosis, etc.)

Biosurveillance Situational Awareness

Business Process Matrix

Analyze and Synthesize Disparate Public Health Surveillance Information

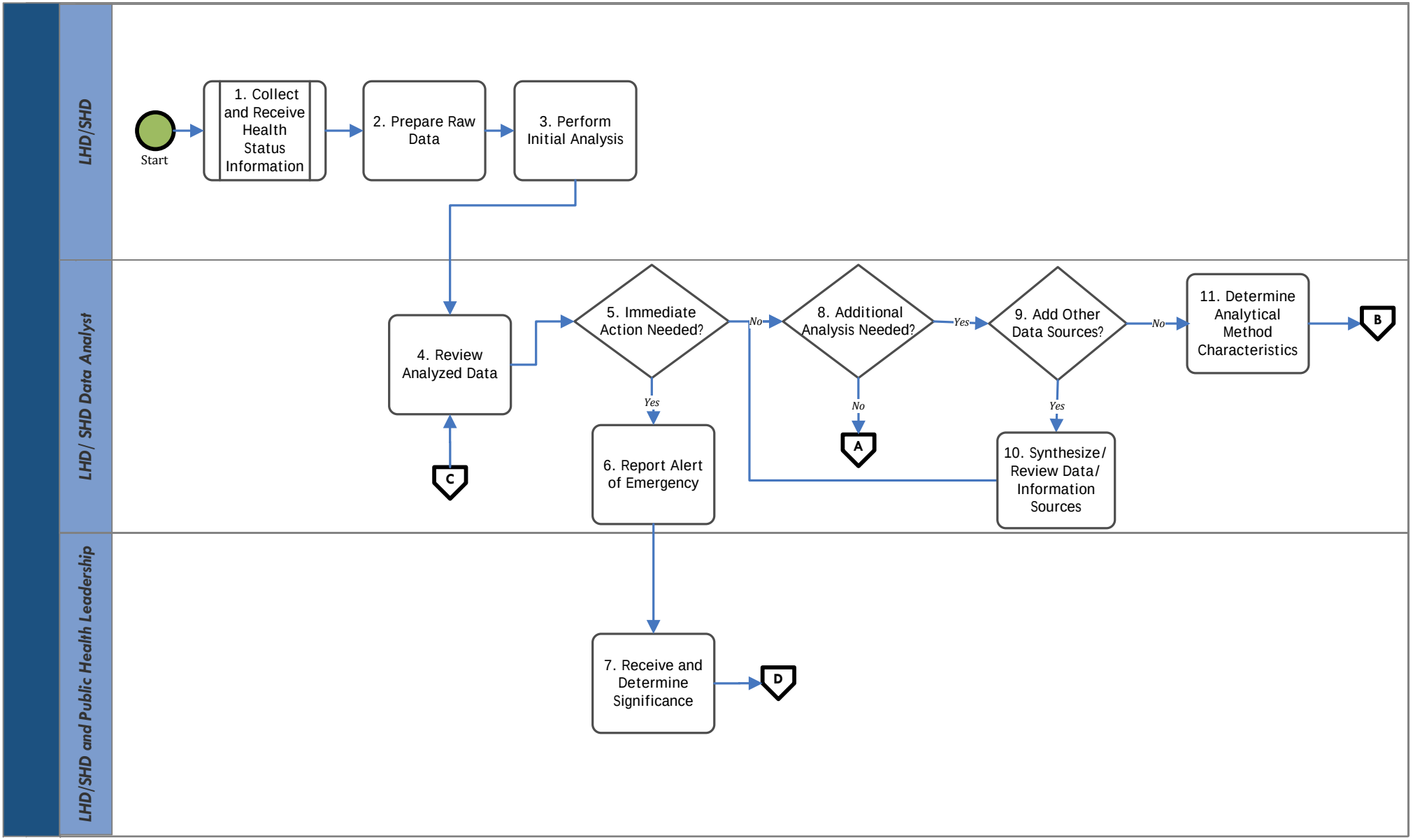
OBJECTIVES	BUSINESS RULES	TRIGGERS	TASK SET	INPUTS	OUTPUTS	MEASURABLE OUTCOMES
• To analyze disparate public health surveillance information from multiple sources (public health and non-public health sources) to identify issues and outcomes during and after an incident or event (Reference: PHP Capability 13, Function 4, Task 1 of the PHP Capabilities) • To determine what additional information may be needed to provide fuller situational awareness • To set priorities for further public health action	• Appropriate epidemiologic and analytic methodology (e.g., person-place-time descriptors, time-trend analysis, statistical significance testing, multivariate analysis, etc.) • Public health laws • Federal, state, territorial, local, and tribal data sharing laws, regulations, policies, and procedures • Analytical methods constraints (e.g., statistical methods, aberration thresholds, etc.)	• New or updated internal or external data or information is received (routinely or upon request) by public health for analysis to achieve public health or stakeholder objectives	1. Collect and Receive Health Status Information 2. Prepare Raw Data 3. Perform Initial Analysis 4. Review Analyzed Data 5. Immediate Action Needed? 6. Report Alert of Emergency 7. Receive and Determine Significance 8. Additional Analysis Needed? 9. Add Other Data Sources? 10. Synthesize/ Review Data/ Information Sources 11. Determine	• Data **Routine Data** • Electronic Medical Records (EMRs)/ Electronic Health Records (EHRs) information • Laboratory reports • Reports from the public • Social media data • Vital records • Geographic Information Systems (GIS) • Reportable conditions • Meta data	• Data summary and situational awareness reports (includes data files) • Condition/ health status trend analysis report • Geospatial disease analysis report • Disease regression and correlation report (e.g., scatterplot) • Investigation/ flags for recommend-ations • Identification of potential cases	• Analysis, synthesis, and assessment of disparate public health surveillance data in a timely manner • Elapse time from receipt of data to completion of analysis, synthesis, and assessment • Elapse time from data request received to output of data • Number of health indicators, environmental risks, counter measures, and/or interventions identified • Number of

