SDC

The Test and Protect Program: A Data-Driven, Community-Engaged Approach to COVID-19 Testing Site Localization

Andrew F. Beck, MD, MPH; Tiffany Mattingly, MSN; Cole Brokamp, PhD; Rashmi Sahay, MD, MS; Erika R. Manning, MS; Stuart Taylor, MA; Pierce Kuhnell, MS; Brian Kegley, RN; Kiana Trabue, MPH; Peter A. Margolis, MD, PhD; Robert S. Kahn, MD, MPH; David M. Hartley, PhD, MPH

ABSTRACT
As the COVID-19 pandemic progressed, reliable, accessible, and equitable community-based testing strategies were sought that did not flood already overburdened hospitals and emergency departments. In Hamilton County, Ohio, home to ~800 000 people across urban, suburban, and rural areas, we sought to develop and optimize an accessible, equitable county-wide COVID-19 testing program. Using Coronavirus Aid, Relief, and Economic Security Act funding, multidisciplinary, multiorganization partners created the test and protect program to deliver safe, reliable testing in neighborhoods and organizations needing it most. Our approach involved: (1) use of geospatial analytics to identify testing locations positioned to optimize access; (2) community engagement to ensure sites were in trusted places; and (3) tracking of data over time to facilitate ongoing improvement. Between August 2020 and December 2021, more than 65 000 tests were completed for nearly 46 000 individuals at community-based testing sites. These methods could have application beyond COVID-19 and our region.

KEY WORDS: community engagement, COVID-19, geographic information systems, quality improvement

In March 2020, Coronavirus Disease 2019 (COVID-19) was first identified in Cincinnati. Initially, testing capabilities were limited, but within several weeks, polymerase chain reaction tests became more available in clinical settings.[1] As laboratory capacity increased, reliable, accessible, and equitable community-based testing strategies were sought that did not flood already overburdened hospitals and emergency departments.

Cincinnati is in Hamilton County, Ohio, home to ~800 000 individuals across urban, suburban, and rural areas. Thousands more work within Hamilton County on any given day. The county includes 12 hospitals and 4 public health jurisdictions, >100 congregate care facilities, 22 school districts, and a diverse business community. Dozens of in-county neighborhoods, many with community councils, agencies, and businesses, were seeking pandemic-related guidance and support in Summer 2020. Questions emerged as to how to provide testing for individuals living and working in the county and how to prioritize the most vulnerable.

We sought to develop and optimize an accessible, equitable county-wide COVID-19 testing program using data-driven, community-engaged methods.

Author Affiliations: *Cincinnati Children's; University of Cincinnati College of Medicine (Drs Beck, Brokamp, Sahay, Margolis, Kahn, Hartley, Ms, Manning, and Mr, Taylor, Kuhnell); The Health Collaborative (Mattingly and Dr Kegley) University of Cincinnati College of Medicine (Drs Beck, Brokamp, Margolis, Kahn, and Hartley); and bi3 (Ms Trabue).*

We are incredibly grateful for the contributions of countless individuals and agencies across Greater Cincinnati to the Test and Protect program and to the regional response to COVID-19 more generally. In particular, we would like to acknowledge Susan Cronin, Elizabeth Quinonez, Adam Carle, Jessica Skelton, Perry Ellington, Alex Vaillancourt, Dustin Calhoun, Jorge Perez, Ashlee Young, Giovanna Alvarez, David Siders, and Denisha Porter. We would also like to recognize and thank the contributions of many other individuals from those agencies so critical to our regional response: Cincinnati Children's, University of Cincinnati Health, The Health Collaborative, YMCA of Greater Cincinnati, All-In Cincinnati, Su Casa Hispanic Center, Urban League of Greater Southwestern Ohio, Talbert House, Cincinnati and Hamilton County Public Library, United Way of Greater Cincinnati, and Center for Closing the Health Gap. This work was supported by Coronavirus Aid, Relief, and Economic Security (CARES) Act (2020) funding from the Hamilton County Board of Commissioners.

Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site (http://www.JPHMP.com).

Correspondence: *Andrew Beck, Cincinnati Children's, 3333 Burnet Ave, MLC 7035, Cincinnati, Ohio, 45229 (Andrew.Beck1@cchmc.org).*

DOI: 10.1097/PHH.0000000000001993

Here, we detail methods used to identify testing sites, results of our efforts, and potential applications beyond COVID-19.

