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Addressing Health Equity Goals for COVID-19 Vaccination Using Integrated Data and Mapping Tools: A Collaboration Between Academia, Public Health, and Health Care Systems in Columbus and Franklin County, Ohio

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ABSTRACT

Context: Data sharing between local health departments and health care systems is challenging during public health crises. In early 2021, the supply of COVID-19 vaccine was limited, vaccine appointments were difficult to schedule, and state health departments were using a phased approach to determine who was eligible to get the vaccine.

Program: Multiple local health departments and health care systems with the capacity for mobile and pop-up vaccine clinics came together in Columbus and Franklin County, Ohio, with a common objective to coordinate where, when, and how to set up mobile/pop-up COVID-19 vaccine clinics. To support this objective, the Equity Mapping Tool, which is a set of integrated tools, workflows, and processes, was developed, implemented, and deployed in partnership with an academic institution.

Implementation: The Equity Mapping Tool was designed after a rapid community engagement phase. Our analytical approaches were informed by community engagement activities, and we translated the Equity Mapping Tool for stakeholders, who typically do not share timely and granular data, to build capacity for data-enabled decision making.

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Discussion: We discuss our observations related to the sustainability of the Equity Mapping Tool, lessons learned for public health scientists/practitioners, and future directions for extending the Equity Mapping Tool to other jurisdictions and public health crises.

KEY WORDS: COVID-19, data analytics, equity, public health practice, vaccination

Context

In early 2021, the COVID-19 vaccine supply was limited, vaccine appointments were difficult to schedule, and state health departments were using a phased approach to roll out COVID-19 vaccines. In addition, limited access to COVID-19 vaccines, in terms of time to make an appointment, navigating appointment scheduling systems, traveling to vaccine administration sites, and taking time off from work to get vaccinated and/or recover from adverse events, exacerbated inequities in COVID-19 vaccine uptake. Inequities in COVID-19 vaccine uptake were associated with hesitancy among historically marginalized populations, such as people of color, immigrants and refugees, and populations who continuously face discrimination in their interactions with public health and health care systems.[1-3] As local health departments and health care systems in Columbus and Franklin County, Ohio, prepared to rapidly coordinate where, when, and how to set up mobile/pop-up clinics, one of their main goals was to eliminate inequities in COVID-19 vaccine uptake through collaborative, comprehensive, and multisectoral approaches.

Collaborations between local health departments and health care systems during public health crises, such as a pandemic, face many challenges.[4] One challenge is the lack of access to timely and granular data for the allocation of limited resources and data-enabled decision making.[5,6] Another challenge is suboptimal use of existing resources when multiple stakeholders are working to address the same problem. For example, a lack of coordination about the timing and location of vaccine clinics by vaccine providers serving the same community may result in clinics operating close to each other in both time and space. This duplication of effort and reduced efficiency during a pandemic is a barrier to eliminating inequities in COVID-19 vaccine uptake. Challenges may also arise within a local health department when incident command structure teams are involved in crisis response efforts. Some of the challenges faced by incident command structure teams include coordinating between various subteams, such as communications, operations, and health equity. Overcoming some or all these challenges whether between local health departments and health care systems or within a local health department is critical to eliminating inequities in COVID-19 vaccine uptake.

The goal of this full practice report is to describe the development and operationalization of the Equity Mapping Tool for data-driven decision making to make progress toward equitable delivery of vaccine education and outreach efforts and vaccine uptake in Columbus and Franklin County, Ohio.

Methods

Design

The Equity Mapping Tool is a set of tools, workflows, and processes that were developed through a partnership with an academic institution (College of Public Health, The Ohio State University), 2 local health departments, multiple health care systems, and community-based organizations. By tools, we mean tangible products, such as reports, graphics, maps, dashboards, and other deliverables, that partners may use for making decisions. Also, a workflow refers to activities that are repeated to achieve or complete a task, such as a public health department sending data weekly for processing and visualization, and a process refers to the overall set of tasks that are needed to achieve an organizational goal, such as closing the gap in vaccine uptake among more and less vulnerable populations. We used a phased approach (Figure 1) to develop and integrate activities (Figure 2) in the design of the Equity Mapping Tool. Figure 1 broadly describes each phase of our approach and Figure 2 shows the integration between phase-specific workflows, activities, and deliverables and examples of tools, workflow, and process.