OBJECTIVES	BUSINESS RULES	TRIGGERS	TASK SET	INPUTS	OUTPUTS	MEASURABLE OUTCOMES
			Analytical Method Characteristics 12. Prepare Data for Analysis and Apply Analytical Method 13. Access Details of Data 14. Additional Information Required? 15. Aberration? 16. Disseminate Timely Public Health Surveillance Information 17. Is It Significant? 18. Mark as "Watch and Wait" 19. Record/ Document Action	**Event/Incident Specific Data** • Medical provider information (e.g., Office of the Assistant Secretary for Preparedness and Response - ASPR, Disaster Medical Assistance Team - DMAT, etc.) • Pharmacy sales (includes OTC sales) • Environmental hazard details (water contaminants, air pollution, etc.) • Poison control center information • Police reports • Emergency medical services (first responders) data • Non-health related		transmissions and confirmation or error reports • Number of data outputs

OBJECTIVES	BUSINESS RULES	TRIGGERS	TASK SET	INPUTS	OUTPUTS	MEASURABLE OUTCOMES
				information to help analyze data (e.g., power outages, infrastructure information, etc.) • Absenteeism data • Meta data		

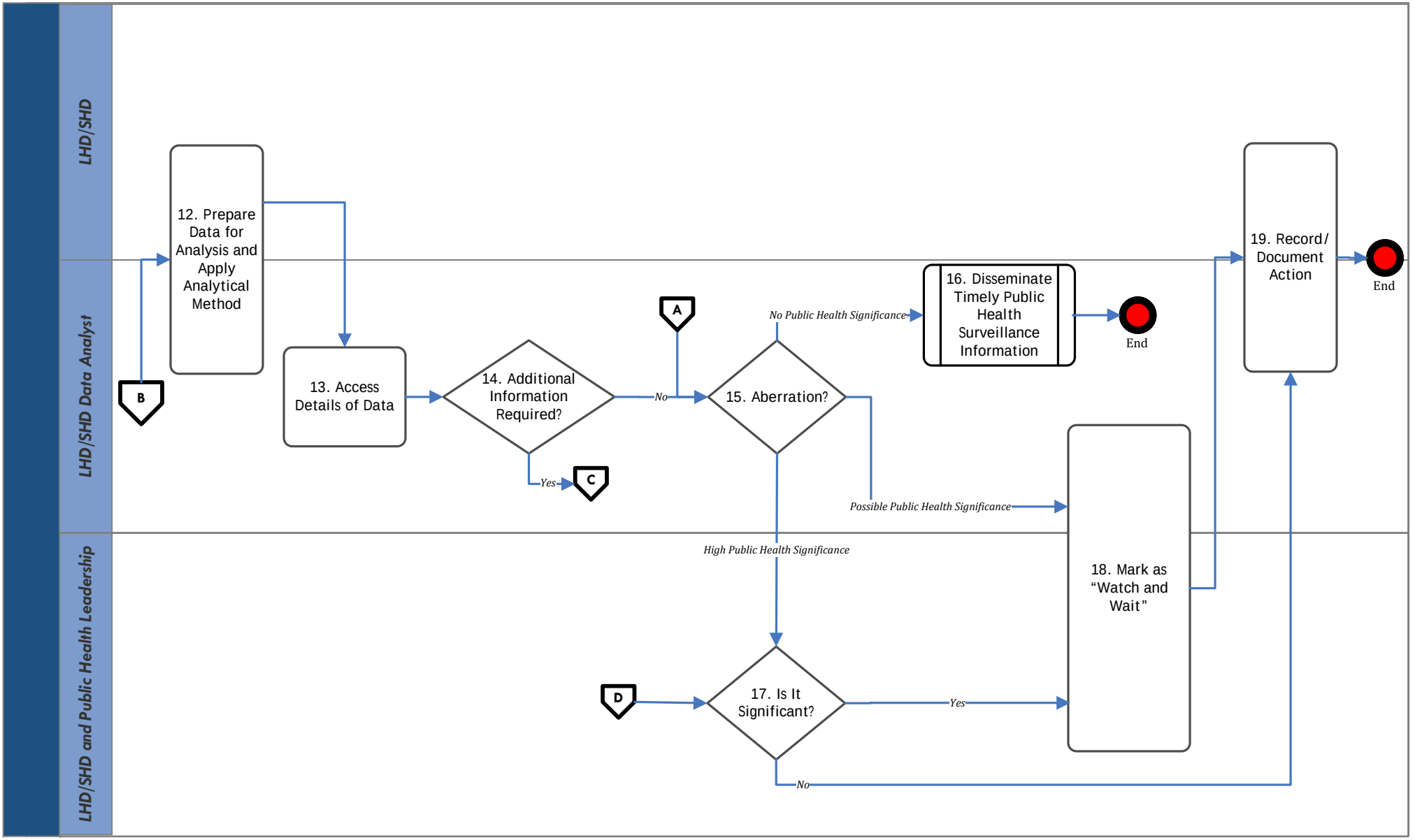
Analyze and Synthesize Disparate Public Health Surveillance Information

