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# The Power of Public Health Surveillance

Rick Hong, MD; Rebecca Walker, PhD, JD, MSN; Gregory Hovan; Lisa Henry, MHSA; Rick Pescatore, DO

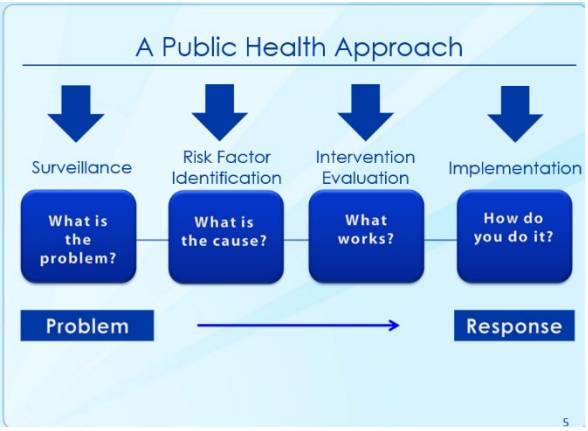
Delaware Division of Public Health

Never has an emergency battered Delaware to such public health, economic, social, and emotional extremes like the one presented by coronavirus disease 2019 (COVID-19). Strict disease mitigation strategies were led by Governor John Carney's March 22, 2020 State of Emergency declaration that closed non-essential businesses and schools, and included a Stay-at-Home order. As of June 11, 2020, the state is experiencing fewer hospitalizations and deaths due to COVID-19. The decreasing trends in the percentage of positive COVID-19 cases and hospitalizations[1] were the result of many statewide infection control measures such as closures of non-essential businesses, use of face coverings, social distancing, general hand hygiene, and community testing. As Delaware reopens in phases, the Delaware Department of Health and Social Services, Division of Public Health (DPH) – the state's lead health agency – is conducting public health surveillance. Case investigations and contact tracing have impacted disease transmission rates by identifying those needing isolation or quarantine. These measures will continue as our society moves towards normalcy.

## Public Health Approach

Public health issues are diverse and dynamic, involving many significant public health threats such as infectious diseases, chronic diseases, emergencies, injuries, and environmental health problems.[2] A public health concern should be addressed by one consistent approach, similar to an all-hazards response in disaster management regardless of the type of event (Figure 1).

Figure 1. A Public Health Approach[2]




A potential public health problem can be identified using surveillance systems to monitor health events and behaviors within communities and populations. Once identified, risk factors leading to the problem – human behaviors, environmental factors, medical conditions, and social determinants – are evaluated. Interventions are then considered to address directly the problem or to focus indirectly on risk factors associated with the concern. For example, during COVID-19, risk factors for increased transmission and complications from disease include unknown personal status of infection or exposure, non-compliance with isolation or quarantine, inability to social

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distance in the home environment, chronic medical conditions, and access barriers to testing. Interventions include near real time notification of positive cases, identification and outreach to their close contacts, active monitoring of those isolated or quarantined, hotel accommodations for those who cannot comply with social distancing at home, focused public messaging for those with chronic medical conditions to follow stay-at-home orders, and community testing sites to accommodate vulnerable populations. The final step is to implement interventions and evaluate their effectiveness.

## Public Health Core Sciences

Public health requires expertise and resources to address successfully public health problems using scientific methods. Public health surveillance methods monitor a public health situation. Epidemiology is the study of distribution and determinants of health-related states among specified populations and the application of that study to the control of health problems. Epidemiologists work closely with laboratories to assist with the identification of cases through testing. Given the vast amount of data in public health surveillance and investigations, public health informatics is critical beyond timely data management to include the conceptualization, design, development, deployment, refinement, maintenance, and evaluation of communication, surveillance, information, and learning systems relevant to public health.[3] Prevention effectiveness studies provide information to allow for decision-making regarding intervention options. The following five elements collaboratively guide DPH in its approaches to address public health issues.