We started designing the Equity Mapping Tool in February/March 2021 when vaccine supply was still limited in Columbus, Ohio, and surrounding cities that make up Franklin County, Ohio. The City of Columbus, which is served by Columbus Public Health, is geographically situated within Franklin County, Ohio. There are multiple municipalities, cities, and villages in Franklin County that are served only by Franklin County Public Health. Franklin County Public Health jurisdiction includes urban and suburban regions whereas Columbus Public Health jurisdiction includes mostly urban regions of Franklin
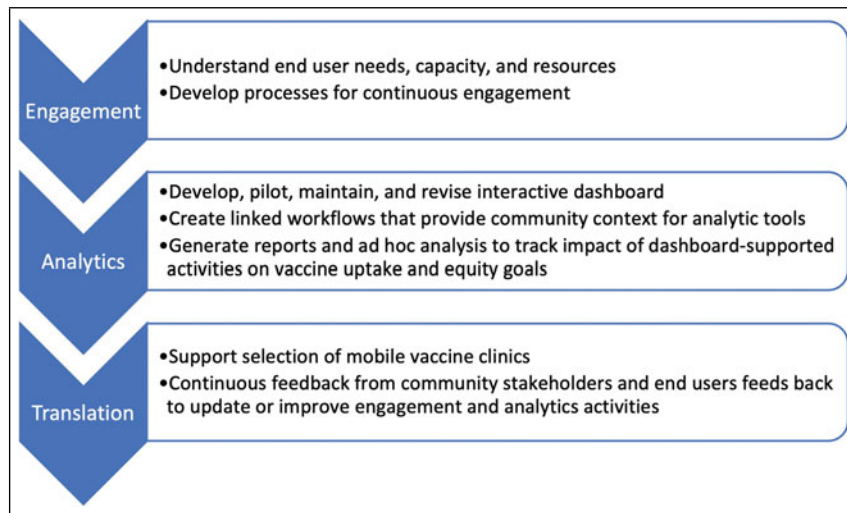
FIGURE 1 A Schematic Drawing of the Engagement, Analytics, and Translation (EAT) Framework for Conducting Translational Data Analytics in Public Health[a]
[a]It was used to develop and operationalize the Equity Mapping Tool. This figure is available in color online (www.JPHMP.com).

County, Ohio. The health care system partners served all residents of Franklin County, Ohio.

In the *Engagement phase*, we met with health commissioners; communications, operations, and health equity teams within health departments; and lead coordinators and data analytics teams supporting mobile vaccination strategy within the health care systems. These stakeholders were selected because they were primarily responsible for administering COVID-19 vaccines when they became available in early 2021. The academic partner visited mass vaccination clinics, participated in vaccine education and outreach working groups within a health care system, and reviewed a comprehensive needs assessment for COVID-19 in Ohio[7] to inform the design of the Equity Mapping Tool. These insights also helped the academic partner to operationalize the Equity Mapping Tool within existing workflows
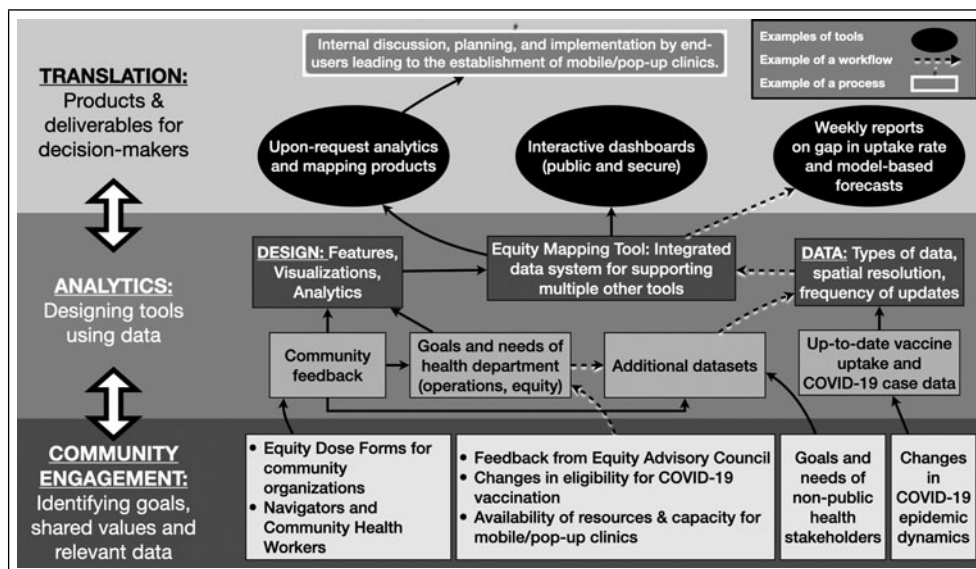
FIGURE 2 Schematic Depicting How the Equity Mapping Tool Integrates Various Types of Engagement, Analytics, and Translation Activities[a]
[a]Also, shown are examples of what we mean by tools, workflow, and process. The arrows between boxes and circles represent the flow of data/information. The design of the Equity Mapping Tool and its data (middle panel in medium grey) were based on various forms of community engagement (bottom panel in dark grey), leading to multiple deliverables (top panel in light grey) that helped achieve the goals of multiple decision makers and improve COVID-19 vaccine equity. Double-sided arrows indicate feedback between each phase where workflows, processes, or tools were refined on the basis of community engagement and translation activities. Three tools are shown in black ovals.

