

# COMMENTARY

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## Planning Considerations and Lessons Learned From a COVID-19 Mass Community Vaccination Center

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**ABSTRACT** The emergency use authorization for multiple coronavirus disease 2019 (COVID-19) vaccines came at a pivotal time for the USA. In January 2021, the country exceeded 400,000 deaths from COVID-19. The USA aimed to quickly distribute and administer the Pfizer and Moderna vaccines, with bright prospects for an additional emergency use authorization for Johnson and Johnson/Janssen's single-dose vaccine on the horizon. Part of the National Strategy for COVID-19 Response and Pandemic Preparedness was to "mount a safe, effective, comprehensive vaccination campaign" so the administration set a goal to have 100 million fully vaccinated citizens after the first 100 days in office. In order to fuel the rapid administration of vaccines, the Department of Health and Human Services was tasked to stand up new, federally supported Community Vaccination Centers across the country. The Federal Emergency Management Agency (FEMA) was the lead agency entrusted to expedite financial assistance, allocate federal equipment and supplies, and deploy federal personnel to states, tribes, territories, and other eligible applicants for vaccination efforts. Early in the process of staffing sites, FEMA recognized the need to bolster the efforts with active duty military personnel and asked for manning assistance from the Department of Defense. As a result, 222 U.S. Air Force personnel were tasked with supporting the FEMA COVID-19 vaccination operations at NRG stadium, Houston, Texas. This reflection aims to cover the lessons learned and provide meaningful insight for future mass medical operations.

### BACKGROUND

In the wake of the Food and Drug Administration's emergency use authorization for coronavirus disease 2019 (COVID-19)

vaccination use, the Department of Health and Human Services Planning was charged with establishing large-scale, federally operated Community Vaccination Centers (CVCs) to expedite the process of vaccinating the U.S. population amidst the ongoing COVID-19 pandemic.<sup>1</sup> Executing a public health initiative of this magnitude required a multiagency approach with a clear delineation of roles and responsibilities for each party. The unified command structure in place at Task Force-Houston (TF-Houston)'s CVC included the Federal Emergency Management Agency (FEMA), U.S. Air Force, Harris County Public Health (HCPH), and the City of Houston. The HCPH was the lead incident command for the mission and was responsible for the overall planning and design of the site. The county also was responsible for scheduling, processing, and documenting vaccinations in VacsTrac, its online vaccination system. The FEMA's primary role was to fund and manage resources, which included vaccines and supplies, in order to coordinate an effective incident response between federal, state, and local agencies. City of Houston personnel were on-site to work in tandem with Harris County and augment this public health service.

Task Force-Houston was set up as a Type 1 CVC with 222 active duty Air Force personnel of various occupations

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deployed from 14 bases. The mission structure was initially formulated utilizing FEMA's CVC Playbook as a manning guideline.<sup>2</sup> The FEMA guide also included recommended security, emergency medical services (EMS), and information technology (IT) personnel ratios. Task Force-Houston's daily operations required the following personnel: 33 vaccinators, 22 vaccination scribes, 21 screeners, 14 registration scanners, 9 observation personnel, 26 pharmacy, 16 manpower, 11 check-in, 12 logistics, and 8 command and control.

### **SCREENING AND REGISTRATION**

Task Force-Houston followed the state guidelines to determine individual vaccine eligibility. Patients registered online or via phone with the City of Houston. Qualified patients were placed on a waiting list and received notification when they were eligible to schedule an appointment based on zip code and other demographics. Upon selection from the waiting list, individuals received a vaccination appointment date and time, as well as a unique quick response (QR) code for rapid appointment verification upon arrival at the site.

Upon arrival at the NRG stadium site, patients presented their QR codes at check-in to verify that they were at the correct site at the correct date and time. Personnel screened patients utilizing the Centers for Disease Control and Prevention (CDC)'s published questionnaire in conjunction with guidance from the HCPH Medical Director. Standardization of the screening questionnaire allowed for routing patients into the appropriate 15- or 30-minute post-vaccination observation categories. Questions regarding a patient's eligibility—whether initiated by the patient or the screener—were directed to the on-site incident commander for the final decision-making.

Patients were screened in one of seven screening tents, each capable of accommodating approximately five vehicles. Vehicles were routed into tent lanes by parking attendants, and non-medical team members (two per lane) would verify all vehicle QR codes via iPad scanners. Medical technicians reviewed the focused screening questionnaire with each patient. At peak throughput, personnel left the tent to screen patients in the queue to optimize efficiency. Conversely, during inclement weather team members remained under the screening tents to maintain operational flow. Patients cleared for vaccination were given vaccine information sheets which contained potential post-vaccination symptoms. These forms were available in numerous languages, and translators were readily available. Site design and traffic flow allowed for rapid egress of patients who were not cleared for vaccination at multiple points along the vaccination pathway.