### Public Health Surveillance

Public health surveillance is the ongoing systematic collection, analysis, and interpretation of health-related data essential to planning, implementation, and evaluation of public health practice, closely integrated with the timely dissemination of these data to those responsible for prevention and control. The effectiveness of surveillance has been documented back in 1854, when Dr. John Snow, referred by many as the “father of field epidemiology,” collected information from hospital and public records to determine that contaminated water from the Broad Street pump was the cause of the cholera outbreak in Soho, London. The goal of public health surveillance is to provide information for public health personnel, government leaders, and the public to guide public health policy and programs. Uses of public health surveillance include identifying patients and their contacts for treatment and intervention of infectious diseases; detecting epidemics, health problems, and changes in health behaviors; estimating the magnitude and scope of health problems; measuring trends and characterizing disease; monitoring changes in infectious and environmental agents; assessing the effectiveness of programs and control measures; developing hypotheses; and stimulating research.

The Delaware Electronic Reporting and Surveillance System is the state-based electronic surveillance system that receives information of significant public health concerns from various community partners such as hospitals, health care providers, and laboratories. DPH is directly responsible for all case investigation and contact tracing for infectious disease cases of significant public health concern. Although public health surveillance may conflict with individual liberties, public welfare must be balanced with individual needs with laws and regulations that allow the state health officer to mandate the reporting of specific diseases or conditions. It is important that the surveillance system be effective with attributes such as

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usefulness, data quality, timeliness, flexibility, simplicity, stability, sensitivity, predictive value positive, representativeness, and acceptability.

There are two main categories of surveillance: passive and active. Passive surveillance relies on health care partners to report diseases and conditions to DPH. Although this method is simple and inexpensive, it can be limited by incompleteness of reporting based on participation and variability in data quality. Active surveillance ensures more complete reporting of diseases and conditions, as DPH directly contacts health care providers and/or patients for case information. This method is used in conjunction with specific epidemiologic investigations for an identified disease or event.

To target a specific geographic area or population, DPH partners with specific health professionals to conduct sentinel surveillance. This type of public health surveillance collects data from a smaller selected group of health care providers, known as sentinel providers. Data collected and reported by sentinel providers are used to identify and quantify health events that may occur among high risk populations and provide situational awareness regarding a health event in the larger population or geographic area.[4] Delaware's COVID-19 sentinel surveillance serves as a tool to describe and monitor the spread of the virus in vulnerable populations across the state with an emphasis on mitigating the spread of the virus by identifying individuals with mild or asymptomatic infection. Sentinel surveillance of COVID-19 is an integral component of Delaware's Reopening Plan. The COVID-19 sentinel provider network consists primarily of Federally Qualified Health Centers and other health care providers serving vulnerable populations, as well as Long Term Care facilities.

Surveillance may monitor for symptoms rather than provider-diagnosed or laboratory-confirmed cases for more timely data collection to detect, understand, and monitor health events. Known as syndromic surveillance, an example of this approach is using the Influenza-like Illness Surveillance Network (ILINet) to track cases of influenza-like illness to guide public health activity. Delaware's COVID-19 sentinel surveillance builds on ILINet, a program conducted by the U.S. Centers for Disease Control and Prevention (CDC) and state health departments to collect influenza surveillance data from volunteer sentinel health care providers. Providers who participate in the ILINet program collect and report information about the level of influenza-like illness (ILI) currently seen in their practices. Data reported by ILINet providers, in combination with other influenza surveillance data, provide a national picture of influenza and ILI activity in the U.S.[5] There are more than 2,900 ILINet sentinel providers in all 50 states, Puerto Rico, the District of Columbia, and the U.S. Virgin Islands. The advantages of using syndromic surveillance are reduced reporting burden, more timely and complete information, consistently applied criteria (e.g., CDC case definition), and year-round monitoring.[6] Using symptoms for early detection allows DPH to initiate quickly public health investigations and infection control measures. For example, certain diseases such as influenza or those associated with bioterrorism may not require a laboratory-confirmed diagnosis for initial treatment.

Overall, the surveillance process involves data collection, data analysis, data interpretation, data dissemination, and link to action. However, before committing to data collection, the surveillance goal must be determined. There are many data sources for public health surveillance, including provider reports of laboratory-confirmed cases or suspected syndromic cases, electronic health records such as the DHIN health information exchange platform, vital statistics records such as death certificates, health registries such as the Delaware Immunization Registry (DelVAX), and surveys. Data analysis and interpretation are closely linked; interpreting

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investigative information such as the person, place, and time of the case can more easily determine how and why the health event happened. Data dissemination is directed by the target audiences. For instance, health alerts inform clinicians and other health care providers, whereas press releases and social media are for the general public. Surveillance efforts must lead to an action or response, including a description of the disease burden or potential; the monitoring of trends and patterns in disease, risk factors, and agents; the detection of sudden changes in disease occurrence and distribution; the provision of data for programs, policies, and priorities; and an evaluation of prevention and control efforts. Data without a plan of action do not justify the resources invested into the initial data collection.