at the local health departments and health care systems.

In the *Analytics phase*, the academic partner used the information and knowledge from the *Engagement phase* to develop, test, and validate multiple computational workflows and data analytics tools. The academic partner developed an interactive dashboard with maps, tables, and visualizations that integrated multiple types of data and performed ad hoc analyses for specific questions posed by stakeholders in the public health department and health care systems. Continuous feedback from all stakeholders was used to refine the computational workflows and data analytics tools.

In the *Translation phase*, the collective focus of the collaborator was on increasing vaccine uptake rates and closing the gap in uptake rates among vulnerable populations using a variety of outputs, including reports and interactive dashboards that were developed during the Analytics phase. Feedback from translation activities (eg, regular check-in meetings and presentations to health department staff) also informed new ways for engagement and new types of analytical approaches. In this manner, each phase (Engagement, Analytics, and Translation) could be viewed as a continuous improvement process that we used to rapidly develop and implement the Equity Mapping Tool during a public health crisis.

Data sources

We used protected and public data sets for the Equity Mapping Tool (Table). Protected data were received from local and state public health departments based on a data use agreement, and the publicly available data were accessible online. The data use agreements were between 2 data providers (Franklin County Public Health and Columbus Public Health) and 1 recipient (The Ohio State University). The data use agreement covered the provision of aggregated COVID-19 case data (by census tract and age group level) and vaccine uptake data (by census tract and race) in a secure manner and specified which organizations would have access to the reports, dashboards, and analysis based on the data.

Data integration

Our approach to data integration included several steps. We use the term "data" broadly to include both qualitative and quantitative data. Figure 2 depicts how we brought together data from multiple sources for integration into dashboards, reports, and analyses in support of multiple goals among stakeholders. We used a centralized spreadsheet to collect community feedback from multiple sources, including requests for pop-up vaccination clinics from community-based organizations, which the public health departments collected using secure online survey software (eg, REDCap, Google Forms), input from health equity teams within health departments, and direct feedback given to stakeholders by community-based organizations on where to site pop-up/mobile clinics. These qualitative data were entered on a daily or weekly basis into the centralized spreadsheet, which was accessible online using Microsoft OneDrive to individuals in local health departments, health care systems, and analysts on The Ohio State University (OSU) team.

