



ASPE REPORT

Best Practices for COVID-19 Vaccination and Testing: Environmental Scan Report

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By
Mathematica

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CONTRIBUTING AUTHORS

Eli Michaels, PhD, Mathematica
Cindy Alvarez, MPH, Mathematica
Katharine Bradley, PhD, Mathematica
Alyssa Bosold, MPH, Mathematica
Colleen Staatz, MPH, Mathematica
Ruth Hsu, MPH, Mathematica
Sheila Hoag, MA, Mathematica

ACKNOWLEDGMENTS

Arnold Chen, MD, MSc, Mathematica
Suzanne Felt-Lisk, MPA, Mathematica
Divya Gupta, MS, Mathematica
Yamai Jack, BA, Mathematica
Rosalind Keith, PhD, Mathematica
Lauren Maul, MA, Mathematica
Nikhil Tiwari, PhD, Mathematica
Madison Vincent, BA, Mathematica
Deliya Wesley, PhD, Mathematica
Members of the Expert Panel for the Best Practices for COVID-19 Testing and Vaccination Study

PROJECT OFFICERS AND PROJECT LEADERSHIP

Trinidad Beleche, PhD, ASPE
Deborah Porterfield, MD, MPH, ASPE
Susan Farrall, MPH, OASH
Sharon Arnold, PhD, ASPE
David Kim, MD, MA, OASH



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Executive Summary

I. Introduction

As part of U.S. Department of Health and Human Services efforts to combat COVID-19 and prioritize health equity, the Office of the Assistant Secretary for Planning and Evaluation (ASPE) and the Office of the Assistant Secretary for Health (OASH) have sponsored a mixed-methods study of testing and vaccination policies and programs for people who are medically or socially at disproportionate risk for COVID-19 or related adverse outcomes (Best Practices for COVID-19 Testing and Vaccination Study). Study goals include identifying and examining promising and best practices to improve (1) **COVID-19 testing** awareness, access, and uptake; (2) **COVID-19 vaccination** confidence, access, and uptake; and (3) **routine vaccination** confidence, access, and uptake during the COVID-19 pandemic. Mathematica is ASPE's research partner for the Best Practices for COVID-19 Testing and Vaccination Study, which started in 2022 and will finish in 2025.

Although the COVID-19 Public Health Emergency ended on May 11, 2023, the COVID-19 virus continues to cause illness, hospitalization, death, and disability. Moreover, experts agree that another pandemic is possible, and even likely. Findings from this study can support ongoing efforts to combat COVID-19 as well as efforts to prepare for future pandemics.

Purpose of this report. This report summarizes findings from an environmental scan of testing and vaccination policies and programs serving the populations of focus for the study, which we have defined as those who are medically or socially at disproportionate risk for COVID-19 or related adverse outcomes.¹ This definition encompasses groups with medical conditions that increase their risk of infection and adverse outcomes, groups that face greater risk of COVID-19 exposure because of where they live and work, and groups facing barriers to services, such as restrictive work schedules, low transportation access, language barriers, or low levels of income. These findings will inform the design of other study components, including a national survey of local organizations that have implemented testing and vaccination programs and site visits to selected organizations. The study team will disseminate synthesized findings from all phases of the research to federal, state, tribal, and local practitioners and policymakers seeking to improve COVID-19 outcomes and prepare for future public health crises.

Methods and limitations. We developed search terms and a screening process for a targeted literature review of materials published since 2020.² We also interviewed key informants to identify guidelines and programs focusing on COVID-19 testing and COVID-19 vaccination and guidelines and programs focusing on routine vaccinations during the pandemic. We extracted information on programs from articles, websites, and our interview notes in an Excel-based tool. We analyzed this information using thematic inductive coding to identify themes within a taxonomy of program elements, including in program approaches, delivery strategies, implementation barriers, and implementation strategies. Because of the study's timeline, we made choices that may have implications for our findings. First, we purposely limited the search of routine vaccination programs to those focused on halting the declining rates during the COVID-19 pandemic. Second, we limited the search to materials printed in English, although there is

¹ Throughout this report, we refer to these groups as “populations at disproportionate risk.”

² For further information on our methodology, see Appendix A.

inherent selection bias in doing so. Another limitation is that relatively few literature sources discussed barriers to program implementation, although understanding this was a goal of the environmental scan.

II. Highlights of environmental scan findings³

Populations at disproportionate risk of COVID-19 or related adverse outcomes and common barriers to testing and vaccination

Populations at disproportionate risk. People and communities may experience disproportionate risks of COVID-19 or related adverse outcomes due to medical factors, social factors, or both. People who are immunocompromised face higher risks of contracting COVID-19 and those with chronic conditions have increased risk of adverse outcomes from infection. Social factors such as living conditions or barriers to care can increase both the risk of COVID-19 exposure and adverse outcomes. These factors often intersect and compound to amplify risk. For example, structural inequities affecting some racial and ethnic groups have resulted in over-representation in essential service jobs and higher risk of COVID-19 exposure, high rates of medical conditions that increase risk of adverse COVID-19 outcomes, and low access to medical care. Populations that face disproportionate risks (medical, social, or both) include ***older adults and people with chronic conditions; Black, Hispanic or Latinx people, American Indian/Alaska Native people, and Native Hawaiian or other Pacific Islander people; people who live in rural areas; people who are incarcerated, experiencing homelessness, or residing in long-term care facilities; and people with disabilities, people with low income, and people who are uninsured.***

Barriers to COVID-19 testing, COVID-19 vaccination, and routine vaccination. Populations at disproportionate risk of COVID-19 face multiple barriers to testing and vaccination related to awareness, confidence, and access. These barriers are rooted in historical and ongoing structural racism, economic inequality, and the inequitable allocation of social and health care resources.

- **Awareness and confidence barriers** include ***misinformation, low health literacy, digital divides, and language barriers*** (for example, lack of access to a computer or smartphone prevents people from being able to register online for testing or vaccination appointments) and ***distrust in the health care system***, often rooted in a legacy of exploitation in clinical research and lived experiences of discrimination in health care settings.
- **Access barriers** include ***geographic barriers***, such as for rural and farmworker communities where health care services are not readily available; ***transportation barriers*** and ***restrictive employment conditions*** that preclude some people from being able to reach testing and vaccination services or to take time off work to do so; and ***financial, health care, and legal barriers***, such as not being able to lose wages to attend an appointment, perceived costs of vaccine or testing, not having a government-issued identification card, or fear of deportation, among others.
- Pandemic-related disruptions—such as stay-at-home orders, social and economic effects on families, and delays in receipt of many routine health care services, among others—exacerbated other barriers, leading to missed or delayed routine vaccinations.

Strategies to overcome barriers to testing and vaccination. Programs worked to help populations at disproportionate risk overcome barriers to awareness of, confidence in, and access to testing and

³ Citations excluded from executive summary for brevity; see main body of report for all sources.

vaccination. This report organizes findings on the programs we identified in the environmental scan using a taxonomy of program elements that includes approaches (the primary mechanism or vehicle programs used to achieve intended outcomes) and strategies for delivering those approaches (the activities used to make the program approach effective). We organize findings on approaches and strategies according to their goals (whether they sought to improve awareness, confidence, access, uptake, or a combination). In practice, most program approaches and strategies were designed to help people overcome barriers to one or more goals.

COVID-19 testing programs

COVID-19 testing programs identified through the scan included primary approaches focused on increasing access. These included **mass clinics or events, testing in health care settings, community testing clinics, mobile testing clinics, and in-home testing**. Programs adopted a wide variety of strategies to enhance the effectiveness of these approaches.

- To increase awareness of, confidence in, and access to COVID-19 testing, programs often **partnered with community organizations and trusted community leaders** (such as faith leaders or school staff) or **engaged multilingual staff** to reduce barriers for those who did not speak English.
- Programs also worked to increase testing awareness and confidence by **using multiple communication methods**, such as using print materials, radio and TV ads, social media ads, and text messaging; sometimes **tailoring or translating messages** into other languages to raise awareness among specific populations. The programs **prioritized comfort, safety, and dignity** by doing things like erecting privacy screens and allowing people to collect their own samples.
- To increase access to testing, programs offered **expanded hours** and **offered walk-up options**, rather than limiting testing to those who made an appointment in advance. They also **addressed financial barriers, reduced documentation requirements, and enhanced registration and tracking** for those without internet access and those with low digital literacy. Some programs **paired testing with other services**, such as offering other health care services or providing concrete supports to address health-related social needs, like a hotel or food voucher.

Testing programs experienced resource limitations, logistical issues, and challenges with some partnerships. To address these challenges, programs **maximized scarce resources** by using volunteers or accepting donations from the government and partners, or by using the infrastructure of community partners, such as electricity, computers, and waiting areas. They also **implemented logistical efficiencies** to ease traffic and patient flow and **used communication tools** to streamline information sharing.

COVID-19 vaccination programs

Some COVID-19 vaccination program approaches identified through the scan mirrored testing program approaches focused on improving access, including **mass clinics or events, vaccination in health care settings, community vaccination clinics, mobile vaccination clinics, and even in-home vaccination** for homebound populations. Other COVID-19 vaccination programs focused on increasing awareness and confidence via **education events and outreach** rather than vaccine delivery. Like testing programs, COVID-19 vaccination programs used a range of strategies to enhance the effectiveness of their primary approaches.

- COVID-19 vaccination programs **partnered with trusted community groups, used multilingual staff, and coordinated with routine vaccination efforts** to expand access for specific populations and to increase confidence in the new vaccines.
- Programs also **developed culturally appropriate, translated messages; and used multiple dissemination channels** to expand the reach of their messages.
- Programs expanded access to the vaccines by **offering extended hours or walk-in appointments** to get vaccinated, while some provided COVID-19 vaccinations **without documentation requirements** like identification, insurance, or proof of residency. Others **helped with transportation services**.
- A few programs **offered financial incentives** to increase uptake of COVID-19 vaccinations and others **paired vaccinations with other services**, such as offering contact tracing and COVID-19 testing, other health care services, or food assistance.

Common implementation challenges for vaccination programs were **limited resources**, including funding, staffing to meet demand, vaccine supply, and storage capacity (like ultracold freezers); **information systems that could not exchange data** with state or county systems about who was or was not vaccinated; and **logistical challenges**, such as transporting vaccines in rural communities or lack of wireless connectivity. In addition to using strategies adopted as part of COVID-19 testing efforts (like using volunteers), **technical assistance** helped many groups by educating staff and volunteers on topics like how to address vaccine hesitancy as well as by connecting programs with community partners. **Flexible funding** and **vaccine donations** helped to alleviate some resource constraints. A few programs **conducted ongoing monitoring and quality improvement activities**, such as collecting data to monitor vaccine equity and using the data to develop proactive strategies to reach underserved groups.

Routine vaccination programs

The environmental scan found few programs focused on increasing routine vaccinations during the pandemic, although there is evidence that declining rates of routine vaccinations motivated some COVID-19 vaccination programs to focus on increasing routine vaccination uptake. Routine vaccination programs used similar approaches to COVID-19 testing and vaccination programs, including **vaccination in health care settings, community and mobile vaccination clinics, and vaccine education outreach**. Strategies to enhance the effectiveness of routine vaccination programs included **drawing on COVID-19 vaccination strategies, at times bundling routine vaccines with COVID-19 vaccines, engaging multilingual staff, forming community partnerships, using multiple channels to amplify messaging, and coordinating with other health services**.

Few routine vaccination programs reported implementation challenges, but some noted **challenges bundling routine and COVID-19 vaccinations** since routine vaccinations had different funding sources and thus required payment or insurance. Others noted **staffing challenges**, in some cases because staff were deployed to work on COVID-19 vaccination efforts or were overwhelmed by the pandemic. Some programs **invested resources in training on specific vaccines and best practices for vaccine delivery**, and others **implemented quality improvement and evaluation efforts or invested in data infrastructure**, which programs expect will have long-term benefits for routine vaccination delivery.

Programs' approaches to identifying populations and assessing effectiveness

Programs in this review used published research and quantitative and qualitative data, sometimes in combination, to identify populations of focus and tailor their services to communities in need. For example, *published literature and national COVID-19 surveillance reporting* helped programs describe COVID-19 inequities by race, ethnicity, age, or other social factors and motivate or emphasize the importance of serving specific populations. *Local surveillance data* helped programs determine intervention sites in communities facing greater levels of transmission, hospitalization, and death from COVID-19; similarly, *information on social vulnerability in specific neighborhoods* helped them allocate resources. Programs also used data on *COVID-19 testing and vaccination* rates to identify communities in need of more services. Qualitative sources included *surveys with community members, physician referrals, community working groups, and social media*, all of which helped programs illuminate contextual and community-specific needs that might be missed using quantitative data.

Testing and vaccination programs that assessed their effectiveness used *measures of the quantity and quality of their activities and services (program outputs)*. These measures included the reach of outreach and education efforts, number of clinics and events, number of appointments made or tests or vaccines ordered, number of tests or vaccine doses administered, number of people tested or vaccinated, geographic reach of services, and patient satisfaction. *Less commonly, programs assessed outcomes, or measures of changes among program participants*, such as changes in rates of COVID-19 testing and vaccination, changes in knowledge or attitudes about vaccination, and changes in routine vaccination rates, sometimes in relation to pre-pandemic rates.

III. Discussion

This environmental scan encompasses programs and policies focused on a variety of populations, operating at the local, state, and federal levels. Most other review or synthesis papers focus on only a single population group, or on either testing or vaccination. The breadth of our focus enables us to identify patterns in barriers to testing and vaccination services and cross-cutting themes in programs' approaches and strategies. These themes support a taxonomy of program activities that aids understanding of how programs work to overcome various barriers to testing and vaccination. The breadth of our focus also supports informed recommendations for future research.

Our findings suggest that many barriers—and programs' efforts to overcome them—are not unique to testing or vaccination, nor even to COVID-19. This is not surprising given that many barriers are rooted in historic and structural inequities. However, COVID-19 added complexity to existing barriers. For example, policies such as stay-at-home orders and early limits on vaccine eligibility inhibited both testing and vaccination for populations bearing the brunt of longstanding social inequities. Fears of missing work and losing income with positive test results inhibited testing for people with low-wage jobs.

Efforts to bring services closer to people were common across programs, as were partnership strategies and strategies for increasing trust. Many of the strategies leveraged community assets, such as partnerships, trusted leaders, systems and infrastructure. Although these strategies are used in other public health interventions, the COVID-19 pandemic also drove some innovations, such as a broader range of partnerships and financial and other supports for people testing positive.

The programs in this review helped people navigate barriers but did not address their root causes. For example, offering extended hours does not address the labor conditions that prevent essential workers from taking time off to get a test or vaccine. However, fixing structural issues is out of the scope and reach of most testing and vaccination programs. Federal policies, though, such as the free testing and vaccination and stimulus payments authorized by the CARES Act, could help to ameliorate structural inequities if they were extended and expanded.

Most programs in our review assessed their performance using outputs, or measures of the quantity and quality of their services, rather than outcomes or community feedback. Focusing on outputs alone, such as the number of people programs reach or the number of services they deliver, might not reveal the effectiveness of program approaches. However, a few programs used comparative outcome data, such as testing rates resulting from different program approaches, vaccination status compared to a baseline or control group, or vaccination and testing rates for different demographic groups. Other than a few programs that used satisfaction surveys, programs we reviewed did not report efforts to solicit community feedback. How communities perceive testing and vaccination programs should matter a great deal for any efforts to serve communities that are medically or socially at disproportionate risk of COVID-19 or related adverse outcomes.

IV. Implications for study design

The goal of this ASPE/OASH project is to disseminate findings on promising practices for closing gaps in COVID-19 testing and vaccination and routine vaccinations and for reducing inequities in testing and vaccination in future pandemics. Ultimately, learnings from this project might help inform policymakers' efforts to mitigate the human and societal devastation of large-scale infectious disease outbreaks and the disproportionate impacts on those most at risk.

This environmental scan is only a first step in developing findings that will be useful to the field and to funders. Our findings point to the need for additional research on several topics, including how federal, state, and tribal context matter for programs, implementation challenges and strategies, which strategies programs view as effective, and how programs gauge community views of what works well, if at all. The project team will use this environmental scan's findings and unanswered questions to shape a national survey of local organizations and site visits to states and tribal organizations, and the programs working within them. Guided by an expert panel of federal and nonfederal experts in COVID-19 testing and vaccination, the project will use these data sources and a theoretical framework to identify promising practices for reducing testing and vaccine inequities that will maximize learnings from the COVID-19 pandemic and response.

V. Implications for future pandemics and public health crises

The findings in this report focus on approaches and strategies to help people overcome barriers to COVID-19 testing, COVID-19 vaccination, and routine vaccination, but the findings are broadly applicable to future pandemics and public health emergencies. In fact, many findings in this report are also relevant to routine care and efforts to overcome persistent inequities in health and wellbeing. Most barriers to COVID-19 testing and vaccination and routine vaccination predated the pandemic, resulting from longstanding inequities in social conditions that drive observable differences in access and health service use. However, the COVID-19 pandemic added complexity to these barriers and to efforts to

overcome them; the same will likely be true of future pandemics. Policymakers and practitioners at federal, state, tribal, and local levels should therefore consider how strategies identified in this report, such as working with trusted community partners to bring health services directly to places where people already congregate, can help to advance health equity in the near term. The findings in this report also suggest that policymakers and practitioners can prepare for future public health threats on two fronts: both by strengthening underlying community infrastructure, partnerships, and resilience, and by developing strategies and funding mechanisms specifically focused on overcoming barriers to public health services that might be exacerbated in a crisis.

I. Introduction

A. Motivation for the study and statement of the problem

The COVID-19 pandemic has exacerbated longstanding health inequities (Simmons et al. 2021). Historically marginalized, systematically under-resourced, and medically underserved U.S. communities have disproportionately experienced more COVID-19-related infections, hospitalizations, and deaths, compounded by limited access to vaccines and other effective mitigation strategies (Khanijahani et al. 2021; Smith et al. 2021; Romano et al. 2021; Webb-Hooper et al. 2020; Islam et al. 2021; Nayak et al. 2020). The evolving nature of COVID-19 guidance and the inconsistent approach to testing and vaccination across jurisdictions in the U.S. delayed shared learnings and rapid implementation of effective strategies for all communities (DeSalvo et al. 2021). Contextual factors such as social and cultural beliefs and norms presented additional challenges to COVID-19 testing and vaccine uptake in many communities once tests and vaccines were available (Reitsma et al. 2021; Nguyen et al. 2022). Further, rates of routine child and adult vaccinations fell during the pandemic in these already hard-hit communities, hampering efforts to eliminate existing inequities in routine vaccination coverage (CDC 2023b; Jain et al. 2022; Skolnik et al. 2021).

COVID-19 not only exacerbated longstanding inequities, but also exposed the structural factors underlying them (Isasi et al. 2021). Structural racism—defined as public and private policies, norms, and cultural representations that lead to unequal freedom, opportunity, value, resources, advantage, restrictions, constraints or disadvantage for individuals and populations according to their race or ethnicity (Braveman et al. 2022)—upholds racial inequities in political, legal, economic, health care, education, and criminal justice systems (Braveman et al. 2022; Feagan and Ducey 2018). As a result, structural and social conditions—including residential segregation, the inequitable allocation of social and health resources, concentrated poverty, over-representation in low-wage jobs and in the prison systems, and higher levels of chronic stress—cluster together to create higher barriers to health and wellness for Black, Latinx, Indigenous, and other communities of color (Egede and Walker 2020; Pirtle 2020). Moreover, historical exploitation and abuse by medical and research entities including the federal government (for example, the Tuskegee Syphilis Study) and present-day lived experiences of racial discrimination in health care settings have led to distrust in the medical establishment, eroding confidence in COVID-19 testing and vaccination (AuYoung et al. 2022; Neely et al. 2021; Willis et al. 2023).

The U.S. Department of Health and Human Services (HHS) responded by making significant investments in COVID-19 programs that prioritize health equity, such as the Administration for Strategic Preparedness

and Response’s investments in home testing, the National Institutes of Health’s Rapid Acceleration of Diagnostics–Underserved Populations (RADx-UP) initiative, and the Centers for Disease Control and Prevention’s Partnering for Vaccine Equity program. These programs have already generated evidence to develop new approaches to improve vaccine access and confidence for specific communities.

Recognizing the need for additional evidence to support federal, state, and local efforts to close testing and vaccination gaps—and to identify useful lessons for future pandemics—the Office of the Assistant Secretary for Planning and Evaluation (ASPE) and the Office of the Assistant Secretary for Health (OASH) sponsored a mixed-methods study of best practices in COVID-19 testing and vaccination and routine vaccination for people who are medically or socially at disproportionate risk for COVID-19 or related adverse outcomes (Best Practices for COVID-19 Testing and Vaccination study). The goals of the study are to identify and examine promising and best practices to (1) increase COVID-19 testing awareness, access, and uptake; (2) increase confidence in, access to, and uptake of COVID-19 vaccines; and (3) improve confidence in, access to, and uptake of routinely recommended vaccines for children and adults during the COVID-19 pandemic. Mathematica is ASPE’s research partner for the Best Practices for COVID-19 Testing and Vaccination study and developed this report based on a targeted environmental scan of testing and vaccination programs serving populations facing disproportionate risks. Although the COVID-19 Public Health Emergency ended on May 11, 2023, the COVID-19 virus continues to cause illness, hospitalization, death, and disability (Schnirring 2023). Moreover, experts agree that another pandemic is possible, and even likely (Linder et al. 2023). Thus, findings from this study can support ongoing efforts to combat COVID-19 as well as efforts to prepare for future pandemics.

B. Purpose of the environmental scan

The environmental scan is an important first step to understand the range of programs intended to improve COVID-19 testing, COVID-19 vaccination, and routine vaccinations for the populations of focus for the study. Findings in this report will inform the design of other components of the study, including a national survey of local organizations that have implemented testing and vaccination programs and site visits to selected organizations. The study team used research questions in the following three topic areas to guide the environmental scan.

Contextual factors for programs. The environmental scan included a review of federal regulations and guidelines that provide context for programs designed to increase COVID-19 testing and vaccination among people who are medically or socially at disproportionate risk for COVID-19 or related adverse outcomes. We also looked for information about how programs have used resources (such as funding,

Federal agencies provided resources to increase COVID-19 testing and vaccination

- Federal agencies—including the U.S. Department of Health and Human Services, Department of Agriculture, Department of Homeland Security, and Housing and Urban Development—funded testing and vaccination programs in amounts ranging from \$15 million to \$5 billion.
- Recipients included state, tribal, and local governments, health centers, and community organizations.
- Some federal funding focused on increasing equitable access to tests and vaccines. Federal agencies also supplied COVID-19 tests and vaccines and established testing sites (CDC 2023g; HRSA 2022c; ASPR 2022).

staffing, and supplies) provided by local, state, or federal jurisdictions to increase COVID-19 testing and vaccination.

COVID-19 testing and vaccination program implementation and evaluation. A primary purpose of the environmental scan was to review information about how programs increased COVID-19 testing and vaccination in intended populations. Although the study initially developed research questions about slightly different outcomes or goals for COVID-19 testing and vaccination and routine vaccination—specifically, naming increased awareness as one goal of testing programs versus increased confidence for vaccination programs—the scan found that programs sought to increase both awareness and confidence for both testing and vaccinations, as well as to increase access. We also reviewed how programs identified their intended populations, how they evaluated their programs (for example, by measuring changes in uptake or use of testing and vaccines), and what data sources they considered for these tasks.

Routine vaccination. The environmental scan included a review of strategies that programs have used to ensure that children and adults were up to date on routine vaccinations during the pandemic, and how or if they addressed inequities in routine vaccination access and uptake.

C. Summary of methods

To inform this report, we conducted a targeted literature review of materials published from 2020 through January 2023,⁴ printed in English, and focused on the United States, and we interviewed key informants. See [Appendix A](#) for more detail on sources and methods.

Literature on testing and vaccination guidelines. We identified background information on COVID-19 testing, vaccination, and disparities and on routine vaccination through focused Google searches. We also searched relevant federal agency websites, such as Centers for Disease Control and Prevention (CDC), Food and Drug Administration (FDA), and Association of Public Health Laboratories (APHL).

Literature on policies and programs. We reviewed peer-reviewed and gray literature on programs focusing on COVID-19 testing and COVID-19 vaccination and routine vaccination during the pandemic. We created specialized search strings that included key words such as “program,” “initiative,” “campaign,” “model,” “intervention,” “policy,” or “strategy,” combined with terms related to the population of focus (people who are medically or socially at disproportionate risk of COVID-19 or related adverse outcomes). We searched the PubMed, CINAHL, SOCIndex, and Health Policy Reference Center bibliographic databases and Google using search strings for each program focus (COVID-19 testing, COVID-19 vaccination, and routine vaccination). For our Google search, we reviewed search results for each of these three program foci until we approached saturation indicated by duplicate links. This yielded roughly 40 results for each program focus. We also reviewed an inventory of federal programs related to COVID-19 testing, COVID-19 vaccinations, and routine vaccinations that ASPE provided.

Key informant interviews. We conducted 22 one-hour interviews with respondents implementing or funding COVID-19 testing and vaccination and/or routine vaccination programs. Respondents were representatives of health care organizations, local and state health departments, community-based organizations, academic institutions, foundations, and federal agencies. We identified key informants

⁴ However, information on COVID-19 vaccination guidelines in Section IV and on routine vaccination guidelines in Section V is current as of April 2023.

through recommendations from the project’s expert panel members and internet searches. We sought variation in organization type, geographic location, and population(s) of focus. We conducted all interviews virtually in February and March 2023, using interview guides tailored for key informants’ organization type. See [Appendix B](#) for more information on key informants and interview topics.

Analysis. We extracted information on specific programs from articles, websites, and our interview notes in an Excel-based tool. We used thematic inductive coding to identify themes within a taxonomy of program elements, including in program approaches, delivery strategies, implementation barriers, and implementation strategies (see Exhibit I.1).

