



United States
Environmental Protection
Agency

Public Health Surveillance Primer

For Water Quality Surveillance and Response Systems



Introduction

A Water Quality Surveillance and Response System (SRS) provides a systematic framework for enhancing distribution system monitoring activities to detect emerging water quality issues and respond before they become problems. An SRS consists of six components grouped into two operational phases, surveillance and response. The surveillance components are designed to provide timely detection of water quality incidents in drinking water distribution systems and include: Online Water Quality Monitoring, Enhanced Security Monitoring, Customer Complaint Surveillance and Public Health Surveillance. The response components include Consequence Management and Sampling & Analysis, which support timely response actions that minimize the consequences of a contamination incident. The *Water Quality Surveillance and Response System Primer* provides a brief overview of the entire system (USEPA, 2015a).

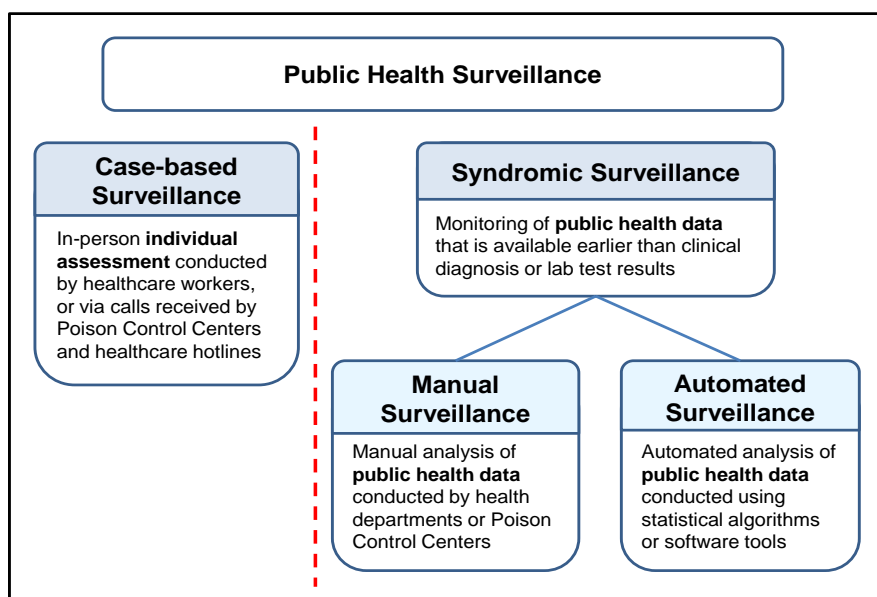
This document provides an overview of the Public Health Surveillance (PHS) component of an SRS. It presents basic information about the goals and objectives of PHS in the context of an SRS. This primer covers the following four topics:

- **Topic 1:** What is PHS?
- **Topic 2:** What are the major design elements of PHS?
- **Topic 3:** What are common design goals and performance objectives for PHS?
- **Topic 4:** What are cost-effective approaches for PHS?



Topic 1: What is PHS?

PHS is the ongoing, systematic collection, analysis and interpretation of public health data. The main goal of PHS is to detect changes in the health status of a community in sufficient time to allow for intervention to mitigate the consequences of an emerging threat to public health. **Figure 1** shows two broad types of PHS, case-based and syndromic surveillance. *Case-based surveillance* involves an assessment of public health status based on in-person observation of individual patients. *Syndromic surveillance* involves the monitoring of aggregated public health data. Each type of surveillance provides community-level health information. Public health partners can increase the potential to detect a change in the health status of a community by conducting both case-based and syndromic surveillance.



PHS is unique in that it is generally monitored by public health partners, whereas other SRS components are monitored by water utility personnel. Communication between water utilities and public health partners has often been insufficient to provide timely detection and response to waterborne disease outbreaks. Incorporating PHS into an SRS helps ensure that data acquisition, analysis and information sharing is coordinated between the drinking water utility and public health partners, resulting in earlier detection of possible drinking water contamination incidents.

Topic 2: What are the major design elements of PHS?