1 of 4



Analyze and Synthesize Disparate Public Health Surveillance Information

2 of 4



Analyze and Synthesize Disparate Public Health Surveillance Information

Activity Details / Narrative

General Process Notes

Objectives:

- To analyze disparate public health surveillance information from multiple sources (public health and non-public health sources) to identify issues and outcomes during and after an incident or event (Reference: PHP Capability 13, Function 4, Task 1 of the PHP Capabilities)
- To determine what additional information may be needed to provide fuller situational awareness
- To set priorities for further public health action

Measurable Outcomes:

- Analysis, synthesis, and assessment of disparate public health surveillance data in a timely manner
- Elapse time from receipt of data to completion of analysis, synthesis, and assessment
- Elapse time from data request received to output of data
- Number of health indicators, environmental risks, counter measures, and/or interventions identified
- Number of transmissions and confirmation or error reports
- Number of data outputs

General Notes:

- All data must be triaged to determine the level of significance to public health and the level of action required
- Integrated coordination with multiple sources may be needed
- Public health leadership, usually senior management level, are those qualified to make the decision whether to take immediate action and next steps

Activity Description:

1. Collect and Receive Health Status Information

- **Predefined Process**

2. Prepare Raw Data

- LHD/SHD subject matter expert (SME) analyzes the data manually and/or using user defined systematic analysis algorithms
- Data is filtered based on user-defined criteria to identify and isolate data deemed significant to public health
- Data may have varying levels of priority or significance, including conditions that are flagged for immediate action
- The format of the data is manipulated so that it is usable for analysis

3. Perform Initial Analysis

- Data analyst begins analysis which may include looking at multiple data sources (i.e., may be combined with other data sources)

4. Review Analyzed Data

- Data analyst reviews analyzed data to determine next steps

5. Immediate Action Needed?

- Data could indicate a situation that requires immediate action and decision making by public health leadership

6. Report Alert of Emergency

- If data analysis indicates a situation that requires action beyond scope of the LHD/SHD, public health leadership must be notified
- There are various possible communications formats for alerts (e.g., Health Alert Network, email, phone, fax, etc.)

7. Receive and Determine Significance

- The public health leadership are usually senior management for the LHD/SHD. Public health leadership receives the information and makes a decision for appropriate next steps based on LHD/SHD analyst analysis and level of significance

8. Additional Analysis Needed?

- LHD/SHD utilizes electronic and/or manual decision making processes to determine if additional information is needed
- LHD/SHD monitors and scrubs data quality, timeliness, completeness of data, duration, occurrence, etc.

9. Add Other Data Sources?

- Data analyst determines if other data sources are available. Data analyst may add additional data sets to the analysis

10. Synthesize/Review Data/Information Sources

- Each data set is analyzed individually and as needed with other data set(s). If an aberration is identified, the aberration is documented and the analyst assesses if further analysis is needed, including analysis with additional data set(s)

11. Determine Analytical Method Characteristics

- Data analyst determines characteristics of analysis method prior to applying method to data

12. Prepare Data for Analysis and Apply Analytical Method

- Prepare (e.g., combine, organize, etc.) data and apply selected analytical method in order to assess public health significance

13. Access Details of Data

- The data analyst may need to access more details of the data to accurately analyze the data to assess the significance

14. Additional Information Required?

- LHD/SHD utilizes electronic and/or manual decision making processes to determine if additional information is needed
- LHD/SHD monitors and scrubs data quality, timeliness, completeness of data, duration, occurrence, etc.

15. Aberration?

- The data analyst determines if the information is of high public health significance and requires immediate reporting to public health leadership for review, if the information should proceed through the normal review process, or if the information is not of public health significance. The information is reported on and recorded as such

16. Disseminate Timely Public Health Surveillance Information

- The results of the data analysis are used to inform the public via various forms of communication (e.g., web postings, news reports, etc.)

17. Is It Significant?

- Data is reviewed by public health leadership/senior management to determine if the information is of high significance and the appropriate next steps (e.g., is immediate action needed or not?)