Limitations. The environmental scan was purposive and targeted, rather than systematic. The findings in this report are not based on an exhaustive search of all relevant programs. They also privilege those programs that were able to publish findings—such as programs administered by universities and funded by federal grants—as well as those able to publish by January 2023. Some reports may be in progress and have not yet been published. Thus, findings do not represent all relevant programs or promising practices, and it is possible that our taxonomy of program elements organized by the goals of increasing awareness, confidence, access, and uptake would change with more (and more updated) data. In addition, sources may exclude programs for, or findings about, some groups of people at disproportionate risk of COVID-19 or related adverse outcomes, for example because they are small and excluded from the data sources that would help programs identify and serve them. We purposely limited the search of routine vaccination programs to those focused on halting the declining rates during the COVID-19 pandemic, but this limited our findings on general promising practices for encouraging routine vaccinations. We also acknowledge the inherent selection bias in limiting the search to materials printed in English. Finally, although understanding barriers to program implementation was a goal of the environmental scan, relatively few sources discussed this topic.

D. Key concepts and definitions

We define and provide examples of concepts central to the environmental scan in this section and in Exhibit I.1. We also explain how we use certain terms to describe findings. See [Appendix C](#) for a glossary with additional terms.

Use of the term “program.” For parsimony, we use program throughout the report to refer to any organized, planned, and ongoing change effort. Sources sometimes used different terms interchangeably, such as intervention and program, or described efforts labeled as programs, projects, or models in similar ways. We searched for a broad list of terms to ensure that we reviewed relevant practices, regardless of word choices in the sources we reviewed. We use specific terms such as “campaign” to describe our findings where such a term adds meaning or clarity. Policies can include guidelines, rules, regulations, laws, procedures, principles, or directions. Like programs, policies can also constitute interventions to reduce COVID-19 testing and vaccination and routine vaccination disparities. In this report, we focus on federal policies—primarily testing and vaccination guidelines, but also key federal legislation—that provide context for program-related findings. State-level policies varied widely. Although the sources we reviewed did not include in-depth descriptions of individual state policies, possibly because states are less likely to publish descriptions of their efforts, the Kaiser Family Foundation (2021) and Williams and others (2023) provide helpful syntheses.

Information on levels and actors. The sources we reviewed included programs at the local (neighborhood, city, county), state (or region of a state), multi-state, and national levels. Programs in our review often involved partnerships among funders, administrators, and implementers operating at different levels. For example, a program might have been funded at the federal level, administered by a state or county health department, and implemented by community-based organizations. The primary administrator or implementer was not always clear in the sources we reviewed. Many of the entities administering programs in this environmental scan were universities, possibly because of universities’ relatively greater ability to publish findings about programs they were involved in. Where possible, we include information on the level or location and entities administering the programs in our discussion of findings.

Terms for program elements and outcomes. Although other resources on COVID-19 testing and vaccination use different terms for program elements or group them differently, for example by describing all COVID-19 vaccination program elements as “strategies” (CDC 2022i), organizing findings according to the taxonomy in Exhibit I.1 allows for more precision in understanding program activities and promising practices for addressing testing and vaccine inequities. We used these concepts to organize findings about program delivery, implementation, and evaluation. Specifically, we categorized programs’ primary approaches and the strategies they use to enhance the effectiveness of their primary approaches. We organized findings on approaches and strategies according to whether they sought to increase testing and vaccination awareness, confidence, access, or uptake. For the most part, those efforts helped people overcome barriers to awareness, confidence, and access). Most programs in our review directly sought to increase awareness, confidence, or access; increased uptake is the desired result. However, a few programs used strategies that directly affected uptake, such as financial incentives.

Exhibit I.1. Key concepts, definitions, and examples

Concept	Definition	Examples
Policy	<ul style="list-style-type: none"> A law, regulation, procedure, administrative action, incentive, or voluntary practice of governments and other institutions intended to influence systems development, organizational change, and individual behavior to promote improvements in health 	<ul style="list-style-type: none"> American Rescue Plan Act of 2021 Public Readiness and Emergency Preparedness (PREP) Act Funding policy and guidance, for example in notices of funding opportunities from the Health Resources and Services Administration (HRSA) and the Centers for Disease Control and Prevention (CDC)
Guideline	<ul style="list-style-type: none"> A specific type of policy; a set of recommendations related to a particular topic provided by an agency and directed to states, public health practitioners, or individuals 	<ul style="list-style-type: none"> Centers for Disease Control and Prevention (CDC)’s evidence-based guidelines, such as: CDC guidelines for COVID-19 testing CDC vaccination schedules for health care providers
Program	<ul style="list-style-type: none"> An organized, planned, and ongoing change effort, at the local, state, multi-state, or national level. A program may include multiple approaches. We use the term “program” to encompass a broad set of terms used by sources, such as intervention, project, model, or campaign. 	<ul style="list-style-type: none"> Say Yes! Covid Test (National Institutes of Health) One Vax Two Lives (University of Washington) Catch Up to Get Ahead (U.S. Department of Health and Human Services)
Program focus	<ul style="list-style-type: none"> The type of program or primary topic of a program, based on the three overarching study objectives 	<ul style="list-style-type: none"> COVID-19 testing COVID-19 vaccination Routine vaccination

Concept	Definition	Examples
Program approach	<ul style="list-style-type: none"> The primary mechanism(s) or vehicle(s) programs used to achieve intended COVID-19 testing, COVID-19 vaccination, and routine vaccination outcomes 	<ul style="list-style-type: none"> Mass testing/vaccination clinics Testing/vaccination in health care settings Community testing/vaccination clinics Mobile testing/vaccination clinics In-home testing/vaccination Vaccine education events or outreach
Strategies to facilitate delivery of program approaches	<ul style="list-style-type: none"> Strategies or activities designed to make the program approach effective, focusing on the needs of program participants. Specific delivery strategies can be used across multiple approaches to further enhance their effectiveness. 	<ul style="list-style-type: none"> Partner with trusted community organizations and leaders to deliver messaging and interventions Develop clear, accessible, and culturally tailored messaging, delivered through multiple channels Provide walk-up options and expanded hours to increase access Remove need for physician referral, health insurance, or other documentation
Strategies to facilitate implementation of program approaches	<ul style="list-style-type: none"> Activities designed to facilitate implementation of program approaches, focusing on program personnel and administration 	<ul style="list-style-type: none"> Ensure staff have adequate training and supplies Hold planning meetings between partnering organizations
Program outputs	<ul style="list-style-type: none"> Proximate measures of the program's performance, including the quantity and quality of service delivery 	<ul style="list-style-type: none"> Number of testing or vaccination events Program reach, such as the number of people reached through outreach and education Number of COVID-19 tests administered Number of COVID-19 vaccines delivered Number of influenza vaccines delivered
Program outcomes	<ul style="list-style-type: none"> Measures of changes among program recipients and program effects on intended populations 	<ul style="list-style-type: none"> Changes in testing and vaccine confidence and awareness Changes in rates of testing and vaccination Changes in COVID-19 incidence and deaths

E. Organization of the report

The report is organized as follows. Section II reviews populations at disproportionate risk for COVID-19 or adverse outcomes, common barriers to testing and vaccination services experienced by these populations, and populations prioritized by the programs we reviewed. The next three sections review findings on COVID-19 testing (Section III), COVID-19 vaccination (Section IV), and routine vaccination (Section V). Each section begins with information on relevant federal guidelines and changes in those guidelines over time. We then describe programs' primary approaches, delivery strategies, implementation challenges, and implementation strategies.⁵ In Section VI, we provide an overview of data sources that are used, or can be used, to identify communities in need of COVID-19 testing, COVID-19

⁵ At the time of this reporting, programs were at various stages of implementation. Some programs were completed, others ongoing, and others had not yet begun. For readability, we use the past tense throughout, except in Section II, where we describe (1) populations that are medically or socially at disproportionate risk of COVID-19 or related adverse outcomes or (2) barriers to COVID-19 testing and vaccination and routine vaccination services. Many risks and barriers are ongoing.

vaccination, and routine vaccination services and to measure the outcomes of programs' efforts. We conclude by summarizing broad themes and implications for future work to address social inequities in COVID-19 testing and vaccination, in routine vaccinations, and in responses to the next pandemic.

II. Populations of focus for COVID-19 testing and vaccination and routine vaccination programs

In this section, we first summarize the evidence on populations that are medically or socially at disproportionate risk of COVID-19 or related adverse outcomes. This definition of the population of focus for the environmental scan encompasses groups with medical conditions that increase their risk of infection and adverse outcomes, groups facing greater risk of COVID-19 infection because of where they live and work where they live and work, and groups facing barriers to health services. Drawing on equity concepts, we then review barriers to COVID-19 testing and vaccination awareness, confidence, access, and uptake. Finally, we provide a high-level summary of how programs sought to address these barriers and how they have defined and prioritized communities facing barriers.

A. Summary of populations at disproportionate risk of COVID-19 and adverse outcomes

People and communities may experience disproportionate risk of COVID-19 due to medical factors, social factors, or both (Au Young et al. 2022; CDC 2020e, 2022a, 2022h). People who are immunocompromised face higher risks of contracting COVID-19 and those with chronic conditions have increased risk of adverse outcomes from infection. Social factors such as living conditions or barriers to care can increase both the risk of COVID-19 exposure and adverse outcomes. These factors often intersect and compound to amplify risk. For example, structural inequities affecting some racial and ethnic groups have resulted in overrepresentation in essential service jobs and higher risk of COVID-19 exposure, high rates of medical conditions that increase risk of adverse COVID-19 outcomes, and low access to medical care.

Below we summarize the disproportionate impacts of COVID-19 exposure, hospitalization, and death on various communities, including older adults, people with comorbidities, specific racial and ethnic groups, people in rural areas, people who are incarcerated, people experiencing homelessness, people residing in long-term care facilities, people with disabilities, and people who are uninsured. We further describe the inequities and barriers contributing to greater risk of COVID-19 and adverse outcomes for these groups in Section 11.B.

Older adults and people with multiple conditions are at highest risk of hospitalization and death from COVID-19. Adults ages 65 and older have had the highest rates of death from COVID-19 throughout the pandemic. Those ages 85 and older have had especially high mortality: in April 2023, the COVID-19 death rate for adults over 85 was 350 times higher than for people ages 18–29 and, as of September 2022, adults over 85 made up about 40 percent of deaths in the U.S. from COVID-19 (CDC 2023d, 2022h). Having medical conditions such as asthma, cancer, HIV, chronic liver or lung diseases, or diabetes increases the risk of death and complications from COVID-19 (CDC 2023f). As people age, their risk of some chronic conditions increases, compounding their risk of adverse outcomes. People with substance use disorder also have a higher prevalence of chronic conditions, such as kidney, liver, and lung diseases, and hence a higher risk of death and hospitalization from COVID-19 (Wang et al. 2021; Baillargeon et al. 2021).

Multiple racial and ethnic groups including Black, Hispanic or Latinx, American Indian/Alaska Native people, and Native Hawaiian or other Pacific Islanders have experienced higher age-adjusted rates of

COVID-19 cases and deaths than non-Hispanic white people. Disparities in COVID-19 cases and mortality by race and ethnicity have changed at different points in the pandemic, generally widening as the virus surged (Ndugga et al. 2022). In 2021, Pacific Islanders, Hispanic or Latinx people, Black people, and American Indian/Alaska Native people had death rates that were double those of non-Hispanic white and Asian Americans (CDC 2021f). Black and Hispanic people had the highest mortality rates during the first few months of the pandemic, but for most of the pandemic, American Indian or Alaska Native people have experienced the highest mortality rates (CDC 2022h). Some gaps in testing and vaccination narrowed over time, particularly as vaccination and testing programs focused on reducing inequities and increasing vaccine confidence (Rubin-Miller et al. 2020; Anderson et al. 2021; Kriss et al. 2022; CDC 2021e). For example, disparities in rates of vaccination between Black and non-Hispanic white populations have narrowed from a 14-percentage point difference in April 2021 to a difference of 8 points in November 2021 (Burki 2021; Kriss et al. 2022). As of July 2021, vaccination rates among American Indian and Alaska Native people changed from being among the lowest by race and ethnicity to the highest (Kriss et al. 2022; Bennett 2021). Disparities in death rates by race and ethnicity have also decreased over time but still persist (CDC 2022h).

People in rural areas have faced higher risk for COVID-19 infection and death in the later phases of the pandemic. Initially, in early 2020, COVID-19 infections were highest in urban areas. However, in late 2020 rural areas began to experience higher rates of infection and death, and the urban–rural disparity in COVID-19 morbidity and mortality has increased throughout the pandemic (Cuadros et al. 2021; Saelee et al. 2022). Testing and vaccination barriers such as provider shortages, distance to test or vaccination sites, and lower levels of vaccine confidence among rural populations compared to urban populations have contributed to these disparities (Saelee et al. 2022; Tan et al. 2020).

COVID-19 death rates are also higher for people who are incarcerated, are experiencing homelessness, or reside in a long-term care facility. In addition to geographic location, living situations also put people at increased risk for COVID-19. For example, in 2020, people who were incarcerated had infection rates 5.5 times higher than the general population and death rates that were three times higher (Saloner et al. 2020). While these disparities began to decline in early 2021, cumulative COVID-19 case and mortality rates are substantially higher among the incarcerated population compared to the general population (Marquez et al., 2021b). People experiencing homelessness often reside in congregate settings, such as encampments and shelters, and have less access to prevention measures and health care. One 2021 study found that the COVID-19 mortality rate was 1.3 times higher for people experiencing homelessness than the general population (Leifheit et al. 2021). Residents in long-term care facilities, while less likely to be infected with COVID-19, had high mortality rates, particularly before the COVID-19 vaccination was available. In March 2021, about 8 percent of people in long-term care facilities had died of COVID-19 (The Covid Tracking Project 2021). However, after the introduction of the vaccine, mortality rates dropped steeply in most states (Chidambaram et al. 2021).

People with disabilities and people who are uninsured also have experienced increased risk for COVID-19 and adverse outcomes. For example, a 2022 study demonstrated that people with a physical or intellectual disability are less likely to be vaccinated than those without a disability, despite having more vaccine confidence (Ryerson et al. 2022). While research on the impact of COVID-19 for people with disabilities is limited (Lebrasseur et al. 2021), research demonstrates that individuals with intellectual disabilities are at increased risk of death (Gleason et al. 2021). One 2020 study cited mortality rates eight

times higher than the general population (Landes et al. 2020). People who are uninsured are also at increased risk of adverse outcomes from COVID-19, despite having access to free testing and vaccination. For example, fear of co-pays and costs of treatment after receiving a positive test, contributes to delayed care and higher rates of COVID-19 hospitalization and mortality (Wafsy 2023; Gaffney et al. 2022; Miller et al. 2021). In addition, while federal legislation requires insurers to cover the costs of COVID-19 tests and provided funding for free tests for uninsured people, some providers nevertheless charge patients for tests, contributing to confusion and concerns around costs (Gaffney et al. 2022).

B. Barriers to COVID-19 testing, COVID-19 vaccination, and routine vaccination

Multiple health equity frameworks recognize that inequities in structures, policies, and systems influence environments, living conditions, resources, and service delivery, posing barriers to health (Hacker et al. 2022; WHO 2010; O’Neil and Wesley 2021). These structural and social inequities cause barriers to COVID-19 testing and vaccination and routine vaccination services through several causal pathways, affecting confidence in and awareness of testing and vaccination services, access to those services, and ultimately use of testing and vaccines. Although other sources categorize barriers to COVID-19 vaccination in different ways—such as structural, behavioral, and informational barriers (CDC 2021), or structural and attitude-related barriers (Gonzalez et al. 2021)—we organize findings on barriers according to our research questions, focusing on awareness, confidence, and access, which drive testing and vaccination uptake. We discuss additional barriers to routine vaccinations during the pandemic in Section V.

1. Barriers to awareness and confidence

Misinformation, low health literacy, digital divides, and language barriers limited awareness about testing and vaccination guidelines and available resources. Misinformation and limited information about current guidelines and available vaccination and testing resources dissuade people from seeking testing (Alcendor et al. 2021; Corneli et al. 2022; Hernandez et al. 2021). For example, one testing program serving a low-income, majority Hispanic community in Northern California described a common misconception that people needed to be symptomatic to be tested or that testing was not necessary post-vaccination (Chamie et al. 2022). Low health literacy and digital divides made it difficult for some people to research available resources and register online for vaccination and testing appointments (Hansotte et al. 2021; Abdul-Mutakabbir et al. 2021; Public Health—Seattle and King County 2021). Many programs also noted language as a critical barrier to engaging with testing and vaccination resources, particularly among Latinx communities (Bigelow et al. 2021; Degarmo et al. 2022); one article we reviewed also noted language as a barrier for the San Carlos Apache Tribe accessing vaccination information (Le-Morawa et al. 2022).

Distrust in the health care system diminished confidence in COVID-19 testing and vaccination. Communities of color, Indigenous communities, immigrants, people with disabilities, and people with low levels of income and education have faced exploitation and discrimination within the U.S. health care system (AuYoung et al. 2022; Jaklevic et al. 2021). Given this legacy, some members of these communities have had lower levels of confidence in health care providers and health care organizations and were therefore hesitant to engage with testing and vaccination programs (Alcendor et al. 2022b; Boyd et al. 2022; Evans et al. 2021; CDC 2020e; DeGarmo et al. 2022; Neely et al. 2021). For example, in describing their intervention to improve the COVID-19 testing experience and build trust among those living in

congregate settings—many of whom were people of color—Neely and colleagues (2021) emphasized how the present-day trauma of the COVID-19 pandemic for these communities compounded the historical trauma of medical racism (for example, in the Tuskegee Syphilis study), necessitating trauma-informed approaches to service delivery.

2. Barriers to access

Structural inequities in the allocation of health care resources resulted in geographic barriers to testing and vaccination services. For example, rural communities (McCollum et al. 2022; Kepka et al. 2021; CDC 2020e), tribal communities (Le-Morawa et al. 2022; Sears et al. 2023), and farmworker communities (UC Davis Health 2020) have been underserved by health care resources. Within urban areas, inequities in the spatial distribution of resources have resulted in health care “deserts” for lower-income communities and communities of color (Alcendor et al. 2022a; Neely et al. 2021; Servick 2020). An analysis of travel time to COVID-19 testing sites found that testing sites were more likely to be located at a farther travel distance from rural communities and communities with a higher percentage of racial and ethnic minorities and people who are uninsured (CDC 2020e).

Lack of reliable transportation and employment conditions are social determinants of health that compounded geographic access problems. For people who do not own vehicles, transportation poses a critical barrier to accessing vaccination and testing services, especially when those services are far away (AuYoung et al. 2022; Ella 2020; Hansotte et al. 2021; Kaiser Family Foundation 2021; Bigelow et al. 2021; Marquez et al. 2021a). Likewise, restrictive work schedules for essential workers and low-wage workers made it difficult to miss work for COVID-19 testing or vaccination appointments (Abdul-Mutakabbir et al. 2022; Jaklevic et al. 2021; Chamie et al. 2022).

Financial, health care, and legal concerns created barriers to testing and vaccination services. For people with low income (Gupta et al. 2022; Relias Media 2021; Hernandez et al. 2021) or who are uninsured (Barry et al. 2020; Budhwani et al. 2023), accessing testing and vaccination services may be financially out of reach. Out-of-pocket costs, lost wages for appointments or a positive test result, or a combination of these factors can impede access (Chamie et al. 2022; Gupta et al. 2022; Rockefeller Foundation 2022; Servick 2020). Moreover, those without a primary care provider may struggle to access testing and vaccination services without a physician referral (Degarmo et al. 2022; Jaklevic et al. 2021). People who are undocumented may face additional barriers to vaccination and testing, including not having a government-issued identification card or fear of deportation (Bigelow et al. 2021, 2022; Hernandez et al. 2021; Winterbauer et al. 2021; Buro et al. 2022; Demeke et al. 2022a; Demeke et al. 2022b). Despite federal legislation and guidance requiring free testing and vaccination with minimal documentation, identification, and referral requirements, people may still be confused by or unaware of these policies (Demeke et al. 2022a; Demeke et al. 2022b).

C. Populations prioritized by programs reviewed in this environmental scan

Programs included in the environmental scan and key informant interviews worked to deliver services to populations that were at disproportionate risk for COVID-19 or adverse outcomes based on the social and medical factors described in Section II.A and those facing barriers to testing and vaccination access, confidence, and awareness, described in Section II.B. The communities served by the programs we reviewed aligned closely with CDC’s guidance for prioritizing the selection of communities for vaccination

interventions (CDC 2021f). In Section VI, we provide details on the data and information that programs used to identify priority populations.

Communities and people with lower access to health care resources were the broad focus of most programs, which aimed to directly deliver interventions to communities. At the community level, many programs worked to deliver testing and vaccination services in rural areas (Appa et al. 2021; Beste et al. 2021; Centene Corporation 2020; Dumproff et al. 2022; Molling et al. 2020) or urban neighborhoods with gaps in health care resources (AuYoung et al. 2022; Gupta et al. 2022; Jaklevic et al. 2021; Baker et al. 2021). At the individual level, many programs sought to provide testing and vaccination services to people who did not have health insurance (Barry et al. 2020; Gillwald et al. 2022; Winterbauer et al. 2021).

People deemed high-risk for COVID-19 due to specific conditions or illnesses were the focus of some programs. This included those living with HIV, people with substance use disorders, frail or older persons, pregnant persons, and those living with chronic disease (Harvard T.H. Chan School of Public Health 2020; Kim et al. 2021; Marcell et al. 2022; Washington et al. 2022; Whanger et al. 2022; Winterbauer et al. 2021).

Communities of color, such as Black, Hispanic or Latinx, and Indigenous communities impacted by the effects of structural racism were the priority for many programs. For example, the Black Doctors COVID-19 Consortium, in partnership with the Philadelphia Department of Public Health, offered church-based and mobile testing to Black residents in Philadelphia, Pennsylvania (Jaklevic et al. 2021). In a program run by the Indian Health Service, pharmacists delivered vaccination services to Indigenous communities living on Indian reservations in Oklahoma, Minnesota, Wisconsin, Michigan, Arizona, and Illinois (Gregory et al. 2021). The Clínica Esperanza/Hope Clinic hosted community testing events for Hispanic/Latino communities in Providence, Rhode Island (Barry et al. 2020). Many programs serving communities of color noted distrust of the health care system due to historical and ongoing discrimination as a barrier to intervention uptake (Evans et al. 2021; CDC 2020e; DeGarmo et al. 2022; Neely et al. 2021).

People in specific occupational or residential settings with increased levels of COVID-19 transmission were the focus of some programs. For example, a California program planned to deploy vans to deliver testing to farmworkers and their families (UC Davis Health 2020). Many farmworkers did not have access to personal protective equipment and could not stay six feet apart due to the nature of their work. A similar vaccination campaign sent vans to rural areas across three states to deliver vaccination services (Relias Media 2021). Other programs set up temporary clinics in congregate settings to serve those living and working there, including homeless shelters (Berner et al. 2022), public housing (Alcendor et al. 2022a), detention centers (Chidavaenzi et al. 2022), and nursing homes (Alcendor et al. 2022a), among other spaces (Neely et al. 2021).

Populations served by these programs are not mutually exclusive. Because of structural racism, people who are Black, Indigenous, Latinx, and from other communities of color are more likely to be essential workers, incarcerated, experiencing homelessness, or living with a chronic health condition (AuYoung et al. 2022; Boyd and Buchwald 2022; Hernandez et al. 2021; National Governors Association 2020; Servick 2020). Social and health resources are also less likely to be allocated to these communities (AuYoung et al. 2022). Many programs recognized these compounding risk factors, leading them to define their populations of focus at the intersections of race and ethnicity and poverty (Chamie et al. 2022; Baker et al. 2021) or occupation (NYU Silver School of Social Work 2022; Feifer et al. 2021).

III. Key findings on COVID-19 testing

This section first presents background on COVID-19 testing, including the testing methods and types of tests currently available and the latest COVID-19 testing guidelines (Section III.A), and how testing guidelines have changed over time as the COVID-19 pandemic and response efforts evolved (Section III.B). Section III.C presents common approaches and strategies used to deliver COVID-19 testing services, challenges programs faced in implementing testing programs, and strategies programs used to overcome those challenges.

A. COVID-19 testing methods, types of tests, and reporting of test data

Diagnostic, screening, and surveillance testing are the three main COVID-19 testing methods. Diagnostic testing identifies a current COVID-19 infection for individuals, particularly for people who have symptoms or were recently exposed. Screening testing identifies infections among groups who may be at higher risk for COVID-19 and are performed regardless of symptoms or exposure. Surveillance testing focuses on ongoing monitoring and collection of de-identified testing data to look for outbreaks of COVID-19 at a population level (FDA n.d.a; CDC 2022k; APHL n.d.).

Molecular and antigen COVID-19 tests are used for diagnosis, screening, and surveillance. Other tests, including antibody tests, are used primarily for surveillance. As described further in Section III.B, types of tests and testing strategies evolved with the introduction of new technology, availability of tests, and organizational capacity for testing.

- **Molecular tests** detect ribonucleic acid (RNA), a genetic material from the SARS-CoV-2 virus that causes COVID-19 (APHL n.d.). These tests include polymerase chain reaction (PCR) tests and other nucleic acid amplification tests and are generally performed in a laboratory (FDA n.d.b). These tests are considered the most accurate. However, because RNA can stay in the body for up to 90 days, these tests are not recommended for people who tested positive for COVID-19 in the past 90 days (CDC 2022c).
- **Antigen tests** produce rapid results, typically within 30 minutes, and can be at-home tests or self-tests (CDC 2022c). Because antigen tests are more likely to produce false negative results, the FDA recommends repeat testing after a negative antigen test (FDA 2022a).
- **Other types of COVID-19 tests** include antibody (or serology) tests, which measure whether people were at one time infected with COVID-19. Because they cannot distinguish between current or past infections, these are not diagnostic tests, but they can be used for general surveillance (FDA n.d.b).

State, local, tribal, and territorial health departments require reporting for molecular and antigen tests, if they are performed in specific health care settings. Clinical Laboratory Improvement Amendments (CLIA)-certified hospitals, health care providers, and laboratories are required to report positive diagnostic and screening test results to patients and to their state, local, tribal, or territorial health department. This includes the results of nucleic acid amplification tests or molecular tests and of antigen test results. If tests are performed outside of a CLIA-certified facility (such as self-tests) or if tests are not FDA-authorized, results may be reported to the health department upon request, if they are de-identified and used for surveillance purposes only. After receiving data, health departments have the option to voluntarily submit

de-identified case data to CDC for national surveillance through the National Notifiable Diseases Surveillance System (CDC 2022k). CDC then displays state and national case counts in a COVID Data Tracker. While health departments may use self-tests for surveillance purposes, national surveillance data does not include positive self-tests or other tests performed outside of CLIA-certified providers (CDC 2022d).

