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Corresponding author:

Scott A. Goldberg,
Email: sagoldberg@bwh.harvard.edu.

Critical Concepts for COVID-19 Mass Vaccination Site Operations

Scott A. Goldberg MD, MPH[1], David Callaway MD, MPA[2], Daniel Resnick-Ault MD[3], Sujal Mandavia MD[4], Rodrigo Martinez[5], Michelle Bass PhD, MS[6] and Eric Goralnick MD, MS[1]

[1]Department of Emergency Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA; [2]Atrium Health Carolinas Medical Center, Charlotte, NC, USA; [3]University of Colorado School of Medicine, Aurora, CO, USA; [4]Carbon Health, Los Angeles, CA, USA; [5]CIC Health, Cambridge, MA, USA and [6]Countway Library of Medicine, Harvard Medical School, Boston, MA, USA

Abstract

Mass vaccination campaigns have been used effectively to limit the impact of communicable disease on public health. However, the scale of the coronavirus disease (COVID-19) vaccination campaign is unprecedented. Mass vaccination sites consolidate resources and experience into a single entity and are essential to achieving community ("herd") immunity rapidly, efficiently, and equitably. Health care systems, local and regional public health entities, emergency medical services, and private organizations can rapidly come together to solve problems and achieve success. As medical directors at several mass vaccination sites across the United States, we describe key mass vaccination site concepts, including site selection, operational models, patient flow, inventory management, staffing, technology, reporting, medical oversight, communication, and equity. Lessons learned from experience operating a diverse group of mass vaccination sites will help inform not only sites operating during the current pandemic, but also may serve as a blueprint for future outbreaks of highly infectious communicable disease.

The genomic sequence of the novel severe acute respiratory syndrome coronavirus-2 (SARS CoV-2) was made publicly available on January 11, 2020, triggering an international race to develop a safe and effective vaccine. Less than a year later, studies demonstrating the efficacy of 2 mRNA vaccines lead the way to Emergency Use Authorizations for use in the United States.[1,2] With studies demonstrating an approximately 70-85% population vaccination rate to achieve community ("herd") immunity,[3] focus soon transitioned from development to deployment. Although mass vaccination campaigns have been used effectively since at least the 1800s to limit the impact of communicable disease on public health, the scale and scope of a global coronavirus disease (COVID-19) vaccination campaign were unprecedented.

A single location used for the large-scale vaccination of a specific community can be an essential component of an effective mass vaccination campaign.[4] As the United States and countries throughout the world moved quickly to vaccinate entire populations, mass vaccination sites were identified as one of several tactics to support this national strategy.[5] A mass vaccination site can consolidate resources and experience into a single entity, and greatly improve the efficiency of a vaccine rollout. One mass vaccination site was able to achieve over 5000 vaccinations per day with only 5 days' notice.[6] However, mass vaccination campaigns depend on the availability of resources, including staff and vaccine, as well as experience in operationalizing such a rollout.[7,8]

As medical directors at several mass vaccination sites across the United States, our objective is to describe key mass vaccination site concepts to include site selection, operational models, patient flow, inventory management, staffing, technology, reporting, medical oversight, communication, and equity. While specific to COVID-19, these key design principles may serve as a blueprint for mass vaccinations for the current and future pandemics.

Site Selection

Several critical factors apply to site selection, including accessibility, existing partnerships, infection control parameters, security, and ability to move people efficiently. Size is a fundamental limiting factor for a mass vaccination site, and many parameters are dictated by infection control needs, including social distancing and ventilation. The expected number of vaccines per day, square footage available, and hours of operation are all key factors in design planning. Considerations include sufficient space for patient flow from check-in through observation, staff needs (including bathroom access and food accessibility), and vaccine preparation. Vaccination cycle times will inform ratios of vaccination stations and observation seating. Additionally,

weather must be considered, especially in climates predisposed to inclement weather where outside lines may present a challenge. Secure storage is also helpful for vaccines and equipment either on or off hours at a site. A secure storage location is especially important at mass vaccination sites that have anticipated long-term use.