18. Mark as "Watch and Wait"

- Active surveillance is performed and data is further analyzed to determine if intervention is necessary

Activity Details / Narrative

18. Mark as "Watch and Wait" (Continued)

- LHD/SHD may wait for results of additional medical tests or lab results before determining if intervention is necessary
- This step could occur at the LHD/SHD data analyst level and at the public health leadership level. LHD/SHD escalates significant data to public health leadership
- Public health leadership determines if a case investigation or further action is needed
- Public health leadership makes a determination about whether an intervention is required or will improve the condition of the client and/or contact

19. Record/Document Action

- Data analyst documents action based on information provided from system(s) and/ or data sources. Documentation can have various formats (e.g., web-based, MS Excel, email, paper copy, etc.)
- Documentation may include: data set(s) analyzed including date performed, report period; method(s) used including aberration threshold(s); and results. Data analyst will document actions taken (e.g., who was notified, time of notification, plan for further actions with this analysis such as closeout, watch and wait, or further analysis). Documentation can reference any relevant protocols

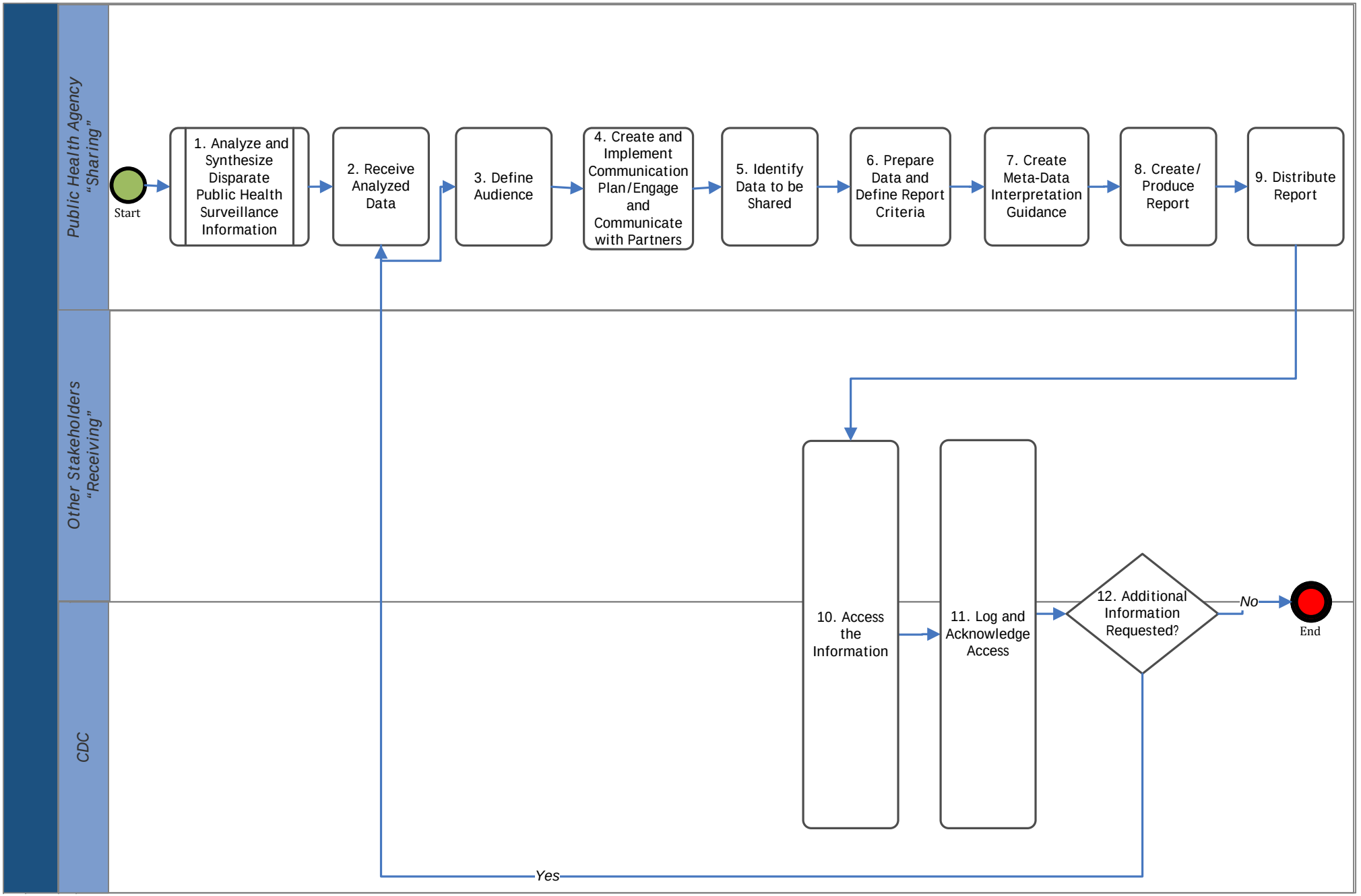
Biosurveillance Situational Awareness

Business Process Matrix

Disseminate Timely Public Health Surveillance Information

OBJECTIVES	BUSINESS RULES	TRIGGERS	TASK SET	INPUTS	OUTPUTS	MEASURABLE OUTCOMES
• Timely aggregation and dissemination of information to inform decision makers at the state, tribal, local, territorial, and federal level, other stakeholders, and the general public of public health threats	• HIPAA privacy rules • Public Health Information Network (PHIN) standards • Office of National Coordinator (ONC) for Health Information Technology standards for the electronic exchange of health information (e.g., Meaningful Use) • Centers for Disease Control and Prevention (CDC) notifiable disease reporting • Jurisdictional requirements on reportable conditions • Data use agreements	• Public health information needs to be communicated to pertinent state, local, territory, tribal, and federal government agencies and the public	1. Analyze and Synthesize Disparate Public Health Surveillance Information 2. Receive Analyzed Data 3. Define Audience 4. Create and Implement Communication Plan/Engage and Communicate with Partners 5. Identify Data to be Shared 6. Prepare Data and Define Report Criteria 7. Create Meta-Data Interpretation Guidance 8. Create/Produce Report	• Raw data (e.g., list of cases, record level data, etc.) • De-identified information • Identified line list of records • Analyzed and synthesized data sources	• Data reports and data analysis/ visualization information of public health and other stakeholder interest • Healthcare Alert Network (HAN) notifications to public health agencies • Standard messages (e.g., PHIN messages, Biosense reports, National Notifiable Diseases Surveillance System reports) • Public communication (e.g., social	• Number of complete, timely, and accurate reports exchanged/ distributed to target agencies • Number of reports created, saved, and sent • Dissemination of surveillance information to public health officials in a timely manner • Elapsed time from recognition of a public health event to reporting to other appropriate agencies • Number of partners that

