



Published in final edited form as:

J Infect Dis. 2025 April 15; 231(4): 837–840. doi:10.1093/infdis/jiae444.

Economic Analyses for Disease Surveillance Planning and Advocacy

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Abstract

Public health disease surveillance can guide a range of decisions related to the protection of populations. Economic analysis can be used to assess how surveillance for specific diseases can substitute for or complement other public health interventions and how to structure surveillance most efficiently. Assessing the value and costs of different disease surveillance options as part of broader disease prevention and control efforts is important for both using available resources efficiently to protect populations and communicating the need for additional resources as appropriate.

Keywords

disease surveillance; health economics; outbreaks; epidemics; pandemics

Public health disease surveillance—the ongoing, systematic collection, analysis, and interpretation of data on specific diseases for planning, implementation, and evaluation of public health efforts to control those diseases [1]—can guide a range of decisions related to the protection of populations. Such decisions include when and where to deploy and over time adjust interventions such as mass vaccination, mass drug administration, travel restrictions, and the withdrawal of unsafe food or other products [2]. Without disease surveillance, public health interventions may be used in an indiscriminate and inefficient manner or not used at all. The coronavirus disease 2019 (COVID-19) pandemic has highlighted the continuing importance of disease surveillance for the detection and monitoring of infectious disease threats [3]. In response, new financial resources have been made available for efforts to strengthen disease surveillance, including the World Bank’s Pandemic Fund [4]. While new funding is helpful, surveillance investment needs are substantial as disease surveillance must cover both potential new threats as well as existing threats such as human immunodeficiency virus, tuberculosis, malaria, and antimicrobial resistant pathogens [5]. Assessing the value and costs of different disease surveillance options is critical for both using available resources efficiently to protect populations and documenting the need for additional resources as appropriate.

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Potential conflicts of interest. Author certifies no potential conflicts of interest.

The author has submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

Although public health disease surveillance and decision making are focused on populations, many of the methods developed to assess the value and costs of diagnostic tests for clinical decision making related to individual patients can be applied to assessing the value and cost of disease surveillance. Cost-effectiveness, cost-benefit, and cost-utility analysis can all potentially be used to assess the value of disease surveillance in economic terms [6–8], which facilitates not only comparisons of different disease surveillance options to determine which are most worth funding but also communication of their value to economists, financial specialists, legislators, and other nonmedical, non–public health audiences. However, despite the availability and usefulness of such approaches, literature reviews have indicated that relatively few economic evaluations of public health disease surveillance efforts have been conducted [9–11], and some evaluations have assessed only the costs of surveillance while omitting its value [10]. Such omissions overlook the value of disease surveillance in substituting for or complementing the use of medicines, vaccines, and nonpharmaceutical interventions to allow those interventions to be used more efficiently, effectively, or equitably in achieving a given level of benefit, that is, the same benefits at lower cost or greater benefits at the same cost (Figure 1).

As with assessments of patient care options, assessments of the cost and value of public health surveillance options rely upon counterfactual analyses in which comparisons are made between situations in which those options are used and situations in which they are not used. Retrospectively, such assessments can compare how well disease control programs worked prior to versus after a new surveillance effort’s initiation or how well programs functioned in areas with improved or functional disease surveillance efforts versus in areas without such surveillance efforts. For example, a retrospective analysis of the impact of enhanced meningococcal surveillance in the African meningitis belt between 1996 and 2007 found that meningococcal disease control efforts were more effective in mitigating outbreaks after enhanced surveillance began, with that enhanced surveillance having an estimated incremental cost-effectiveness ratio of up to \$23 per case averted and \$98 per meningitis-related death averted compared to no enhanced surveillance [12]. A study of the United States’ PulseNet surveillance system for foodborne diseases found that states participating in PulseNet had fewer foodborne disease cases and outbreaks than nonparticipating states, annually preventing more than 295 000 foodborne disease cases and reducing medical and lost productivity costs by over \$540 million a year, with PulseNet itself annually costing \$7.3 million [13]. An analysis of Ebola outbreaks between 2013 and 2022 found that outbreaks detected within 33 days of their start were all contained with less than 150 cases while 2 outbreaks detected more than 80 days after their start caused 28 610 and 3470 reported cases and respectively cost international donors alone at least \$1.8 billion and \$730 million before being contained [14].

Prospectively, decision analysis can be very useful in estimating the impact of disease surveillance. For example, decision analytic modeling of the expected impact of cholera vaccination in sub-Saharan Africa has indicated that oral cholera vaccine would prevent up to 8 times more cases of cholera if targeted based on disease surveillance data than on water and sanitation risk factor data [15]. A follow-up decision analysis study found that targeting of oral cholera vaccine preventive vaccination campaigns with information from enhanced surveillance with point-of-care testing instead of surveillance of clinically

suspected cholera cases should increase the number of cases prevented per fully vaccinated individual by approximately 50% [16]. Sensitivity analyses of prospective decision analytic modeling of the impact of interventions such as vaccines can also highlight the value of additional information such as disease surveillance data [17, 18]. For example, an analysis of the costeffectiveness of typhoid conjugate vaccination found that improved surveillance data on the incidence of typhoid across low- and middle-income countries could increase the value of a typhoid conjugate vaccination program by approximately \$100 million due to better targeting of typhoid vaccination [19, 20].