Existing partnerships are an asset in scaling rapidly. For example, our hospital system has a long-standing relationship with a large sports venue, Gillette Stadium, as well as local transporting and emergency medical services (EMS).[9] These established relationships, including a shared understanding of day-to-day operations and mutual trust, were helpful to rapidly scale with new partners, including state, regional, and private sector assets.

Ideally, mass vaccination sites are located near a large population center with easy access by foot, car, or public transportation to maximize utilization and equity. Rideshare companies may be leveraged to increase accessibility.[10] Every effort should be made to ensure American Disabilities Act compliancy. City and state aging and disability commissions, community-based groups, and advocacy organizations are critical stakeholders in design.[11]

Uniqueness and experience are also immeasurable factors that may help with diminishing vaccine hesitancy. Sites like the Charlotte Speedway and Fenway Park may generate excitement and encourage individuals to come for the unique experience of vaccination in these iconic settings. Many large venues and sports arenas are available and eager partners.[12]

Operational Models

Mass vaccination sites may use an ambulatory model, a drive-through model, or a hybrid. The effectiveness of a drive-through vaccination model has been demonstrated in the setting of previous influenza pandemics,[13,14] and both drive-through and walk-in mass vaccination clinics have been successful in vaccinating more than 10 000 patients per day in the COVID-19 pandemic.[15,16] Drive-through testing centers offer certain advantages to their walk-in counterparts,[17,18] including the ability to enforce social distancing by default, promoting rapid ingress and egress of a large number of patients, and improving access for patients with limited mobility. However, drive-through centers require additional staffing to perform traffic control and an adequate physical footprint to accommodate in-vehicle observation—a potential challenge in many urban areas. As most appropriate drive-through mass vaccination sites are outdoors, inclement weather is of greater concern. If a parallel walk-in process is not established, drive-through centers unintentionally neglect patients without access to a vehicle.

Security is an essential component of mass vaccination sites. Vaccines can be politically charged, and some mass vaccination sites have seen operational threats.[19] More common is the potential influx of citizens arriving without appointments or otherwise ineligible to receive vaccination,[20] and security personnel are an essential component of crowd control. Security personnel are also essential for maintaining the safety of vaccine supply. If using a drive-through model, a bailout traffic flow for patients arriving without an appointment or emergencies should be designed to not interrupt forward progress of scheduled patients.

Patient Flow

The patient experience should begin before arrival, online, with multilingual information about the site including flow, a facilities map, prehealth screening, and appointment confirmation. Experience has demonstrated that queues often form shortly before the clinic start time and clinics should consider beginning operations at least 30 minutes prior to forward-facing start times. On arrival to the vaccination site, patients should undergo a check-in, including a health screening and appointment verification. The check-in area should have sufficient capacity to allow adequate flow while maintaining physical distancing. The check-in area should also have resources available to support patients with mobility challenges (eg, wheelchairs and support staff).

Once at the site, steady throughput should be a primary goal to minimize wait times and eliminate bottlenecks. Maintaining a constant, linear patient flow is paramount to decreasing queuing and avoiding confusion, whether for a drive-through or walk-in site. Linear flow can mitigate queues and preempt bottlenecks, decreasing staffing requirements and increasing efficiency, and reduces potential for error such as duplicate vaccine administration or inaccurate documentation.[21] Processes should be engineered to decrease event interdependence. For example, 3 vaccine stations positioned in series will inevitably cause increased queuing and decreased throughput compared to 1 queue feeding 3 parallel stations. Appointments should be staggered at defined intervals based on the maximum number of patients per hour, which will vary with clinician experience and individual cycle times. Efforts should be made to minimize patient time on site to both increase efficiency and decrease exposure risk.[22] Computer simulation is a valuable tool in preemptively identifying bottlenecks and throughput problems before they can manifest during a mass vaccination clinic.[23]

Flow should be designed to avoid crossing or bidirectional traffic at any stage. Signage with clear, simple, and concise messaging can help improve operational efficiency. Signage is also a critical component of the patient experience. Design principles should include not just brand and tone consistency but also should build on the emotional aspect of the vaccination event. For example, all CIC Health sites welcome patients as "guests" with an acknowledgment of the importance of the moment ("Welcome, we know this is an important moment for you and our community.").