OBJECTIVES	BUSINESS RULES	TRIGGERS	TASK SET	INPUTS	OUTPUTS	MEASURABLE OUTCOMES
	• Data suppression rules • Small number guidelines • Public health law • Data etiquette • Best practices for sharing others' data		9. Distribute Report 10. Access the Information 11. Log and Acknowledge Access 12. Additional Information Requested?		media, tweets, press releases, etc.) • Prepared data sets	have accessed the data • Number of failed jobs (reports sent unsuccessfully)


Public Health Agency "Sharing"
Other Stakeholders "Receiving"
CDC
Start
1. Analyze and Synthesize Disparate Public Health Surveillance Information
2. Receive Analyzed Data
3. Define Audience
4. Create and Implement Communication Plan/Engage and Communicate with Partners
5. Identify Data to be Shared
6. Prepare Data and Define Report Criteria
7. Create Meta-Data Interpretation Guidance
8. Create/ Produce Report
9. Distribute Report
10. Access the Information
11. Log and Acknowledge Access
12. Additional Information Requested?
No
End
Yes

Disseminate Timely Public Health Surveillance Information

Activity Details / Narrative

General Process Notes

Objectives:

- Timely aggregation and dissemination of information to inform decision makers at the state, tribal, local, territorial, and federal level, other stakeholders, and the general public of public health threats

Measurable Outcomes:

- Number of complete, timely, and accurate reports exchanged/distributed to target agencies
- Number of reports created, saved, and sent
- Dissemination of surveillance information to public health officials in a timely manner
- Elapsed time from recognition of a public health event to reporting to other appropriate agencies
- Number of partners that have accessed the data
- Number of failed jobs (reports sent unsuccessfully)

General Notes:

- The order in which activities 4 and 5 are performed is interchangeable based on the particular scenario
- "Sharing agency" is typically the public health agency (e.g., LHD/SHD)
- "Receiving agency" is typically other stakeholders and/or data sources

Activity Description:

1. Analyze and Synthesize Disparate Public Health Surveillance Information

- **Predefined process**

2. Receive Analyzed Data

- Pre-analyzed data is received and available to disseminate to appropriate recipient. See Analyze Disparate Data process

3. Define Audience

- The public health agency, or "sharing" agency", determines the intended audience the report is to be distributed to
- In many situations, identifying the audience drives the data to be shared

4. Create and Implement Communication Plan/Engage and Communicate with Partners

- LHD/SHD and other partners will create and implement a communications plan for reporting public health information (other agencies may include: Emergency Preparedness Teams, Police, Department of Transportation, Commissioner of Environmental Protection, CDC, etc.)

5. Identify Data to be Shared

- The "sharing agency" identifies what data is to be shared and/or acknowledges data request
- The data to be shared is dependent on the end user of the data, or "receiving agency", and the decisions made by the LHD/SHD
- The public health agency could identify data to be shared prior to creating the implementation plan

6. Prepare Data and Define Report Criteria

- The public health agency defines report characteristics (e.g., format, etc.)

7. Create Meta-Data Interpretation Guidance

- The "sharing agency" produces the report from the analysis of the datasets

8. Create/Produce Report

- The public health agency can tailor the report for specific recipients

9. Distribute Report

- LHD/SHD distributes the report to target agencies via multiple formats (e.g., email, fax, website, uploading to a "cloud", social media, etc.)

10. Access the Information

- The "receiving agency" accesses the report via multiple formats (e.g., email, fax, website, uploading to a "cloud", social media, etc.)

11. Log and Acknowledge Access

- An electronic acknowledgment is sent to the "sharing agency" when the "receiving agency" receives or logs in to the system to access the data
- The "receiving agency" sends a notification that the report was received (electronic notifications, phone call, SMS, etc.)
- Not all reporting requires this activity

12. Additional Information Requested?

- The receiver of the information determines if additional information is needed to make an informed decision. If so, once the information is received the dissemination process is repeated

Appendix B: Alternate and Ancillary Information Sources

Ambulatory Clinic Data

Animal Health Information

College/University Health Clinic Reports

Coroner and Death Certificate Information

Correctional Facility Data

Emergency Call Center Logs

Emergency Medical Services Data

Emergency Shelter Information

Environmental Complaints and Monitoring

Poison Control Center Calls

Police Reports

School and Workplace Absenteeism and Illness Information

Population Socioeconomic Status

Senior Living Center Health Reports

Social Media Data

Appendix C: Examples of Natural Disasters, Mass Gatherings, and Outbreaks

Natural Disasters, Mass Gatherings, and Outbreak Events (predictable and unpredictable)