Methods

In August 2020, the Hamilton County Board of Commissioners used Coronavirus Aid, Relief, and Economic Security (CARES) Act (2020) funding for a COVID-19 testing program. With these resources, partners from Cincinnati Children's, University of Cincinnati Health, and The Health Collaborative (THC, non-profit entity acting as the regional health information and disaster preparedness organization) created Test and Protect (TaP). TaP sought to deliver safe, reliable testing in neighborhoods and organizations needing it most. TaP was overseen by a Project Leadership Group – ~15 individuals representing healthcare, public health, and community-based organizations.[2]

To identify when and where to locate testing sites, we: (1) employed geospatial analytics to identify locations for optimal access; (2) pursued community engagement to ensure sites were in trusted places; and (3) used data tracked over time to facilitate ongoing improvement.

Geospatial analytics

Prior to TaP, testing primarily occurred in hospitals, emergency departments, and clinics. Our analytic team geocoded and mapped existing testing locations using geographic information system (GIS) methods. GIS enables storage, visualization, analysis, and interpretation of geomarkers, geospatial data relevant to public health practice.[3] Geomarkers can be laid atop one another to efficiently identify patterns.[4] We added layers to county maps displaying existing testing locations, illustrating socioeconomic deprivation,[5] concentration of marginalized racial or ethnic groups, and transportation access. We computed walk- and drive-times using isochrones to existing testing locations in 5-, 10-, and 15-minute intervals, calculated from openroute service data.[6] We also mapped facilities at risk for outbreaks (eg, shelters, nursing homes, and public housing complexes). We found that many parts of the county had limited functional access to testing locations, particularly socioeconomically disadvantaged areas. This was a critical limitation of testing infrastructure, especially given limited public transportation options and infection risk when reliant upon public transportation.

To identify potential new testing sites and expand access, we first divided Hamilton County into several grids using the st_make_grid function in R. We then geospatially placed virtual pins on the map, starting with 10 pins to optimize access. Socioeconomically disadvantaged,[4] population-dense areas were weighted most highly, prioritized for pin localization. We then identified potential physical testing sites in the vicinity of pins (eg, recreation centers, public schools, and libraries).

Figure 1 illustrates this geospatial approach. Hamilton County neighborhoods are colored according to socioeconomic deprivation.[5] The turquoise shading represents a 10-minute drive-time buffer surrounding pre-existing testing locations. The 10 initial pins are displayed in red, located to optimize equitable coverage for new TaP sites. Additional map layers could be turned on and off to aid in planning and community engagement (eg, landmarks, roads, other walk- or drive-times, geomarkers). We made this view public at https://geomarker.io/covid_testing_locations/.

Community engagement

The translation of virtual pins to physical sites was accelerated by community engagement. Maps were provided to THC community engagement specialists with trusted relationships across the county. These specialists worked with community councils and formal and informal community leaders from organizations like Cincinnati and Hamilton County Public Library, Su Casa (provider of social services to region's Hispanic/Latino community), Urban League of Greater Southwestern Ohio, and YMCA of Greater Cincinnati to translate each virtual pin into an accessible, acceptable physical TaP testing site (or sites). They walked neighborhood blocks and co-constructed approaches to site localization that were community-engaged and community-centered.

Once locations were identified, community leaders, THC specialists, and personnel from Cincinnati Children's and University of Cincinnati Health co-designed practical approaches to preparing sites for testing, ensuring sites would be accessible for those walking or driving, safe and secure, and large enough to enable physical distancing. Potential sites within churches, recreation centers, libraries, and YMCA community centers emerged. Areas with a dearth of accessible testing locations, more socioeconomic deprivation, and larger populations were targeted first for fixed, recurrent sites. As testing capabilities expanded, more pins were added to broaden access. Areas with emergent outbreaks were targeted for one-time, short-term, or intermittent sites, operationalized via "strike teams" of personnel from THC and University of Cincinnati Health ready to rapidly set up testing sites.

Data measured over time to drive improvement

By August 2020, TaP testing sites were up and running. Quality improvement methods were used to remain nimble and optimize test deployment, bolstered by data tracked over time on run-charts or statistical process control charts.[7,8] Such charts were used for planning and evaluation – for both fixed and intermittent sites. Tracking data over time allowed predictability in testing numbers and staffing needs.