B. Changes in COVID-19 testing guidelines over time

COVID-19 testing guidelines have evolved rapidly from 2020 to the present, influenced by changing science and key milestones such as the (1) development of testing and vaccine technology, (2) introduction of policies and funding to support expanded testing, and (3) implementation of federal programs to expand testing capacity. Exhibit III.1 provides an overview of testing accomplishments and milestones that represented turning points in the COVID-19 response, as well as changes in guidelines for using various tests and testing modalities, that were influenced by these milestones. We describe these changes and the current COVID-19 testing guidelines further in the text below.

Exhibit III.1. Summary of COVID-19 testing milestones and guidelines February 2020–July 2022

Key Milestones	Changes to Guidance
2020	
<p>FEBRUARY</p> <ul style="list-style-type: none"> The Food and Drug Administration (FDA) issued an emergency use authorization (EUA) for a Centers for Disease Control and Prevention (CDC)-developed SARS-CoV-2 diagnostic test (CDC 2023a). 	<p>FEBRUARY</p> <ul style="list-style-type: none"> COVID-19 testing guidelines suggested reporting specific Patients Under Investigation (PUI) to CDC, including patients who (1) had fever or respiratory illness and close contact with someone who had COVID-19 or (2) had fever and respiratory illness and recently traveled from China. COVID-19 diagnoses needed to be confirmed with a CDC-developed test kit (CDC 2020b). Later, CDC updated PUI criteria to include any patients with a respiratory illness regardless of travel history (CDC 2020c). The FDA also allowed some laboratories to begin using COVID-19 tests that were not developed by CDC, prior to their EUA (FDA 2020).
<p>MARCH</p> <ul style="list-style-type: none"> The federal government declared COVID-19 a national public health emergency (CDC 2023a). The Coronavirus Aid, Relief, and Economic Security Act was signed into law, requiring insurance providers to cover COVID-19 diagnostic testing (Coronavirus Aid, Relief, and Economic Security Act 2020). A White House Joint Task Force established the Community-Based Testing Sites (CBTS) program, which began with 39 drive-through testing sites (CDC 2023a; Miller et al. 2021). 	<p>MARCH</p> <ul style="list-style-type: none"> The FDA announced that CDC did not need to complete confirmatory testing for a positive COVID-19 diagnosis (CDC 2023a). CDC expanded testing guidelines to prioritize testing for people who were (1) hospitalized with symptoms, (2) immunocompromised or otherwise at higher risk for poor outcomes, or (3) in close contact with confirmed COVID-19 cases (CDC 2020c).
<p>APRIL</p> <ul style="list-style-type: none"> The CBTS program expanded to include the Pharmacies+ Testing program, which established testing sites at retail pharmacies and laboratories. This program supported testing at 7,708 locations across the United States (CDC 2023a). The National Institutes of Health (NIH) launched the RADx Initiative to rapidly develop and scale COVID-19 testing technology and increase testing capacity (NIH 2020). 	
<p>MAY</p> <ul style="list-style-type: none"> The FDA authorized the first at-home test for COVID-19 (CDC 2023a). The U.S. Department of Health and Human Services, CDC's Epidemiology and Laboratory Capacity for Prevention and Control of Emerging Infections, and Indian Health Services provided funding to states, territories, tribes, urban Indian health programs, and local health jurisdictions to expand COVID-19 testing capacity (CDC 2023a). 	
<p>JUNE</p> <ul style="list-style-type: none"> The CBTS program established surge testing in 658 communities that experienced, or were likely to experience, large increases in COVID-19 transmission and infection rates (CDC 2023a). 	<p>JUNE</p> <ul style="list-style-type: none"> CDC released COVID-19 testing guidelines, recommending testing for all close contacts, regardless of symptoms and suggesting screening testing to identify asymptomatic individuals in congregate settings (CDC 2023a).
	<p>AUGUST</p> <ul style="list-style-type: none"> CDC updated testing guidelines, noting that individuals who were in close contact with someone who had COVID-19 did not need to test if they were asymptomatic (Guzman 2020).
	<p>SEPTEMBER</p> <ul style="list-style-type: none"> CDC reversed its prior updates, emphasizing that all close contacts of people with COVID-19 should seek testing (Feuer 2020).
2021	
<p>JANUARY</p> <ul style="list-style-type: none"> The Coronavirus Response and Relief Supplemental Appropriations Act authorized HHS and CDC to provide \$22 billion for testing and vaccine roll-out in states, localities, and territories (CDC 2023a). This included CDC funding to address COVID-19 disparities through expanded testing, contact tracing, and other strategies (CDC 2023a). 	

Key Milestones	Changes to Guidance
2021	
<p>FEBRUARY</p> <ul style="list-style-type: none"> • Ellume agreed to send 100,000 at-home rapid test kits per month to the United States through July 2021 (CDC 2023a). • The federal government invested \$680 million to expand testing in communities at disproportionate risk of COVID-19, schools, and congregate settings. With this funding, CDC launched Operation Expanded Testing, which established regional coordination hubs to support testing, specimen collection, and laboratory analysis (HHS 2021b; CDC 2022e). 	
<p>MARCH</p> <ul style="list-style-type: none"> • The American Rescue Plan was signed into law and included \$50 billion to expand COVID-19 testing capabilities (American Rescue Plan Act 2021; CDC 2021b). • NIH and CDC started a pilot of the Say Yes! COVID Test program in Pitt County, North Carolina, and Chattanooga/Hamilton County, Tennessee. The program measured whether at-home tests reduced the transmission of COVID-19 and identified best practices for distributing at-home tests (CDC 2023a). The program later expanded to Georgia, Hawaii, Kentucky, and Indiana (Collins 2021). 	<p>MARCH</p> <ul style="list-style-type: none"> • CDC expanded COVID-19 screening testing guidelines, suggesting screening testing in communities where transmission was high. • CDC updated guidelines to include health equity considerations, such as expanding access to testing for populations at disproportionate risk for COVID-19 (CDC 2021h).
<p>JUNE</p> <ul style="list-style-type: none"> • Using funds from the American Rescue Plan, the Health Resources and Services Administration (HRSA) launched the Rural Health Clinic COVID-19 Testing and Mitigation Program, which supported rural health clinics with expanding testing capacity (HRSA, 2022). 	<p>JUNE</p> <ul style="list-style-type: none"> • CDC updated guidelines for fully vaccinated people, suggesting testing was not needed after contact with someone who has COVID-19 (Christ 2021).
<p>DECEMBER</p> <ul style="list-style-type: none"> • Through the HRSA COVID-19 Testing Supply Program, HRSA offered free testing supplies to any HRSA-funded health centers and Medicare-certified rural health clinics (HRSA 2023). 	<p>OCTOBER</p> <ul style="list-style-type: none"> • CDC updated guidelines for fully vaccinated people based on evolving evidence, suggesting testing 5–7 days after close contact with someone who has COVID-19, regardless of vaccination status (CDC 2021g).
2022	
<p>JANUARY</p> <ul style="list-style-type: none"> • The federal government announced a requirement that insurance providers must cover the cost of at-home COVID-19 test kits (CMS 2022). • The federal government purchased 1 billion COVID-19 at-home test kits and created an online portal to provide people with free tests and delivery (CDC 2023a). • The federal government launched the Test to Treat initiative. Through this initiative, people who test positive for COVID-19 at specific locations can have a prescription filled for oral antiviral medication at the same location. Test to Treat sites include pharmacies, Federally Qualified Health Centers, and other clinics (CDC 2023a; ASPR, n.d.a). 	
<p>JULY</p> <ul style="list-style-type: none"> • As part of CDC's Increasing Community Access to Testing program, Quest Diagnostics offered free COVID-19 testing to uninsured people (Quest Diagnostics 2022). 	

Initial guidelines for COVID-19 testing reflected limited testing supply and recommended only performing diagnostic testing for priority populations. In February 2020, CDC required providers to report patients who either (1) had fever or respiratory illness and close contact with someone who had COVID-19 or (2) had fever and respiratory illness and recently traveled from China (CDC 2020b). Diagnostic testing for these patients could only be completed using CDC test kits analyzed at CDC laboratories. To support increased testing, the FDA released a policy in late February allowing some laboratories to use tests before they were authorized for emergency use (FDA 2020). Following this policy, CDC expanded its guidelines slightly to prioritize testing for people who were (1) hospitalized with symptoms, (2) immunocompromised or otherwise at higher risk for poor outcomes from COVID-19, or (3) in close contact with confirmed COVID-19 cases (CDC 2020k).

As new COVID-19 tests were authorized for use and testing capacity expanded, populations prioritized for testing also expanded. In June 2020, CDC recommended testing for all close contacts of people with COVID-19, regardless of symptoms, and suggested regularly testing asymptomatic people in high-density living situations such as shelters, nursing homes, or long-term care facilities (CDC 2020d). In March of 2021, CDC noted the expanded availability of tests and expanded its screening testing guidance, referring to screening of asymptomatic people as a key strategy in COVID-19 prevention, particularly in communities or settings such as schools with high levels of transmission (CDC 2021h).

CDC continues to change its testing guidelines as research on COVID-19 evolves. For example, as COVID-19 vaccines became widely available, CDC updated guidelines to note that only unvaccinated close contacts needed to be tested. However, the agency later reversed this change with new research demonstrating that asymptomatic vaccinated people could still transmit the SARS-CoV-2 Delta variant (CDC 2021h; Haroun and Brueck 2021; CDC 2021g). CDC also made more recent updates to de-emphasize screening in certain situations, based on research suggesting that this may be less cost-effective in settings with low rates of COVID-19 (Goodman and Cohen 2022; Massetti et al. 2022).

As of April 14, 2023, CDC recommends diagnostic testing for people with symptoms of or exposure to COVID-19 and screening testing in specific high-risk scenarios. CDC recommends (1) testing immediately if experiencing symptoms of COVID-19, (2) testing at least five days after exposure to COVID-19, and (3) considering testing before visiting someone who is at risk for severe COVID-19 (CDC 2022c). Screening testing recommendations are based on COVID-19 community levels. Community levels (low, medium, and high) help to classify the burden of COVID-19 in counties based on case and hospitalization data (CDC 2022i). CDC outlines prevention and testing strategies at each community level. While all communities are encouraged to provide access to testing, including at-home tests, CDC also recommends that communities with medium or high levels consider screening testing in high-risk settings such as schools, assisted living facilities, correctional facilities, and homeless shelters (CDC 2022b, 2022g).

CDC's current guidelines also emphasize the importance of providing affordable, quality testing, with timely results for racial and ethnic minority communities, rural communities, and other groups experiencing inequities (CDC 2022g, 2023c). Recognizing that systemic health and social inequities influence disparities in COVID-19 burden as well as access to vaccination and testing, CDC established a COVID-19 Response Health Equity Strategy (CDC 2022a). The testing-related elements of the strategy include plans to (1) collect data to monitor and identify differences in testing by age, race, ethnicity, sex, and other demographic variables; (2) expand culturally relevant testing programs; (3) disseminate

culturally relevant materials and practices to frontline workers serving communities experiencing disparities; and (4) build a more diverse and representative COVID-19 response workforce.

C. COVID-19 testing programs

Despite new testing technologies and evolutions in testing practices and guidelines, testing rates have shown inequitable uptake in different communities due to the barriers discussed in Section II.B (Pond et al. 2022; Rader et al. 2022). A primary goal of this environmental scan is to understand how public and private programs attempted to overcome these barriers and reduce inequities. In this section, we discuss the primary approaches and delivery strategies reported by COVID-19 testing programs that we reviewed, as well as the barriers to implementation they experienced and the implementation strategies they used to overcome those barriers.

1. Primary approaches used for COVID-19 testing programs

Programs’ primary approaches to increase COVID-19 testing identified in the scan all addressed access to testing, and fell along a continuum in terms of the travel required of test recipients. On one end of this continuum, centralized testing sites required test recipients to travel, often outside of their neighborhoods, and on the other end of the continuum, programs brought tests to recipients’ homes. We use travel to categorize these approaches because it represents the effort required to access different testing services, and because inequities in the distribution of services, coupled with limited transportation and scheduling constraints, posed critical barriers to testing (and vaccination) services. Exhibit III.2. summarizes these approaches. They are not mutually exclusive; some programs used them in combination. Many programs also bundled testing services with education and outreach intended to increase awareness and confidence in testing, although we did not find any testing programs whose sole approaches consisted of education or outreach (in the absence of testing services).

Exhibit III.2. Primary approaches of COVID-19 testing programs

Approach	Description
Increase access to COVID-19 testing	
Mass testing clinics or events	Programs held large-scale testing clinics or events set up to provide a high volume of tests in one location. These could be drive-through or walk-up events and could be recurring or one-time events. If they were recurring, they usually had a consistent time and location.
Testing in health care settings	Programs delivered testing in health care settings, such as federally qualified health centers. These services were generally recurring, rather than one-time events.
Community testing clinics	Programs set up testing clinics in community spaces where people congregate. The clinics relied on existing infrastructure from the community sites. These services were generally recurring, rather than one-time events.
Mobile testing clinics	Programs deployed traveling vans or mobile units to convenient locations in the community, and individuals came to the mobile units to receive testing.
In-home testing	Mail-in testing programs enabled people to self-test. In addition, mobile teams provided COVID-19 testing in the recipients’ homes. Some organizations also distributed rapid tests (for later home use) at community events.

COVID-19 testing programs implemented several approaches to make testing convenient for communities.

- **Mass testing clinics or events.** Mass testing clinics were large in scale, functioning to provide a high volume of tests in a single location, such as a parking lot or other open space. Mass testing programs were mostly commonly administered by city, county, or state health departments. For example, the Utah Department of Public Health, in partnership with the Utah National Guard and Centers for Disease Control and Prevention, established a mass testing site in a vacant rodeo barn outside of Salt Lake City, Utah, providing tests to nearly 40,000 people from December 2020, through April 30, 2021 (Gillwald et al. 2022).
- **Testing in health care settings.** Federally qualified health centers (FQHCs) commonly provided testing for communities (Berner et al. 2022; Davis et al. 2020; Kim et al. 2021). Other examples of health care-based clinics included community health clinics (Barry et al. 2020) and rehabilitation centers for people experiencing homelessness (Berner et al. 2022). Testing clinics in health care settings sometimes integrated testing into clinical care and sometimes set up separate testing operations directly outside of the clinics. For example, La Clínica Esperanza, a community clinic in Providence, Rhode Island, set up a tent outside of the clinic where people could receive testing (Barry et al. 2020). Many health care-based clinics offered testing to people regardless of whether they were existing patients (Barry et al. 2020; Davis et al. 2020).
- **Community testing clinics.** Community testing clinics delivered testing at specific spaces in the community where people regularly congregate for work, education, worship, or other activities, as shown in the call-out box. Of the testing programs we reviewed, most such clinics were administered by local health departments, followed by academic institutions, often in partnership with local community-based organizations (CBOs). Testing services were typically recurring and integrated into existing operations at these locations. For example, in the Faithful Response to COVID-19 program, staff from the Kansas City, Missouri Health Department partnered with local faith-based organizations and church to integrate COVID-19 testing with church activities at a predominantly African American church in Kansas City (Berkley-Patton et al. 2022).
- **Mobile testing clinics.** Some programs deployed vans or trailers to provide testing at various locations around the community. In some cases, mobile testing units supported the community-based testing services described above, with mobile units parked outside of venues like churches and barber shops (Whanger et al. 2022, key informants). One key informant from a county health department described setting up vans at community events such as health fairs. In other cases, vans moved around communities and residential areas based on communities' needs. For example, Atrium Health deployed mobile testing units to emerging COVID-19 hotspots in Charlotte, North Carolina, based on

Bringing testing to communities

Examples of community clinic locations:

- Churches
- Food pantries
- Homeless shelters
- Schools
- Workplaces

Examples of sites that mobile clinics visited:

- Airports and bus transfer stations
- Areas where farmworkers live and congregate
- Barber shop parking lots
- Church parking lots
- Homeless encampments
- Parks
- Roaming

geographic information system data mapping COVID-19 incidence (Atrium Health 2020). In Section VI, we describe methods for identifying hotspots and communities at disproportionate risk of COVID-19 in more detail. Mobile testing programs were administered by academic institutions, CBOs, and hospitals or health systems, often working in partnership.

- **In-home testing.** In-home testing programs, commonly administered by academic institutions and state health departments, enabled patients to get tested for COVID-19 without leaving their homes. In most cases, this occurred through mail-in testing programs that provide test kits (generally rapid antigen tests) to qualifying households and included instructions for their use (Barrett et al. 2022; Illinois Department of Public Health 2022, the Rockefeller Foundation 2022; Singler et al. 2023; University of Utah 2022). For example, the NIH-administered Say Yes! Covid Test program mailed COVID-19 test kits to households, along with instructions for their use and post-testing guidance (Singler et al. 2023). While most in-home testing programs in our review operated by mail, we identified one program in the literature that deployed vans staffed with emergency medical service providers to the households of frail and older adults to administer in-home PCR testing (Goldberg et al. 2020). Similarly, a key informant’s academic institution used community health workers (*promotoras*) to visit and perform in-home testing for local residents who could not attend community testing clinics due to their age or health status. Several key informants’ organizations, often CBOs, distributed rapid antigen tests (for later home use) at community events where people were already congregating, such as community vaccination clinics.

Programs selected testing sites based on the needs of the populations they served. For example, mass testing sites often were established in communities with lower income, communities with high proportions of people of color, and communities with notable gaps in testing services (Hansotte et al. 2021; Gillwald et al. 2022). Beyond addressing resource sparsity, community-based and mobile testing clinics often selected locations based on convenience, with specific populations in mind. For example, several programs serving Black and Latinx populations selected churches as venues for community-based testing clinics, given the recognition of the central role that churches often play in these communities (Berkley-Patton et al. 2022; Bigelow et al. 2021; 2022; Jaklevic et al. 2021). An NIH-funded, academic-community partnership seeking to increase testing access among farmworkers in California planned to deploy mobile vans to areas where farmworkers regularly congregate (UC Davis Health 2020). Information on community needs and assets was often gained through collaboration and planning with CBOs that have knowledge of their communities, as discussed in Sections III.C.4 and VI.A.

2. Strategies to facilitate delivery of COVID-19 testing programs

COVID-19 testing programs used a variety of delivery strategies to enhance the effectiveness of the approaches described above. Exhibit III.3 and the following section presents these delivery strategies, organized according to whether they had the potential to achieve the following outcomes: (1) strategies to increase access to, awareness of, and confidence in COVID-19 testing; (2) strategies focused on increasing awareness of and confidence in COVID-19 testing; and (3) strategies used to increase access to testing. Within each of these categories, we present strategies organized by how commonly they appeared in the literature.

Exhibit III.3. Strategies to facilitate delivery of COVID-19 testing programs

Strategy	Examples
Increase access to, awareness of, and confidence in COVID-19 testing	
Partner with established community organizations and trusted leaders to promote and deliver testing	<ul style="list-style-type: none"> Partnerships with community-based organizations, such as nonprofits (Brown et al. 2021), food pantries (Barry et al. 2021), churches (Bigelow et al. 2021) Trusted community leaders such as faith leaders (Berkley-Patton et al. 2022) and school staff (Chamie et al. 2021) Community health workers (University of Utah 2022), including promotores/as (DeGarmo et al. 2022)
Engage multilingual staff	<ul style="list-style-type: none"> On-site interpreters (e.g., DeGarmo et al. 2022)
Increase awareness of and confidence in COVID-19 testing	
Develop population-specific or culturally tailored messaging to raise awareness about the importance of testing and available services	<ul style="list-style-type: none"> Materials translated into multiple languages (Hansotte et al. 2021) Religiously tailored messaging (Berkley-Patton et al. 2022)
Use multiple channels to increase reach of testing information	<ul style="list-style-type: none"> Printed materials (Barry et al. 2020) Radio and TV advertisements (Hansotte et al. 2021) Social and digital media (Singler et al. 2023) Phone calls and text messages (University of Utah 2022)
Prioritize patient experience, comfort, safety, and dignity	<ul style="list-style-type: none"> Expedited testing process (Chamie et al. 2021) Privacy screens (Neely et al. 2021) Anonymized testing (Chidavaenzi et al. 2022)
Increase access to COVID-19 testing	
Offer walk-up options and expand hours	<ul style="list-style-type: none"> Evening and weekend hours (e.g., Chamie et al. 2022) Testing offered during workplace shift changes (Chidavaenzi et al. 2022) Walk-up options (e.g., Appa et al. 2021; Barry et al. 2020)
Address financial barriers to testing	<ul style="list-style-type: none"> Free testing (Berkley-Patton et al. 2020) Evening and weekend hours so recipients would not have to forego income (Chamie et al. 2022) Financial resources to help people testing positive make up for lost income (Bigelow et al. 2021)
Reduce documentation requirements for testing	<ul style="list-style-type: none"> No identification requirement (Hernandez et al. 2021) No health insurance requirement (Atrium Health 2023) No referral requirement (DeGarmo et al. 2022)
Provide alternatives to online registration and tracking	<ul style="list-style-type: none"> On-site registration (Hansotte et al. 2021) Phone or text message follow-ups (Barry et al. 2020)
Other goals	
Coordinate testing with other health and social services to meet health-related social needs	<ul style="list-style-type: none"> Vaccination services (Chamie et al. 2022) Food resources (Barry et al. 2020)

The most common delivery strategies in our review—partnering with established community organizations and leaders and engaging bilingual staff—helped programs increase testing access, awareness, and confidence at the same time.

- Partnerships with CBOs provided venues to expand testing access while drawing on their trusted status.** Many programs involved collaborations between academic institutions, medical centers, or public health departments and established CBOs (Berkley-Patton et al. 2022; Hansotte et al. 2021; Brown et al. 2021). As described above, these partnerships enhanced access by providing testing venues in places like churches and schools (Degarmo et al. 2021; Hansotte et al. 2021). These partnerships increased awareness by promoting testing events through existing communication channels (Berkley-Patton et al. 2020). They also helped to foster testing confidence by building on CBOs’ longstanding relationships with the communities they serve (Hansotte et al. 2021; UC Davis Health 2020).
- Community leaders served as ambassadors to help increase awareness of and confidence in testing services** (Barry et al. 2022; Berkley-Patton et al. 2022; Chamie et al. 2022). Church pastors (Berkley-Patton et al. 2022), school staff (Chamie et al. 2022), health care navigators (Barrett et al. 2022; DeGarmo et al. 2022), and other members of the community used their reach, influence, and cultural competency to dispel misinformation, emphasize the importance of testing, and promote testing services. In some cases, these community partners also helped administer testing. For example, an NIH-funded central California mass testing program, run through a community-academic partnership, engaged the school superintendent—described as a trusted community leader—to administer tests to Latinx residents (Chamie et al. 2022). Community leaders also volunteered to support testing programs, by acting as greeters and directing traffic (Appa et al. 2021; Hernandez et al. 2021), or conducting follow-up calls with those testing positive (Barry et al. 2020).
- Engaging bilingual staff increased access and confidence among non-English speakers.** A key informant from an academic institution noted that *promotoras* publicized testing events on social media and by word of mouth, in English and Spanish. Many programs in our literature review similarly engaged Spanish-language interpreters (Chamie et al. 2022; Gillwald et al. 2022), while several also provided interpreters for other languages, including Vietnamese (Hernandez et al. 2021) and Indigenous-Mayan language (DeGarmo et al. 2022). By making information accessible to people who did not speak English, this strategy addressed a key language access barrier. In addition to increasing access, the presence of bilingual staff on-site may have also fostered trust and confidence among non-English speaking communities (Degarmo et al. 2022).

**Program spotlight:
Partnering with African
American churches**



In the Faithful Response to COVID-19 program, the Kansas City Health Department partnered with local faith-based organizations to deliver testing to African American churchgoers (Berkley-Patton et al. 2022). Eight participating churches increased access by providing convenient venues for testing services, which were often scheduled to align with church programming. They disseminated information through church bulletins to raise awareness. Partnering with churches also gave programs access to pastors who were trusted and respected by many in the community. Church pastors used their influence to communicate the importance of testing to church attendees. They also role-modeled the process of being tested from the pulpit during church services, which may have increased confidence among churchgoers.

Thoughtfully designed communication strategies and efforts to ensure positive testing experiences further increased awareness of and confidence in testing.

- **Programs used clear, accessible, and culturally tailored messaging to raise awareness about the importance of testing, address misinformation, and promote specific testing services.** These outreach strategies often involved a combination of educational content about the importance of testing and promotion of specific testing services (Barry et al. 2020; Davis et al. 2020; Whanger et al. 2022). Given that many people were unaware of COVID-19 policies, such as free testing made possible by the CARES Act, it was important for programs to communicate that testing was offered free of charge. It was also important that programs ensure promotional messaging was accessible for diverse communities. One program, run by an academic medical center in partnership with rural FQHCs, developed information at a 6th-grade reading level (Davis et al. 2022), and many programs translated communications into multiple languages, including English, Burmese, Spanish, and Vietnamese (Hansotte et al. 2021; Hernandez et al. 2021). Messaging was sometimes culturally tailored to specific communities. For example, the Faithful Response program developed religiously tailored messages about the importance of testing for African American church attendees (Berkley-Patton et al. 2022). In the Oregon Saludable: Juntos Podemos (Healthy Oregon: Together We Can) program, academic and community partners engaged Spanish-speaking *promotoras* to conduct outreach to Latinx communities to address misinformation and promote testing services; their communications drew on Latinx cultural values, such as collective welfare (DeGarmo et al. 2022).

- **Disseminating information through a range of channels helped programs expand reach to different communities and raise awareness about testing.** Digital platforms included social media (Jaklevic et al. 2021; Singler et al. 2023) and local health department websites (Barry et al. 2020; Whanger et al. 2022). Some programs used TV and radio advertising to promote testing, often with an emphasis on

**Program spotlight:
Using multiple dissemination
channels to provide education
and raise awareness about testing**



Drawing on principles of social marketing, the federal Say Yes! COVID Test program used a combination of website, digital advertising, social media, and paid media to encourage the use of home testing among historically marginalized communities (Singler et al. 2023). The NIH-administered program emphasized the importance of engaging local partner organizations and leaders to act as spokespeople and share personal experiences with testing. It also translated all promotional material into English and Spanish to broaden reach.

reaching specific populations like Spanish-speakers (Chamie et al. 2022; DeGarmo et al. 2022). Some programs distributed printed materials like pamphlets and flyers around the community (Hansotte et al. 2021; Davis et al. 2022). Other programs used in-person strategies such as door-to-door campaigning (Hansotte et al. 2021) or promoting in high-traffic areas like grocery stores, church services, schools, and workplaces (DeGarmo et al. 2022). In many cases, staff and volunteers made phone calls or sent text messages to inform people of testing services and remind them about upcoming appointments (University of Utah 2022). Many programs used multiple strategies to expand their reach (Hansotte et al. 2021; DeGarmo et al. 2022; Singler et al. 2023).