Prior to vaccine administration, an additional health and safety screening must be conducted, including identifying the risk of potential allergic reactions. Novel vaccines naturally lead to a certain degree of hesitancy, increased questions, and patient anxiety.[7] To decrease the time spent with the vaccinator, common questions should be anticipated and answers provided in advance of arrival at the vaccination station. Scribes can be helpful, allowing efficient data entry while the clinician can dedicate additional attention to the patient.[6]

Vaccine Management

Vaccine management, including storage, security, and cold chain, can be complex and recommendations regarding storage and handling differ among the various available vaccines.[24] The Vaccine Coordinator (Table 1) must be familiar with all regulations pertaining to all vaccines used at the site. There must be capacity to store sufficient vaccine at the appropriate temperature, including a designated area to thaw frozen vaccine. Temperature must be regulated, recorded, tracked, and reported. Further, the amount of time that vaccine can remain at room temperature may vary between manufacturers, and this time must be carefully tracked. A backup plan in case of refrigeration or freezer failure must be developed prior to receiving vaccine on site.[7]

To facilitate throughput and avoid delays, sites may opt to prepare vaccine in bulk. Sites implementing this practice should

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Table 1. Key management positions for mass vaccine site operations

Title	Responsibilities
Medical Director	• Responsible for oversight of all clinical activities, including protocol development, training, and quality and performance improvement
Vaccine Coordinator	• Vaccine ordering, receipt, and storage • Maintaining accurate vaccine inventory • Vaccine monitoring, including temperature monitoring and inventory maintenance • Identifying, reporting, and mitigating temperature variations. • Oversees vaccine transport when indicated • Oversees safe and efficient real-time vaccine drawing and administration
Site Supervisor	• Shift leader • Operational oversight of daily vaccine site operations • Real-time troubleshooting of issues
Operations Manager	• Coordination with site staff and partners, including security, EMS, vaccinators, and managers • Ensure appropriate staffing for guest volume
IT Director	• Maintain safe and secure reporting to IIS and/or electronic medical records

IIS, Immunization Information System.

make sure that each syringe is appropriately labeled with the vaccine name, dose, lot number, date, and time the syringe was filled, as well as the name of the preparer. Vaccine should be drawn carefully, and excess draw should be avoided. A mantra of "no dose wasted" should be maintained. The preparation site should be close to the vaccination area to decrease the physical distance between supply and demand. At the vaccination station, each vaccine should be checked to confirm dose, route, manufacturer, and lot number prior to administration. Additionally, the number of expected patients and the number of drawn vaccine doses must be closely monitored to avoid over-drawing. A real-time system to match drawn vaccines and expected appointments is helpful.

The team should have a contingency plan to use potential excess doses remaining after primary operations. Strategies deployed include vaccinating site staff members, first responders, or pre-registered community members. Some sites have partnered with community leaders and business owners to build a phone tree to rapidly identify the public, customers, or staff for vaccines. Social media communication can be effective but can inadvertently result in large numbers of people arriving to the site who may need to be turned away.[25]

Staffing

Availability of skilled vaccinators poses one of the biggest challenges to mass vaccination sites.[7] Mass vaccination sites offer speed and scale but require a substantial amount of staffing. Unfortunately, during a pandemic, clinical staff are also needed for other sectors of health care, and supply may be further limited because of illness or quarantine. Expanding the scope of practice of clinicians such as medical or nursing students, emergency medical technicians, and pharmacists may be helpful in increasing the number of available staff.[7,8]

Volunteers can be an asset for both clinical and non-clinical staff, and mass vaccination sites may serve as a tool to "energize" the COVID-weary.[6] However, maintaining quality and performance may be challenging when using a volunteer workforce. Further, there is variability in staffs' efficiency and productivity, and attention must be paid to staff throughput metrics.[22] Staffing schedules must account for appropriate break time and rest cycles to mitigate staff fatigue.