Data also enabled rapid learning. If a site was not used as expected, rapid-cycle tests of change were employed to optimize performance. Changes implemented included revising site hours, providing proactive communications to those who may benefit from site presence, and installing wrap-around supports (eg, connections to community agencies, food pop-ups) to make use of the site more attractive. If volumes remained low, sites were closed. Closures did not occur often, but they did allow for efficient site shifting to match demand more effectively with supply. Up-to-date information about site locations, and the pandemic, was communicated on a public website, including translation options for multiple languages. This website also allowed community partners (eg, councils and businesses) to request testing, with prompt responses by the "strike team."

Results

Between August 2020 and December 2021, more than 65 000 tests were completed for ~46 000 individuals at TaP testing sites. Ninety-four recurrent, or fixed sites, were selected using the combination of methods detailed above. As a result, ~90% of in-county residents were within a 10-minute drive of a TaP site. More than 100 additional intermittent, or one-time, sites were established in response to emergent outbreaks or community requests. We estimate that the unit cost per test was $75-90, inclusive of planning, implementing, and operationalizing testing sites.

Our approach enhanced connections with communities that have long borne the brunt of health inequities. Indeed, many of the neighborhoods which saw the most completed TaP tests were in Cincinnati's urban core, neighborhoods characterized by more socioeconomic disadvantage, higher concentration of marginalized racial or ethnic groups, and more limited transportation access.

Supplemental digital content, Figure 1 (available at http://links.lww.com/JPHMP/B376) depicts an operational dashboard used by TaP teams to track progress, enumerating tests completed and positive tests at certain TaP sites and in specific neighborhoods. The team also tracked testing numbers and computed positivity rates over time, for the county as a whole and for unique sites, informing responses to peaks and valleys characterizing various phases of the pandemic.

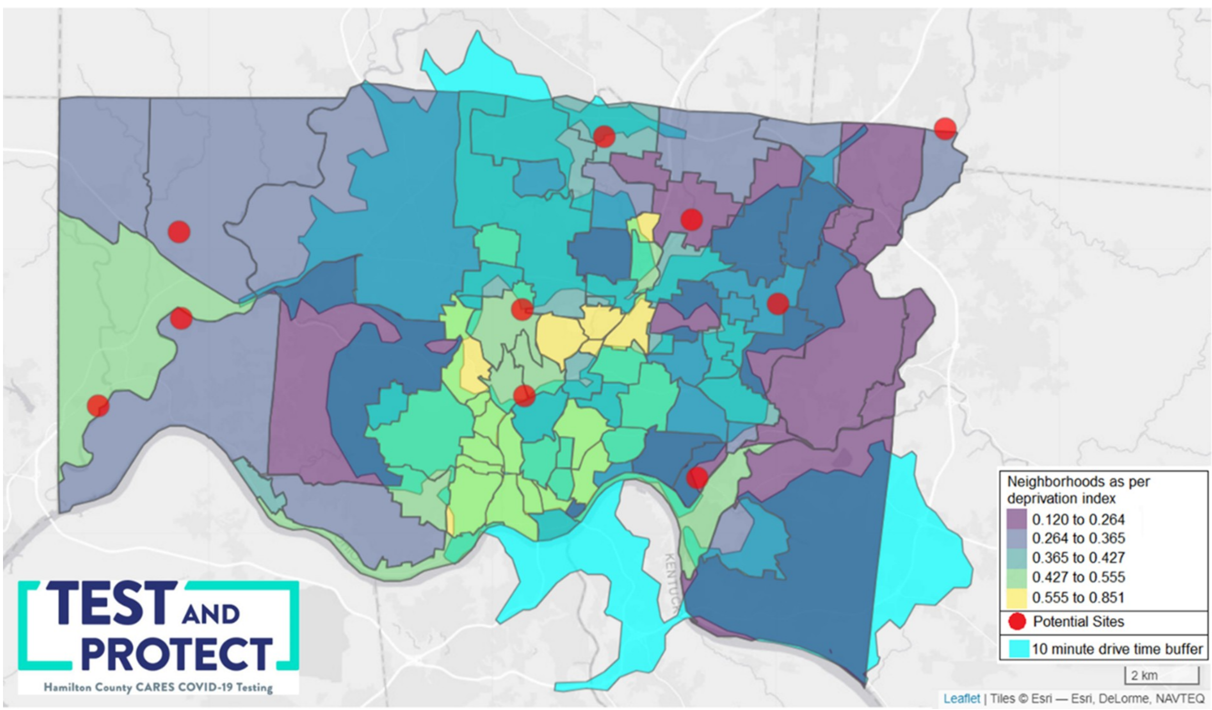

FIGURE 1 Hamilton County Map Illustrating Potential Sites Designed to Optimize Equitable Access to Viral Testing

Given that vaccine distribution strategies initially differed from testing approaches (ie, use of mass vaccination sites, waste requirements for unused doses), not all aspects of our testing approach were easily adapted for vaccination. That said, several principles of our approach were adapted to both vaccination and distribution of home test kits as they became available.