- **Programs prioritized patient experience, comfort, privacy, and dignity throughout the testing process.** Efforts to maximize patient comfort and create a positive testing experience included

expediting testing procedures (Chamie et al. 2022; McCollum et al. 2022); staffing on-site greeters to welcome patients and answer questions (Appa et al. 2021; Gillwald et al. 2022), creating a clean and welcoming testing space, and offering hygiene kits and snacks (Davis et al. 2020; Winterbauer et al. 2021). Several programs took measures to increase patient privacy and dignity, including anonymizing the testing process (Chamie et al. 2022; Chidavaenzi et al. 2022), erecting privacy screens (Neely et al. 2021), and using saliva testing kits, which are less invasive than to nasal swabs (Key informant). In a collaboration between several universities, an academic medical center, and the Chicago Department of Public health, nursing student volunteers allowed patients to collect their own samples (Neely et al. 2021). Self-sampling was described as a way to give patients control over their own bodies and build trust among communities who have been traumatized (Neely et al. 2021). These strategies are important because medical racism and stigma have undermined patient trust and decreased confidence in testing (Neely et al. 2021; Corneli et al. 2022; DeGarmo et al. 2022).

Programs took measures to further enhance access to testing, beyond the primary approaches to increase geographic access described above.

- **Offering walk-up testing and expanded hours helped to increase access to testing for people without cars or with restrictive work schedules.** For example, an academic-community partnership bringing testing services to two predominantly Latinx counties in California selected walk-up testing sites in central, well-known locations that people could easily access on-foot, including a park and a community center (Chamie et al. 2022). Many of the mass testing events, while designed for drive-through operations, also offered walk-up options for those without vehicles (Appa et al. 2021; Hansotte et al. 2021). To accommodate workers facing scheduling constraints, programs offered testing services outside of typical business hours (Chamie et al. 2022; Gillwald et al. 2022).
- **Programs increased financial accessibility by lessening the economic burden associated with going to get tested or receiving a positive test result.** Under the CARES Act, insurance carriers were required to cover COVID-19 testing without cost sharing, and programs were funded to provide free testing to people who were uninsured (Coronavirus Aid, Relief, and Economic Security Act 2020). However, lost wages associated with testing still posed a barrier to testing for many people. Programs that offered testing outside of standard working hours not only increased accessibility for workers but also helped to ensure recipients would not forego income when seeking testing (Chamie et al. 2022; Gillwald et al. 2022). Some testing programs also connected people who tested positive to financial resources to help them make up for lost income while they isolated (Bigelow et al. 2021; Chamie et al. 2022).
- **Reducing or eliminating requirements for documentation or referrals further increased accessibility.** Many programs eliminated requirements for physician referral or health insurance (Davis et al. 2020; Degarmo et al. 2022). This ensured that anyone could access testing, regardless of prior access to or engagement with the health care system. Some programs, particularly those serving Latinx and immigrant communities, did not require identification to be tested, thereby mitigating concerns about deportation among those who were undocumented (Chamie et al. 2022; Hernandez et al. 2021).
- **Programs ensured those without internet or digital literacy could access testing appointments and test results.** Many testing programs offered on-site registration for those without internet access or with less familiarity of online systems (Gillwald et al. 2022; Hansotte et al. 2022). In some cases,

program staff or volunteers called or texted patients to deliver test results instead of requiring them to log onto an online system (Barry et al. 2020; Chamie et al. 2022). Similarly, a key informant from a tribal health system described implementing a patient portal with an SMS system, which allowed patients to receive their COVID-19 test results via text message without having to use the internet. Follow-up calls and texts also presented an opportunity for staff to provide information to patients, including isolation guidance and COVID-19 treatment options for those testing positive (Barry et al. 2020; Chamie et al. 2022; DeGarmo et al. 2022; Gillwald et al. 2022).

Key informant spotlight: Using community health workers to deliver test results



An academic organization offering testing services in different communities throughout a state noted that having to check test results online was a barrier for its populations of focus. To overcome this, community health workers called program recipients who had not checked their online results within 48 hours to ask for permission to share their results via phone instead.

Some programs began with COVID-19 testing and then recognized an opportunity to support people's health and social needs more broadly.

- **Some testing programs addressed health care needs by bundling services or providing referrals.** For example, a community testing program in California adapted their testing site to double as a vaccination clinic and also began linking patients with mental health services (Chamie et al. 2022). A qualitative review of best practices for providing community testing to vulnerable populations described a mobile testing service that doubled as a portable clinic, offering blood pressure and HIV screenings and referrals to primary care providers in their community (Winterbauer et al. 2021).
- **Other programs addressed health-related social needs.** For example, testing programs provided referrals to child care, hotels, food vouchers, and financial resources (Barry et al. 2020; Bigelow et al. 2021; Winterbauer et al. 2021). Similarly, a key informant at a local health department described coordinating testing with the provision of hot meals, groceries, and care packages. Another key informant from a CBO, operating at the county level, noted that such strategies not only enhance access to services but also build the community's trust in the organization sponsoring the testing program.

Key informant spotlight: Meeting community needs



A local health department worked with the U.S. Department of Housing and Urban Development to set up testing and vaccination sites at housing facilities for senior citizens. They also used these sites to provide hot meals, groceries, care packages, mental health assessments, and follow-up check-ins for senior residents.

3. Challenges to COVID-19 testing program implementation

Both the literature and key informants described implementation challenges related to resources, operational inefficiencies, and partnerships. These challenges applied across different testing approaches. In this section, we describe common challenges to implementation that presented across different testing approaches. In the next section, we describe strategies that staff used to overcome those challenges.

Exhibit III.4. Implementation challenges and strategies of COVID-19 testing programs

Category	Challenges staff faced in program implementation	Strategies staff used to facilitate program implementation
Resources	Budget and funding constraints, staffing limitations, and issues with obtaining and storing supplies posed a challenge to program implementation.	Diverse staffing and donated supplies provided programs with needed resources. Logistical efficiencies also helped staff make use of scarce resources.
Operations and logistics	Issues with patient tracking, staff communication, and staff driving time decreased efficiency of program operations.	Integrating testing into existing institutional infrastructure and processes; developing traffic management and other logistical efficiencies; and implementing systems for staff communication and coordination helped to facilitate smooth program delivery while making use of scarce resources.
Community partnerships	Some programs faced challenges related to buy-in and trust when engaging with community partners.	Early and frequent communication with community partners helped gain community buy-in.

Resource limitations—including constraints on budget, staffing, and supplies—were among the most cited challenges to implementation among the testing programs we reviewed.

- Issues with obtaining, storing, and transporting testing supplies were among the most common challenges staff faced.** Several programs noted a shortage of supplies early in the pandemic, such as test kits and personal protective equipment for staff (Appa et al. 2021; Jaklevic et al. 2021; Molling et al. 2020; Whanger et al. 2022). For example, a city-level mobile testing program run by a Black physicians’ group in partnership with the Philadelphia Department of Public Health noted that it was difficult to obtain testing kits early in the pandemic (Jaklevic et al. 2021). Programs also faced challenges with storing and transporting supplies, including test samples (Appa et al. 2021) and privacy screens (Neely et al. 2021). For example, a university-administered, city-level mass testing clinic in Bolinas, California noted that some of their samples leaked on transport (Appa et al. 2021).
- More broadly, some programs described constraints related to the cost of providing testing and restrictions placed on them by funders.** Testing events were associated with numerous costs, including staff time, community mobilization, laboratory testing costs, and government support for people testing positive (Chamie et al. 2022). A source describing a partnership between a local CBO, the West Virginia Department of Health and Human Services, and the West Virginia National Guard to advance testing in West Virginia reported budgetary constraints for rural clinics related to obtaining and transporting supplies (Whanger et al. 2022). Programs also faced challenges related to funding requirements. For example, a key informant from an academic institution explained how restrictions on grant funds limited their options in implementing testing programs in coordination with vaccination services.
- Staff availability and capacity were also challenges for testing programs.** For example, Whanger et al. (2022) conducted focus groups with rural clinic staff in West Virginia, who noted a strain on staff time needed to provide testing in addition to basic care. A program in which the National Guard partnered with local public health agencies to deliver mass testing to rural communities in West Virginia held events that were often scheduled with only 24 hours of lead time, which did not give them adequate time to find and onboard staff and volunteers (Dumproff et al. 2022).

Some testing programs also experienced logistical issues related to patient tracking and staff communication and transportation.

- **Some programs faced challenges with patient registration and tracking.** For example, a mass clinic in rural Wisconsin described challenges faced by staff when registering and following up with patients who did not have a preexisting relationship with the health system (Molling et al. 2020). This was because these patients did not have screening data available for registration and they did not have employer information available for sending return-to-work instructions (Molling et al. 2020). As described above, on-site registration was helpful for people without access to the internet; however, it posed challenges to implementation if hand-written labels were difficult for staff to read (Appa et al. 2021).
- **Challenges with staff communication and transportation reduced program efficiencies.** Program staff sometimes struggled to communicate about test results and participant information, particularly at the larger testing sites where they were stationed at a distance from one another (Gillwald et al. 2020) or when all parties were wearing masks (Appa et al. 2021). These communication issues made testing operations slower and less efficient. Programs noted additional inefficiencies related to staff transportation (Goldberg et al. 2020; Whanger et al. 2022). For example, health care workers faced long and inefficient driving routes to see only a few patients when traveling to older adults' homes to administer tests as a part of a state-level program run by a hospital system in partnership with the state department of public health (Goldberg et al. 2020).

Programs involving health care–community collaborations described challenges around obtaining buy-in from potential community partners. For example, a key informant representing an academic institution described challenges collaborating with potential testing venues. While the organization identified grocery store parking lots as convenient testing venues, the grocery stores objected to being associated with a COVID-19 testing events and having potentially ill people congregate in their parking lots, fearing these activities would drive away customers. The informant's organization ended up moving its testing sites to community locations, such as parks, instead. One study from the peer-reviewed literature described a state-level trial in which community sites were randomly assigned to receive information about testing from *promotores* versus standard outreach protocols (DeGarmo et al. 2022). Authors noted that some community partners initially objected to the mode of outreach being randomized, but they eventually were supportive after trust between the researchers and community was established.

4. Strategies to facilitate COVID-19 testing program implementation

In this section, we elaborate on the third column of Exhibit III.4 to describe the strategies that staff, volunteers, and partners used to overcome common challenges and successfully implement testing programs.

Programs maximized scarce resources through creative staffing and donated supplies.

- **At a time when health care staff were overburdened, diverse clinical and nonclinical staff and volunteers worked together to implement COVID-19 testing programs.** In addition to health care providers (Davis et al. 2020; McCollum et al. 2022), staff and volunteers included medical students

(Neely et al. 2021), community health workers (Barrett et al. 2022; Barry et al. 2020; DeGarmo et al. 2022), church leaders (Berkley-Patton et al. 2022), and teachers (Chamie et al. 2022), among others. Engaging nonclinical staff helped to manage the workload and unburden clinical staff (Chidavaenzi et al. 2022; Whanger et al. 2022). By coordinating with CBOs, programs had access to robust networks of motivated volunteers to help promote, facilitate, and deliver testing services (Appa et al. 2021; Berkley-Patton et al. 2022; Chamie et al. 2022). In some cases, existing professional teams pivoted their services to support testing efforts. Examples include paramedics administering in-home testing to homebound residents (Goldberg et al. 2020), a mobile mammography clinic delivering COVID-19 testing in rural Louisiana, and the West Virginia National Guard helping to coordinate mass testing events (Dumproff et al. 2022).

- **Programs facing supply shortages benefited from donations from the government and partners.** A surgeon in Philadelphia drew on her professional network to gather free COVID-19 tests for use by a small, city-level community testing clinic (Jaklevic et al. 2021). Several key informants from CBOs and health systems received at-home test kits for free through their state or county health departments, allowing them to spend grant funding on other needs, such as outreach and building staff capacity.

Operational efficiencies helped staff to deliver services while making use of scarce resources.

- **Integrating testing services into host venues' existing infrastructure and systems took advantage of community assets and helped staff deliver services efficiently.** Churches, schools, and other community-based testing venues provided needed infrastructure, such as electricity, computers, refrigeration, and gathering and waiting areas (Berkley-Patton et al. 2022; Molling et al. 2020; Neely et al. 2021). Programs increased the efficiency of staff efforts by delivering testing to coincide with host institutions' schedules, such as delivering testing during scheduled church programming (Berkley-Patton et al. 2022) or workplace shift changes (Chidavaenzi et al. 2022; see program spotlight). These integrations also helped to improve access and confidence among program recipients.

Key informant spotlight: Partnering with test manufacturers and a pharmaceutical company



- A foundation worked with COVID-19 test manufacturers to ensure a steady supply of tests throughout the country. The foundation also invested in a public-private partnership between one test manufacturer, state health departments, and a global logistics and distribution provider to ensure widespread access to at-home COVID-19 tests in five states.
- A local health department was approached early in the pandemic by a pharmaceutical company headquartered in its area, which offered to provide free testing services to frontline workers, including grocery store and day care workers.

- **Program staff developed various systems to improve program operations.** For mass testing clinics, which served hundreds and sometimes thousands of people daily, traffic management was critical to success (Dumproff et al. 2022; Gillwald et al. 2022; Hernandez et al. 2021). Several articles about larger testing clinics made a point to describe their traffic and site layouts (Appa et al. 2021; Molling et al. 2020). Designating personnel to direct traffic, greet patients, and provide additional logistical supports improved flow during testing events (Appa et al. 2021; Hernandez et al. 2021; Whanger et al. 2021). Similarly, a program administering in-home testing to homebound residents decided to cluster home visits to increase driving efficiency (Goldberg et al. 2020). Program staff also made improvements to internal communication (Gillwald et al. 2022; Molling et al. 2020). For example, one mass testing program, run by state and county health departments, faced challenges to communications between staff. The program responded to this challenge by using a Google spreadsheet so staff could track and communicate patient results in real time (Gillwald et al. 2022).

Program spotlight: Integrating testing into the workplace



A program seeking to increase COVID-19 testing among members of the San Carlos Apache Tribe in southeastern Arizona implemented serial testing at a detention center and casino locations (Chidavaenzi et al. 2022). Staff from the tribe's Department of Health and Human Services, with support from the CDC, conducted testing in different physical spaces within each venue, such as in detention center pods. They also conducted testing to align with workplace scheduling, including late nights and early mornings when casino employees changed shifts. Adapting testing protocols to the specific workplace buildings and employee schedules likely helped increase efficiencies for program staff while also enhancing accessibility and ultimately uptake among people being tested.

Regular planning meetings were important for building strong community partnerships and designing effective services. Partnerships between two or more organizations, including academic institutions, health departments, health systems, and local CBOs were nearly universal among the testing programs in our scan. Programs involving such collaborations described the importance of holding regular meetings

Key informant spotlight: Adapting reporting requirements to communities



Recognizing that some tribal communities have a historically informed distrust of reporting information to the federal government, a federal funder did not want significant reporting requirements to discourage these entities from applying for a federal grant. The agency purposefully required less reporting on outcomes than is typically required to make its COVID-19 grant accessible to tribal entities that had not previously received federal funding.

for all partners to communicate and learn from each other throughout program planning and implementation (Berkeley-Patton et al. 2022, Davis et al. 2020; DeGarmo et al. 2022; Molling et al. 2020). CBOs have built robust and trusted relationships with communities, allowing them to offer insight into residents' needs, and what kinds of intervention strategies would be most resonant and effective (Office of Minority Health 2020, UC Davis Health 2020). For example, a university-administered program to bring mobile testing to farmworker communities in California's central valley gained insights from community partners who had longstanding relationships with farmworkers and could offer recommendations for convenient testing locations (UC Davis Health 2020).

IV. Key findings on COVID-19 vaccination

This section reviews COVID-19 vaccine types and guidelines as of April 2023 (Section IV.A), key changes to vaccination guidelines over time (Section IV.B), and equity implications of vaccine distribution throughout the pandemic (Section IV.C). Section IV.D summarizes COVID-19 vaccination programs' primary approaches and delivery strategies, the implementation challenges they experienced, and the implementation strategies they used to overcome those barriers.

A. COVID-19 vaccine types and current vaccination guidelines

The FDA initially granted emergency use authorization for four COVID-19 vaccines. These vaccines included two mRNA (messenger ribonucleic acid) vaccines developed by Pfizer-BioNTech and Moderna, Johnson & Johnson's Janssen viral vector vaccine, and the protein subunit Novavax (Adjuvanted) vaccine (CDC 2023e; FDA n.d.c). CDC issued a preferential recommendation for mRNA vaccines in December 2021. It fully approved the Pfizer BioNTech COVID-19 vaccine in August 2021 and the Moderna COVID-19 vaccine in January 2022 (CDC 2023a). For each vaccine, there is a recommended primary series, as well as a booster series. CDC distinguishes between original boosters, which were recommended in August 2021 to protect against the initial SARS-CoV-2 virus, and updated bivalent boosters, which were authorized by the FDA in September 2022 and provide additional protection against Omicron variants BA.4 and BA.5.

As of April 14, 2023, COVID-19 vaccination guidelines are based on age, vaccine type, and whether people are moderately or severely immunocompromised (CDC 2023e). Guidelines by age group for those who are not immunocompromised are as follows.⁶

- **Children ages 17 and under:** CDC recommends that children ages 17 and under receive two doses of the Moderna or Pfizer-BioNTech COVID-19 vaccine (primary series), with an updated booster shot at least two months after the last dose of the primary series. Children ages 12–17 are also eligible to receive the Novavax vaccine for their primary series, with an updated Pfizer or Moderna booster (CDC 2023e).
- **Adults ages 18 and over:** Recommendations are similar for adults ages 18 or over, but adults who completed a Novavax primary series may be eligible for an updated Novavax booster. In addition, the Johnson & Johnson vaccine is available to adults ages 18 or over but is not recommended as a first choice due to a risk of thrombosis with thrombocytopenia syndrome (CDC 2023e; CDC 2022f).

B. Changes in COVID-19 vaccination guidelines over time

COVID-19 vaccination guidelines evolved with the development and approval of vaccines for different age groups and as vaccines became available. COVID-19 vaccines were initially distributed under emergency authorization use and in phases for specific populations, due to limited supply (National Academies 2020; CDC 2023a). In December 2021, CDC and Advisory Committee on Immunization Practices (ACIP) released guidelines for phased vaccine allocation with populations prioritized for vaccination as follows: health care workers and residents of long-term care facilities (Phase 1a), people ages 75 or older and non-health-care essential workers (Phase 1b), people ages 65–74 years and ages 16–64 with medical

⁶ There are specific recommendations for people who are severely or moderately immunocompromised, which are outlined further at <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/recommendations/immuno.html>.

conditions that put them at high-risk for COVID-19 (Phase 1c), and all others ages 16 years and older (Phase 2) (Dooling et al. 2020). Children under age 16 were not included in these initial phases because vaccines were not authorized for them at the time. Vaccines became widely available in May 2021 and were added to CDC’s routine vaccination schedules in February 2023 (The White House 2021a, Weixel 2023). Exhibit IV.1 provides a summary of changing guidelines throughout the pandemic.

Exhibit IV.1. Changes in COVID-19 vaccination guidelines December 2020–April 2023

Changes in COVID-19 Vaccine Guidelines	
2020	
<p>DECEMBER</p> <ul style="list-style-type: none"> The Centers for Disease Control and Prevention (CDC) and the Advisory Committee on Immunization Practices (ACIP) recommended phased allocation of COVID-19 vaccination with the following phases: <ul style="list-style-type: none"> Phase 1a: Health care workers and residents of long-term care facilities Phase 1b: Other non-health-care essential workers and people ages 75 and older Phase 1c: People ages 65–76 and people ages 16–64 years old with comorbidities Phase 2: People ages 16 and older (CDC 2023a). 	<p>DECEMBER</p> <ul style="list-style-type: none"> States implemented the recommended phased approach, beginning with Pfizer-BioNTech and Moderna vaccines (administered in a two-dose series), which ACIP recommended and the Food and Drug Administration (FDA) authorized through an emergency use authorization (EUA) (CDC 2023a).
2021	
<p>FEBRUARY</p> <ul style="list-style-type: none"> ACIP recommended Johnson & Johnson's vaccine and FDA issued an EUA (CDC 2023a). 	<p>MARCH</p> <ul style="list-style-type: none"> Federal guidelines suggested that all states make school staff, teachers (pre-K to grade 12), and child care workers eligible for vaccination. The federal government specified a goal to reach Phase 2 of vaccination for all Americans by May 2021 (CDC 2023a).
<p>MAY</p> <ul style="list-style-type: none"> ACIP recommended and FDA issued an EUA for use of the Pfizer-BioNTech vaccine for children ages 12–15 (CDC 2023a; Morello 2021). 	<p>AUGUST</p> <ul style="list-style-type: none"> In a joint statement, the U.S. Department of Health and Human Services, CDC, and FDA reversed prior guidelines stating that booster shots were not necessary. The statement suggested that a booster dose will support protection against severe disease, hospitalization, and death. ACIP and CDC announced recommendations for specific priority populations to receive booster shots over the coming months (CDC 2023a).
<p>OCTOBER</p> <ul style="list-style-type: none"> CDC and ACIP recommended that the following groups receive a booster of the Pfizer- BioNTech or Moderna COVID-19 vaccine: <ul style="list-style-type: none"> Adults ages 65 and older Adults over 18 with underlying medical conditions, who are residents of long-term care settings or who live or work in high-risk settings Anyone who received a Johnson & Johnson vaccine (CDC 2021c) FDA issued an EUA for the Pfizer-BioNTech vaccine for children ages 5–11 (FDA 2021). 	<p>NOVEMBER</p> <ul style="list-style-type: none"> CDC and ACIP recommended a booster dose for all adults (Gumbrecht et al. 2021).
<p>DECEMBER</p> <ul style="list-style-type: none"> CDC made a preferential recommendation for use of mRNA COVID-19 vaccines, including Pfizer-BioNTech or Moderna vaccines, over the use of the Johnson & Johnson adenoviral-vectored vaccine due to safety concerns (CDC 2023a). 	
2022	
<p>JANUARY</p> <ul style="list-style-type: none"> CDC and ACIP recommended that immunocompromised children receive an additional dose of the Pfizer-BioNTech vaccine in the primary series (for three doses total), and FDA amended its EUA to allow this. FDA issued an EUA to authorize booster doses of the Pfizer-BioNTech vaccine for children ages 12–15 (CDC 2023a; FDA 2022b). 	<p>MARCH</p> <ul style="list-style-type: none"> CDC and FDA recommended a second Pfizer-BioNTech or Moderna booster dose for the following groups: <ul style="list-style-type: none"> Adults over 50 People who are immunocompromised Anyone who received the Johnson & Johnson vaccine as their primary series and booster dose (CDC 2023a)
<p>MAY</p> <ul style="list-style-type: none"> FDA issued an EUA to authorize booster doses of the Pfizer-BioNTech vaccine for children ages 5–11 (CDC 2023a; FDA 2022d). 	<p>JUNE</p> <ul style="list-style-type: none"> FDA issued an EUA to authorize Moderna and Pfizer-BioNTech vaccines for children ages 6 months to 5 years (FDA 2022c).
<p>SEPTEMBER</p> <ul style="list-style-type: none"> CDC amended its guidelines to recommend updated bivalent booster shots, with additional protections against Omicron variants of COVID-19, for adults and FDA authorized bivalent booster shots with an EUA (PBS 2022). 	<p>OCTOBER</p> <ul style="list-style-type: none"> FDA issued an EUA to authorize bivalent booster doses for children as young as age 5 (FDA 2022d).
2023	
<p>FEBRUARY</p> <ul style="list-style-type: none"> CDC added COVID-19 vaccines to its routine vaccination schedules (Weixel 2023). 	<p>MARCH</p> <ul style="list-style-type: none"> FDA issued an EUA to authorize bivalent booster doses for children ages 6 months to 4 years (FDA 2023).

C. Equity implications of vaccine distribution

CDC and ACIP's initial guidelines for phased administration of the COVID-19 vaccine, when vaccine supply was limited, were informed by equity-focused research (Dooling et al. 2020). This research included work by the National Academy of Sciences, Engineering and Medicine which outlined priority phases for vaccination and suggested equity considerations within each phase (National Academies 2020). CDC's and ACIP's guidelines also prioritized essential workers in early phases of vaccination, emphasizing that people from racial and ethnic groups experiencing disproportionate risk of COVID-19 were often over-represented in these essential jobs (Dooling et al. 2020; CISA 2020). In addition, CDC launched programs such as Partnering for Vaccine Equity (P4VE) to support equity in adult vaccination (CDC 2020a).

Ultimately, states determined how vaccines would be allocated, leading to geographic variation in access. States primarily adhered to the CDC and ACIP guidelines for phased vaccine distribution. However, there was some variation primarily due to states adding additional groups in initial phases. States also rolled out the vaccine on different timelines, meaning access and availability to the vaccine initially varied by state (Kates et al. 2021). In addition, states took different approaches to vaccine mandates, resulting in differential vaccination rates for certain people and geographic areas (McGarry et al. 2022, Juarez et al. 2022).

In March 2021, the president stated a commitment to equitable and widespread vaccine distribution. Specifically, the president expressed a goal to make the vaccines available to all Americans (Phase 2) by May 2021 and announced plans to double the number of federal mass vaccination centers and pharmacies with COVID-19 vaccines, particularly in communities at disproportionate risk for COVID-19 (The White House 2021a, 2021b). At this time, CDC also released its COVID-19 Response Health Equity Strategy, which prioritizes (1) collecting data to monitor and identify differences in vaccination by age, race, ethnicity, sex and other demographic variables; (2) expanding culturally relevant vaccination programs and information; (3) addressing barriers to access; and (4) building capacity for vaccine distribution and delivery (CDC 2022a).