Staff training will be determined by local regulations and staff experience. The Centers for Disease Control and Prevention (CDC) defines a minimum training standard for all staff in contact with vaccine,[26] although additional training may be required depending on an individual's level of previous experience and local regulations. The CDC's Vaccine Administration Competencies Form provides a standard for assessment of vaccinator skills, techniques, and procedures.[27]

Technology

The focus on bioterrorism following September 11, 2001, created interest in preparedness for mass dispensing events, and the use of technology was found to improve efficiency in operations.[28] Technology can be applied to support the strategic goals of quality, efficiency, cost-effectiveness, and equity in mass vaccination. Selection of a technology platform involves many factors, some of which could be out of local control of your program.

Patient Registration and Scheduling

Creation and control of scheduling access is a complex issue that spans eligibility, supply management, operational efficiency, and equity. The scheduling platform must be flexible, accommodating changing eligibility, should support multiple languages, and should confirm eligibility groups or tiers as applicable. If ineligible, the patient should be placed on a waitlist for future notification. The platform should register patients into the electronic medical record (EMR) and collect clinical questionnaire data, as well as billing information if applicable. An efficient public-facing website for registration should be simple and accurate. It should work well on both desktop computers as well as mobile devices and reflect the available doses at a particular site.[29] In addition, to address concerns of equitable Internet access, many states require an option for registration by telephone.

Reusable links for appointments should be avoided as these can be shared openly outside of eligible tiers. Network traffic associated with appointment demand can be substantial, especially near the date of a change in eligibility criteria, and the scheduling platform must be able to accommodate demand surges.[29] Appointment strategies must also accommodate individuals without Internet access or the technology skills required to complete the scheduling process.[30] Third-party solutions have become increasingly available, assisting people with finding and registering for an available vaccine. However, these solutions intrinsically favor those with computer and Internet access and those with the technical know-how to use these sites. To increase parity and equity, several states have moved away from self-registration to a system of pre-registration, in which the citizen is notified when there is an available vaccine for their tier of eligibility.

For vaccines that require second doses, booking second dose appointments automatically avoids issues with manual appointment scheduling or incorrect allocation of doses as second appointments come due. Scheduling technology can play a key role in supply chain management, helping to anticipate expected doses for the day, as well as historical no-show rates and patterns of patient arrival. Additional technology considerations related to scheduling include communication to patients for upcoming appointments for reminders, canceling, or rescheduling.

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Table 2. Minimum reporting elements for COVID-19 vaccine administration

After administering a dose of COVID-19 vaccine, record to the extent not already recorded in the vaccine recipient's record all information marked below by an asterisk and report the following required vaccine administration data, or other data elements if revised by CDC, to the appropriate entity noted in the agreement:
Administered at location/facility name/ID
Administered at location type
Administration address (including Company)*
Recipient name and ID*
Recipient date of birth*
Recipient sex*
Recipient race
Recipient ethnicity
Recipient address*
Administration date*
CVX (product)*
NDC (national drug code)
Dose number*
Lot number (Unit of Use [UoU] or Unit of Sale [UoS]) *
MVX (manufacturer)*
Sending organization (name of the agency submitting the report)
Vaccine administering provider's name and suffix*
Administering provider's address, if different than the administration address*
Vaccine administration site (on the body) *
Vaccine expiration date*
Vaccine route of administration*
Vaccine series