The major design elements for PHS are shown in **Figure 2** and described under the remainder of this topic.



Figure 2. PHS Design Elements

Integration of Public Health Surveillance Capabilities

A well designed PHS component is able to provide both timely and detailed information to investigators. Potential public health datastreams include:

- 911 calls
- Emergency medical services runs
- Poison control center calls
- National Poison Data System
- Emergency department data
- Over-the-counter medication sales
- Direct observation by healthcare professionals

For purposes of an SRS, these datastreams are analyzed in order to detect patterns that may signal a public health incident that could be related to drinking water contamination. Many of these datastreams

include geographic identifiers that can be used to investigate spatial clustering of cases. Factors to consider when deciding which datastreams to leverage for PHS may include:

- Availability of datastreams
- Frequency of data analysis
- Level of confidence in the datastream as an indicator of illness or disease in the population
- Types of contamination incidents that could be identified through this datastream
- Availability of methods to automate data collection and analysis
- Availability of underlying case data, such as patient information such as symptoms, age and location of the exposure, during alert investigations

Ideally, PHS should include surveillance of datastreams that would provide detection capability for contaminants with both rapid and delayed symptom onset, thus covering a wide range of potential contaminants.

PHS Communication and Coordination

Communication and coordination involves identifying relevant public health partners, engaging them during planning activities, and working with them during the investigation of PHS alerts in a manner that facilitates efficient data sharing and consensus building. An SRS can only be successful if the water utility and public health partners communicate and share information. Public health experts provide information that might not otherwise be available to utilities and which is useful for investigating possible water contamination incidents.

PHS Alert Investigation Procedures

PHS alert investigation procedures describe how public health partners use PHS datastreams and other resources to investigate PHS alerts and determine whether or not they are caused by possible drinking water contamination. In general, PHS alert investigations are conducted jointly by the utility and public health partners. **Figure 3** illustrates how an investigation into a possible water contamination incident can begin with either a PHS alert or a utility alert.

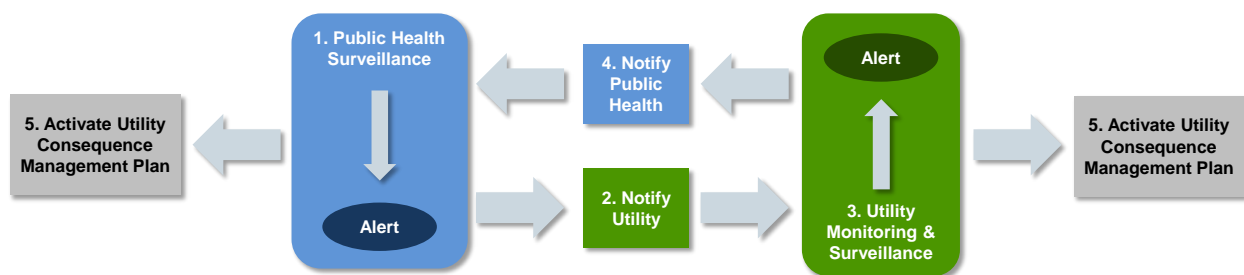


Figure 3. Example of a PHS Alert Investigation Process

In the example shown in Figure 3, the investigation is assumed to begin with the generation of a PHS alert, and illustrates the communication pathways between the utility and public health agencies during the investigation. The numbered steps in this figure are briefly described below:

1. The investigation begins following receipt of a PHS alert generated through one of the surveillance methods. Public health personnel review underlying case data related to the alert in order to determine whether the alert is valid.

2. If public health partners determine that the PHS alert is valid, and if investigators cannot rule out possible water contamination as the cause of the alert, the public health investigator notifies the water utility.
3. Once notified of the PHS alert, the utility reviews data from other SRS components, such as customer complaint surveillance, along with other utility information that can help investigators determine whether or not the PHS alert is related to drinking water quality.
4. The utility shares the results of their investigation with public health partners. If information provided by the utility is sufficient to rule out drinking water contamination, the investigation is closed.
5. If contamination cannot be ruled out following the utility investigation, water contamination is considered possible and the consequence management plan is activated.