The purpose of these qualitative data, in terms of data integration, was twofold. First, they were used to strengthen the case for ranking a neighborhood or potential pop-up/mobile site higher or lower compared with other neighborhoods and potential sites. The added value of the qualitative data was the level of confidence it gave stakeholders in deciding between multiple potential sites, given limited capacity within their organization to set up pop-up/mobile clinics. Second, if community engagement activities by navigators suggested setting up a pop-up/mobile clinic in a specific neighborhood, we used the interactive dashboard to determine (i) the health department with jurisdiction in that neighborhood that could coordinate setting up the clinic; and (ii) whether the neighborhood met certain criteria, such as high social vulnerability (eg, Social Vulnerability Index [SVI][8] >0.7), limited access to vaccine providers, and a high burden of COVID-19 cases in the past 3 weeks (Table). The SVI was developed by the Centers for Disease Control and Prevention and the Agency for Toxic Substances and Disease Registry where social vulnerability refers to "the potential negative effects on communities caused by external stresses on human health."[8] We used the Centers for Disease Control and Prevention's SVI because it was familiar to all partners and widely being used by the state health department and the national pharmacy retailors to identify areas for additional outreach and education efforts. The SVI uses several census tract–level variables to help public health and other organizations identify areas in need of support before, during, or after disasters. Previous analyses at the county level have shown that higher SVI was associated with greater burden of COVID-19 cases[9] and lower vaccine uptake.[10]

In the interactive dashboard, we integrated quantitative data into an interactive map and tables with fused data. Different data points were fused or combined on the basis of geography (eg, census tract) or jurisdiction (eg, Fire/Emergency Medical Services areas). The interactive map included map layers for each

TABLE
Data Sources With Brief Descriptions and Details on Access and Resolution[a]

Data Set Description	Data Source	Type of Access	Spatial Resolution	Temporal Resolution
COVID-19 public health data				
COVID-19 case rates over past 3 wk and overall and by age group	Columbus Public Health	Secure	Census Tracts	3 wk
COVID-19 vaccine uptake rate overall and by race	Columbus Public Health and Franklin County Public Health	Secure	Census Tracts	Weekly or every 2 wk
COVID-19 vaccine providers	Centers for Disease Control and Prevention	Public	Points	Daily
Locations of past and upcoming pop-up/mobile sites	Columbus Public Health and consortium of health care systems with mobile clinic capacity	Secure	Points	Daily
Population sociodemographic factors				
CDC's Social Vulnerability Index	CDC	Public	Census Tracts	Annual
Measures of spatial accessibility by car and public transit to vaccination sites	The Ohio State University, College of Public Health	Internal analysis	Polygons	Annual
Socioeconomic and demographic variables at the block group level	Integrated Public Use Microdata Series—National Historical Geographic Information System	Public	Block Group level	Annual
Welfare benefits data	Franklin County Public Health	Upon request		Annual
Health Prism Data	Ohio Department of Health	Upon request	Census Tract	Annual
Health care/emergency facilities				
Pediatric vaccination locations	Nationwide Children's Hospital via Ohio Department of Health	Upon request	Points	Annual
Health care facilities	OhioHealth, The Ohio State University Wexner Medical Center	Upon request	Points	Annual
Fire/emergency facilities and service boundary	Mid-Ohio Regional Planning Commission	Public	Points + polygons	Annual
Community resources and organizations				
City administrative areas	City of Columbus GIS Portal	Public	Polygons	Annual
Other administrative boundaries (school districts, zip codes, census tracts, public health department jurisdiction)	Mid-Ohio Regional Planning Commission/City of Columbus GIS Portal	Public	Polygons	Annual
Polling locations	Franklin County Board of Elections	Public	Points	Annual
Community centers (eg, libraries, recreation centers)	Ohio Geographically Referenced Information Program	Public	Points	Annual
Faith places	Columbus Public Health	Upon request	Points	Annual
Barber shops, hair salons	Mid-Ohio Regional Planning Commission/City of Columbus GIS Portal	Public	Points	Annual

Abbreviation: CDC, Centers for Disease Control and Prevention.
[a]These data sources were used for the Equity Mapping Tool.

data type (eg, points for faith places, polygons for census tracts, and isoclines for access to vaccine providers based on the mode of travel and threshold for travel time). The end user could filter the data to be mapped on the basis of their preferences. We used a subset of data sources to create a profile for locations (eg, faith places, libraries, schools) by fusing the data in a meaningful manner and identifying potential locations based on preset criteria from stakeholders (see Supplemental Digital Content Table S1, available at http://links.lww.com/JPHMP/A973).