## Public Health Laboratory Role in Surveillance

DPH's Delaware Public Health Laboratory (DPHL) has a critical role in disease surveillance programs that focus on identifying diseases in state populations. DPHL tests collected samples to identify newly emerging or recurring disease outbreaks, delivering results through shared networks used by the CDC and other state public health laboratories. Historically, DPHL has developed and implemented systems that can be quickly activated in response to critical needs related to public health surveillance. Generally, this is done by facilitating data production (test results) to assess high risk groups without causing laboratory system overloads.

Scientific analysis takes anywhere from a few weeks to over 12 months, depending on the complexity and level of testing needed, to develop testing methods, validate methodology for reliability, and set up sensitive laboratory instrumentation. Once the methodology is validated and determined reliable, efforts turn to the automation of results and the production of data. The ability to optimize turn-around times (TAT) and produce accurate data is critical to public health community response efforts. Throughout the COVID-19 pandemic, DPHL has served as a primary testing laboratory for hospitals and clinics that identified COVID-19 patients. Once DPHL developed methods and established reliability, it achieved a turnaround time for results within 24 hours of receiving the specimen. DPHL was the first laboratory in Delaware to verify CDC's diagnostic method for detecting SARS-CoV-2 (SC2), the virus that causes COVID-19. To expand on this scientific method, it should be noted that this test calls for the performance of a high complex polymerase chain reaction (PCR) test that can only be performed by federally certified laboratorians. This high sensitivity process involves amplifying (making copies of) targeted viral RNA strands to identify SC2. The amplification process is continuously repeated until enough sample is produced to allow for a detectable fluorescent response. Once the response is detectable, laboratory instruments measure the intensity of fluorescence to produce the final test results.

Over the last few months, the need for high-throughput automated systems became more apparent based on the projected demand for testing. Also, DPHL's ability to re-designate instrumentation to alternative methods when needed was critical to the surveillance response as the demand for testing increased. Within this year, DPHL plans to transition to data production using sophisticated instrumentation such as the Illumina MiSeqs for "Next Generation Sequencing" to provide for more comprehensive and retrospective data centered on the identity and behavior of epidemic and pandemic organisms. The goal of this initiative is to provide information that can be utilized to better target epidemiological surveillance investigations.

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## Contact Tracing

Case investigation and contract tracing are critical components to prevent further spread of infectious diseases such as COVID-19. These methods support patients with suspected or confirmed infection and potential contacts, those who have been exposed to a case or a case's environment such that they had an opportunity to acquire the infection. Certain high-risk subpopulations, segments of the population with characteristics that increase the risk of infection or severe disease, need to be identified quickly to prevent further spread of disease. As part of the case investigation, contact tracing identifies those with close contact to positive individuals during the infectious period, the period of time during which a case is able to transmit a disease to others, as they are at higher risk of being infected, becoming infected, and potentially infecting others.[7] Since those exposed may not present with evidence of infection due to the incubation period between the time of invasion by an infectious agent and appearance of the first sign or symptoms of the disease, quarantine is an effective option to limit spread of disease when implemented prior to the infectious period. DPH's contact tracers give close contacts of COVID-19 positive persons information about the disease, education about risks and transmission, and recommendations to reduce further spread of disease, including separation from others, self-monitoring of symptoms, and other infection control measures. Identifying contacts early so they do not expose others is vital to limiting community spread, especially with the concern for asymptomatic or pre-symptomatic spread. By decreasing the reproduction number ($R_0$), the average number of people who will contract a disease from one infected case, the disease will burn out when the each infected case causes fewer than one new infection (see Figure 2). The contact tracing process should also include monitoring for symptoms throughout the quarantine period (14 days for COVID-19).