Topic 3: What are common design goals and performance objectives for PHS?

The design goals and performance objectives established for PHS by the utility and its public health partners provide the basis for the design of an effective component.

PHS Design Goals

Design goals are the specific benefits that utilities expect to achieve by implementing PHS. A fundamental design goal of an SRS is the ability to detect and respond to water quality anomalies in the distribution system. In addition to this fundamental SRS design goal, other PHS-specific design goals such as improved coordination between the utility and public health partners can be realized. Examples of common PHS design goals are listed in **Table 1**.

Table 1. Examples of Common PHS Design Goals

Design Goal	Description
Detect water contamination incidents	Training healthcare providers and creating systems to monitor for symptoms related to waterborne disease outbreaks, such as those resulting from <i>Cryptosporidium</i> and norovirus infections. Training is also provided to improve recognition of exposures to toxic chemicals via contaminated drinking water.
Increase awareness of the relationships between public health protection and drinking water quality	Establishing a joint public health and utility workgroup will encourage collaboration to effectively address water quality issues that may impact public health.
Monitor for other community health issues of interest	Beyond possible drinking water contamination, PHS systems used in an SRS can support other public health goals such as monitoring for low-level but potentially harmful background environmental exposures.

PHS Performance Objectives

Performance objectives are measurable indicators of how well the SRS meets the design goals established by the utility. Throughout design, implementation and operation of the SRS or its components, the utility can use performance objectives to evaluate the added value of each capability, procedure or partnership. While specific performance objectives should be developed by each utility in the context of its unique design goals, general performance objectives for an SRS were defined in the *Water Quality Surveillance and Response System Primer* (USEPA, 2015a) and are further described in the context of PHS as follows.

- **Incident coverage:** Detect and respond to a broad spectrum of water quality incidents. PHS is limited to detection of contaminants that result in illness. It should be noted that while some contaminants do not result in short or long term health impacts, they may elicit physiological effects such as nausea or headaches if they have strong aesthetic characteristics such as a foul odor. Thus, these contaminants may prompt exposed individuals to seek healthcare, and potentially generate a PHS alert.
- **Spatial coverage:** Achieve spatial coverage of the entire distribution system. Theoretically, PHS has the ability to cover every customer in the distribution system, but the actual spatial coverage achieved by PHS may be impacted by the degree to which public health data can be effectively collected in real-time throughout the distribution system.
- **Timeliness of detection:** Detect public health incidents in sufficient time for effective response. This performance objective is impacted by how quickly data is available for analysis and how often the analysis is performed.
- **Alert occurrence:** Minimize the number of invalid alerts while maintaining the ability of the system to detect true alerts based on pre-established thresholds of syndrome and case frequencies. This performance objective is primarily impacted by the accuracy of data generated and the data analysis method(s) used.
- **Sustainability:** Maintain surveillance systems and relationships between the utility and public health partners. The effectiveness of PHS requires maintenance of relationships and communication pathways across multiple agencies.

Topic 4: What are cost-effective approaches for PHS?

Utilities can take the following simple steps to develop the foundation for PHS:

- Meet with local public health partners to establish relationships, exchange contact information, and learn how public health partners could support detection of and response to contaminated drinking water. USEPA has developed a Public Health Assessment Interview Form that utilities can use to engage their local public health partners (USEPA, 2015b).
- Evaluate PHS datastreams currently monitored by public health partners to determine if they have the potential to provide timely detection of contaminated drinking water.
- Establish procedures for the joint utility and public health investigation of PHS alerts that might be indicative of contaminated drinking water.

Next Steps

Visit the Water Quality Surveillance and Response Website at <http://water.epa.gov/infrastructure/watersecurity/lawsregs/initiative.cfm> for more information about SRS practices. The Website contains guidance and tools that will help a utility to enhance surveillance and response capabilities, as well as case studies that share utility experiences with SRS implementation and operation.

References

USEPA. (2015a). *Water Quality Surveillance and Response System Primer*, 817-B-15-002.

USEPA. (2015b). *Public Health Surveillance Assessment Interview Form*, 817-B-15-001.