Discussion

TaP sought to ensure that COVID-19 testing was accessible and equitable across our county. TaP was not set up in a way to easily evaluate its effect on infection rates, morbidity, or mortality, nor to survey community reception. Claiming that Hamilton County did better (or worse) than other regions because of our intervention is problematic epidemiologically, and we do not want to overstate (or understate) TaP's impact. Moreover, although we have no data to evaluate the performance of our site selection scheme relative to other schemes (eg, randomly selecting community centers), we found success in enhancing access to testing for those most vulnerable. Our data and results suggest that TaP was well utilized and received by community members across the region that it served.

Our methods – geospatial analytics, community engagement, and data tracked over time – could have application beyond the pandemic and region.[9,10] Indeed, learning from regional public health practice experiences, like TaP, could enhance preparedness for future pandemics and inform responses to analogous challenges best addressed by community coalitions (eg, epidemics related to opioid use, gun violence). Furthermore, the incentivization of multisectoral, multiorganizational collaborations could enhance uptake and effectiveness of public health practice innovations, particularly when those innovations are in familiar places, co-designed by trusted community members, and delivered in accessible, equitable ways.

Implications for Policy & Practice

- Geospatial analytics, community engagement, and data tracked over time were useful in the identification of COVID-19 testing sites, utility which could extend beyond the pandemic.
- Resources promoting public health are most likely to be used when located in familiar places, co-designed by trusted community members, and delivered in accessible, equitable ways.
- Learning from regional responses to key aspects of the COVID-19 pandemic could enhance preparedness for future pandemics.
- Public health practice innovations emergent from the COVID-19 pandemic may similarly influence approaches to pre-existing complex, multisector challenges (eg, epidemics related to opioid use, gun violence).
- Policies that incentivize innovation, cross-sector collaboration, and amplification of community voice (and priorities) could enhance uptake and effectiveness of public health practice innovations.

References

1. Ward S, Lindsley A, Courter J, Assa'ad A. Clinical testing for COVID-19. *J Allergy Clin Immunol.* 2020; 146(1):23-34. doi:10.1016/j.jaci.2020.05.012
2. Wong CA, Houry D, Cohen MK. Integrating public health and health care - protecting health as a team sport. *N Engl J Med.* Apr 10 2024 (online ahead of print). doi:10.1056/NEJMp2403274
3. GIS and Public Health at CDC (2019). Centers for Disease Control and Prevention. Available at: https://www.cdc.gov/gis/index.htm. Accessed August 1, 2023
4. Beck AF, Sandel MT, Ryan PH, Kahn RS. Mapping neighborhood health geomarkers to clinical care decisions to promote equity in child health. *Health Aff (Millwood)* Jun 1 2017;36(6):999-1005. doi:10.1377/hlthaff.2016.1425
5. Brokamp C, Beck AF, Goyal NK, Ryan P, Greenberg JM, Hall ES. Material community deprivation and hospital utilization during the first year of life: an urban population–based cohort study. *Ann Epidemiol.* 2019;30:37-43. doi:10.1016/j.annepidem.2018.11.008
6. openrouteservice service (2022). Available at: https://openrouteservice.org/terms-of-service/#attribution. Accessed August 1, 2023.
7. Benneyan JC, Lloyd RC, Plsek PE. Statistical process control as a tool for research and healthcare improvement. *Qual Saf Health Care.* 2003;12(6):458-464. doi:10.1136/qhc.12.6.458
8. Provost LP, Murray SK. *The Health Care Data Guide: Learning from Data for Improvement*, 1st ed. Jossey-Bass; 2011. xxviii, 445.
9. Shearkhani S, Plett D, Powis J, et al. Evaluating an integrated local system response to the COVID-19 Pandemic: case study of East Toronto Health Partners. *Int J Integr Care.* 2023 Jun 22;23(2):31. doi:10.5334/ijic.7014
10. Beck AF, Hartley DM, Kahn RS, et al. Rapid, bottom-up design of a regional learning health system in response to COVID-19. *Mayo Clin Proc.* 2021;96(4):849-855. doi:10.1016/j.mayocp.2021.02.006