Dashboard development and maintenance

The development of the interactive dashboard was an iterative process. We used R[11] and ShinyR[12] to create the dashboard, which was hosted on a password-protected Web server maintained by the Ohio Supercomputing Center. There were 2 versions of the dashboard—secure and public. The secure version was developed in March 2021 and was restricted to local health department employees and health care systems coordinating on vaccine administration with local health departments. A screenshot of the secure dashboard without any public health data is shown for illustrative purposes (see Supplemental Digital Content Figure S1, available at http://links.lww.com/JPHMP/A974). The public version of the dashboard was developed in August 2021 at the request of a public health department stakeholder who was working with external partners, such as community health workers and community navigators. These external partners were not public health department employees and, therefore, were not authorized to view the sensitive data on census tract–level COVID-19 case rates and vaccine uptake. Also, these external partners were offered the public dashboard to help them identify on their own which neighborhoods to target for vaccine education and outreach. The initial set of data added to the secure dashboard included vaccination uptake, COVID-19 case rates, accessibility to vaccine providers, administrative boundaries, and faith places (Table). Accessibility to vaccine providers was shown as an isochrone map based on different modes of transportation and travel time cost (in minutes).[13] The dashboard underwent additional development as the needs and goals of all stakeholders changed over the course of 2021 and 2022. These changes included eligibility requirements and types of vaccines available, increased availability of vaccine appointments and providers, and real-time evaluation and monitoring of initiatives and programs to increase uptake, such as the VaxCash program[14] implemented by Columbus Public Health.

Technology and staffing requirements

To access and use the dashboard, public health and health care system stakeholders used a Web browser on a desktop, laptop, tablet, or smartphone. The dashboard was accessible using these devices but not easy to use and navigate on a smartphone. No other specialized software was needed by stakeholders to access and use the interactive dashboard and other analyses and reports available through the Equity Mapping Tool. The staffing requirements at the public health departments changed over time. After the initial discussions with public health department leadership staff, both departments assigned a specific point of contact (Graffagnino at Columbus Public Health and Baryeh at Franklin County Public Health) to coordinate with the academic partners (Hyder) through weekly check-ins via email and/or online meetings related to the partnership. The staff at the health departments utilized the Equity Mapping Tool as part of their job/role at the health department, which included using and providing data-driven insights for the COVID-19 vaccination effort.

Rapid evaluation

We provided an in-depth description of how each stakeholder used the Equity Mapping Tool as a type of rapid evaluation to assess the effectiveness of the Equity Mapping Tool to inform further program planning. We informally asked end users via email to provide a summary of how they used the Equity Mapping Tool and supplemented these data with our own experience (ie, the academic partner) of interactions with partners. We did not collect or conduct any formal data and analysis for the rapid evaluation. We described the effectiveness of the Equity Mapping Tool in this manner because it was developed, deployed, and operationalized through a rapid response mechanism, and the burden of the ongoing pandemic has so far prevented us from conducting a more formal and extensive evaluation[15] of the Equity Mapping Tool.

Results

The main results from the development and utilization of the Equity Mapping Tool are reported below in terms of how it was used in practice by various stakeholders. Comparatively, Franklin County Public Health used the Equity Mapping Tool in more ways compared with Columbus Public Health although both health departments were actively involved in the engagement and translation phase of the partnership.

Implementation of the equity mapping tool by public health departments

Franklin County Public Health

Franklin County Public Health implemented a jurisdictional vaccination strategy with a 3-pronged approach: communications, engagement, and access. It was integral to use reliable data from sources, such as the Equity Mapping Tool, to identify the most vulnerable communities and understand the social determinants of health affecting those residents. The Equity Mapping Tool helped to ensure that COVID-19 information and materials were culturally sensitive and reflected the needs of the residents. Data and reports extracted from the Equity Mapping Tool informed the decisions and programming efforts of the Equity Advisory Council, consisting of 37 member organizations tasked with implementing equity-focused initiatives, such as the Navigators project, which included navigators from 5 partnering community-based organizations. The navigators provided greater access by scheduling appointments for residents, working in specific locations serving high SVI and low-vaccine-uptake areas. Emergency medical services teams and fire stations serving communities in the health department's jurisdiction helped administer vaccines via pop-up clinics. In addition to supporting the development of weekly internal operational reports, the Equity Mapping Tool was used to create monthly presentations for the Equity Advisory Council members and supporting staff and periodic jurisdictional updates for the public at large. It also helped determine the allocation of equity doses reserved for specific communities served by the health department and Medical Reserve Corps–staffed COVID-19 vaccine clinics.