Accidents
- *Derailed trains*
- *Explosions*
- *Mass vehicle accident pile-ups*
- *Plane crash*

Environmental Contaminations
- *Chemical spills*
- *Contaminations*
- *Oil spills*
- *Nuclear events*

Natural Disasters
- *Blizzards*
- *Earthquakes*
- *Floods*
- *Ice storms*
- *Heat waves*
- *Hurricanes*
- *Tornadoes*
- *Tsunamis*
- *Volcanoes*
- *Wildfires*

Outbreaks/Clusters
- *Cancer clusters*
- *Disease outbreaks (i.e., pandemics)*
- *Drug overdoses*
- *Food and water borne outbreaks*
- *Other infectious disease outbreak*

Political Events
- *Inauguration**
- *Presidential nominating conventions**
- *United Nations assembly*

Public Celebrations/Mass Gatherings
- *Fairs (county and state)*
- *Fourth of July celebrations*
- *Music festivals*
- *National Scout jamboree (Boy Scouts of America)*
- *New Year's Eve and New Year's Day*
- *Parades*
- *Religious gatherings*

Sporting Events
- *Auto race (e.g., Indy 500)*
- *Marathons*
- *NBA finals*
- *NCAA finals*
- *Olympics**
- *Super Bowl**
- *World Series*

Terrorism (Requires unique process)**
- *Biological*
- *Bombs*
- *Chemical*
- *Nuclear*
- *Radiological*

**National Special Security Events – Require enhanced surveillance activities*

*** Terrorism requires a unique biosurveillance process*

Note: The type of event or scenario drives the data sources and processes to consider for biosurveillance situational awareness. This list is not comprehensive. Other predictable and unpredictable events may be applicable.

Appendix D: Glossary of Terms

Term	Definition	Source
Aggregate Hospitalizations and Deaths Reporting Activity (AHDRA)	Following the 2009 H1N1 influenza pandemic, the web-based AHDRA system was established to collect case reports of hospitalizations and deaths related to influenza in the United States.	http://www.cdc.gov/h1n1flu/flu_surv_ahdra.htm
Ambulatory Care	Ambulatory care refers to primary care offices and other outpatient care settings (e.g., OB/GYN, cardiology, etc.).	
BioSense 2.0	BioSense 2.0 is a national biosurveillance system implemented by the CDC to collect de-identified medical information, such as ED and hospitalization data from Veterans Affairs, Department of Defense, and civilian hospitals across the country. Data is reported electronically by federal agencies and state and local health departments.	http://www.cdc.gov/biosense/
Biosurveillance	According to the National Strategy for Biosurveillance, biosurveillance is "[t]he process of gathering, integrating, interpreting, and communicating essential information related to all-hazards threats or disease activity affecting human, animal, or plant health to achieve early detection and warning, contribute to overall situational awareness of the health aspects of an incident, and to enable better decision-making at all levels."	
Bioterrorism	According to the CDC, "[a] bioterrorism attack is the deliberate release of viruses, bacteria, or other germs (agents) used to cause illness or death in people, animals, or plants."	http://www.bt.cdc.gov/bioterrorism/overview.asp
Business Process	A set of related work tasks designed to produce a specific desired programmatic (business) result. The process involves multiple parties internal or external to the organization and frequently cuts across organization boundaries.	www.phii.org
Case	An instance of a particular disease, injury, or other health condition that meets selected criteria.	
Case Investigation	The collection of information about an individual for public health purposes.	
Case/Conditions Reporting	The process of reporting disease, injury, or other health conditions of public health importance to public health agencies.	
Centers for Disease Control and Prevention (CDC)	The CDC is the United States' national public health institution, focused on the prevention and control of illness and injury.	www.cdc.gov
Chief Complaint	A subjective statement made by a patient describing the most significant or serious symptoms or signs of illness or dysfunction that	

Term	Definition	Source
	caused him or her to seek health care. It is used most often in a health history.	
Collaborative Requirements Development Methodology (CRDM)	A facilitated collaborative approach to developing requirements for reportable conditions surveillance information systems, developed by the Public Health Informatics Institute.	www.phii.org
Confirmed Case	A case that is classified as confirmed for reporting purposes.	
Council of State and Territorial Epidemiologists (CSTE)	CSTE is comprised of state and territorial public health epidemiologists who work together to build stronger working relationships across jurisdictional boundaries. CSTE also collaborates with the CDC.	www.cste.org
Data Element	A basic unit of definable information; a basic unit of data for the purpose of recording and interchange.	
Data Use Agreement	A contractual document used for the transfer of data that has been developed by nonprofit, government, or private industry, where the data is nonpublic or is otherwise subject to some restrictions on its use.	
Department of Defense (DoD)	The DoD provides the military resources necessary to ensure the safety of the United States.	www.defense.gov
Electronic Health Record (EHR)	According to HIMSS, "A longitudinal electronic record of patient health information generated by one or more encounters in any care delivery setting."	http://www.himss.org/library/ehr/?navItemNumber=13261
Electronic Lab Reporting (ELR)	According to CDC, "The automated transmission of laboratory-related data from commercial, public health, hospital, and other labs to state and local public health departments through an EHR system or a Laboratory Information Management System (LIMS)."	http://wwwn.cdc.gov/nndss/script/MU_ELR.aspx
Emergency Department (ED)	EDs provide acute care to sick persons without prior medical appointments.	
Emergency Medical Services (EMS)	EMS provides acute care of patients outside of a hospital and transport of patients to a hospital or other point of care.	
Emergency Response	The carrying out of planned activities by government agencies, law enforcement, and public health agencies to mitigate the health and safety hazards posed by a public health emergency.	
Epidemiology	The study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to the control of health problems.	