Key informant spotlight: Benefitting from the Public Readiness and Emergency Preparedness (PREP) Act



Several key informants reported that the PREP Act Declaration (issued March 2020) helped increase COVID-19 vaccination access by allowing pharmacists to administer COVID-19 vaccines, as well as routine vaccines. An informant from a federal agency explained that this was instrumental in expanding the pool of available vaccinators, especially given staffing shortages of nurses.

Following this announcement, several important programs and policies launched to support health equity.

For example, the Health Resources and Services Administration (HRSA) launched programs to expand vaccine access in specific communities. These included (1) the Community-Based Outreach Program, which focused on building vaccine confidence through locally focused and culturally tailored outreach in partnership with CBOs (HRSA 2022a); (2) the Rural Health Clinic Vaccine Distribution and Vaccine Confidence Programs, focused on partnering with rural health clinics to increase vaccination (HRSA 2022f, 2022g); and (3) the Health Center COVID-19 Vaccine Program, to

provide vaccines directly to FQHCs (HRSA 2022c). Analysis of three federal programs, including HRSA's Health Center COVID-19 Vaccine Program, CDC's Retail Pharmacy Program (2023h), and the Federal

Emergency Management Agency (FEMA) Community Vaccination Center Pilot Site and Mobile Vaccination Program (FEMA 2021), found that these programs implemented equity-focused strategies, such as using population data on race and ethnicity when selecting vaccination sites (U.S. Government Accountability Office 2022).

D. COVID-19 vaccination programs

As in Section III, this section presents findings on the COVID-19 vaccination programs we reviewed, including how they used primary approaches and delivery strategies to attempt to overcome barriers to vaccine use, the implementation challenges they experienced, and their implementation strategies.

1. Primary approaches used for COVID-19 vaccination programs

The primary approaches of the COVID-19 vaccination programs we identified in the scan intended to influence access to vaccination and awareness of and confidence in vaccination. Like COVID-19 testing programs, COVID-19 vaccination programs' primary approaches to address access differed in terms of the travel or effort required for recipients to access services. They also differed in terms of the number of people they reached at a given time and whether they were recurring or one-time approaches. Programs in this review often combined approaches to increasing access with approaches to increasing awareness and confidence (Abdul-Mutakabbir et al. 2022; Le-Morawa et al. 2022). Programs focused on increasing awareness of and confidence in COVID-19 vaccinations that did not deliver vaccines used educational events and outreach to populations of focus (Gregory 2021; Association of American Medical Colleges. 2022; AuYoung et al. 2022; Peteet et al. 2022; Venegas-Murillo et al. 2022). Exhibit IV.2 summarizes COVID-19 vaccination programs' primary approaches.

Exhibit IV.2. Primary approaches of COVID-19 vaccination programs

Approach	Description
Increase access to COVID-19 vaccinations	
Mass vaccination clinics or events	Programs held large-scale vaccination clinics or events set up to provide a high volume of vaccinations in one location. These could be drive-through or walk-up events and can be recurring or one-time events. If they were recurring, they usually had a consistent time and place.
Vaccination in health care settings	Programs set up vaccination clinics in health care settings such as health centers, rural health clinics, and pharmacies.
Community vaccination clinics	Programs set up vaccination clinics in convenient community sites where people congregate. The clinics relied on existing infrastructure from the community site. These were usually recurring venue-based initiatives but also included one-time vaccination clinics set up at community events (for example, school sports events).
Mobile vaccination clinics	Traveling vans or mobile units brought vaccines to convenient locations in the community, and individuals came to the mobile unit to receive vaccines.
In-home vaccination	Mobile teams traveled to recipients and provided COVID-19 vaccinations in the recipients' homes. These services supported homebound people who cannot travel to vaccination sites.
Increase awareness of and confidence in COVID-19 vaccinations	
Vaccination education events	Educational events disseminated information about COVID-19 and COVID-19 vaccinations. These included webinars, forums, and town halls. They included both one-time and recurring events.
Vaccination education outreach	Programs conducted outreach to populations of focus as a primary approach, not related to an accompanying vaccination delivery effort. They shared educational information on COVID-19 and COVID-19 vaccinations and address vaccine hesitancy or promote and coordinate uptake of

vaccines. Outreach methods included social media, phone calls, text messages, radio and television ads, and flyers.

COVID-19 vaccination programs implemented several approaches to deliver vaccines. These approaches were largely similar to those identified for testing, with the addition of approaches focused on increasing vaccination confidence.

- **Mass vaccination clinics or events.** Mass vaccination clinics or events, like mass testing events, are larger in scale than community vaccination clinics and enable programs to vaccinate many people in short periods of time. For example, one program serving the San Carlos Apache Tribe in Arizona found that its mass drive-through clinics had the biggest impact early in its vaccination campaign (Le-Morawa et al. 2022). Of the mass vaccination clinics or events we identified in the literature, most were administered by community-based organizations, local health departments (city or county health departments), health clinics, and tribal health departments.
- **Vaccination in health care settings.** Vaccination in health care settings allowed programs to leverage the established infrastructure, staff, and resources available in health care settings to deliver vaccines to communities. Health care settings included community health centers, (Public Health – Seattle and King County 2021), rural health clinics (Beste et al. 2021), retail pharmacies (Osibanjo et al. 2022), nursing homes (Feifer et al. 2021), and substance use disorder agencies (Washington et al. 2022). For example, a program in Clarkston, Georgia set up a recurring vaccination clinic directly outside of the primary health clinic to provide community members a consistent and familiar location (Malone et al. 2022). Of the programs we reviewed, most of those that implemented this approach were administered by health clinics, sometimes in partnership with CBOs, and local health departments.
- **Community vaccination clinics.** Community vaccination clinics helped programs more equitably distribute vaccinations by using convenient locations such as churches, businesses, schools, and sites where populations of focus gather such as food pantries and senior centers (Bigelow et al. 2022; New York State Department of Health 2020). Some programs implemented community vaccination clinics with consistent locations and times (Bigelow et al. 2022) and others held pop-up clinics to meet community needs (Relias Media 2021; Le-Morawa et al. 2022). Similarly, key informants described strategically choosing community vaccination sites such as libraries and public transportation centers, as well as various agencies providing social services to their populations of focus. Community vaccination clinics in the literature were most commonly administered by CBOs, followed by local health departments and state health departments.
- **Mobile vaccination clinics.** Like community vaccination clinics, mobile vaccination clinics enabled programs to provide COVID-19 vaccines more equitably by tailoring the site of the vaccination clinic to the needs of the program’s population of focus. For example, programs implemented mobile

Key informant spotlight:
Federally qualified health center (FQHC)-sponsored community vaccination clinics



An FQHC partnered with five meatpacking plants in its service area to offer vaccination services on-site, as many of the FQHC’s patients were employed at the plants. The FQHC also partnered with a local food bank and a homeless shelter to offer regular on-site vaccination services in those locations.

vaccination clinics at community sites like church parking lots (Abdul-Mutakabbir et al. 2022), parks and recreation centers (Alcendor et al. 2022a), or encampments (Rosen et al. 2023). Recognizing potential transportation barriers, one program, administered by a university, the San Francisco Department of Public Health, and local community-based organizations, sought to increase vaccination rates among Latinx individuals in San Francisco by setting up a vaccination site in a small parking lot near a busy transport hub (Marquez et al. 2021a). It remained open four days a week. Mobile vaccination clinics in the literature were most often administered by local health departments followed by academic institutions and community-based organizations.

- **In-home vaccinations.** In-home vaccination supported homebound people who could not travel to vaccination sites (Public Health - Seattle and King County 2021). For example, one multi-city program run by the Veterans Health Administration (VHA) sent off-site teams to vaccinate homebound veterans (Beste et al. 2021), and another program serving the San Carlos Apache tribe in Arizona offered in-home vaccinations to increase access (Le-Morawa et al. 2022). COVID-19 vaccination programs in the literature we reviewed did not implement in-home services as commonly as COVID-19 testing programs, but those that did were administered by CBOs, local health departments, large hospitals or health systems, health clinics, and tribal health departments.

COVID-19 vaccination programs also implemented stand-alone approaches to increase awareness of and confidence in COVID-19 vaccinations.

- **Vaccination education events.** Some programs implemented vaccine education events such as community town halls (AuYoung et al. 2022; Marquez et al. 2021a; Mathur and Dolgin 2022), webinars (Abdul-Mutakabbir et al. 2022; Peteet et al. 2022), or provider-led educational lessons for patients (Venegas-Murillo et al. 2022) in addition to conducting vaccine education outreach efforts as stand-alone approaches. Vaccination education events were most often administered by academic institutions, followed by CBOs, local health departments, and large hospitals or health systems.
- **Vaccination education outreach.** Several programs conducted vaccination education outreach as their primary focus, without an accompanying vaccination service component. These programs had providers or program staff call community members and provide education on COVID-19 vaccinations, used social media to dispel myths and boost confidence in vaccines, and created and posting flyers around the community (Marcell et al. 2022; Moore et al. 2022; AuYoung et al. 2022). One state-level campaign run by University of Washington, Seattle, created a website where providers, pregnant people, and community members could learn more about the risks of COVID-19 and the benefits of vaccination during pregnancy (Marcell et al. 2022).

Program spotlight: COVID-19 educational webinars



A program partnered with faith organizations and a Latinx organization led by community health workers to hold a series of educational webinars to build community trust and vaccine confidence among non-Latinx Black and Latinx community members (Abdul-Mutakabbir et al. 2022).

2. Strategies to facilitate delivery of COVID-19 vaccination programs

Like COVID-19 testing programs, COVID-19 vaccination programs used a combination of strategies to enhance the effectiveness of their primary approaches. Exhibit IV.3 and the following section are organized by the primary goal(s) of the delivery strategy. Strategies that worked to increase access, awareness, and confidence at the same time were most common. Programs also pursued strategies focused on increasing awareness of and confidence in vaccines and other strategies focused on increasing access. Within each of these sections, we present strategies according to how commonly they appeared in the literature we reviewed.

Exhibit IV.3. Strategies to facilitate delivery of COVID-19 vaccination programs

Strategy	Examples
Increase access to, awareness of, and confidence in COVID-19 vaccinations	
Form community partnerships to deliver COVID-19 vaccines and messaging	<ul style="list-style-type: none"> Partnerships with community-based organizations, such as faith-based organizations and community health organizations (Faherty et al. 2022) Peer vaccine ambassadors (Marquez et al. 2021a) Community advocates (Mathur and Dolgin 2022)
Engage multilingual staff	<ul style="list-style-type: none"> In-person translators (Malone et al. 2022) Phone translation services (Malone et al. 2022)
Coordinating with routine vaccination efforts	<ul style="list-style-type: none"> Using routine immunization infrastructure (Gregory 2021)
Increase awareness of and confidence in COVID-19 vaccinations	
Develop population-specific or culturally tailored messaging	<ul style="list-style-type: none"> Messaging in multiple languages (Alcendor et al. 2022a) Culturally competent messaging (Feifer et al. 2021) Motivational interviewing and trauma-informed messaging (e.g., Rosen et al. 2023)
Use multiple channels to increase reach of vaccination messaging	<ul style="list-style-type: none"> Flyers, infographics, and Facebook Live sessions (Alcendor et al. 2022a) Radio (Marquez et al. 2021a) Phone calls (Relias Media 2021) Street outreach (Bigelow et al. 2022) Door-to-door campaigns (Relias Media 2021)
Increase access to COVID-19 vaccinations	
Offer walk-up options and expand hours	<ul style="list-style-type: none"> Expanded operating hours (Relias Media 2021) Walk-up appointments (Malone et al. 2022) Individualized registration processes (Marquez et al. 2021a)
Reduce documentation requirements for vaccination	<ul style="list-style-type: none"> No requirement of proof of residency, vaccine eligibility, or health insurance status (Marquez et al. 2021a)
Provide transportation assistance	<ul style="list-style-type: none"> Transportation coordination services (Malone et al. 2022) Partnerships with ride-share apps (key informants)
Increase uptake of COVID-19 vaccinations	
Offer financial incentives	Gift cards (key informants)
Other goals	
Coordinate vaccination with other health and social services to meet health-related social needs	<ul style="list-style-type: none"> Referrals to social and case management supports (Gupta et al. 2022) Food supports (Relias Media 2021)

Like testing programs, most COVID-19 vaccination programs implemented strategies to address all three goals related to COVID-19 vaccination, placing priority on partnerships.

- **Programs partnered with trusted community leaders, CBOs, and community members to deliver COVID-19 vaccines and messaging.** This helped programs increase their reach among populations of focus (Faherty et al. 2022; Faherty et al. 2021). For example, through the Rockefeller Foundation’s U.S. Equity First Vaccination Initiative, partners like CBOs made nearly 15 million connections with community members to disseminate accurate COVID-19 information and held more than 4,000 vaccination events (Faherty et al. 2022). Another program, funded by the NIH and administered by California’s statewide alliance, STOP COVID-19 CA, leveraged community partnerships and brought together 11 academic sites and 75 community partners to learn from each other and better

Key informant spotlight: Sharing personal stories of vaccination



A community-based organization that focuses on media strategies and works across several states captured stories from about 500 people talking about their COVID-19 vaccination experiences and then shared those stories at events hosted in conjunction with community partners. The key informant noted that having “real people” share their stories of COVID-19 vaccination was more effective than testimonials from celebrities or others outside the community.

communities in San Bernardino County, California partnered with faith and community leaders to host educational webinars to address vaccine hesitancy (Abdul-Mutakabbir et al. 2022). One program administered by an academic hospital, the San Francisco Department of Public Health, and community members had peer vaccine ambassadors speak with unvaccinated friends and family about the COVID-19 vaccine, share their positive experiences at the community vaccination site, and provide information about how to register for vaccination (Marquez et al. 2021a).

- **Several programs serving immigrant and non-English speaking communities had multilingual staff or translators available on site to ensure accessibility of services.** This helped programs reach Latinx communities (Faherty et al. 2022; Gupta et al. 2022). One program in San Francisco, California had Spanish-speaking Latinx community members conduct educational outreach such as going door-to-door and hosting townhalls to raise awareness about vaccine eligibility, disseminate vaccine education, and promote the program’s vaccination site (Marquez et al. 2021a). Another program administered by a primary care clinic in Clarkson, Georgia used a combination of in-person translators and phone translation services to increase access to COVID-19 vaccinations for non-English speaking populations (Malone et al. 2022). Likewise, one key informant described their health system’s community health worker program in a tribal nation that paired community health workers with native speakers of the local tribal language to promote COVID-19 vaccination and testing via outreach.

- **COVID-19 vaccination programs took advantage of routine vaccination services and messaging.**

For example, a multi-state program using pharmacists to provide COVID-19 vaccines to American Indians and Alaska Natives found that existing infrastructure from a previous mass vaccination program designed to improve routine immunization rates among Native American children facilitated a successful COVID-19 vaccination rollout (Gregory 2021). Similarly, key informants described efforts to incorporate COVID-19 vaccines into routine vaccination delivery or messaging. A CBO serving tribal populations in several states that previously focused on routine vaccination efforts used some of its strategies (such as peer education about vaccination) to also promote COVID-19 vaccination. As COVID-19 vaccines become part of a more routine vaccination schedule, with similar funding sources to other vaccinations, bundling services or messaging may become a more prevalent strategy. For example, a key informant representing a health system in a tribal nation described incorporating COVID-19 vaccinations into flu vaccine clinics offered in the community during the fall and winter months.

Key informant spotlight: Bundling information on COVID-19 vaccination with routine vaccination



A key informant from a foundation with national reach reported that incorporating information about COVID-19 into routine vaccination messaging was effective, given that “people are just done with hearing about COVID.” The key informant believed that sharing information more broadly about vaccinations in general, including COVID-19, softened the message and made it more appealing to people who may have otherwise been hesitant to engage.

Programs developed population-specific messaging strategies to increase vaccine awareness and confidence.

- **Programs developed and translated culturally tailored messaging to ensure the relevance and accessibility of COVID-19 information for their populations of focus.**

Programs developed messaging in multiple languages to address COVID-19 misinformation among community members who speak English as a second language (Alcendor et al. 2022a). One program administered by the state health department, a health system, faith-based groups, and community-based organizations in Baltimore, Maryland advertised bilingual hotline numbers through Spanish-language local media outlets (Bigelow et al. 2022). Another program in California also developed tailored materials that were informed by the local and contextual needs of communities, such as whether they were farmworker or urban communities (AuYoung 2022). Several programs also used trusted messengers from the same backgrounds as communities of focus. These messengers were able to have culturally relevant conversations about COVID-19 vaccination

Key informant spotlight: Using trusted messengers



A local health department implemented a trusted messenger program to increase vaccine awareness and acceptance. The health department trained individuals representative of the local population, such as community health workers, to speak with people about COVID-19 vaccination at community events and provided small grants that these individuals could use to develop and implement vaccine awareness campaigns in their communities. The key informant noted that using trusted messengers helped overcome community mistrust in medical institutions due to historical marginalization.

with other community members. For example, one national program administered by a long-term care provider that sought to increase vaccine confidence among Black and Latinx nursing home staff had nursing leaders from racially diverse backgrounds offer small group discussions and one-on-one conversations to answer culturally sensitive questions and increase vaccine acceptance (Feifer et al. 2021). Providing early vaccination to nursing home staff was enabled by the CDC's Pharmacy Partnership for Long-Term Care Program. Another program in Los Angeles County used providers trained in motivational interviewing and trauma-informed care to provide COVID-19 vaccine education and administration (Rosen et al. 2023).

- **Programs used a broad range of communication channels, from social media to mass media to door-to-door outreach.** This strategy helped programs promote vaccination services and increase the reach of their messaging. For example, one program administered by an academic institution, the state

Key informant spotlight: Social media strategies to promote vaccine confidence



A foundation with national reach partnered with media agencies to create campaigns to identify, monitor, and reduce vaccine hesitancy among racial and ethnic minority groups. Media agencies created materials without branding so that community-based organizations could use their organizational logos and launch them on their social media pages. The lack of centralized branding was a deliberate effort to avoid impressions of government agency involvement, as the foundation recognized that many racial and ethnic minority groups have a historically informed distrust of government and institutional involvement in their health.

health department, and community-based organizations in Tennessee developed flyers, infographics, and held Facebook Live sessions focused on vaccine safety and efficacy to address COVID-19 misinformation (Alcendor et al. 2022a). Other programs specifically disseminated their COVID-19 vaccination messaging on Spanish-language radio shows (Marquez et al. 2021a; AuYoung et al. 2022). Additional outreach methods included phone calls (Relias Media 2021; Gregory 2021), street outreach (Bigelow et al. 2022), and door-to-door campaigns (Relias Media 2021; Massachusetts Department of Public Health 2021; Marquez et al. 2021a). Similarly, key informants echoed strategies of disseminating messages through culturally specific media channels and hosting community conversations to address vaccine hesitancy.

Programs provided participants with additional supports to overcome barriers to services and enhance availability of and access to COVID-19 vaccinations.

- **Programs offered extended or shifted hours and walk-in appointments to accommodate community members' working schedules and inability to take time off from work.** For example, staff from the Planned Parenthood COVID-19 Vaccination Campaign expanded the operating hours of their vaccine clinics to better serve people who finish their working day in the evening and are unable to take time off (Relias Media 2021). Complicated scheduling and registration processes can also deter individuals who might have unconventional working schedules or do not have time to register for an appointment in advance. To address this, several programs offered walk-in appointments or individualized registration processes that allowed for community members to bypass registration forms and phone lines (Malone et al. 2022; Marquez et al. 2021a; Faherty et al. 2021). Similarly, a key informant's FQHC offered COVID-19 vaccine appointments on evenings and weekends and provided

on-site vaccinations at major employers and social service organizations to increase access among the clinic's patient population.

- **Several programs provided COVID-19 vaccinations without requiring identification or proof of insurance, residency, or occupation to increase vaccine access among low-income and immigrant populations.** For example, some programs primarily serving Latinx communities provided COVID-19 vaccinations without requiring community members to provide proof of residency, vaccine eligibility, or health insurance status (Marquez et al. 2021a) or identification or proof of occupation (Bigelow et al. 2022). One mobile vaccination program in New York offered free services to all patients, regardless of insurance status (Association of American Medical Colleges 2022). Several key informants from organizations serving people without documentation implemented these strategies as well. For example, one key informant from a CBO in a large city noted that it assured its clients receiving COVID-19 vaccinations that none of their personal data would be shared. The informant also believed its clients were more comfortable receiving vaccinations at the CBO's community center, because they perceived it as a safe space, rather than at a government facility such as a health department.
- **A few programs offered recipients transportation assistance.** For example, one national program planned to have health insurance providers coordinate transportation services for senior patients (American's Health Insurance Plans 2021), and another program's community engagement coordinator collaborated with community partners to help recipients register for and access transportation to vaccine appointments in Clarkston, Georgia (Malone et al. 2022). A few key informants described partnering with ride-share apps; for example, a national pharmacy retailer partnered with Lyft to provide free or discounted rides for clients to vaccine appointments. Similarly, a CBO partnered with ride-share apps to help transport clients to vaccine appointments at clinics offered through the city health department.

Programs offered financial incentives to increase uptake for low-income recipients. Only a few programs identified in the literature provided financial incentives to increase vaccine uptake among low-income communities (Rosen et al. 2023; Relias Media 2021; Faherty et al. 2021). In contrast, offering financial incentives was common among key informants' organizations (including CBOs, health centers, and state and local health departments), usually in the form of gift cards, ranging in value from \$25 to \$300. One key informant from a federal agency noted that there was a high level of interest in providing incentives for COVID-19 vaccination, including from the White House, which may have prompted many programs to offer vaccine incentives. Key informants noted that offering gift cards helped to offset some financial barriers to vaccination, such as money for gas to drive to vaccination events.

Finally, some programs worked to address social and other health needs while providing vaccine services. A few vaccination programs identified in the literature provided additional services or referrals to address social and other health care needs such as case management, food supports, ride vouchers, COVID-19 tests, contact tracing, and other preventive health care services (Gregory et al. 2021; Gupta et al. 2022; Ahmad et al. 2022; Mathur et al. 2022). Several key informants' organizations also provided services to meet an identified need in their community, such as food assistance. For example, CBOs and local health departments partnered with food pantries or mobile farmer's markets to distribute food at vaccination events. Other programs addressed unique needs in their community; for example, one CBO partnered with a local organization to provide legal aid at vaccination events.

3. Challenges to COVID-19 vaccination program implementation

Like COVID-19 testing programs, COVID-19 vaccination programs faced implementation challenges related to insufficient resources and inefficient program operations and logistics. In this section, we describe these challenges. In the following section, we discuss the strategies program personnel used to facilitate program implementation.

Exhibit IV.4. Implementation challenges and strategies of COVID-19 vaccination programs

Category	Challenges staff faced in program implementation	Strategies staff used to facilitate program implementation
Resources	Budget and funding constraints, staffing limitations, and issues with meeting vaccine storage and handling requirements posed a challenge to program implementation.	Training existing and additional personnel and volunteers, relying on technical assistance from funders or government agencies, and taking advantage of flexibility from funders to implement innovative strategies helped programs overcome resource limitations.
Operations and logistics	Issues with patient tracking, site-specific challenges, and inconsistent information sharing decreased efficiency of program operations.	Conducting careful planning prior to program rollout and conducting ongoing program monitoring and quality improvement helped programs strengthen their operations.

Programs commonly faced resource challenges.

- Some key informants reported insufficient funding, while others struggled to use the amount of funding that was available.** For example, one CBO struggled with limited funding availability at the beginning of the pandemic and restrictions on how grant funds could be used (for example, they could not be used to purchase vaccine incentives). Conversely, even when sufficient funding was available, organizations sometimes struggled to use large amounts of funding in short periods of time. For example, a respondent from a federal agency noted that during the COVID-19 pandemic, there was more funding going to tribal jurisdictions than ever before, and some grantees experienced challenges quickly expanding their staffing and operations in response.
- Several programs faced staffing challenges that made it difficult for programs to effectively reach community members.** For example, some programs had insufficient staff to implement additional vaccination sites and more staff-intensive modes of vaccine delivery, such as personalized telephone outreach and door-to-door campaigns (Beste et al. 2021; Le-Morawa et al. 2022). Another program that used pharmacists to provide vaccines to Medicaid-insured populations faced staffing challenges in retail pharmacies (Osibanjo et al. 2022; see spotlight). Some key informants also

Spotlight on staffing challenges and solutions



Challenge: A program that provided vaccines to Medicaid-insured populations through retail pharmacists faced staffing challenges due to competing demands for pharmacists' time, including their responsibilities to provide other vaccinations and fill prescriptions. At times, pharmacists needed to conduct outreach to unvaccinated individuals but did not have the capacity to do so.

Solution: The program used a rapid response team composed of nurses and care management staff to conduct scheduling outreach on behalf of pharmacists (Osibanjo et al. 2022).

reported staffing challenges, both with hiring new staff and utilizing resources and meeting grant reporting requirements due to limited staff capacity.

- **Insufficient or unpredictable vaccine supply, as well as requirements for storing and handling vaccines, hindered program activities.** Programs had to develop strategies to minimize disruption for community members (Beste et al. 2021; Public Health—Seattle and King County 2021). For example, one program that delivered vaccines to veterans struggled with inconsistent vaccine supply and had to maintain constant communication with recipients and partners to keep them apprised of the availability of vaccines (Beste et al. 2021). A key informant from a national retail pharmacy chain shared that ensuring that transportation trucks and pharmacies had the capability to store vaccines (for example, having enough ultracold freezers) was a major challenge.

Programs also faced operational and logistical challenges that hindered appropriate vaccine delivery and messaging.