The weekly report from the academic team included several items (see Supplemental Digital Content Table S2, available at http://links.lww.com/JPHMP/A975). Franklin County Public Health epidemiologists (Baryeh) and the operations team (Jones, McAdams) met with the academic team (Hyder) every week from April to September 2021 to review potential locations for pop-up/mobile clinics, provide feedback from navigators, and address questions about the health department's vaccine education and outreach efforts (see Supplemental Digital Content Table S2, available at http://links.lww.com/JPHMP/A975). The community engagement and liaison team at Franklin County Public Health used outputs from the Equity Mapping Tool to direct the expansion of community partnerships and prioritize locations for efforts, such as COVID-19 vaccine–related phone outreach and text banking. The information contained in the reports (report items no. 1, no. 2, and no. 3 in Supplemental Digital Content Table S2, available at http://links.lww.com/JPHMP/A975) such as the gap in vaccine uptake between neighborhoods with low and high SVI was used by the teams at the health department to monitor progress toward their COVID-19 vaccine equity goals.

Columbus Public Health

From Columbus Public Health, the community engagement (Graffagnino) and operations (French) team collaborated with the academic team (Hyder) to identify potential locations for pop-up/mobile clinics, provide access to a curated list of current and planned pop-up/mobile sites, and develop real-time monitoring and evaluation dashboard for the VaxCash program within the interactive dashboard in the Equity Mapping Tool. The curated list of pop-up/mobile sites was a Google Sheet that Columbus Public Health maintained to coordinate efforts with local health care system partners. The data provided in the weekly reports (report items no.2, no. 3, and no. 4 in Supplemental Digital Content Table S2, available at http://links.lww.com/JPHMP/A975) were used by the Columbus Public Health staff to determine where to send their vaccination teams; prioritize requests for clinics from community-based organizations; support site selection for the VaxCash program; and assist community engagement teams in identifying specific neighborhoods to target for vaccine education and outreach activities. Specifically, the Columbus Public Health staff created presentations for others at the health department in order to facilitate conversations internally regarding where to target vaccine outreach and education efforts, including which recreation centers, public libraries, fire departments, and faith places to partner up or reach out to for setting up a mobile/pop-up vaccine clinic. Columbus Public Health also coordinated weekly meetings to coordinate vaccination efforts between health care systems and health departments during part of the partnership (early to mid-2021) when mobile/pop-up clinics were being widely used by all partners.

Implementation of the equity mapping tool by a health care system

OhioHealth

During the first month of OhioHealth's Community COVID Vaccine Administration Program (early 2021), 88.7% of the first-dose vaccines were administered to White patients. There was significant demand for the vaccine with limited supply, and a disproportionate number of the open appointments were getting booked by White patients. Internal and

Equity Mapping Tool data analysis confirmed that there was a racial equity and geographic access gap among Black, Hispanic/Latinx, and other communities of color. OhioHealth established an internal racial equity work group to build an improved strategy to meet the unique needs of these communities.

The OhioHealth Racial Equity Workgroup utilized zip code analysis based on SVI for census tracts where patients lived and other demographics from the US Centers for Disease Control and Prevention and used the Equity Mapping Tool to identify populations requiring greater vaccine access. As a result of this analysis, new clinic locations were established to improve access in communities with significant Black, Hispanic/Latinx, and New American populations, and other communities of color. In collaboration with Columbus Public Health and Franklin County Public Health, these clinics were featured in a Web-based reference guide to assist people in finding vaccination sites close to where they live and work.

OhioHealth dedicated clinics through its mobile health enterprise—Wellness on Wheels (WOW)—to increase flexibility and access. This expanded project received a $1 million grant from Health Resources & Services Administration, allowing it to continue through 2022. The WOW Vaccine Equity Project provided appointments in targeted zip codes, based on Equity Mapping Tool data, to reach people with the greatest need. Once the zip codes and populations were identified, a dedicated team formed community partnerships with trusted brokers in the communities to staff the clinics on days and at times and locations offering the greatest convenience. These partnerships allowed OhioHealth to enter new communities neutrally and gather input on vaccine hesitancy and the preferred ways to receive health information through focus groups.