Wet erase chalk markers were used to mark windshields with the following information: eligible vaccine recipients per vehicle (1, 2, etc.), registration or QR code issues (IT), patients with a history of syncope (S), or patients requiring a 30-minute post-vaccination observation period (30). This step

facilitated the effective routing of patients requiring additional accommodations. During rain and other inclement weather, windshield annotations were written on the vaccine information handouts and placed on vehicle dashboards to minimize process disruption. Drivers were instructed to place their hazard lights on if one of the aforementioned circumstances applied to their vehicle in order to ensure an appropriate lane routing by parking attendants.

### **VACCINE HANDLING, DISTRIBUTION, AND ADMINISTRATION**

Vaccines, personal protective equipment, and other supplies were obtained through a joint effort between FEMA, State of Texas, and HCPH. Establishing frequent supply inventory schedules to minimize item shortages was essential for an operation that ran 7 days per week. Pharmacy, logistics, and county personnel worked to ensure proper handling and temperature monitoring of the Pfizer vaccines, which were the only ones used at the site during the first 6 weeks. Manufacturer protocols involving thermal shipping containers, ultra-cold freezer storage, and subsequent refrigeration were rigorously adhered to.<sup>3</sup> The on-site pharmacy was responsible for thawing, diluting, and drawing up 6,000 vaccines per day. Quality checks were performed on all vaccine doses to ensure the safe administration of vaccine.<sup>4</sup>

Before injection, the vaccines required distribution from the pharmacy to the 11 drive-through lanes. This task required a methodical approach to ensure careful handling and proper monitoring of time-use and ultraviolet light exposure requirements. Pfizer vaccine is only good for 6 hours after reconstitution and must be kept at a temperature of 77 °F or below. The vaccine distribution team placed doses into small insulated carrying bags with a maximum of 20 doses per bag. These bags were temporarily stored for first-in, first-out distribution from a pharmacy trailer window. Outside of the distribution window, the team utilized post-it notes or digital clickers as a stock indicator for the number of available bags for runners to distribute into the lanes.

The final control used to ensure cold chain management and proper lead time for restocking occurred within the vaccine lanes. Each lane had a mini-refrigerator and two carrying bins. Vaccine was first delivered to the refrigerators, and delivery time was recorded. The vaccinators in the lanes placed doses into bins next to the refrigerators. When the bins were emptied, personnel would refill their bins from the refrigerator and place traffic cones to notify runners of the need for additional vaccines.

Vaccinations were administered under tent cover in vaccination lanes. Each lane's team consisted of two vaccinators and two scribes to vaccinate a vehicle's vaccine recipients. Vaccine administration information was documented and tracked utilizing Harris County's VacsTrac registry system. A CDC vaccination card was also given to each patient following vaccination.

## POST-VACCINATION OBSERVATION

Following vaccination, vehicles proceeded into the parking lot for a CDC-recommended 15-minute post-vaccination waiting period. The waiting period was self-timed. Vaccine recipients with a history of immediate allergic reaction to an injectable therapy or history of anaphylaxis of any cause were instructed to wait 30 minutes in this area.<sup>5</sup> Once in the observation area, vehicles were instructed to honk their horns if post-vaccination symptoms developed and medical attention was required.

Nine medical personnel monitored the observation area using golf carts. The carts optimized rapid medical responses to vehicles when needed. Local EMS personnel on-site each day included a team chief, three EMS ambulance units, and six EMS personnel. The EMS had their own golf cart to navigate gap lanes in the event that patients were unable to be driven to the EMS ambulance. Frequent radio communication between medical personnel, EMS, and command staff was essential for effective care coordination.

Team members were familiarized with common post-vaccination events, including lightheadedness, dizziness, vasovagal syncope, perioral paresthesia, tachycardia, anxiety, nausea, and facial flushing.<sup>6</sup> Although uncommon, anaphylaxis may occur, and protocols for site-specific management should be clearly defined. Each golf cart was equipped with two auto-injector epinephrine pens. Based on the reported anaphylaxis rate for the Pfizer-BioNTech COVID-19 vaccine of 11.1 cases per million doses, TF-Houston expected 2.77 episodes of anaphylaxis for the 252,000 vaccines projected to be given over the 42-day period.<sup>7</sup>

Vaccine Adverse Event Reporting System (VAERS) reports were initiated for each vaccine recipient who developed symptoms and electronically uploaded into the VAERS database at the end of each day.

