

VIEWPOINT

Precision Public Health as a Key Tool in the COVID-19 Response

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With more than 20 million cases of coronavirus disease 2019 (COVID-19) globally and now exceeding 5 million cases in the United States, the COVID-19 pandemic represents one of the greatest public health challenges in more than a century. To succeed against COVID-19, multiple public health tools and interventions will be needed to minimize morbidity and mortality related to COVID-19. Although extreme public health interventions, for example, lockdowns and stay-at-home mandates, were initially critical to flattening the curve, many fundamental questions remain, such as when can employees deemed nonessential return to work, how can children safely return to school, and who should be first to receive a vaccine once it becomes available. Information about who is at highest risk of hospitalization, intensive care unit admission, and death based on age, sex, race/ethnicity, and underlying conditions is now becoming available.¹ In addition, the relationship between neighborhood factors (eg, increased neighborhood household crowding rate) and risks for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection and COVID-19 disease outcomes are now recognized.²

These rapidly accruing data suggest that it might be possible to better target interventions for populations, ie, precision public health. Similar to how precision medicine uses genomic and other personalized patient data to provide the right treatment to the right patient at the right time, precision public health is an emerging discipline that uses extensive population-specific data to provide the right intervention to the right population at the right time.³ Precision public health uses data from traditional and emerging sources to target interventions for populations by person, place, and time, in part with a focus on reducing health disparities. Analogous to the use of genomic information in precision medicine, pathogen genomics has become the leading prototype of precision public health, with numerous applications in tracking and control of infectious disease outbreaks, most notably for foodborne diseases. An example of using pathogenic genomics for the COVID-19 response is the application of a combination of whole-genome sequence analyses and epidemiological data in the Netherlands to provide reliable assessments of SARS-CoV-2 community transmission patterns. These data about transmission patterns were used to better inform decisions regarding cancellation of mass gatherings and recommendations regarding working from home and school closures.⁴

Beyond genomics, granular data from public health surveillance are essential to target public health interventions. For example, when assessing child mortality in Africa, maps that include a high spatial resolution identified significant disparities that would have been missed with a country-level analysis.³ Another example is the na-

tional "End the HIV Epidemic" initiative, which is focusing on 50 locations in the United States (48 counties; San Juan, Puerto Rico; and Washington, DC) where more than 50% of new HIV diagnoses are occurring.⁵ Data on levels of COVID-19 infection and disease in a community need to be available so clinicians and public health professionals can provide the best guidance to communities about optimal interventions to prevent illness and death and to target public health interventions to regions of most need. Geographic information and other technologies can be integrated to identify hot spots to allow targeting of interventions.⁶ Measures such as number of daily cases per 100 000 (low <1, moderate 1-10, high 10-25, and critical >25) and percent positive rate on polymerase chain reaction testing (low <3%, moderate 3%-6%, high 6%-10%, and critical >10%) could be used to determine phases of reopening of communities. As an example, knowing the number of new infections, the percentage of laboratory test results for the virus that were positive, and how many hospital and intensive care unit beds were available in real time allowed the Atlanta mayor to roll back reopening from phase 2 to phase 1.⁷

Identifying and protecting populations at high risk of morbidity and mortality because of age, underlying conditions, sex, and race/ethnicity¹ are critical. For example, restricting access to nursing homes and long-term care facilities and frequent testing of residents and employees has proven effective in controlling outbreaks and reducing mortality.⁸ These efforts initially led to lower mortality rates in states with recent spikes due to cases being primarily in younger populations at lower risk of death. Factors other than age that have been shown to independently be associated with increased risk of hospitalization in a study in metropolitan Atlanta included being of Black race, uninsured, a smoker, or obese.¹ Increasingly focusing prevention efforts on communities at the highest risk of morbidity and mortality will have greater benefits than focusing those efforts in lower-risk communities. For example, if a population has a higher proportion of persons at increased risk of severe disease, messages could be provided to educate persons on when to seek medical attention. Although these data might vary by location, they are sufficient to begin to tailor guidance for communities at most risk (eg, tailoring prevention messages to specific racial/ethnic groups); ongoing research will be needed to identify other high-risk populations that could benefit from additional protection.

Data are also accumulating on infection risks based on neighborhood factors. For example, based on universal SARS-CoV-2 testing of pregnant women upon presentation to the labor and delivery unit in New York City hospitals, several neighborhood factors were shown to

be associated with increased likelihood of infection, including lower median household income and higher unemployment, household membership, and household crowding rates.² If neighborhood factors suggest that isolation of a person identified as SARS-CoV-2-positive will be difficult, ensuring that other options for isolation outside the family home (eg, programs that offer hotel space for persons with COVID-19 who are unable to self-isolate in their homes) could be offered to decrease household transmission.

Although traditional public health data are useful, the use of emerging digital data should also be explored. Some of these data are derived from nontraditional data sources and are included under the rubric of “big data” and associated predictive analytics³ including cell phone mobility data, information from wearable fitness trackers, and geographic information systems. These data sources could be used to identify communities where risks of transmission or of severe disease may be high. Information on areas of high disease transmission could be used to target prevention strategies (stay-at-home orders, public education regarding physical distancing, and wearing of face coverings, etc). For example, aggregated anonymized location data on mobility from cell phones from metropolitan areas in the United States were used to assess adherence with community mitigation measures during stay-at-home orders.⁹ Other emerging data sources (eg, fitness trackers and monitoring of sewage for SARS-CoV-2 virus) could also be used to predict the presence of infection.¹⁰ Although some of these emerging data sources require careful consideration of ethical, legal, and social implications, they hold promise in informing the pandemic re-

sponse by serving potentially as an early alert system. Evidence of community nonadherence to mitigation measures from cell phones, increasing levels of SARS-CoV-2 in sewage, and changes in resting heart rate on fitness trackers might have predicted impending outbreaks in some states before the increases were recognized by public health surveillance efforts. Early identification would have allowed for prompt implementation of interventions, at a time when they would have been more effective. Early indications of disease spread could also be used to ensure that adequate testing sites and contact tracing capacity are available to allow for rapid implementation of isolation of cases and quarantine of contacts. Understanding how to best integrate these data sources to inform public health might be an important strategy in the response to COVID-19.

In summary, the COVID-19 pandemic provides an opportunity for further evolution of the field of precision public health, as new tools and technologies begin to complement traditional medical and public health approaches to prevention and control. Just like precision medicine, precision public health will still need a strong evidentiary foundation. Careful evaluation of the validity and utility of these new technologies as applied to precision public health and their effectiveness in reducing COVID-19 cases and decreasing morbidity and mortality will be essential, along with consideration of the ethical, legal, and social implications. These applications will require a strong collaboration among the health care sector, individual clinicians and health centers, private sector, governments, and communities. Despite these challenges, at no time has precision public health been needed more than now.

ARTICLE INFORMATION

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