The Equity Mapping Tool supported OhioHealth in taking a focused, geographic approach to create partnerships with more than 30 community-based organizations to address the following:

- Vaccine convenience—ensuring that the vaccines were easy for vulnerable communities to access, concerning the day, time, and location.
- Vaccine confidence—addressing hesitancy and medical mistrust through community engagement, including focus groups and individualized counseling.
- Vaccine complacency—combating misconceptions among healthy younger people, who believed that they were not at high risk for COVID-19 and that a prior infection was enough protection, through one-on-one counseling.

OhioHealth's success in reaching communities of color is evidenced by a 38% increase in the vaccine doses administered. The vaccine doses administered in Franklin County by OhioHealth clinics increased from 12% to 50% between January 2021 and July 2021 (Figure 3).

Discussion and Conclusion

We developed and operationalized the Equity Mapping Tool, which was a set of tools, workflows, and processes to support COVID-19 vaccination efforts in Columbus and Franklin County, Ohio. We discuss later some observations related to the usefulness and sustainability of the Equity Mapping Tool, lessons learned that may be relevant for public health scientists and public health practitioners, and future directions.

Certain types of data, analysis, and reports were more useful than others in this partnership. Report items no. 2 and no. 3 (see Supplemental Digital Content Table S2, available at http://links.lww.com/JPHMP/A975) were most frequently and continuously requested by both public health departments. These reports, which focused on the gap in vaccine uptake, were used to highlight the impact of each health department's vaccine education and outreach efforts and initiatives to achieve their health equity goals. The most used types of data from the interactive dashboard were the COVID-19 data (on cases, overall vaccine uptake, and vaccine uptake by race), administrative boundaries, fire/emergency medical services area boundaries and station locations, and community resources (eg, faith places, libraries, barber shops). The COVID-19 data were of high quality because they collected public health disease reporting and immunization reporting systems, which were maintained by accredited state and public health
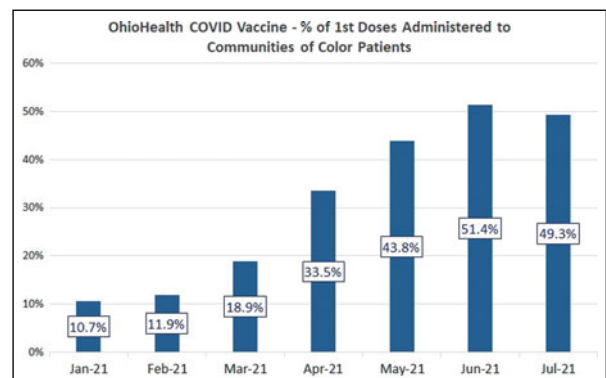

FIGURE 3 Percentage of First Doses Administered to Communities of Color Patients by OhioHealth, a Key Health Care System Stakeholder That Used the Equity Mapping Tool
This figure is available in color online (www.JPHMP.com).

departments. The data set with the most quality issues was the faith places data, which had been compiled manually by local health departments for community engagement purposes. The remaining data sets were of high quality because they were obtained from data vendors who met guidelines for providing research-quality data products and licensed to the academic partner.

Our experience suggests that the sustainability of the Equity Mapping Tool, in terms of promoting the equitable delivery of vaccine education and outreach efforts and vaccine uptake in Columbus and Franklin County, Ohio, requires the following conditions: (i) maintaining the flow of data from secure data sources, such as state and public health departments, (ii) identifying dynamic data needs and goals of stakeholders without overburdening them, and (iii) modifying the tools, workflows, and processes based on the changing goals and needs of stakeholders and changing dynamics of the public health crisis.