- **Some regional and state programs faced challenges around accessing and sharing patient vaccination data.** One program administered by a regional Veteran’s Affairs health care system reported being unable to access data on vaccinations that veterans received outside of the VHA because the VHA and state immunization systems are unable to exchange data (Beste et al. 2021). This meant that some veterans received multiple outreach communications despite being vaccinated. Similarly, another program administered by a health plan in Oregon that serves Medicaid found that data lags between the county and pharmacies meant adult care home vaccinators did not always know whether a person had already been vaccinated, making it difficult to identify priority adult care homes for vaccination (Osibanjo et al. 2022).
- **Inconsistent information sharing was also a challenge.** A state-level program in California in our review found that the lack of infrastructure for consistent information sharing across federal, state, and county agencies made it difficult to understand and communicate the rapidly changing COVID-19 guidelines to its community (AuYoung et al. 2022).
- **Several programs that implemented vaccination clinics encountered challenges related to characteristics of their vaccination sites.** For example, one program serving tribal reservations in rural settings faced difficulties transporting vaccines (Gregory 2021), and another program serving the San Carlos Apache Tribe struggled to implement mass vaccination events due to inconsistent wireless connectivity (Le-Morawa et al. 2022). Another program in Los Angeles, California faced difficulties implementing community vaccination clinics for unsheltered people experiencing homelessness due to frequent encampment sweeps (Choi et al. 2022; Rosen et al. 2023).

4. Strategies to facilitate COVID-19 vaccination program implementation

In this section, we elaborate on the strategies program personnel used to facilitate program implementation introduced in Exhibit IV.4.

While most programs did not describe implementation strategies, those that did commonly used strategies to alleviate resource constraints.

- **Some programs trained additional staff and volunteers to expand their capacity or to incorporate new program approaches.** For example, as part of the COVID-19 vaccine rollout in the San Carlos Apache Tribe, a program offered trainings with support from FEMA on door-to-door vaccination campaigns (Le-Morawa et al. 2022). Trainings

Key informant spotlight: Training pharmacists



- A national pharmacy retailer partnered with community-based organizations to hold community dialogue events in major cities to gather community feedback about the COVID-19 vaccine; it then used learnings from the events to train pharmacists to talk about the vaccine with clients.
- A national pharmacy association provided educational web-based resources to community pharmacists about increasing COVID-19 vaccine confidence among their patients. The resources covered a range of topics intended to address concerns about and build confidence in the COVID-19 vaccines.

also provided personnel (including staff and volunteers) with information on COVID-19 symptoms, transmission, guidelines, vaccine efficacy, and guidance around how to communicate with certain populations (Marquez et al. 2021a; Beste et al. 2021; Faherty et al. 2022; Abdul-Mutakabbir et al. 2022). One neighborhood vaccination program provided site staff COVID-19 education and ongoing refresher trainings that would enable them to answer community questions and address concerns (Marquez et al. 2021a). Key informants also emphasized the importance of staff training; for example, one FQHC aimed for all its clinical staff to become so-called vaccine advocates.

- **Key informants valued the technical assistance that they received from funders or government agencies.** These included trainings on topics such as effective outreach and messaging to promote COVID-19 vaccines, community engagement strategies, addressing vaccine hesitancy, data and metrics to inform program delivery (such as the [Social Vulnerability Index](#)), addressing staff burnout, and sustainability planning. In addition, several CBOs reported their technical assistance providers facilitated connections to local clinical or public health partners that were willing to co-host vaccination events. Some CBOs also had regular meetings with their cohort of grantees implementing similar programs, which was useful for sharing challenges and lessons learned. Key informants that reported the benefits of technical assistance commonly represented CBOs and health departments.
- **Several key informants took advantage of flexibilities in their funding sources when implementing COVID-19 vaccination strategies.** For example, a key informant from a federal agency noted that its awardees used COVID-19 vaccination funds to purchase vehicles (to offer mobile vaccination) or provide vaccine incentives; using funding for these activities as part of routine vaccination programs was not allowed prior to the pandemic. A state-wide program in California identified reducing bureaucratic obstacles to obtaining funding as a key strategy to minimize the administrative burden on community organizations (AuYoung et al. 2022). In addition to funding, some key informants

(primarily from CBOs) reported receiving resources such as vaccines from local health agencies or clinical partners, which enabled them to use their grant funding for other purposes, such as community outreach.

Programs used other strategies to overcome operational and logistical challenges, including careful implementation planning and ongoing quality improvement.

- **Program planning enabled a smoother vaccine rollout.** Program planning centered around vaccination prioritization strategies, obtaining and storing vaccine supply, and outreach and education strategies (Le-Morawa et al. 2022; Gregory 2021; New York State Department of Health 2020; Petet et al. 2022; Feifer et al. 2021). For example, prior to the COVID-19 vaccine rollout in the San Carlos Apache Tribe, program staff acquired an ultracold freezer to store vaccines, developed a playbook to administer vaccines based on ACIP guidelines, identified high-priority individuals for vaccination, and developed call lists for future community outreach (Le-Morawa et al. 2022).
- **A few programs in the literature, as well as several key informants' organizations, conducted ongoing monitoring and quality improvement strategies during program implementation.** Programs used findings from their monitoring to identify lags in vaccination across zip codes and communities and inform their vaccine delivery and messaging approaches. For example, the Puget Sound Veterans Affairs Health Care System Vaccination Drive team regularly monitored vaccine equity by comparing the cumulative proportion of individuals vaccinated by race and ethnicity, sex, and rural status within defined age groups. The team then discussed findings and developed proactive, tailored interventions focusing on equitable vaccine delivery (Beste et al. 2021). Another mobile vaccination clinic used ongoing quality improvement to identify disparities in access across groups, evaluate outreach strategies, and understand drivers of vaccine hesitancy (Rosen et al. 2023). The program then developed educational pamphlets and games to address the most common reasons for hesitancy. Similarly, key informants from state and local health departments, as well as a federal funder and a national pharmacy retailer, described regularly reviewing COVID-19 vaccination rates and tracking COVID-19 outbreaks among the communities they serve and using these data to focus their vaccination efforts.

**Key informant spotlight:
Clinician report cards**



A federally qualified health center developed a report card for every clinician that assessed COVID-19 vaccination rates for each clinician's patient panel. The report card also assessed the rate of patients who came in unvaccinated and "converted" by agreeing to receive the vaccine. The key informant noted that this program helped foster a healthy sense of competition among clinicians.

V. Key findings on routine vaccination

This section provides an overview of guidelines for routine vaccinations and how the COVID-19 pandemic affected routine vaccination rates (Section V.A). We then summarize the routine vaccination programs' primary approaches and delivery strategies, the implementation challenges they experienced, and the implementation strategies they used to overcome those barriers (Section V.B).

A. Routine vaccination guidelines, changes in vaccination rates during the COVID-19 pandemic, and pandemic-related barriers to routine vaccination

Guidelines for recommended routine vaccinations vary by age, as outlined in Exhibit V.1 below. In addition to age-specific guidelines, influenza vaccination is recommended yearly across age groups, starting at age 6 months (CDC 2016).

Exhibit V.1. Guidelines on routine vaccinations by age group as of April 2023

Age group	Recommended vaccination	Recommended schedule
Children under age 6 ^a	Hepatitis B (HepB)	Administered in three doses: at birth, ages 1–2 months, and between ages 6–18 months
	Rotavirus (RV)	Administered in two or three doses (depending on the vaccine brand): at ages 2 months, 4 months, and 6 months
	Diphtheria, pertussis, tetanus (DTaP)	Administered in five doses: at ages 2 months, 4 months, 6 months, between 15–18 months, and between 4–6 years
	Haemophilus influenzae type b (Hib)	Administered in three or four doses (depending on the vaccine brand): at ages 2 months, 4 months, 12 months, and at 6 months in the four-dose series
	Pneumococcal disease (PCV13, PCV15)	Administered in four doses: at ages 2 months, 4 months, 6 months, and between 12–15 months
	Polio (IPV)	Administered in four doses: at ages 2 months, 4 months, between 6–18 months, and between 4–6 years
	Measles, mumps, and rubella (MMR)	Administered in two doses: between ages 12–15 months and between ages 4–6 years
	Varicella (Chickenpox)	Administered in two doses: between ages 12–15 months old and between ages 4–6 years
	Hepatitis A (HepA)	Administered in two doses: at age 12 months and between ages 18–23 months
	Influenza	Recommended yearly after 6 months of age
	COVID-19	The number of doses recommended vary by vaccine history, age, and type of COVID-19 vaccine ^e
Youth between ages 9–17 ^{b, c}	Meningococcal conjugate vaccine (MenACWY)	Administered in two doses: at ages 11–12 years and at age 16
	Human papillomavirus (HPV)	Administered in a two-dose series, separated by 6–12 months, starting as young as age 9
	Tetanus, diphtheria, pertussis, booster (Tdap)	Administered between ages 11–12 years

Age group	Recommended vaccination	Recommended schedule
	Meningococcal vaccine for serogroup B virus (MenB)	Recommended for those at risk due to an outbreak and for people with specific medical conditions
	Influenza	Recommended yearly
	COVID-19	The number of doses recommended vary by vaccine history, age, and type of COVID-19 vaccine ^e
Adults ages 18 and over ^d	Hepatitis B (HepB)	Recommended for adults ages 19-59. Administered in two, three, or four doses (depending on the vaccine brand)
	Tetanus (Td) or Tetanus, diphtheria, pertussis (Tdap)	Td or Tdap booster recommended every 10 years and one Tdap booster recommended during pregnancy
	Measles, mumps, and rubella (MMR)	Recommended for adults if no evidence of immunity or prior vaccination is available
	Varicella (Chickenpox)	Recommended for adults if no evidence of immunity or prior vaccination is available
	Human papillomavirus (HPV)	Recommended for adults through age 26 years, if an initial HPV series was not completed using the recommended dosing intervals
	Pneumococcal vaccines	Recommended for all adults ages 65 years and older and persons with certain medical conditions
	Shingles (zoster)	Recommended for adults over age 50
	Influenza	Recommended yearly
	COVID-19	The number of doses recommended vary by vaccine history and type of COVID-19 vaccine ^e

Notes: The table outlines routine vaccination guidelines. CDC also provides detailed recommendations for catch-up vaccinations for children, for people with specific risk factors, and for people in geographic areas where diseases (such as dengue) are endemic. The following references provide additional information and comprehensive guidelines.

- Sources:
- a. Centers for Disease Control and Prevention. (February 10, 2023). Recommended Vaccinations for Infants and Children, Parent-Friendly Version. Birth through 6 Years, United States, 2023. <https://www.cdc.gov/vaccines/schedules/easy-to-read/child-easyread.html>. Accessed May 2, 2023.
 - b. Centers for Disease Control and Prevention. (October 12, 2021). Meningococcal Vaccine Recommendations. <https://www.cdc.gov/vaccines/vpd/mening/hcp/recommendations.html>. Accessed March 16, 2021.
 - c. Centers for Disease Control and Prevention. (February 10, 2023). Recommended Vaccinations for Children 7 to 18 Years Old, Parent-Friendly Version. <https://www.cdc.gov/vaccines/schedules/easy-to-read/adolescent-easyread.html>. Accessed May 2, 2023.
 - d. Centers for Disease Control and Prevention. (April 27, 2023). Adult Immunization Schedule by Age. <https://www.cdc.gov/vaccines/schedules/hcp/imz/adult.html#note-pneumo>. Accessed May 2, 2023.
 - e. Centers for Disease Control and Prevention. (May 31, 2023). COVID-19 Vaccine Interim COVID-19 Immunization Schedule for Persons 6 Months of Age and Older. <https://www.cdc.gov/vaccines/covid-19/downloads/COVID-19-immunization-schedule-ages-6months-older.pdf>. Accessed June 1, 2023.

Routine vaccination rates for school-age children and youth fell during the COVID-19 pandemic but were relatively consistent for children in the first 24 months of life. Children who were living below the poverty level, uninsured or on Medicaid, or in rural areas experienced declines in vaccination rates. CDC data on children in kindergarten during the 2020–21 school year show a 1-percent decrease in vaccination rates across routine vaccinations (including the measles, mumps, and rubella vaccine; the diphtheria, pertussis, tetanus vaccine; and the varicella vaccine) compared to the 2019–20 school year (Seither et al. 2022). A similar 1-percent decrease occurred between the 2020-21 and 2021-22 school year (Seither et al. 2023). For younger children, born in 2018-2019, vaccination coverage remained consistent during the

pandemic for most routine vaccinations (Hill et al. 2023). However, flu vaccination rates for children ages 6 months to 17 years dipped by 6 percentage points in the 2020–21 flu season compared to the 2019–20 season (Williams et al. 2022). There were also reductions in human papillomavirus (HPV) vaccination rates for youth, with one study estimating a 60 percent decline in March–May 2020 compared to March–May 2021 (Stokley 2022; Patel Murthy et al. 2021). Studies have also demonstrated disparities in vaccination coverage for specific populations during the pandemic. For example, despite overall consistency in vaccine coverage for children in the first 24 months of life, one study identified dips in routine vaccination for children under 24 months who were living in rural areas or below the federal poverty level (Hill et al. 2023). The study also noted persistent disparities in vaccination coverage by race and ethnicity and socioeconomic status, with routine vaccination coverage being lowest among Black children and children without private insurance (Hill et al. 2023). Another study similarly identified that children who were uninsured or insured through Medicaid had sharper declines in routine vaccination compared to the general population (Skolnik et al. 2021).

Influenza vaccination rates were associated with COVID-19 vaccination rates for adults ages 18-64. Flu vaccination rates for adults remained relatively consistent between the 2019-20 and 2020-21 flu seasons (Williams et al. 2022; Leuchter et al. 2022). However, this relationship shifted in 2021-22 after the introduction of COVID-19 vaccinations. To illustrate, in the 2021-22 flu season, states with the highest rates of COVID-19 vaccination experienced an increase in rates of flu vaccination compared to the 2019-20 flu season. States with the lowest rates of COVID-19 vaccination in 2021-22 experienced a decrease in flu vaccination rates compared to the 2019-20 flu season (Leuchter et al. 2022). This suggests that factors influencing rates of COVID-19 vaccination, such as mistrust, may have also impacted flu vaccination rates (Leuchter et al. 2022).

Pandemic-related disruptions in health care, fears about COVID-19 transmission, and social and economic impacts on families were primary causes of reduced rates of routine vaccinations. Studies suggest that reduced availability of primary care services during the pandemic, parental concerns about COVID-19 transmission, social and economic effects of the pandemic on families, stay-at-home orders, and disruption to the health care system contributed to declines in routine vaccination rates during the pandemic (Santoli et al. 2021; Stokley 2022; Seither et al. 2022). Programs in our review observed similar pandemic-related barriers to routine vaccinations. For example, one health center in Boston developed a mobile vaccination program after parental concerns about COVID-19 transmission and other social and economic effects from the pandemic led to reduced routine pediatric vaccination rates (Leibowitz et al. 2021). Similarly, another vaccine education outreach program cited the negative impact of stay-at-home orders, fears of contracting COVID-19 in medical settings, and general disruption of health care operations on well-child visits and routine childhood vaccinations (Deerin et al. 2022).

COVID-19 vaccine hesitancy and relaxed school vaccine requirements may also have impacted routine vaccination rates. COVID-19 vaccine hesitancy may have affected confidence in routine childhood vaccination and flu vaccination (referred to as a carryover effect) (CDC 2022j; Leuchter et al. 2022). Predominant sources of information on vaccination also impacted vaccine confidence: during the pandemic, people received more vaccine-related information from the news, internet, and social media and less information from primary care clinicians (American Academy of Family Physicians 2021). Relaxed vaccine requirements for remote students, reduced staffing in schools, and lower reporting and response

rates from schools and parents may have also impacted reported routine vaccination rates in school-based data (Seither et al. 2022).

B. Routine vaccination programs

Our literature review identified a relatively small number of sources (six) describing programs focused on increasing routine vaccination rates during the COVID-19 pandemic. These programs cited the negative impact of the COVID-19 pandemic on routine vaccination as motivation for their efforts. Observing declines in routine vaccination rates, some federal programs and funders shifted some focus from COVID-19 to support local programs’ efforts. For example, the Office of Infectious Disease and HIV/AIDS Policy in OASH, HHS, launched a campaign to promote routine childhood immunizations, Catch-up to Get Ahead.

In this section, we discuss findings from the literature and key informant interviews on how programs used primary approaches and delivery strategies to attempt to improve routine vaccination rates, the implementation challenges they experienced, and their implementation strategies.

1. Primary approaches used for routine vaccination programs during the COVID-19 pandemic

While routine vaccination programs used some approaches that COVID-19 testing and vaccination programs used, routine vaccination programs also used traditional primary care settings to increase access to vaccinations. Unlike COVID-19 testing and vaccination programs, routine vaccination programs in our review did not use mass vaccination clinics or vaccination education events as primary approaches during the pandemic. Exhibit V.2. summarizes the routine program approaches described in the literature and by key informants.

Exhibit V.2. Primary approaches of routine vaccination programs during the COVID-19 pandemic

Approach	Description
Increase access to routine vaccinations	
Vaccination in health care settings	Health care settings such as federally qualified health centers administered vaccines at well-child visits and other appointments, or established walk-in clinics to administer routine vaccines at their facilities.
Community vaccination clinics	Programs held vaccination clinics in convenient community sites where people congregate. The clinics relied on existing infrastructure from the community sites. These were usually recurring initiatives but also included one-time vaccination clinics (for example, at schools).
Mobile vaccination clinics	Traveling vans or mobile units brought vaccines to convenient locations in the community, and individuals came to the mobile unit to receive vaccines.
Increase awareness of and confidence in routine vaccinations	
Vaccination education outreach	Programs conducted outreach to populations of focus to share educational information on vaccine-preventable diseases and routine vaccinations to address vaccine hesitancy or to promote and coordinate uptake of vaccines. Outreach methods included social media, phone calls, text messages, radio and television ads, and flyers.

Routine vaccination programs prioritized community-centered approaches and approaches in health care settings.

- **Vaccination in health care settings.** Clinical providers typically provide routine vaccinations for children and adults during primary care visits and other types of appointments. During the COVID-19 pandemic, key informants described continuing to use this approach in health care settings such as

FQHCs and tribal health facilities. For example, a key informant from a federal agency reported that the tribal health facilities that it funds offered routine child and adult vaccines at all health care appointments, regardless of the reason for the visit. These tribal health facilities also began offering regular on-site walk-in clinics for routine vaccination.

- **Community vaccination clinics.** Like COVID-19 vaccination clinics, community clinics for routine vaccinations enabled programs to use community sites or community events to deliver vaccines more equitably and make them more convenient for community members. For example, one key informant’s CBO began offering routine adult vaccinations on-site at their community center in early 2023, after successfully using this approach for COVID-19 vaccination. Another key informant’s local health department used community vaccination sites established during the pandemic (such as those at libraries) to administer routine vaccines. Organizations that reported implementing this approach in key informant interviews included tribal health systems, a CBO, a state health department, and a local health department.
- **Mobile vaccination clinics.** Mobile vaccination clinics similarly enabled programs to make services more convenient and tailor them to the needs of specific populations. One program administered by FQHCs in partnership with a hospital that implemented mobile vaccination clinics found that this approach was particularly helpful for reaching families who had COVID-19 transmission concerns (Leibowitz et al. 2021). Routine vaccination programs in our scan that implemented mobile vaccination clinics were administered by FQHCs, a hospital, and a local health department.

Key informant spotlight:
Using COVID-19
infrastructure for routine vaccines



One local health department used mobile units that had provided COVID-19 vaccines to provide routine vaccines in communities with the highest geographic barriers to access. The health department has used the mobile units to administer flu and mpox vaccines, as well as other health services and social supports. The health department also used sites at schools that it had originally established for COVID-19 vaccination to administer flu vaccines.

Vaccination education and outreach was another primary programmatic approach. This approach helped programs increase awareness of routine vaccines and combat declining rates during the pandemic. For example, a rural health care center in Colorado implemented a reminder message campaign for HPV vaccination to improve rates of appointment scheduling (Kepka et al. 2021). Some national programs explicitly implemented vaccine education outreach approaches to increase routine vaccination rates that declined due to the COVID-19 pandemic (Deerin et al. 2022; U.S. Department of Health Human Services 2021; March of Dimes 2021; National Foundation for Infectious Diseases 2022). Of the vaccine education outreach programs we identified, most were administered by national entities, such as federal agencies, national foundations and non-profit organizations, and large hospitals or health systems. Similarly, key informants described campaigns to promote routine vaccinations via email, text, print, and social media. One CBO working with tribal communities across three states also worked with schools to provide technical assistance and educational materials for administrators and nurses to talk about vaccines.

2. Strategies to facilitate delivery of routine vaccination programs during the COVID-19 pandemic

Like COVID-19 vaccination programs, routine vaccination programs used several key strategies to enhance the effectiveness of their primary approaches (Exhibit V.3). These strategies simultaneously worked to increase access to, awareness of, and confidence in vaccines.

Exhibit V.3. Strategies to facilitate delivery of routine vaccination programs during the COVID-19 pandemic

Strategy	Examples
Increase access to, awareness of, and confidence in routine vaccinations	
Draw on strategies from COVID-19 for routine vaccination	<ul style="list-style-type: none"> • Telling personal stories (Key informants) • Streamlining check-in processes (Key informants) • Reducing wait times (Key informants) • Offering extended hours (Key informants)
Engage multilingual staff	<ul style="list-style-type: none"> • Diverse staff (Leibowitz et al. 2021) • Interpretation staff (Leibowitz et al. 2021)
Increase awareness of and confidence in routine vaccinations	
Form partnerships to deliver messaging	<ul style="list-style-type: none"> • Partners disseminate vaccine messaging and advocacy (March of Dimes 2021)
Use multiple channels to increase reach of vaccination messaging	<ul style="list-style-type: none"> • Text message vaccine reminders (Kepka et al. 2021) • Email vaccine reminders (Kepka et al. 2021) • Social media (Deerin et al. 2022) • Postcards (Deerin et al. 2022) • Local newspaper (Deerin et al. 2022) • Radio (Deerin et al. 2022) • Patient education from providers (Key informants)
Other goals	
Coordinate vaccination with other health services	<ul style="list-style-type: none"> • Preventive pediatric care (Leibowitz et al. 2021) • Physical examinations (Leibowitz et al. 2021)

Routine vaccination programs built upon strategies used to deliver COVID-19 vaccination services—or used strategies similar to those used for COVID-19—to enhance vaccine delivery and increase vaccine awareness and confidence.

- **Key informants drew on messaging strategies and infrastructure used to promote and deliver COVID-19 vaccination, helping them enhance routine vaccination delivery services.** For example, a key informant from an FQHC seeking to improve routine childhood vaccination rates found telling personal stories and testimonials to be an effective method to promote vaccine confidence for COVID-19. This informant (a clinician) began sharing with patients about getting their own children vaccinated against flu and other illnesses. The FQHC also incorporated process improvements from the COVID-19 vaccination rollout into routine vaccination efforts, such as streamlining check-in, reducing wait times, and offering expanded hours for vaccination. Another key informant from a federal agency reported that tribal health facilities implemented similar improvements, such as expanding evening and weekend hours and establishing standing times for walk-in vaccinations. In

addition to drawing on process improvements developed for COVID-19 vaccination, some key informants also bundled routine vaccinations, like the flu vaccine, with COVID-19 vaccination at their community vaccination clinics.

- **Like COVID-19 programs, one routine vaccination program in our review hired multilingual and diverse staff to facilitate communication with non-English speaking populations and enhance vaccine delivery.** The program, administered by health centers and a hospital in Boston, Massachusetts, involved staff “who reflected the diversity of their patient population” to deliver mobile vaccine services (Leibowitz et al. 2021, p. 3). It also offered interpretation services on-site to ensure effective communication.

Like COVID-19 programs, routine vaccination programs used partnerships and specific dissemination strategies to augment primary approaches focused on increasing awareness of and confidence in routine vaccinations.

- **Routine vaccination programs partnered with national, state, and community organizations to disseminate information and provide advocacy support.** Partnerships with organizations that have a broader reach than programs augmented vaccine education outreach efforts (HHS 2021d; NFID 2022). For example, a national vaccine education outreach program that sought to educate families about recommended vaccines and no-cost access through the Vaccines for Children program proposed using a national network of partners, community leaders, health care providers, and influencers to support dissemination of educational information and advocacy (March of Dimes 2021).

Key informant spotlight: Community conversations to promote routine vaccination



A community-based organization focused on tribal populations in three states trained community members to share their vaccine-related experiences with their families, friends, and coworkers to encourage routine vaccination, and later COVID-19 vaccination. This organization also hosted community listening sessions led by tribal leaders and providers; they used learnings from these events to inform their education and outreach materials about routine vaccines, as well as the COVID-19 vaccine.

- **Programs used various channels to effectively disseminate routine vaccination information.** This strategy supported programs’ efforts to schedule vaccination appointments (Kepka et al. 2021; Deerin et al. 2022). For example, one program that sought to increase HPV vaccination rates implemented an HPV vaccination reminder message campaign using text messages and email to contact parents or caregivers (Kepka et al. 2021). As part of an HHS-funded, federal program that promoted routine childhood immunizations, FQHCs had staff conduct on-site promotion at health centers; call patients; mail postcards and letters to patients; and use social media, local newspapers, radio, television, and email to promote vaccines (Deerin et al. 2022). Similarly, key informants described clinicians providing patient education on routine vaccination during medical appointments using techniques such as motivational interviewing.

One program that implemented a mobile vaccination clinic also offered other health services to maximize access to vaccinations and preventive care visits (Leibowitz et al. 2021). Specifically, the program offered examinations and other preventive pediatric care to families who might not otherwise seek in-person care due to concerns about COVID-19 transmission.

3. Challenges to routine vaccination program implementation

Few of the routine vaccination programs in the literature we reviewed reported implementation challenges. Below we summarize the implementation challenges described in environmental scan sources, followed by the strategies programs used to facilitate program implementation.

Exhibit V.4. Implementation challenges and strategies of routine vaccination programs during the COVID-19 pandemic

Category	Challenges staff faced in program implementation	Strategies staff used to facilitate program implementation
Resources	Budget and funding constraints, staffing limitations, and issues with obtaining supplies posed a challenge to program implementation.	Training existing and additional personnel helped address resource challenges.
Operations and logistics	Lack of time to conduct vaccination activities posed a challenge to program implementation.	Conducting ongoing program monitoring and quality improvement and taking advantage of improvements made during the COVID-19 pandemic for routine vaccination efforts helped programs strengthen their operations.

While few routine vaccination programs reported implementation challenges, those that did faced resource limitations similar to COVID-19 programs. These limitations were compounded by the pandemic.