Term	Definition	Source
Electronic Surveillance System for Early Notification of Community-Based Epidemics (ESSENCE)	Developed by the DoD, ESSENCE is an automated, electronic biosurveillance system that detects aberrations in disease and bioterror occurrences.	http://www.health.mil/MHSCIO/programs_products/DHSS/DHSS-Products/ESSENCE.aspx
Event Management	The organization and coordination of the public health response to an occurrence of importance to public health.	
Georgia State Electronic Notifiable Disease Surveillance System (GA SendSS)	GA SendSS is an electronic biosurveillance system for collecting notifiable disease data in the state of Georgia.	http://health.state.ga.us/epi/sendss.asp
Health Information Exchange (HIE)	Organizations that provide a mechanism for the sharing of clinical and administrative health care data among health care institutions, providers, and data repositories.	
Health Information Technology (HIT)	According to HHS, "An electronic environment used for the exchange and utilization of health information."	www.hhs.gov
Health Insurance Portability and Accountability Act (HIPAA)	HIPAA protects the confidentiality of identifiable patient health information while allowing it to be collected and utilized for surveillance purposes.	http://www.hhs.gov/ocr/privacy/
Influenza-like Illness (ILI)	A case of possible influenza or other illness consisting of symptoms that resemble influenza.	
Inpatient Care	Inpatient care, in contrast to ambulatory care, occurs upon admission to a hospital or health care facility. Therefore, information from inpatient electronic health records will generally offer information on illness and injury severity.	
Interoperability	Interoperability allows disparate electronic data management systems to work together to transmit and exchange data.	http://www.healthit.gov/policy-researchers-implementers/hitech-programs-advisory-committees
International Society for Disease Surveillance (ISDS)	ISDS is a not-for-profit organization comprised of experts in surveillance, informatics, and other public health fields who advance the field of disease surveillance through research and capacity building.	www.syndromic.org
Laboratory Confirmed Case	A case of disease that is confirmed by the isolation of a pathogenic agent in a laboratory setting using acceptable diagnostic methods.	
Mass Gathering	Preplanned public events that are held for a limited time period and attended by more than 25,000 people. Mass gatherings represent specific challenges for public health officials because of the health risks associated with crowd size and duration of stay. In addition, population movement requires public health departments to interact across jurisdictional	www.phii.org

Term	Definition	Source
	boundaries to identify risks and disease-management solutions.	
Meaningful Use	Meaningful Use refers to the set of standards imposed by the Centers for Medicare and Medicaid Services (CMS) to promote effective use of electronic health information for improving health services and public health.	http://www.healthit.gov/policy-researchers-implementers/hitech-programs-advisory-committees
National Strategy for Biosurveillance	The National Strategy for Biosurveillance was signed by President Barack Obama in July 2012 to solidify the nation's commitment to advancing biosurveillance practice, promoting situational awareness, and early detection of public health and safety threats.	
Natural Disaster	A major adverse event resulting from natural processes of the Earth.	
North Carolina Disease Event Tracking and Epidemiologic Collection Tool (NC DETECT)	NC DETECT is the statewide biosurveillance system implemented in North Carolina for early detection of public health events, using data from emergency departments, EMS, poison control centers, and other sources.	www.ncdetect.org
North Carolina Electronic Disease Surveillance System (NC EDSS)	NC EDSS is the statewide electronic lab reporting environment for North Carolina.	http://epi.publichealth.nc.gov/cd/lhds/manuals/cd/ncedss.html
National Electronic Disease Surveillance System (NEDSS)	NEDSS is the electronic system that facilitates the transfer of surveillance data from state and local health departments to the CDC.	http://wwwn.cdc.gov/nndss/script/nedss.aspx
National Notifiable Diseases Surveillance System (NNDSS)	NNDSS is, "a multifaceted public health disease surveillance system that gives public health officials powerful capabilities to monitor the occurrence and spread of diseases." NEDSS is a key component of NNDSS.	http://wwwn.cdc.gov/nndss/
Notifiable Condition	A disease, injury, or other health condition under national surveillance as agreed upon by the Council of State and Territorial Epidemiologists, about which data are systematically collected and reported to the CDC. Not to be confused with *reportable condition*.	
Office of the National Coordinator for Health Information Technology (ONC)	ONC is the federal department responsible for promoting the most advanced health informatics practices and health information exchange mechanisms.	http://www.healthit.gov/newsroom/about-onc
Over-the-counter (OTC)	OTC refers to drugs and sick products that are sold directly to consumers without a prescription from a health care professional.	
Outbreak	The occurrence of more cases of disease, injury, or other health conditions than expected in a given area or among a specific group of persons during a specific period. Usually, the cases are presumed to have a common cause or to be related to one another in some way.	