A potential mechanism for ensuring these 3 conditions is the Community-based Distributed Data Escrow. Community-based Distributed Data Escrow is a mechanism in which stakeholders identify a set of data or tools that are typically not shared and agree that they would be shared in a prespecified manner only if a public health disaster or crisis occurs.[16] By collectively predefining what constitutes a public health disaster/crisis, the sharing of data between stakeholders can automatically be triggered, enabling quicker access to the data needed for collaborative and coordinated decision making during public health disasters, including pandemics. Currently, Community-based Distributed Data Escrow remains a concept on paper, but such a mechanism may be one way to sustain the Equity Mapping Tool and, potentially, extend it to other public health crises (eg, the opioid addiction epidemic, youth mental health). Identifying the dynamic needs and goals of stakeholders is critically important to help improve public health outcomes and increase the adaptive capacity of public health departments during a crisis.

We learned several lessons in the process of developing and operationalizing the Equity Mapping Tool for COVID-19 vaccinations that may help extend the Equity Mapping Tool to other public health crises. First, while the incident command structure offers a way to coordinate and respond to crises, and academic-practice partnerships through the Centers for Public Health Preparedness[17] can quickly leverage and deploy academic expertise and resources during a crisis, a gap remains in the knowledge and skills needed to compile and share data across the various health sectors. A solution to this challenge may be to embed one or more academic experts within an incident command structure team who have a background in data integration, public health informatics, and translational public health data analytics. This may help expedite access to secure data and generate data analytics solutions more quickly during a public health crisis or incident. It would be especially advantageous if a local health department is designated as an academic public health department so that preexisting memorandums of understanding cover the activities of the academic partner within the public health department, such as access to data and being part of the incident command structure teams.

Second, we learned that leveraging existing relationships around data sharing was instrumental in building trust between academic and public health partners. The academic team had been working with both local health departments on a COVID-19 school surveillance project, and several of its data sets, analytical tools, and infrastructure were relatively easy to extend to the Equity Mapping Tool project. As a result, we also learned that the diverse applications of the Equity Mapping Tool and the regularity and consistency of the data-driven insights it provided greatly advanced stakeholder collaboration and coordination within the local community. The tool remained useful to all stakeholders, as their needs and goals changed over time in response to pandemic and vaccination uptake dynamics

Finally, we learned that direct use of the Equity Mapping Tool by individuals from community-based organizations (eg, navigators or community health workers) was not viable in its current form. This issue was likely due to information overload among community navigators who may not have been trained on the use of interactive dashboards for decision making during a pandemic as opposed to public health department and health care system staff who may have experience with using interactive dashboards and data-intensive reports. Community-based organizations should have been engaged in the development of the Equity Mapping Tool to help ensure that it was a useful resource for them. The Community Planning Tool[18] is one example of a methodology for engaging with community-based organizations for this purpose.

A promising future direction for the Equity Mapping Tool includes scaling up the tools, workflows, and processes to multiple local health departments, health care systems, and community-based organizations promoting COVID-19 vaccination and other public health crisis response initiatives. This would require 2 key issues to be worked out. The first challenge is to streamline data use agreements for multiple jurisdictions to access COVID-19 case and vaccination data. Since these data are reported to

Implications for Policy & Practice

- Integrated tools, workflows, and processes can help eliminate data silos among stakeholders who typically do not share timely and granular data and build capacity for data-enabled decision making during public health crises.

- The Engagement, Analytics, and Translation framework was applied to COVID-19 vaccination efforts and may be scalable and generalizable to other public health crises.

- New approaches to developing and implementing academic-public health partnerships are needed to ensure the rapid development of tools, workflows, and processes for data-enabled decision making that can be adapted and sustained during a public health crisis.

state health departments, it should be possible to create statewide data use agreements. Another challenge is to orchestrate the use of the Equity Mapping Tool among multiple health departments, health care systems, community-based organizations, and community health workers at care coordination agencies. For example, community health workers may be able to use the interactive dashboard's analytics capabilities and personalized data-driven reports sent to their email regularly (eg, weekly) to identify specific areas where they can provide vaccine education and vaccination clinics that are accessible to their clients or launch a social/news media campaign in a specific set of zip codes.

In conclusion, we developed and operationalized several tools, workflows, and processes that collectively make up the Equity Mapping Tool to support COVID-19 vaccination efforts among collaborators from multiple sectors in Columbus and Franklin County, Ohio. Our results suggest that the Equity Mapping Tool was a useful resource for multiple public health departments and health care systems as they planned, established, and promoted mobile/pop-up vaccination clinics, with a focus on achieving COVID-19 vaccine equity.

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