Figure 2. A Public Health Approach[8]

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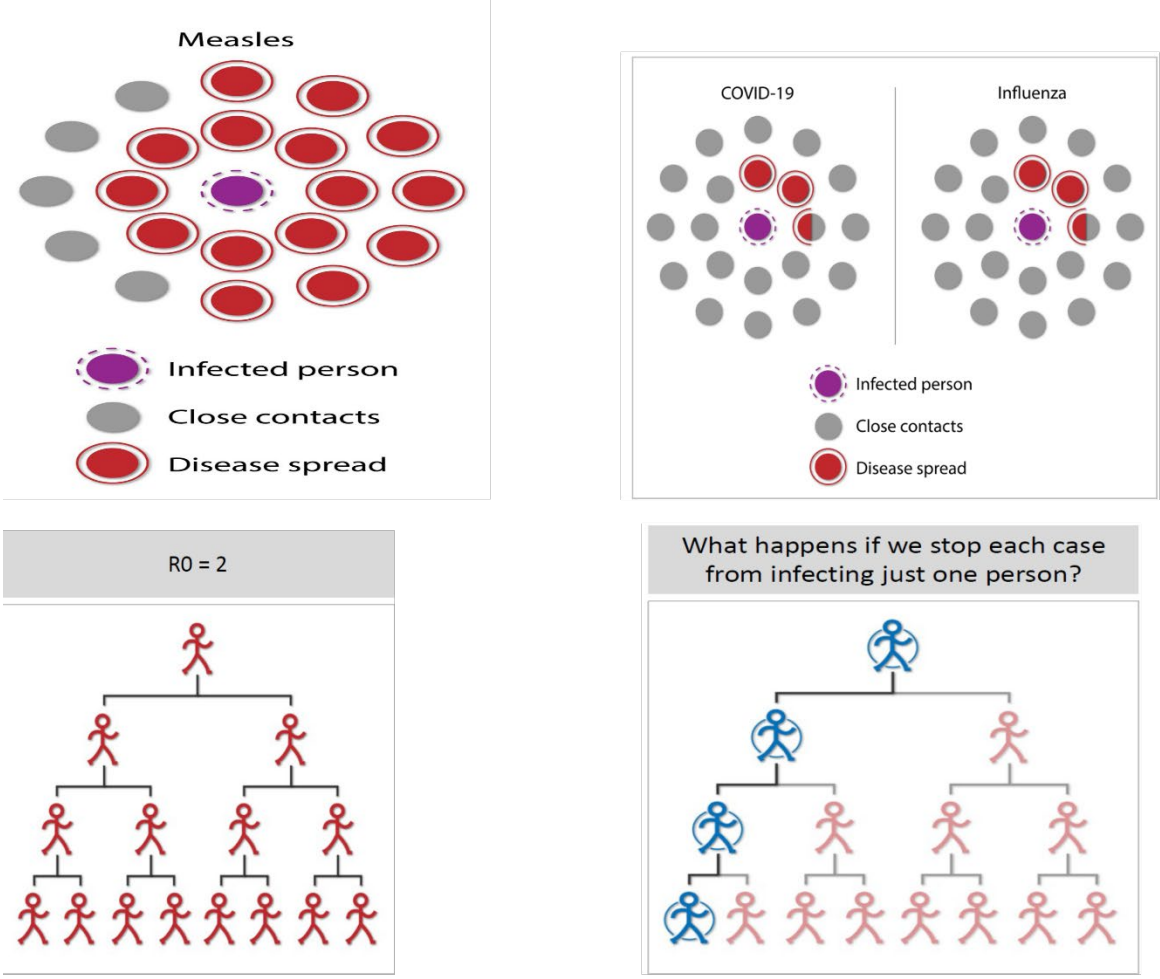


Image source: Johns Hopkins University

Source: Eisenberg, J. (2020 March 17). R0: How scientists quantify the intensity of an outbreak like coronavirus and predict the pandemic's spread. The Conversation US. Accessed May 4, 2020.

## Conclusion

As Delaware progresses through its reopening phases, DPH's surveillance ensures that the public remains safe and healthy. Surveillance allows DPH to provide informed recommendations around a phased re-opening approach to best mitigate risk for re-introducing spread of the virus throughout the community. DPH remains vigilant for any resurgence of cases that could lead to the re-implementation of strict mitigation strategies to contain the infection once again, including the closure of businesses.[9] All efforts ultimately depend on how well Delawareans follow the COVID-19 guidance to prevent disease transmission.

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