Term	Definition	Source
Outbreak Management	The organization and coordination of the public health response to a cluster or outbreak. Outbreak management gives a standardized approach to aid in outbreak investigation, control, and communication involving all partners across government agencies, non-government entities, and the public.	
Preparedness and Emergency Response Research Center (PERRC)	PERRC centers, based in nine US schools of public health, conduct research on the current state of emergency preparedness and provide recommendations to optimize response capabilities at the national, state, and local levels.	http://www.asph.org/document.cfm?page=1088
Public Health Emergency Preparedness (PHEP)	The PHEP cooperative agreement provides funds to public health departments through the Office of Public Health Preparedness and Response to enhance emergency response capabilities.	www.cdc.gov/phpr/coopagreement.htm
Public Health Informatics Institute (PHII)	PHII (a program of the Task Force for Global Health) works with public health professionals and their stakeholders on projects centered on requirements development, practice support, and informatics training. Our mission is to improve health outcomes worldwide by transforming health practitioners' ability to apply information effectively.	www.phii.org
The Public Health Information Network (PHIN)	PHIN is a CDC initiative to develop standards for health information exchange across public health agencies and to the federal government.	http://www.cdc.gov/phin/
Primary Care	Care provided by a health care provider who is the first point of consultation for a patient, including primary care physicians, physician's assistants, and nurse practitioners. Primary care providers generally do not provide specialized or inpatient care.	
Public Health Agency	Organizations that operate at the federal, state, territorial, and local levels to provide health care and promote public health within their respective jurisdictions. They are responsible for collection and sharing public health data internally and to federal agencies.	
Public Health Informatics	The systematic application of information and computer science and technology to public health practice, research, and learning.	
Public Health Preparedness	Activities related to both practice and policy that enhance readiness to respond to public health emergencies and other disasters.	www.naacho.org
Public Health Surveillance	The systematic collection, analysis, interpretation, and dissemination of health data on an ongoing basis, to gain knowledge of the pattern of reportable or notifiable condition occurrence and potential in a community, in	

Term	Definition	Source
	order to control and prevent disease in the community.	
Reportable Condition	A disease, injury, or other health condition under surveillance at the state, territory, or local level, about which data must be provided to the appropriate state, territorial, or local health authority. Not to be confused with *notifiable condition.*	
Requirement	A necessary characteristic of a system that makes it valuable to users.	
Sensitivity	The degree to which a surveillance system is able to identify a given condition or event with a low level of false negative results.	
Situational Awareness	Understanding the current public health context by examining health-related data for an analysis of the situation and subsequent decision-making.	
Specificity	The degree to which a surveillance system is able to identify a given condition or event with a low level of false positive results.	
Surveillance System	"An organized infrastructure that enables the ongoing, systematic collection, management, analysis, and interpretation of health-related data followed by their dissemination to those who require the information in order to: 1) monitor populations to detect unusual instances or patterns of disease, toxic exposure, or injury; 2) act to prevent or control these threats; 3) intervene to promote and improve health. The term applies to both electronic and paper-based systems."	
Syndrome	A collection of symptoms that tend to present together and indicate the occurrence of a particular disease.	
Syndromic Surveillance	Syndromic surveillance uses near real-time health data from emergency departments, ambulatory care, and urgent care settings to detect pre-defined syndromes (e.g., influenza-like illness) based on chief complaint, symptoms, and/or diagnosis data. Syndromic surveillance is used for monitoring health trends and detecting unusual increases in events.	
Timeliness	The ability of a surveillance system to detect an event, condition, or emergency of public health concern in real-time, or as close to real-time as possible.	
Urgent Care Setting	A health care setting that is often open longer hours than physician offices, does not require an	

Term	Definition	Source
	appointment, and is ideally used for urgent, but non-emergency, illnesses and conditions.	
Validation	The process to ensure that data received 1) represents the data the reporting entity intended to submit, 2) is accurate, and 3) conforms to the data requirements of the receiving entity.	
Vital Statistics	Statistics on live births, deaths, fetal deaths, marriages, and divorces.	

Appendix E: Acronyms

Acronym	Definition
AHDRA	Aggregate Hospitalizations and Deaths Reporting Activity
CDC	Centers for Disease Control and Prevention
CSTE	Council of State and Territorial Epidemiologists
DoD	Department of Defense
ED	Emergency Department
EHR	Electronic Health Record
ELR	Electronic Laboratory Reporting
EMS	Emergency Medical Services
ESSENCE	Electronic Surveillance System for Early Notification of Community-Based Epidemics
GA SendSS	Georgia State Electronic Notifiable Disease Surveillance System
HD	Health Department
HIE	Health Information Exchange
HIPAA	Health Insurance Portability and Accountability Act
ILI	Influenza-like Illness
ISDS	International Society for Disease Surveillance
IT	Information Technology
NC EDSS	North Carolina Electronic Disease Surveillance System
NC DETECT	North Carolina Disease Event Tracking and Epidemiologic Collection Tool
NEDSS	National Electronic Disease Surveillance System
NNDSS	National Notifiable Diseases Surveillance System
ONC	Office of the National Coordinator for Health Information Technology
OTC	Over the Counter
PERRC	Preparedness and Emergency Response Research Center
PHEP	Public Health Emergency Preparedness
PHII	Public Health Informatics Institute
PHIN	The Public Health Information Network
SS	Syndromic Surveillance