Electronic Medical Records

Documentation of vaccine administration is key to accurate supply management and reconciliation, tracking adverse events, and portability of vaccine records. An ideal EMR solution will focus on vaccination workflow and data collection to optimize efficiency. This is particularly important in the mass vaccination setting, and many ambulatory EMR vendors have prepared their platforms for the workflows, documentation, and reporting of COVID-19 vaccines.[31] Differences in vaccine dosing, regimen, and contraindications can be incorporated into clinical decision support to avoid administration errors. The EMR can also assist in identifying patients at higher risk for adverse events, including anaphylaxis. In addition, patients who might require counseling prior to vaccination (ie, breastfeeding, pregnant, immunocompromised) can be identified and escalated for those services. Unfortunately, not all vaccine sites, especially those operating outside of the traditional health care infrastructure, will have access to robust EMRs. Availability, cost, and functionality must be considered when selecting a platform for documentation of vaccine administration. The minimum data required documentation can be found in Table 2.32 For sites that are unable to use an EMR, a paper medical record may be used but should contain all of the essential elements of a patient medical record. Sites using paper medical records must also consider additional reporting challenges.

Reporting

Mandatory reporting requirements for mass vaccination clinics include public health immunization registries and vaccination adverse events. Vaccine providers should report to their jurisdiction's vaccine inventory system daily.[32] Other suggested reports include operational reports (number of vaccinations per day, average vaccination length of stay) and demographic reports (zip code analysis, ethnic segmentation) that may be used to focus vaccine equity efforts. Whether directly from the EMR, or via data integration, reporting completed vaccination records to the appropriate Immunization Information System (IIS) is critical to maintaining accurate records for public health purposes as well as for individual health record portability. Any immediate adverse reactions should be documented in the EMR, including medication administration, response, and patient disposition. Reporting to the Vaccine Adverse Event Reporting System (VAERS) is mandatory for certain conditions, as listed in Table 3, although providers are encouraged to report any additional clinically significant adverse event following vaccination.[33] Adverse outcomes should be reviewed by the site medical director.

Table 3. Minimum reporting requirements for the Vaccine Adverse Event Reporting System (VAERS)

Health care providers are required to report to VAERS the following adverse events after COVID-19 vaccination, under Emergency Use Authorization (EUA), and other adverse events if later revised by CDC: • Vaccine administration errors, whether or not associated with an adverse event (AE) • Cases of COVID-19 that result in hospitalization or death • Serious AEs regardless of causality. Serious AEs per FDA are defined as: a. Death b. A life-threatening AE c. Inpatient hospitalization or prolongation of existing hospitalization d. A persistent or significant incapacity or substantial disruption of the ability to conduct normal life functions e. A congenital anomaly/birth defect f. An important medical event that based on appropriate medical judgment may jeopardize the individual and may require medical or surgical intervention to prevent one of the outcomes listed above g. Cases of multisystem inflammatory syndrome

Communication

Defining and implementing a comprehensive communication strategy is necessary for a successful operation. Communications should be seen as an opportunity to engage guests for their own vaccination experience, but also so every guest, in turn, becomes an advocate of vaccinations. One of the most important aspects of the operation is providing all guests with a platform from which to share their own story. Across all CIC Health sites, a "selfie" station anchors the end of the vaccination experience. This has enabled tens of thousands of guests to communicate across their own social media networks the reasons they got vaccinated, and de facto become a megaphone for vaccinations. From the site's website and emails, through social media and public relations, each channel can help match demand with supply. Every key milestone or event is an opportunity to invite media and further amplify the importance of vaccinations. Examples include opening day, reaching 5000 or 500 000 vaccinations, or celebrities and faith leaders getting vaccinated.

Medical Oversight

Protocol Development

Mass vaccination sites should have a set of protocols based on national best practices for vaccine administration. Several checklists are available to help guide sites in establishing local

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protocols.[34,35] The site medical director is instrumental in guiding the development of on-site medical protocols, not only for the safe administration of vaccine but also for the management of patients' post-vaccination, including any adverse events. As on-site medical care is often provided by local EMS agencies, on-site treatment and transport protocols should follow local or regional EMS protocols. The site medical director should review and approve a standing order for vaccine administration.[36–38] At a minimum, protocols should include site infection control, patient health screening, vaccine preparation and administration, workplace safety (including needlesticks), adverse event management (including anaphylaxis), and adverse event reporting.