## RESULTS

The vaccination operation at NRG stadium occurred for a 6-week period from February 24 through April 6, 2021, for 41 days. The site hours were from 8:00 AM until 4:00 PM to 6:00 PM depending on the number of patients registered. NRG Houston gave 3 weeks of first dose Pfizer vaccine and 3 weeks of second dose Pfizer vaccine. [Table 1](#) summarizes key data points from the operation. A total of 241,248 vaccinations were given to 126,257 patients. This represents an average of 5,884 vaccinations per day. The least productive day was 3,083 vaccinations due to a scheduling error, and the most productive day was 7,035 vaccinations. The fastest hourly rate was day 41 from 9:00 AM to 1:00 PM when 1,078 patients were vaccinated in a single hour with one vaccination happening every 3 seconds. With 11 lanes running with two vaccinators per lane, this represents 49 vaccinations per person per hour or one vaccination every 1.2 minutes. There were 402 adverse events documented (308 during first dose [77%]; 94 during second dose [23%]) and 43 transports to the emergency room (34 during first dose [79%]; 9 during second

dose [21%]). Epinephrine was given eight times (seven during first dose [88%]; one during second dose [12%]). There were 17,871 no-shows over the entire period, representing 6.9% of registrations; 16,558 (93%) of no-shows were for first dose vaccinations and 1,313 (7%) were for second dose.

Task Force-Houston had 264 wasted doses representing 0.11% of total vaccinations. The most frequent cause of waste was a wrong dose in the syringe (54, 20%) and particulate in a vial or syringe was the second leading cause (49, 19%). Syringe malfunctions were the third-highest cause (37, 14%), which led to a change in vendor to prevent further issues.

## DISCUSSION

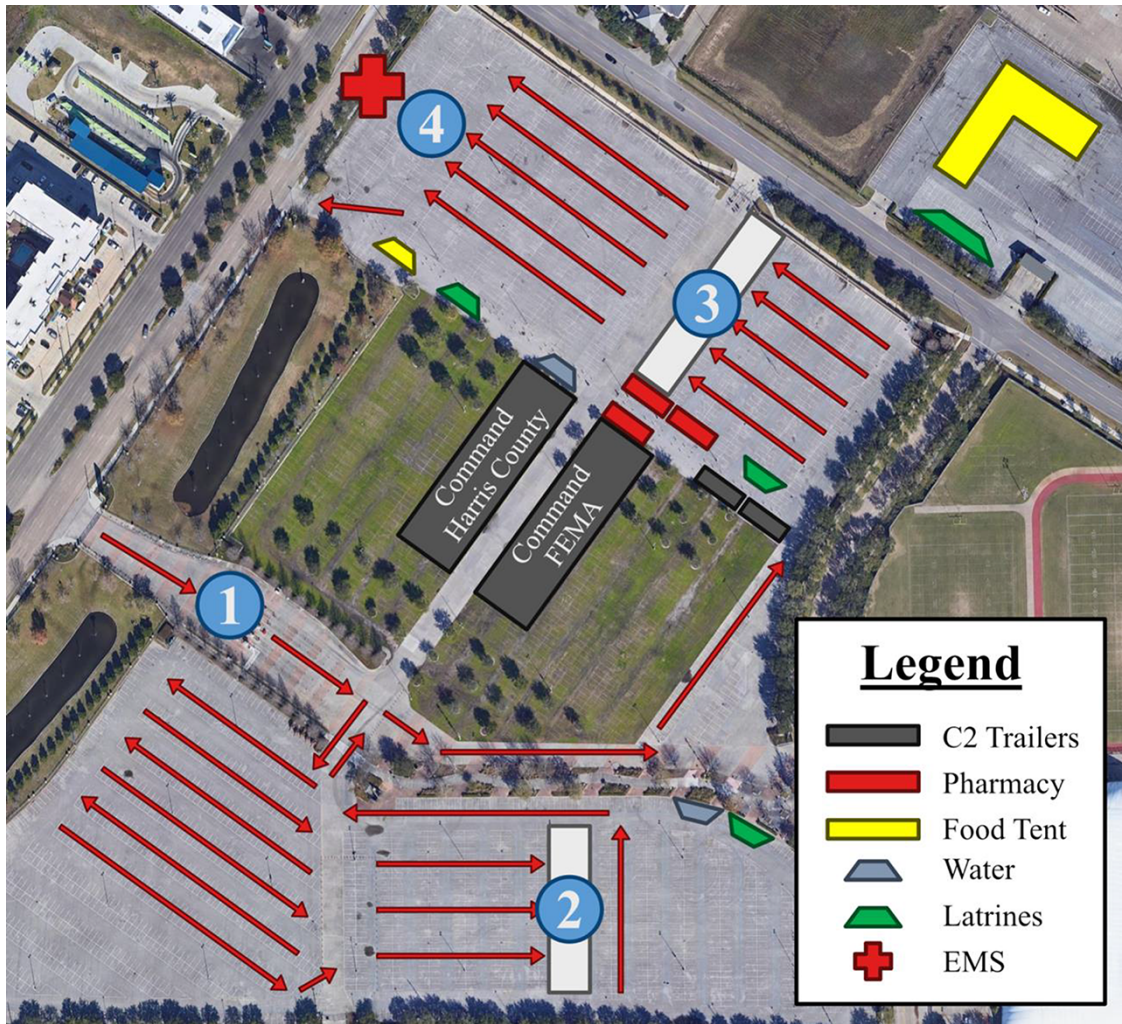
Over the course of the operation, the authors identified the following lessons. They represent a small sampling of the observations that could prove beneficial in the future.