- **A few key informants reported challenges with bundling routine vaccinations and COVID-19 vaccines due to different funding sources.** For example, a CBO noted that routine vaccinations usually still had a cost or required insurance (which could be a barrier to their client population), unlike the COVID-19 vaccine. The CBO was able to overcome this challenge by partnering with its local health department, which was able to secure funding to provide these vaccines for free. A key informant from a federal agency noted that routine and COVID-19 vaccinations had different funding sources (as of March 2023), and different providers were authorized to distribute them, which made it difficult to fully coordinate distribution.
- **Some routine vaccination programs faced staffing challenges.** One program in the literature faced challenges staffing mobile vaccination clinics aimed at providing routine childhood vaccinations and preventive care visits (Leibowitz et al. 2021). A key informant from a federal agency noted that early in the pandemic, many immunization staff were pulled from their day jobs to work on COVID-19 vaccination efforts, which likely contributed to the decline in routine childhood immunizations during the pandemic.

Routine vaccination programs also faced operational and logistical challenges related to insufficient time to administer vaccines or conduct needed outreach. This was driven by the vaccine delivery approaches used by programs or was a general challenge for providers (Kepka et al. 2021; Leibowitz et al. 2021). For example, a program that implemented a mobile vaccination clinic found that mobile initiatives require more time for outreach and scheduling than traditional clinic visits (Leibowitz et al. 2021). Providers in another program reported that they often did not have enough time to administer vaccines (Kepka et al. 2021). Key informants also described staff being overwhelmed by the COVID-19 pandemic

and not having time to focus on routine vaccination efforts. For example, one state health department shared that encouraging COVID-19 and influenza vaccines was “all our providers could handle,” rather than focusing on all routine vaccinations.

4. Strategies to facilitate routine vaccination program implementation

In this section we elaborate on the strategies introduced in Exhibit V.4 that programs used to facilitate implementation.

Programs invested in personnel who administer routine vaccination programs, helping to address resource challenges.

- **Some programs trained their staff on specific vaccines and best practices for vaccine delivery.** One program offered staff training about the HPV vaccine (Kepka et al. 2021; see spotlight box). Programs also provided training on how to educate recipients, how to communicate about their respective initiative, and how to schedule appointments (Kepka et al. 2021; Leibowitz et al. 2021). Key informants echoed these strategies; for example, one CBO trained providers on motivational interviewing to encourage routine vaccination for children. Additionally, a federal agency developed a new strategy—called E3, or Every patient, Every encounter, Every vaccine—to standardize practices among health care providers and remind them to offer routine vaccinations to every patient, regardless of the reason for the visit.
- **As a counterpoint to staff challenges caused or compounded by the pandemic, one key informant noted that investments in staff and partnerships during the pandemic will ultimately benefit routine vaccination programs.** This informant from a federal agency noted that states have been able to substantially increase the infrastructure for adult vaccinations by increasing the number of staff and immunization providers they work with.

Program spotlight: Personnel training on human papillomavirus (HPV) vaccination



A program offered providers training about the HPV vaccine consisting of two one-hour long video call trainings on HPV vaccination systems, vaccine recommendations, and population-specific guidance. Providers were taught how to deliver a compelling and brief recommendation for the HPV vaccine to their patients (Kepka et al. 2021).

Routine vaccination programs drew on program feedback and investments in data infrastructure to strengthen operations.

- **Some programs implemented quality improvement and evaluation efforts to learn from operational challenges.** One program administered by health centers and a hospital conducted a quality improvement survey with families via telephone and had staff participate in a debrief regarding their experiences after the intervention (Leibowitz et al. 2021; see spotlight). Another program administered by a medical center implemented a pre- and post-intervention survey to assess the effect of its health care provider training efforts on provider knowledge of HPV, HPV vaccination, and barriers to vaccination (Kepka et al. 2021).
- **Like investments in staff and partnerships, key informants noted that investments in data infrastructure during the COVID-19 pandemic will benefit routine vaccination programs.** For example, a federal agency previously did not receive real-time data on any vaccinations but, because of the pandemic, has required that states must report all vaccine data in real time. Similarly, a CBO serving tribal populations in three states used pandemic funding to provide technical assistance on data reporting to smaller tribal organizations that provide routine vaccination services in addition to COVID-19 vaccinations. The CBO assisted the other organizations with new processes for reporting data to funders on activities implemented to improve vaccine confidence and uptake.

Program spotlight: Conducting quality improvement surveys



A program conducted a quality improvement survey of families who used their mobile vaccination clinics. Program staff conducted outreach and interviewed families via telephone. Survey data revealed that families experienced high levels of patient satisfaction and were likely to use mobile clinics again in the future.

Providers in the program also shared their experiences supporting the mobile clinics and reported that clear communication and cultural competency were crucial to the program's success (Leibowitz et al. 2021).

VI. Programs’ approaches to identifying populations and assessing performance

This section provides details on the data sources the programs in our review used to identify priority populations and the metrics they used to assess their performance. We first discuss programs’ approaches to identifying populations of focus and then describe how they assessed their activities and success.

A. Data sources to identify populations at disproportionate risk

In Section II, we described populations that are medically or socially at disproportionate risk of COVID-19 and related adverse outcomes and the populations of focus for the programs we reviewed. In this section, we describe the data sources programs used to identify populations of focus—according to individual risk factors—or areas in need of services (summarized in Exhibit VI.1). Most of these data sources characterize geographic areas rather than people or groups.

Exhibit VI.1. Data sources used to identify populations at disproportionate risk and direct services

Type	Example Sources	Example Metrics	Advantages	Limitations
National COVID-19 epidemiology data and data about attitudes about COVID-19 vaccines	<ul style="list-style-type: none"> Peer-reviewed literature Federal reporting, for example from the CDC Morbidity and Mortality Weekly Reports National COVID-19 surveillance data from the CDC COVID Data Tracker, sometimes disaggregated by race and ethnicity National surveys assessing attitudes about COVID-19 vaccination, for example, from the Pew Research Center 	<ul style="list-style-type: none"> National rates of COVID-19 incidence, test positivity, hospitalizations, and deaths, disaggregated by race/ethnicity Self-reported willingness and intent to be vaccinated 	<ul style="list-style-type: none"> Provide broad overview of patterns and inequities in disease incidence, prevalence, burden, and public attitudes CDC data are updated regularly Reliable estimates from large national samples; allows for disaggregation by important subpopulations 	<ul style="list-style-type: none"> Data displayed at the national level do not reveal localized patterns and heterogeneities Missing race and ethnicity data masks disparities in COVID-19 incidence
Local COVID-19 epidemiology data	<ul style="list-style-type: none"> City, county, or state public health department COVID-19 surveillance data County-level COVID-19 surveillance data from the CDC COVID Data Tracker 	<ul style="list-style-type: none"> Neighborhood-level rates of COVID-19 incidence, test positivity, hospitalizations, and deaths, disaggregated by race/ethnicity 	<ul style="list-style-type: none"> Identify hotspots and heterogeneity in COVID-19 burden within cities, counties, and states Respond to real-time community needs (with ongoing monitoring) 	<ul style="list-style-type: none"> Limited testing availability in communities with low income and communities of color results in under-assessment of COVID-19 incidence Missing race and ethnicity data masks disparities in COVID-19 incidence Limited availability of reliable local data,

Type	Example Sources	Example Metrics	Advantages	Limitations
				especially disaggregated by race/ethnicity or other demographic characteristics
Local data on COVID-19 testing and vaccination	<ul style="list-style-type: none"> Local information on availability of testing venues Vaccination rates from health care organizations, local public health departments, or county-level data from the CDC COVID Data Tracker, sometimes disaggregated by race and ethnicity 	<ul style="list-style-type: none"> Locations or numbers of neighborhoods that have few known testing venues Percent of residents vaccinated, disaggregated by race and ethnicity 	<ul style="list-style-type: none"> Identify communities in need of more services 	<ul style="list-style-type: none"> Differences in reporting make it difficult to identify and prioritize communities of focus Limited availability of reliable local data, especially disaggregated by race/ethnicity or other demographic characteristics
Data on community characteristics	<ul style="list-style-type: none"> CDC's Social Vulnerability Index (SVI) COVID-19 Vulnerability Index, constructed using Medicare data Neighborhood racial and ethnic composition data from the U.S. Census or American Community Survey 	<ul style="list-style-type: none"> Census tract SVI score Percent of residents with different racial identities (for example, percent non-Hispanic Black) 	<ul style="list-style-type: none"> Places focus on “upstream” social and structural factors that shape multiple health inequities 	<ul style="list-style-type: none"> Geographic boundaries for census-based measures may not correspond to people’s neighborhood definitions SVI and racial/ethnic composition do not capture all barriers to testing and vaccination
Data from communities (often qualitative)	<ul style="list-style-type: none"> Referrals from service providers Community working groups Surveys of participants or community members Social media Expert input 	<ul style="list-style-type: none"> Counts of people with greater risk of adverse outcomes, such as homebound adults Qualitative descriptions of a community’s barriers, needs, and opportunities Fears, misinformation, strengths expressed online 	<ul style="list-style-type: none"> Illuminates contextual or community-specific considerations that would be missed using other data sources Integrates community voice in data for decision making 	<ul style="list-style-type: none"> Qualitative research is sometimes perceived as less rigorous or valuable
Multiple data sources used in combination	<ul style="list-style-type: none"> National and local Qualitative and quantitative 	<ul style="list-style-type: none"> Multiple 	<ul style="list-style-type: none"> Triangulating data sources provides a more accurate picture of community needs and assets 	<ul style="list-style-type: none"> Time- and resource-intensive

Note: Advantages and limitations of metrics and data sources are based on subject matter expertise of research team. Most sources we reviewed did not explicitly describe such advantages and limitations.

National COVID-19 epidemiology data, obtained from published literature and federal reporting helped programs describe COVID-19 transmission, burden, and inequities by individual risk factors, including race, ethnicity, age, or relevant social factors. Peer-reviewed and gray literature sources on COVID-19 testing and vaccination programs often cited other published information on disparities or needs among specific groups (Abdul-Mutakabbir et al. 2022; Chamie et al. 2022; Kepka et al. 2021). Many programs cited federal reporting from the CDC’s *Morbidity and Mortality Weekly Report (MMWR)* (Abdul-Mutakabbir et al. 2022, Feifer et al. 2021; Washington et al. 2022) and COVID Data Tracker (Abdul-Mutakabbir et al. 2021; Abdul-Mutakabbir et al. 2022; Alcendor et al. 2022), often disaggregated by race and ethnicity to describe racial inequities in COVID-19 incidence, morbidity, mortality, and vaccination rates (Mullin et al. 2022; Peteet et al. 2022). However, it was not always clear whether these programs used this information to identify populations of focus as they designed programs, or whether they used it to communicate specific populations’ (already well-known) need for services or the role of structural, social, and medical factors in driving COVID-19 inequities. Several programs also cited national surveys to describe attitudes about COVID-19 vaccination, including confidence or willingness to be vaccinated (Bigelow et al. 2022; Budhwani et al. 2023; Washington et al. 2022).

Local epidemiology data on COVID-19 transmission and burden helped programs develop place-based interventions. Surveillance data from city, county, and state health departments enabled programs to select service delivery sites in communities facing greater levels of transmission, hospitalization, and death from COVID-19 (Jaklevic et al. 2021; Kim et al. 2021; McCollum et al. 2022). For example, a COVID-19 testing program in Chicago used daily reports on the number of COVID-19 cases from the City of Chicago to identify specific neighborhoods with clusters of cases (Kim et al. 2021). Disaggregating COVID-19 data by race or other demographic factors enabled programs to identify inequities within cities or states and plan service sites accordingly (Brown et al. 2021; Chamie et al. 2022; DeGarmo et al. 2022; Kim et al. 2021). Other testing programs used local epidemiology data in conjunction with machine learning and mapping approaches to identify emerging hotspots of COVID-19 transmission (Atrium Health 2020; Whanger et al. 2022). For example, a mobile testing clinic in West Virginia used a machine learning algorithm to identify counties with predicted one-week increases in COVID-19 incidence based on local epidemiology and other data (Whanger et al. 2022).

Reviewing place-based data on COVID-19 testing and vaccination access and use helped programs identify specific communities in need of more testing and vaccination resources. Several COVID-19 testing programs selected communities with low testing availability (Hernandez et al. 2022; Whanger et al. 2022). For example, one program deployed mobile vans to communities with limited or no testing venues; however, authors did not state the data source used to determine testing availability (Whanger et al. 2022). Vaccination programs often focused their efforts in communities with low rates of vaccination using data from health care organizations (Beste et al. 2021; Bigelow et al. 2022), state health departments (Alcendor et al. 2021), or localized (rather than national) vaccination information from the COVID Data Tracker (Abdul-Mutakabbir et al. 2022); key informants echoed these approaches.

Programs used place-based data to prioritize communities identified as socially vulnerable without an explicit focus on COVID-19 transmission or burden. Social vulnerability stems from structural and social inequities and reflects community capacity to respond to stresses such as COVID-19 outbreaks (Tsai et al. 2022). Several programs identified communities of focus using data from the CDC Social Vulnerability Index (SVI), an area-based measure of community resilience often used for planning and allocating

resources (Berkley-Patton et al. 2022; Massachusetts Department of Public Health 2021; Public Health—Seattle and King County 2021). Key informants also described using the SVI as a data source, including representatives of a CBO, a state health department, a foundation, and several federal agencies. One program constructed its own COVID-19 Vulnerability Index using Medicare data (Baker et al. 2021). Programs in our literature review that aimed to serve specific racial and ethnic groups also referenced data on neighborhood racial composition to determine service locations (Barrett et al. 2022; Dumproff et al. 2022; Gillwald et al. 2022; Singler et al. 2023) or used the American Community Survey to understand the demographics of communities they reached (Baker et al. 2021).

Other programs used qualitative data to identify specific people or populations and plan services, including data from physician referrals, community work groups, surveys, social media, and experts’ knowledge of communities. Several programs used physician referrals to identify people at high risk of COVID-19 or severe outcomes, including veterans with multiple risk factors (Beste et al. 2021) and adults who were older, frail, or homebound (Goldberg et al. 2020). Programs also used community work groups to prioritize populations, understand contextual factors, and plan service delivery. For example, one program planned the site for their COVID-19 vaccination intervention based on expert input from a working group of local community partners (AuYoung et al. 2021). Based on their deep knowledge of the community, the working group was able to provide more nuanced information about intersectional

factors affecting risk of COVID-19 exposure, including occupation and household composition for specific groups. As another example, a COVID-19 testing program in Northern California formed a Latino COVID-19 collaborative comprised of community partners, residents, and academics. To plan locations for COVID-19 testing events, the collaborative conducted a brief survey of community members to understand barriers to testing and met monthly to discuss findings and plan test sites accordingly (Chamie et al. 2022). Several key informants described similar approaches to identifying populations of focus based on historical knowledge of the communities they serve.

Key informant spotlight: Using social listening



Staff from a foundation working throughout the country and its funded community-based organizations followed social media conversations about COVID-19 testing and vaccination to identify emerging patterns of COVID-related fears, strengths, concerns, and misinformation. This so-called social listening approach enabled program staff to identify real-time topics of conversation predominant among specific communities and respond in contextually specific ways.

Synthesizing multiple data sources helped programs gain a robust understanding of community needs and assets and plan accordingly. Many of the programs we reviewed began with an overview of national epidemiologic data to describe inequities in the COVID-19 burden across social groups, then assessed more localized data or expert input to select communities of focus (Barry et al. 2020; Brown et al. Public Health - Seattle and King County 2021). Some programs combined population characteristics from several data sources to select program sites (Barrett et al. 2022; Whanger et al. 2022). For example, a multi-city mobile vaccination program run by the Puget Sound Veterans Affairs Health Care System developed a survey to assess veterans’ risk factors for severe COVID-19 outcomes, aggregated survey data at the zip code level, and combined survey data with place-based sociodemographic data to prioritize sites for mobile vaccination clinics (Beste et al. 2021). A vaccine equity team then assisted program planners in interpreting emerging trends and tailoring services accordingly. Key informants sometimes reported using multiple data sources as well. For example, one key informant representing an academic institution working statewide combined test positivity rates with geographic information to understand distance from testing centers in zip codes with high test-positivity rates.

Key informant spotlight:
Combining the Social Vulnerability Index with qualitative input



A state health department mapped data from the Social Vulnerability Index at the zip code level. The health department then found trusted partners (local public health boards, tribal public health boards, federally qualified health centers, and community-based organizations) in those zip codes to collect data about level of need for vaccines, and then the state health department allocated vaccines accordingly.

B. Metrics programs reported using to assess performance

In this section, we describe the metrics and data sources programs used to assess their performance and understand the effects of their work. Programs in our review that mentioned specific metrics or data sources for this purpose typically assessed *program outputs*, which are measures of the quantity and quality of program activities and service delivery. Some programs also assessed *program outcomes*, which are measures of changes among program recipients, such as changes to COVID-19 testing and vaccination awareness and confidence and changes in testing and vaccination rates. Table VI.2 lists outputs and short-term outcomes used by programs in our review.

Exhibit VI.2. Metrics programs used to assess their effectiveness

Focus	Program outputs	Program outcomes
COVID-19 testing	<ul style="list-style-type: none"> • Measures of outreach • Number of clinics and events • Number of appointments made • Number of tests ordered • Number of tests administered • Number of people tested • Geographic reach of services • Participant satisfaction 	<ul style="list-style-type: none"> • Population rates of testing

Focus	Program outputs	Program outcomes
COVID-19 vaccination	<ul style="list-style-type: none"> Measures of outreach or education efforts Number of clinics and events Number of appointments made Number of vaccine doses administered 	<ul style="list-style-type: none"> Changes in knowledge about vaccination and willingness or intent to be vaccinated (vaccine confidence) Population rates of vaccination
Routine vaccination	<ul style="list-style-type: none"> Number of people vaccinated Geographic reach of services Participant satisfaction 	<ul style="list-style-type: none"> Population rates of vaccination, sometimes in relation to pre-pandemic rates

Note: Metrics in this table reflect only those that were used by the programs we reviewed. There are other possible metrics that we did not see in this targeted review such as changes in knowledge about or confidence in COVID-19 testing, or COVID-19 vaccinations metrics that distinguish between any dose, first dose, series completion, or boosters. Many metrics could be assessed overall and by race, ethnicity, age, and other demographic characteristics.

1. Program outputs

Types of program outputs in our review were similar across COVID-19 testing, COVID-19 vaccination, and routine vaccination programs. Programs generally tracked outputs using data they collected as a part of their operations. They commonly disaggregated these outputs by demographic characteristics such as age and race.

Programs focused on outreach and education assessed their reach using a variety of measures, depending on the type of outreach or education activity. Examples include number of phone calls made (Deerin et al. 2022), text messages sent (Marquez et al. 2021a), doors knocked on (Relias Media 2022), radio advertisements aired (Long et al. 2021), and social media advertisements distributed (Singler et al. 2023). Some vaccine education campaigns tracked user engagement with and reactions to social media (Marcell et al. 2022; Singler et al. 2023). Programs also monitored the number of people attending educational events. For example, in one NIH-funded program, mental health therapists delivered a COVID-19 educational intervention to 254 clients from March to June 2021 (Venegas-Murillo et al. 2021).

Programs delivering testing and vaccination services typically counted services and people served to characterize their activities, although some assessed geographic reach or participant satisfaction.

- Number of clinic sites or number of events held.** Programs tracked the number of sites established or used, including at mass sites, health care setting-based clinics, venue-based clinics, and mobile units, as well as the number of testing and vaccination events they held at these sites (Dumproff et al. 2022; Hernandez et al. 2021). For example, a FQHC-administered program delivering COVID-19 testing to people experiencing homelessness offered testing in 37 Health Care for the Homeless (HCH) clinics across the nation (Berner et al. 2022). Because their goal was to serve many people in one location, mass testing and vaccination clinics tended to have fewer sites; for example, one mass testing program hosted two drive-through and six walk-up testing sites in Chicago (Kim et al. 2021). Testing and vaccination programs that characterized their services as events reported the number of events held, usually over a specific time frame (Faherty et al. 2022; DeGarmo et al. 2022; Berner et al. 2022; Evans et al. 2021). For example, a program run by the Los Angeles County Health Department in partnership with the University of California, Los Angeles held over 157 vaccination events for people experiencing homelessness in Los Angeles, as of August 2021 (Choi et al. 2022).

- **Number of home test kits ordered and vaccine appointments made.** Several at-home testing programs tracked the number of test kits distributed (Barrett et al. 2022; Singler et al. 2023). Vaccination programs tracked the number of appointments made (Osibanjo et al. 2022).
- **Number of tests and vaccines delivered and number of persons receiving tests or vaccination.** The most common program outputs tracked by COVID-19 testing programs were the number of tests they administered and the number of people they tested. For example, a mass testing site in West Virginia administered 98,846 tests between May and December of 2020 (Dumproff et al. 2022). A walk-up testing site in New Orleans tested 9,721 individuals over a 50-day period (Hernandez et al. 2021). Likewise, COVID-19 and routine vaccination programs tracked the number of individuals vaccinated and the number of vaccine doses administered. For example, a routine vaccination program in Boston delivered 146 vaccinations to 50 children through mobile clinics (Leibowitz et al. 2021). Many programs reported the demographics of people receiving services (Baker et al. 2021; Bigelow et al. 2021; Davis et al. 2020; Feifer et al. 2021).
- **Geographic reach of testing and vaccination services.** Some programs described their geographic reach, including the number of counties they served (Baker et al. 2021; Brown et al. 2021; Dumproff et al. 2022) and distance traveled or census tract coverage among people receiving services (Chamie et al. 2022; Hernandez et al. 2021). Several sources in this review included maps to show programs' geographic reach (Brown et al. 2021; Hernandez et al. 2021). Likewise, one key informant at a local health department described regularly updating a map of intervention sites to show where vaccination mobile units had been deployed to deliver vaccines.
- **Participant satisfaction.** Programs assessed participants' satisfaction with testing and vaccination services to understand opportunities for improvement; this could be characterized as either an output or outcome. Several programs administered surveys to assess satisfaction with testing and vaccination services (Baker et al. 2021; Leibowitz et al. 2021; Marquez et al. 2021a; Sears et al. 2022; Whanger et al. 2022). For example, a mobile COVID-19 testing program asked families questions about the ease of scheduling appointments, convenience of the mobile vaccination unit, quality of care, and whether services were offered in a way that was easy to understand and met their cultural and language needs (Leibowitz et al. 2021). Despite the emphasis on community buy-in and engagement, few programs seemed to measure community satisfaction more broadly.

2. Program outcomes

Program outcomes are changes in program participants' behavior, knowledge, skills, status (such as vaccination status), or level of functioning. Examples of short-term outcomes include changes in vaccine awareness, knowledge, or confidence and increased rates of testing and vaccination uptake at the community or population level. Long-term outcomes could include reduced COVID-19 transmission, morbidity, and mortality, although only one of the programs we reviewed assessed a long-term outcome (Hansotte et al. 2021).

Programs conducting vaccination outreach and education used surveys to measure changes in knowledge and attitudes. As a part of their evaluation efforts, several programs administered surveys to measure changes in program recipients' knowledge about vaccination and willingness to be vaccinated, before and after receiving the intervention (Sears et al. 2022; Venegas-Murillo et al. 2022). For example, a community-academic partnership that delivered a vaccine education webinar to Black churchgoers in the western U.S. documented a statistically significant increase in participants' willingness to be vaccinated after the webinar in comparison to before (Peteet et al. 2022). No testing programs in our review assessed changes in people's attitudes about testing, likely because we did not identify testing programs focused on education or outreach without a testing delivery component. A few other testing and vaccination surveyed knowledge and attitudes at a single point in time, but they did so to understand barriers to services rather than program effectiveness (Chamie et al. 2022; Long et al. 2021).

Program spotlight: Increasing vaccination knowledge and self-efficacy among tribal communities in Arizona



A partnership between the University of Arizona and three tribal communities implemented a COVID-19 vaccination education campaign to increase vaccine knowledge and self-efficacy among tribal community members through outreach from trusted community members and culturally tailored printed materials. Comparisons of pre-test and post-test survey results indicated statistically significant changes in knowledge about how the COVID-19 vaccine works, possible side effects, and how to schedule vaccine appointments (Sears et al. 2022).

**Program spotlight:
Increasing testing among
Latinx communities through
culturally tailored promotion and
outreach**



The Oregon Saludable: Juntos Podemos (Healthy Oregon: Together We Can) program randomized communities to receive culturally tailored COVID-19 testing information, designed to increase trust and delivered by *promotoras*, versus outreach as usual. By comparing population-level rates of testing among Latinx people in treatment versus control counties, authors were able to show that the program increased testing among the Latinx community (Degarmo et al. 2022).

Some assessed changes in rates of testing and vaccination at the community level. For example, several vaccination programs assessed vaccination rates using immunization registries or other surveillance data (Osibanjo et al. 2022; Marquez et al. 2021a; Public Health—Seattle and King County 2021). One routine vaccination program reported trends in children’s seven-vaccine series relative to pre-pandemic trends, given the focus on addressing interruptions to routine vaccination schedules during COVID-19 (Deerin et al. 2022). Although less common than for the vaccination programs, several testing programs also measured community-level testing rates: one program compared rates between census tracts with walk-up versus drive-through testing options (Hernandez et al. 2022); another program compared changes over time in population testing rates between counties receiving different kinds of testing outreach strategies (DeGarmo et al. 2022).

Other programs, including both outreach and service delivery programs, quantified differences in testing and vaccination rates between people receiving specific interventions and a control group. For example, several programs designed randomized controlled trials to compare culturally tailored outreach strategies for testing and vaccination services to standard strategies (Barrett et al. 2022; Berkley-Patton et al. 2022; Budhwani et al. 2022; Degarmo et al. 2022). Similarly, a key informant’s academic institution compared outcomes for participants in testing events throughout the state to a control group. Outcomes of interest included adherence to recommended CDC guidelines, such as isolating when infection happened, masking, and vaccination status.

Testing and vaccination programs reported outcomes that were disaggregated by race, ethnicity, age, gender, and social factors (Beste et al. 2021; DeGarmo et al. 2022; Hansotte et al. 2021). This approach enabled programs to explicitly evaluate their impact on testing and vaccine inequities. For example, an article describing a community testing clinic, run by a county health department in partnership with CBOs, reported changes in countywide testing rates by race and ethnicity during the study period (Hansotte et al. 2021). Key informants from state and local health departments, as well as a national pharmacy retailer, likewise described using vaccine dashboards or other internal databases to assess vaccination data by race and ethnicity, or among certain groups such as people experiencing housing insecurity. A key informant from a federal agency also noted that its awardees were required to monitor vaccination coverage among demographic subgroups and communities with high social vulnerability (using the SVI).