On-Site Medical Care

Post-vaccination, all patients must be observed for a period of 15 to 30 minutes, according to individual risk profile. The observation area must be sufficiently staffed to identify any adverse reactions in a timely manner. On-site health care providers should be trained in the medical response to anaphylaxis, and there should be sufficient available medical supplies, including pre-drawn epinephrine or epinephrine auto-injectors. A quiet area with cots is helpful for patients experiencing lightheadedness during or immediately following vaccine administration. Additionally, a private room or partitioned area should be available for those needing additional privacy for personal, medical, or religious reasons.

A plan for rapid extrication and transport should be identified and partnerships with local transporting EMS agencies are ideal. While the incidence of adverse events is low and drive-through sites have a long history of efficacy and safety,[39] they nevertheless warrant particular caution, as extrication from a vehicle in the event of an emergency can be challenging. Observers on elevated platforms, mobile health care providers, and other similar safety measures may be considered. Clear egress routes for emergency response vehicles are essential. At the Charlotte Motor Speedway site, adequate spacing of cars allows easy access by an all-terrain vehicle equipped with medical supplies and personnel.

Table 4. Sample Equity Operational Matrix

Population	Barriers	Actions (examples)
Black	Trust	• Partner with local churches to hold information seminars. • Engage faith leaders as early vaccine adopters. • Create messaging strategies leveraging local and national social influencers.
	Internet access	• Work with community centers, houses of worship, and local business to establish registration pods. • Establish restricted registrations periods for certain demographics.
	Transportation	• Community and faith groups can coordinate COVID-19-safe transportation options.
Latin X	Trust	• Partner with local businesses to create targeted messaging. • Clear messaging about identity and data protection (eg, no requirement for government identification).
	Internet access	• Ensure native language reviews of content. • Leverage community centers and high-volume employers to create access portals.
	Language	• Native speaker reviews of online and social media messaging. • In-person recruitment drives and question and answer sessions.
Rural	Internet access	• Establish restricted registration periods for certain demographics.
	Transportation	• Strategic placement of mass vaccination locations to limit drives to less than 2 hours. • Establishment of "mini-mass" sites within lower population density zip codes.

Equity

Health equity is a broad and complex challenge, but for the purposes of community mass vaccinations, the term should include any population with historic or contemporary disparity in access to care.[40] In the United States, current vaccination rates for black and Latin X populations are disproportionately low compared to white communities relative to COVID-19 infection rates, mortality, and total population.[41] Beyond ethnicity, rural residence is also a key risk factor for health and vaccine inequity.[42]

Vaccination equity is a critical pillar in any holistic mass vaccination strategy. Ensuring vaccination equity requires rigorous operational planning and execution. There are three broad challenges to ensuring vaccination equity, including variable trust in the health system and vaccine (ie, vaccine hesitancy), geographic and physical access barriers, and technological impediments. The specific nuances within each of these categories vary and local community leaders should tailor solutions to meet each specific barrier.

First, development of an intentional planning matrix with gap analysis and implementing data-driven operations is essential (Table 4). Planners can leverage a variety of data tools, including geographic information systems mapping at the census track level to map social vulnerability indices against relevant COVID-19 metrics.[43] The social vulnerability indices needs assessment data should be combined with population surveys to determine granular barriers to vaccine administration. A real-time dashboard that tracks vaccine administration targets providing processes for dynamic monitoring of operational trends and can shape strategic messaging efforts is an essential tool.[44] These data will inform messaging, pre-planning, and operational pivots.