In addition to their utility for prioritization and advocacy, assessments of the value of disease surveillance can also inform planning and budgeting for surveillance efforts. Since the costs of surveillance efforts would ideally not exceed their benefits, estimates of the value of the information generated by those efforts can provide an upper limit on how much those efforts would ideally cost. programs that are highly valuable—that is, ones that can have major health, social, and economic impacts—even relatively small improvements resulting from the availability of disease surveillance information can be worthwhile (Figure 1). Conversely, if a disease control program’s maximum potential benefit is small, the additional benefit from surveillance of that disease must be quite large relative to the program’s value without surveillance to make allocating substantial resources to surveillance of that disease worthwhile compared to other options for using those resources. As programs evolve, the value of disease surveillance can change. For example, surveillance data have regularly guided major decisions by the Global Polio Eradication Initiative (GPEI) on use of polio vaccines, particularly in mass vaccination campaigns [21]. To secure polio surveillance data, GPEI spent \$120 million in 2023 [22]. If global polio efforts shift so that decisions on how and where polio vaccines are used become smaller in number and importance [23], assessing the new value of polio surveillance could help guide reform of global polio surveillance to ensure its cost-effectiveness.

Economic analyses can also help identify how disease surveillance systems can be structured to collect the information needed for decision making as cost-effectively and sustainably as possible. The lower the costs of surveillance, the more likely it is that the benefits of surveillance will exceed the costs. Efficiencies can be gained by using information generated for other purposes, for example, clinical treatment decision making, as well as by making tradeoffs between costs, speed, and accuracy that may be acceptable for surveillance information but not for clinical decision making. Surveillance cost-effectiveness can also benefit from synergies in using the same systems to monitor multiple diseases. Given that many steps in disease surveillance, specifically case identification, case reporting, case investigation, sample collection, sample analysis, and sometimes diagnostic testing, are similar across diseases, general platforms can often be used to monitor multiple diseases. Such multidisease surveillance systems can provide the benefits of informing multiple decisions but at lower marginal cost than would be the case with standalone systems for individual diseases [24]. Combining disease surveillance with other types of data (eg, on health service availability and utilization) can also improve its cost-effectiveness by providing insights for decision making beyond what disease surveillance alone can provide and by allowing disease surveillance systems to focus on providing information for decisions in which disease surveillance is most valuable. To better capitalize on such

opportunities, efforts with funding to improve disease surveillance capacity can regularly support research into the most efficient and effective ways to structure disease surveillance systems and to identify the decisions for which disease surveillance data provide the most value for money. Including basic economic evaluation methods, such as decision analysis, in the training of individuals involved with planning or managing disease surveillance systems could also aid efforts to efficiently improve surveillance capacity.

As indicated by experiences during the COVID-19 pandemic as well as recent Ebola virus disease outbreaks [14], disease surveillance data can be extremely useful if acted upon promptly. Efforts to improve assessment and use of disease surveillance information can be combined with efforts to strengthen the capacities of organizations and individuals to act decisively even in the face of uncertainty [25]. Recent successes, such as the rapid containment of many Ebola outbreaks since 2013, indicate that effective use of such data can have significant public health impacts and help to avert strain on healthcare systems [14]. Better appreciation of the value and costs of disease surveillance information should aid efforts to control infectious diseases and minimize the economic and social disruption such diseases can cause.

Disclaimer.

The findings and conclusions in this report are those of the author and do not represent the official position of the Centers for Disease Control and Prevention.

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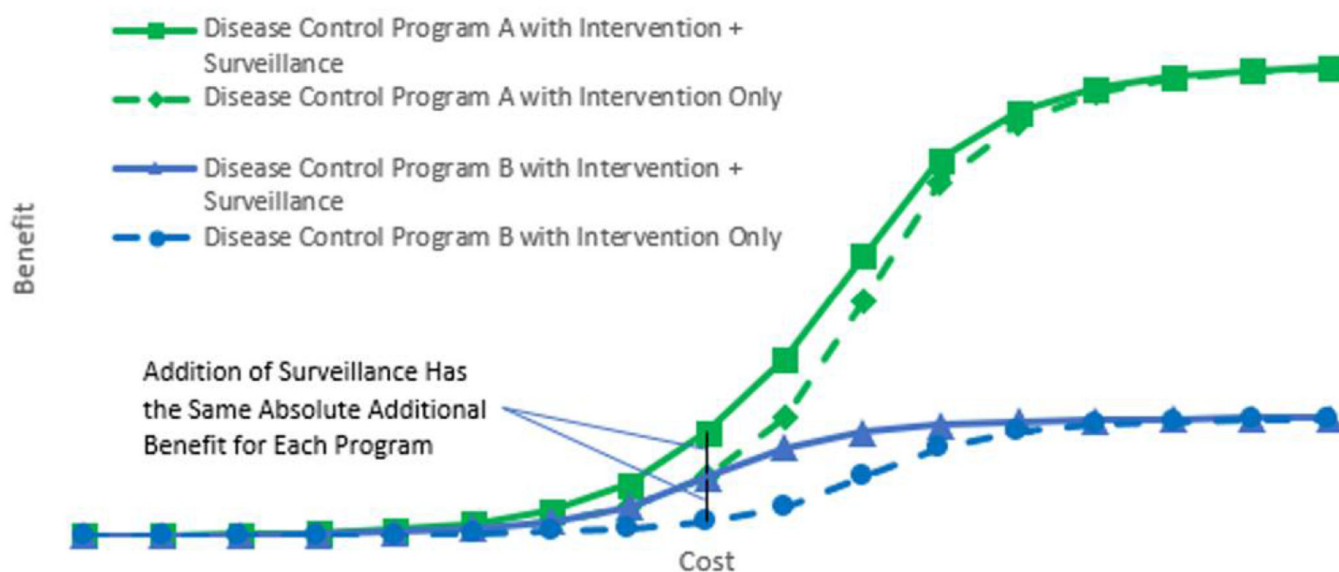


Figure 1. Illustration of the value of combining disease surveillance and interventions in two hypothetical disease control programs. Although the benefit from adding a disease surveillance component to disease control program A is proportionately less relative to the original benefit from the intervention only program than for program B, the absolute additional benefit is the same.