VII. Discussion

This environmental scan report has several strengths relative to the substantial literature on policies and programs intended to reduce remaining COVID-19 testing and vaccination disparities. Many published studies, including review or synthesis papers, focus on a single population group. Our literature search included programs focused on all populations that are medically or socially at disproportionate risk of COVID-19 or related adverse outcomes. We also reviewed programs implemented at the local, state, and federal level, focused on a range of outcomes for COVID-19 testing and vaccination and routine vaccination. In addition, we synthesized findings from peer-reviewed and gray literature and key informant interviews, which helps us mitigate publication bias and develop more holistic findings than other studies.

Because of the breadth of our focus and methods, we can identify patterns in barriers to services and cross-cutting themes in programs' approaches and strategies. Our analysis revealed that many barriers—and programs' efforts to help people overcome them—are not unique to testing or vaccination. These themes enabled us to create a taxonomy of program activities that aids understanding of what programs did and why. For example, both testing and vaccination programs sought to overcome access barriers by bringing services closer to people, and commonly worked with trusted messengers and community leaders to increase confidence in services. This taxonomy is based on sources we reviewed and is thus a work in progress; we expect to refine it in future phases of the project. Preliminarily, themes based on the sources we reviewed point to where information on promising practices might be most broadly useful. They also serve as a foundation for identifying less common and novel strategies, in both the sources we reviewed and in future research.

In the following discussion, we highlight themes in barriers to services and the strategies programs used to address resulting needs (Section VII.A). Next, we comment on programs' implementation experiences and attempts to assess their performance (Section VII.B). Finally, the breadth of this environmental scan makes it possible to point to gaps in the literature. We close with a discussion of opportunities for further research, including for the survey and site visits planned as part of this study (Section VII.C).

A. Key findings across testing and vaccination programs

The COVID-19 testing and vaccination programs and routine vaccination programs that we reviewed worked to address similar barriers to service use. It is not surprising that programs with different foci addressed barriers such as lack of primary care access, lack of transportation, low income, and misinformation, given that these barriers are rooted in historic and structural inequities. For example, transportation barriers reflect economic inequality and maldistribution of public and private transportation resources. Misinformation is exacerbated by distrust of medical and public health systems among minoritized populations.

Some barriers were more common in the literature than expected: although distrust and low confidence are well known barriers to vaccination, they also posed barriers to COVID-19 testing. Distrust of medical and public health systems affected willingness to engage in testing as well as vaccination, necessitating trauma-informed approaches to service delivery (Neely et al. 2021). This finding is underscored by

multiple delivery strategies that testing programs used to increase trust, such as working with community partners, using trusted community messengers, and prioritizing patient dignity.

Most barriers to COVID-19 testing and vaccination and routine vaccination predated the pandemic, although the pandemic added complexity. Inequities in social conditions are longstanding and continue to drive observable differences in access and service use across multiple systems, including health care. But some access and other barriers arguably rose to a higher level of complexity during the COVID-19 pandemic. Supply chain disruptions and pandemic-related policies such as stay-at-home orders and early limits on vaccination eligibility inhibited both testing and vaccination for the same populations bearing the brunt of longstanding social inequities. Although there were many similar barriers across program foci, the scan revealed several barriers unique to testing. Fear of missing work for a positive test result was a new barrier that emerged with the pandemic, and was more significant for people with low-wage jobs. In addition, lack of Internet access may have posed a relatively severe barrier to testing, compounding other barriers, since internet access is generally required not only to make an appointment but also to check one's results.

Barriers to service use cluster and compound each other, resulting in multiple needs that are difficult for a single organization to address and helping to explain the prevalence of partnership strategies. As noted, social factors such as residential segregation, the inequitable allocation of social and health resources, concentrated poverty, over-representation in low-wage jobs and in the prison systems, and higher levels of chronic stress cluster together to create higher barriers to wellness for Black, Latinx, Indigenous, and other communities of color (Egede and Walker 2020; Pirtle 2020). This results in complex and multi-level needs among specific communities. Our finding that partnerships were common across programs we reviewed might reflect that partnerships are better suited than single organizations to address multiple needs. Although partnerships are a common strategy in other public health interventions, the COVID-19 pandemic seems to have expanded the range of partners working together. For example, the National Guard partnered with community organizations, although several programs noted that the National Guard's presence caused fear in some communities.

Programs with all three study foci—COVID-19 testing and vaccination and routine vaccination—developed similar approaches, or primary mechanisms, for service delivery to enhance access. Programs sought to reduce travel burden on program recipients and to make services as convenient as possible. The most common approaches to delivering services were community clinics, followed by mobile clinics. COVID-19 vaccination and routine vaccination programs also commonly used stand-alone educational outreach approaches (without an accompanying service delivery component), although this approach was not used by testing programs in our review.

Likewise, programs used similar delivery strategies to enhance the effectiveness of their primary approaches and achieve desired outcomes. These strategies were frequently asset-based, leveraging existing community resources and relationships to meet multiple program goals. The most common delivery strategies across all programs were forming partnerships with community organizations and trusted leaders, using multiple channels to increase the reach of messaging, and developing population-specific or culturally tailored messaging. Many programs also engaged multi-lingual staff and coordinated with other health care services. We also found some strategies unique to testing or vaccination programs among the programs we reviewed. Offering financial and other supports (such as food and hotel vouchers)

for people testing positive was a strategy unique to COVID-19 testing programs. Offering financial incentives to get vaccinated was a strategy unique to COVID-19 vaccination programs in the programs we reviewed.

Routine vaccination programs drew on resources and strategies used for COVID-19 vaccinations to close gaps in routine vaccinations. However, only a few COVID-19 vaccination programs in the literature we reviewed coordinated their efforts with routine vaccination efforts. As COVID-19 vaccines become more routinized, bundling them with routine vaccinations may become a more prevalent strategy. However, given both low COVID-19 vaccination uptake among some population groups and declining rates of routine vaccinations, effective strategies might also need to take advantage of opportunities to bundle vaccines with other health or social services, not related to vaccination.

The programs in this review helped people navigate barriers but did not address their root causes. For example, offering extended hours does not address the labor conditions that prevent essential workers from taking time off to get a test or vaccine. Providing services in convenient locations helps people without access to transportation but does not address the inequitable distribution of wealth and resources that results in differential car ownership or residence in areas without public transportation. However, fixing structural issues is out of the scope and reach of testing and vaccination programs.

The approaches and strategies programs used to help people overcome barriers to COVID-19 services are likely to be relevant in the next public health crisis. Without additional structural interventions, the next pandemic is likely to result in similar inequities in testing and vaccination rates. Programs may find themselves using many of the same approaches and strategies they developed during the COVID-19 pandemic in future pandemics or public health crises. To lessen the burden on programs to help people overcome barriers in times of crisis, federal policies, such as the free testing and vaccination and stimulus payments authorized by the CARES Act, could help to ameliorate structural inequities if they were extended and expanded.

B. Understanding programs' implementation experiences and performance

Testing and vaccination programs experienced similar implementation challenges, including resource limitations and logistical challenges. However, most of the sources we reviewed did not describe implementation challenges and strategies. Budget and funding constraints, limited staff, and shortages of tests and vaccines all posed barriers to programs' effectiveness, in addition to supplies of equipment like freezers. Logistical challenges varied somewhat by program focus, although patient tracking and information sharing were cited by both testing and vaccination programs. Programs worked to develop creative solutions to these challenges, making use of volunteers, donated supplies, partners' infrastructure, technical assistance, funding flexibilities, and other implementation strategies.

Programs commonly tracked outputs using data they collected as a part of their operations, such as the number of events they held and the number of tests and vaccines they administered. Relatively few programs assessed *outcomes*, such as changes in vaccine awareness, knowledge, or confidence among program participants or increased rates of testing and vaccination uptake at the community or population level. Outputs are helpful in specific ways. For example, they help programs quantify their reach and provide funders with information on how many people they were able to serve from different communities. Programs can also use outputs to understand how they can adjust implementation to reach

more or different people, especially if they pair outputs with qualitative information on implementation experience or with community feedback. We did not see specific examples of programs conducting this kind of holistic implementation evaluation in the literature we reviewed, likely because they did not have the capacity or funding to do that work.

Focusing on outputs alone, such as the number of people programs reach or the number of services they deliver, might not reveal the effectiveness of program approaches. For example, outputs might not reveal whether program approaches ultimately worked to reduce testing or vaccine disparities, how many people programs need to reach to make a difference in testing or vaccination rates for certain groups, or how well or how quickly certain approaches worked compared to alternatives. Ideally, to gain a full understanding of their effectiveness, programs would synthesize outputs and outcomes and seek to learn about the relationships between them. Doing so helps programs understand the connections between program design, implementation choices, and outcomes. This would increase learnings available to programs and the field more broadly but would require additional capacity and funding.

Outcomes that incorporate comparative information put programs on a better footing to understand their effectiveness and share practices that advance the field. Several sources in our review were able to use comparative outcome data, such as testing rates resulting from different program approaches, vaccination status compared to a baseline or control group, or vaccination and testing rates for different demographic groups. Other metrics that could help programs put their work in perspective include community test positivity, speed of vaccine coverage in a community, and maintenance of high routine vaccination rates for specific communities, all compared to baseline measures.

Other than a few programs that used satisfaction surveys, programs we reviewed did not report efforts to solicit community feedback. How communities perceive testing and vaccination programs should matter a great deal for any efforts to serve communities at disproportionate risk. There is evidence to suggest that engaging communities to design COVID-19 testing and vaccination approaches is more effective than top-down approaches (Gilmore et al. 2020; Bogdewic and Ramaswamy 2021). Likewise, engaging communities to request feedback and to help define effectiveness—that is, what works for them—might help programs define promising and best practices in community-specific ways (Center for Evaluation Innovation 2017).

C. How these findings inform the survey and site visits for the study

This ASPE/OASH project is intended to develop and disseminate findings on promising and best practices for closing gaps in COVID-19 testing and vaccination and routine vaccinations and for reducing inequities in testing and vaccination in future pandemics. Ultimately, these practices could help to reduce the human and societal devastation of large-scale infectious disease outbreaks and the disproportionate impacts on those most at risk.

To achieve these goals, best practices must meet the needs of the communities they seek to serve and be feasible, replicable, and sustainable. They should help future programs select approaches and decide how to deliver and implement them, including how to overcome likely implementation challenges. They should also influence how federal and state agencies and private funders support local programs—for example, findings of this report suggest that flexibility in funding guidelines will help local programs adapt to changing conditions.

This environmental scan is only a first step in developing findings that will be useful to the field and to funders. Our findings point to the need for further research on the following topics.

- **Context and how it interacts with programs.** Future research could shed light on how federal, state, or tribal policy contexts intersect and matter for programs, and on best practices for programs working in specific contexts. New research could also focus on how programs have evolved, shifted, and adapted as context changes, and on how community characteristics such as resilience can improve service delivery.
- **Information programs need to make choices.** Most sources we reviewed for this environmental scan did not report implementation challenges or strategies for overcoming them. Programs need additional information on these topics to make design and implementation choices. Future research could also shed light on the kinds of information programs need to understand how to align programmatic options with community needs.
- **Effectiveness.** This report illuminates patterns in programs' approaches and strategies but cannot determine which are most effective, and the available information on outcomes is limited. More research is needed on the approaches and strategies that programs view as effective, and how they assess this. More importantly, future research should assess community views of what works well, and how programs take community views into account, if at all.

The project team will use the findings and unanswered questions from this environmental scan to shape a national survey of local organizations and site visits to states and tribal organizations. Guided by an expert panel of federal and nonfederal experts in COVID-19 testing and vaccination, the project will use these data sources and a theoretical framework to identify and disseminate best practices for reducing testing and vaccine inequities that support the efforts of local, state, tribal, and national organizations and public agencies at all levels. Synthesized findings from the environmental scan, national surveys, and site visits can help to inform efforts to strengthen capacity and preparedness for the next pandemic or public health crisis, as well as efforts to advance equity in health care, health, and wellbeing in the meantime.

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Appendix A. Additional information on research methodology for the literature review

Exhibit A.1 lists the search terms and search strings we used to identify scholarly and gray literature.

Exhibit A.1. Literature search terms and search strings

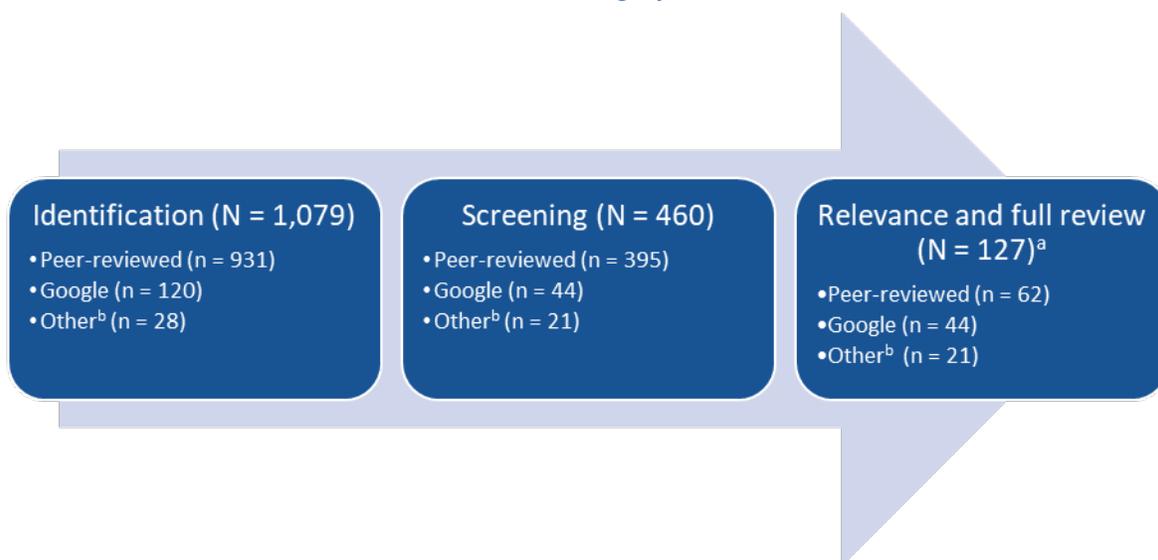
Category	Search term
Search terms for scholarly literature	
Subjects	<ol style="list-style-type: none"> 1. COVID* AND test* 2. COVID* AND vaccin* OR immuniz* OR immunis* OR innoculat* 3. Routine OR compulsory* OR scheduled OR mandatory OR Monovalent OR Bivalent OR booster) AND (vaccin* OR immunis* OR immuniz* OR innoculat*)
Population of interest	(race OR racial OR racism OR ethnic* OR nonwhite OR Black* OR (African N2 American) OR Hispanic OR Latin* OR Mexican* OR Dominican* OR Haitian* OR Asian* OR Hmong OR Vietnamese OR (Native N2 American) OR (American N2 Indian) OR (pacific N2 islander) OR (Native N2 Hawaiian) OR indigenous OR native* OR Indian* OR tribe OR tribal OR refugee* OR immigrant* OR undocument* OR elder* OR (older N2 adult) OR (limited N2 English) OR disabilit* OR disabled OR Medicaid OR rural OR impair* OR homeless* OR incarcerated OR (chronic* N2 (ill OR illness)) OR "chronically ill" OR pregnan* OR "low income" OR poor OR poverty OR lesbian OR gay OR "bi-sexual" OR bisexual OR transgender OR LGBTQ* OR "at risk" OR "high risk" OR minorit* OR marginali* OR discrimin* OR segregat* OR "under-insured" OR underinsured OR uninsured OR "under-resourced" OR underresourced OR vulnerabl* OR disadvantag*)
Topic	((uptake OR confiden* OR hesitan* OR trust OR mistrust OR barrier OR program* OR interven* OR initiat* OR incentiv* OR implement* OR policy OR policies OR coverage OR strateg* OR educat* OR expand* OR communit* OR clinic* OR progress* OR challeng* OR attitude* OR measur* OR practice* OR campaign* OR study OR model* OR respon* OR resource* OR recommend* OR opportunit* facilitat* OR aware* OR Local* OR "Community-Based" OR communit* OR "Place-Based" OR "Local Health" OR Jurisdiction* OR "Indian Health" OR IHS OR "Federally Qualified" OR "Health Center*" OR FQHC OR Pharmac* OR nonprofit OR "Non-profit" OR City OR cities OR County OR counties OR State OR states OR Territor* OR Federal* OR Nationwide OR Tribal)) OR AB ((uptake OR confiden* OR hesitan* OR trust OR mistrust OR barrier OR program* OR interven* OR initiat* OR incentiv* OR implement* OR policy OR policies OR coverage OR strateg* OR educat* OR expand* OR communit* OR clinic* OR progress* OR challeng* OR attitude* OR measur* OR practice* OR campaign* OR study OR model* OR respon* OR resource* OR recommend* OR opportunit* facilitat* OR aware* OR Local* OR "Community-Based" OR communit* OR "Place-Based" OR "Local Health" OR Jurisdiction* OR "Indian Health" OR IHS OR "Federally Qualified" OR "Health Center*" OR FQHC OR Pharmac* OR nonprofit OR "Non-profit" OR City OR cities OR County OR counties OR State OR states OR Territor* OR Federal* OR Nationwide OR Tribal))
Geography	"United States" OR america* OR "USA" OR alabama OR alaska OR arizona OR arkansas OR california OR colorado OR connecticut OR delaware OR "District of Columbia" OR florida OR georgia OR hawaii OR idaho OR illinois OR indiana OR iowa OR kansas OR kentucky OR louisiana OR maine OR maryland OR massachusetts OR michigan OR minnesota OR mississippi OR missouri OR montana OR nebraska OR nevada OR "New Hampshire" OR "New Jersey" OR "New Mexico" OR "New York" OR carolina OR dakota OR ohio OR oklahoma OR oregon OR pennsylvania OR "Rhode Island" OR tennessee OR texas OR utah OR vermont OR virginia OR washington OR wisconsin OR Wyoming

Category	Search term
Search strings for gray literature	
COVID-19 testing	(Covid testing) AND (race minority vulnerable underserved) AND (program model initiative campaign strategy)
COVID-19 vaccination	(Covid vaccination) AND (race minority vulnerable underserved) AND (program model initiative campaign strategy)
Routine vaccination	(routine vaccination) AND Covid AND (race minority vulnerable underserved) AND (program model initiative campaign strategy)

Asterisks denote search terms that are root words and that we searched in the sources with a variety of word endings. For example, the search engine searched the term “test” as “test”, “tests”, “testing”, and “tester”.

Exhibit A.1. provides information on how many sources we identified through our searches and through items provided by ASPE, how many sources screened in, how many sources Mathematica content experts identified as highly relevant, how many sources we reviewed, and source categories. We first screened in sources based on a review of the source title if they met the following inclusion criteria: (1) source title discusses COVID-19 testing or COVID-19 vaccination best practices, recommendations, or guidance; (2) source title discusses routine vaccination best practices, recommendations, or guidance; or (3), source title discusses COVID-19 vaccination, COVID-19 testing, or routine vaccination programs or initiatives. We also applied the following exclusion criteria: (1) source was published before 2020; (2) source does not focus on the United States. We further prioritized sources by reviewing the title and abstract for explicit discussion of programs, initiatives, campaigns, models, and strategies.

Exhibit A.2. Sources identified, screened, deemed highly relevant, and reviewed



Note: The reference list includes more than the 127 reviewed papers because we conducted supplementary searching to inform complete descriptions of barriers to COVID-19 testing and vaccination, structural racism, federal guidelines and recommendations on testing and vaccination, and other topics.

^a We reviewed all sources deemed highly relevant.

^b Sources with the “Other” designation include items provided by ASPE, such as gray literature and links to federal programs that we included after de-duplicating sources.

Exhibit A.3. Sources reviewed and included in analysis

Source type or focus	Count
COVID-19 testing	35
COVID-19 vaccinations	33
Routine vaccinations	6
Federal programs	30
Synthesis papers ^a	23

^a Sources included in the “Synthesis papers” group are sources that we identified through our peer-reviewed literature and gray literature searches that synthesized information on multiple programs, initiatives, campaigns, models or strategies at a high level or described general best practices related to COVID-19 vaccinations, COVID-19 testing, or routine vaccinations, but did not describe one program in depth. They also included papers on barriers to testing and vaccination.

Appendix B. Organizations included in key informant interviews

Exhibit B.1 presents the types of organizations that key informants represent and number of interviews with each type of organization.

Exhibit B.1. Organizations included in key informant interviews

Category	Number of organizations	Description
Clinical/local providers	4 clinical organizations/health systems	<ul style="list-style-type: none"> - FQHC in the Midwest - Tribal health system in the West - National pharmacy retailer - National pharmacy association
	2 local health departments	<ul style="list-style-type: none"> - Local health department in the South - Local health department in the Midwest
	1 academic institution	<ul style="list-style-type: none"> - Academic institution in the West
State health departments	2 state health departments	<ul style="list-style-type: none"> - State health department in the Northeast - State health department in the South
CBOs	6 CBOs	<ul style="list-style-type: none"> - CBO in Midwest that serves a large immigrant population - CBO in West that that works to advance health and racial equity among the populations they serve - CBO in South that works in 3 primarily rural counties - CBO that uses media and communications strategies to serve Black populations, primarily in the South. - CBO focused in tribal populations on Northwest - CBO in South that primarily serves Latinx populations
Funders	2 non-federal funders	<ul style="list-style-type: none"> - Foundations that fund health interventions in the U.S. and abroad.
	5 federal funders	<ul style="list-style-type: none"> - Federal agencies that fund health services/ public health programs and respond to disasters

We developed and used semi-structured interview guides tailored for the following categories of key informants: (1) clinical and local providers, (2) state health departments, (3) CBOs, and (4) funders. Exhibit B2. presents the research questions covered in these interview guides, by respondent type. We developed interview questions for each category of key informants related to the research questions.

Exhibit B.2. Research questions covered interview guides, by respondent type

	Clinical/local providers	State health depts	CBOs	Funders
RQ1. [Policy context] What policies did local, state, or federal jurisdictions use to increase COVID-19 testing and vaccination (for example, public health system structure, laws, and regulations, etc.) in underserved populations? What policies were effective at increasing outcomes of interest?		X		X
RQ2. [Resource distribution/Administrative preparedness] How did programs use resources (such as funding, staffing, materials) provided by local, state, or federal jurisdictions to increase COVID-19 testing and vaccination? What challenges did programs face using resources? What resources were effective?	X	X	X	X
RQ3. [Program definition] What key programs deliver COVID-19 testing and vaccination services to underserved populations?	X	X	X	X
RQ3. [Program implementation] (1) Through what entities/mechanisms are programs delivered? (2) What are the combinations of intervention strategies that make up the programs? (3) Do the programs/intervention strategies vary by population? (4) What are the barriers and facilitators to implementing these programs/intervention strategies? (5) How has program delivery changed over time?	X		X	X
RQ4. [Ensure equity] How do programs identify the populations they intend to receive the COVID-19 testing and vaccination services? How are data, metrics (indices, data tools), or intentional strategies used to identify the intended populations, including strategies to identify underserved populations that existed prior to the pandemic? How has this changed over time?	X	X	X	X
RQ 8. [Evaluating programs] How are COVID-19 testing and vaccination programs in underserved population(s) being evaluated? Are there metrics (for example, indices, data tools) used to identify and assess implementation and program outcomes? What data or resources are needed to develop these metrics?	X	X		X
RQ10. [Ensuring routine vaccinations] How have federal, state, or local jurisdictions ensured that children and adults are up-to-date for routinely recommended vaccines during the pandemic?	X	X		X
RQ12. [Novel strategies for bundling vaccines] What novel strategies to promote COVID-19 vaccines simultaneously with routine vaccines are being used? What strategies or resources from the COVID-19 vaccination rollout can be utilized for routinely recommended vaccines for children and adults?	X	X		X

Appendix C. Glossary of terms

Exhibit C.1. Glossary of terms

Term	Definition
Equity concepts	
Health inequity	Health disparities that are deemed unfair or that stem from some form of injustice (Meghani & Gallagher 2008)
Health-related social needs	Barriers to health, experienced at the individual level, that are within the purview of health care providers to identify and help address, such as housing instability, safety needs, food insecurity, and financial strain, among others (CMS 2022)
Social determinants of health	The conditions in which people are born, grow, work, live, worship, and age, including neighborhood environments, schools, and the workplace (World Health Organization 2023)
Structural racism	Public and private policies, norms, and cultural representations that inherently lead to unequal freedom, opportunity, value, resources, advantage, restrictions, constraints or disadvantage for individuals and populations according to their race or ethnicity (Braveman et al. 2022)
Program goals	
Awareness	The degree to which individuals have knowledge of the need for, and availability of, recommended vaccines [or testing] and their objective benefits and risks (Thomson et al. 2016)
Access	The ability of individuals to be reached by, or to reach, recommended vaccines [or testing] (Thomson et al. 2016)
Confidence	Trust in (1) the effectiveness and safety of vaccines [or testing]; (2) the system that delivers them, including the reliability and competence of the health services and health professionals and (3) the motivations of policymakers who decide on the needed vaccines [or testing] (MacDonald 2015)
Uptake	The action of getting a vaccine or test ^a
Metrics	
Testing or vaccination rate	Uptake of COVID-19 testing or vaccination, generally measured as a proportion of the eligible population, or: # people tested or vaccinated/total eligible population x 100% (Leuchter et al. 2022)
Test positivity rate	Sometimes called the “positivity rate,” quantifies the percentage of all coronavirus tests performed that are actually positive, or: (positive tests)/(total tests) x 100% (Johns Hopkins 2020)
Terms relevant to study goals	
Promising practices	A practice that worked within one organization, shows promise for becoming a best practice, has some objective basis for a claim of effectiveness, and has potential for replication among other organizations (Brennan et al. 2011).
Best practices	A practice that has been proven to be effective in improving population health through rigorous evaluations. It is effective in a specific real-life setting and likely to be replicable in other settings (Brennan et al. 2011).

^a The term “uptake” was used in many ways across the sources in our scan, as well as the epidemiology literature more broadly. Some sources use uptake synonymously with rate, which is a population-level measure (for example, [Leuchter et al. 2022](#)). For the purposes of this report, we define uptake as an individual-level action or outcome.