Second, building trusted relationships is foundational for strengthening vaccine confidence. Trusted local partners can validate health system messaging to build vaccine confidence and serve as community ambassadors for vaccination. For example, in the black community, especially in the Southern states, there are higher levels of vaccine hesitancy secondary to historical social inequity, long-standing health access disparities, and demonstrable patterns of unethical medical research. Data suggest that, within these communities, hesitancy often reflects a lack of confidence versus opposition to vaccines.[45] In the Latin X community, both vaccine-specific and broad system concerns drive hesitancy. Common knowledge barriers include understanding the severity of COVID-19 infection and the importance of vaccinations. However, data suggest that language barriers, data-privacy concerns, and "documentation- status" drive community-level hesitancy within Latin X communities.[45] Leveraging "trust agents"

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such as community leaders, including clergy, local organizations, and businesses that can assist with recruitment and pre-registering of individuals within historically marginalized communities, has demonstrated some success. Health systems can partner with houses of worship to be highly effective at educating communities, recruiting, and registering individuals, and expanding vaccination penetrance.[46]

Third is ensuring physical and geographic access to mass vaccination sites. Specific to access, when planning for personal vehicles, planners must ensure either smooth drive through operations or free parking, especially in urban environments. Acknowledging that lack of vehicle ownership is a marker of higher social vulnerability index, equity plans should influence site selection to ensure easy access to public transportation, the ability to leverage chartered group transportation options (eg, church group) or reasonable pedestrian access. These plans should be regionally tailored, as in many rural regions public transportation is limited, but access to personal vehicles is critical for activities of daily living. Here again, local knowledge and appropriate operational data collection can inform effective solutions.

Finally, planners must create a nuanced technology plan for mass vaccination. Technological solutions have expanded during the COVID-19 pandemic, and pre-registration of individuals is clearly the most efficient way to execute mass vaccination operations. However, "digital equity" remains a true barrier to vaccination access for many who lack access to the high-speed Internet, have limited technical knowledge, or face language barriers. When planning for web-based registration, some successful tactics include ensuring native language speakers review content, designating "equity appointments," and training relevant community partner organizations to assist with registration drives. In addition, processes should be deployed that allow for organized on-site, in-person, or telephonic registration.

Conclusions

Mass vaccination sites are an essential component of a strategy to rapidly, efficiently, and equitably reach a sufficient level of community immunization to end the COVID-19 pandemic. The lessons learned from our experience operating a diverse group of mass vaccination sites can help inform not only sites operating during the current pandemic, but also will be applicable to future outbreaks of highly infectious communicable disease. Varied models of mass vaccination site operation have taught us important lessons, including the importance of site selection and community engagement. Operational models must be carefully considered, weighing the benefits and challenges of ambulatory and drive-through models. Staffing, accessibility, and space will all inform this selection. Vaccine availability and throughput will dictate site capacity. While a variety of technologic solutions for registration and for documentation are available, it is of the utmost importance that all patients have a record of vaccination administration, and that all adverse reactions are reported in a timely manner. Medical oversight for mass vaccinations should be based on best practices and local regulations. The site must be appropriately staffed and equipped to provide immediate care in the event of an adverse reaction. Clear egress for emergent medical transport should be defined in advance. A commitment to improvement and to addressing contingencies is also essential using an improvement framework such as "Plan, Do, Study, Act" by which issues are identified as they arise, solutions trialed, and processes modified based on results.

Ultimately, vaccine administration will fall to traditional resources, including primary care and community clinics. However, while mass vaccination sites are a temporary resource, they are nevertheless essential in achieving the necessary levels of community vaccination. While mass vaccination sites present unique challenges, health care systems, local and regional public health entities, emergency medical services, and private organizations can rapidly come together to solve problems and achieve success. Although this reflects lessons learned from US-based sites, our hope is that other nations, particularly low middle income countries can benefit from our shared experience. Through collaboration and perseverance, mass vaccinations can achieve the scale necessary to vaccinate a substantial segment of our population—rapidly, safely, and equitably.

Conflicts of Interest. None.

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