### **Lesson 1: Traffic Cones—Analog Communication in a Digital Age**

Task Force-Houston learned that using traffic cones as a visual cue was an effective means of communication to request additional vaccine. Early on, vaccinators and distribution teams struggled to properly supply vaccination lanes. With 11 lanes spanning over 200 feet, it was imperative to quickly and efficiently communicate vaccine stock to ensure the site continues to run smoothly. Traffic cones were used to accomplish this task. When a lane was running low on vaccine, personnel placed a standing traffic cone in front of their lane. This indicated that the lane had some vaccine on hand but were running low. When the lane was completely out, they would lay the cone down with the base facing “toward” the lane. When the lane needed doses with 1.5" needles, they also laid the cone down but with the base facing “away” from the lane. This analog method of communicating allowed the Vaccine Operations Manager (VOM) to quickly identify which lanes needed doses so they could coordinate with the pharmacy to draw up more vaccine. Trying to accomplish this with a radio communication would take too long and create redundant chatter. This method is simple, error free, and worked extremely well to communicate the needs of the vaccine lanes.

### **Lesson 2: Crawl before Walking—Do Not Sprint Out of the Gate**

One challenge TF-Houston experienced was the lack of an opportunity to ramp up to full operating capacity. On the day before opening, the site had a “soft open” with 100 patients scheduled. With 11 lanes, this amounts to nine patients per lane. At this time, we had four vaccinators per lane, which meant each vaccinator was able to vaccinate only two people. The next day, the site gave 5,511 vaccines. This meant the system had to operate at 92% capacity without any additional training opportunities. Regardless, it is the recommendation of these authors that future sites operate a crawl, walk, run ramp up where the soft open schedules a few 100 patients,



**FIGURE 1.** Site layout for the Houston, Texas Community Vaccination Center at NRG Park. Arrows indicate traffic flow through the following sections: 1—Check-in; 2—Registration/Screening; 3—Vaccination; and 4—Observation.

day 1 has 25-50% of capacity and day 2 has 75% capacity. The site can operate fully after that.

**Lesson 3: The Tactical Pause—End-of-Day Operations with Military Precision**

The lesson which went through the most iterative development was the end-of-day procedure. Overall, TF-Houston learned that a site-wide pause with a precise dose inventory was the most effective way to eliminate vaccine waste and ensure the site did not prematurely run out of vaccine at the end of the day. While the total number of vaccination appointments scheduled for a given day was known, the no-show rates for scheduled appointments fluctuated between zero and 16% per day and hourly vehicle arrival rates varied dramatically. In order to prevent wasted vaccines, the site developed a process to draw up only the necessary number of doses to meet this unpredictable daily demand.

The first step for end-of-day operations included a site-wide pause 2 hours before site closure. During the pause, vehicles were held at the screening checkpoint until all vehicles in the vaccine lanes were cleared. At that time, runners and vaccinators calculated the total number of doses remaining in the vaccine lanes and the pharmacy. Vehicles waiting in screening were counted in bulk and then released back to the system, allowing the VOM to monitor vaccine inventory status compared to vehicle flow through the system. Using these two numbers, the VOM could signal the pharmacy to prepare additional vaccine doses. After the initial bulk car count, the VOM received a message from a car counter for every 20 cars that entered the site. As vehicles often carry multiple vaccine recipients, counting vehicles instead of patients helped prevent any overcounting and reduced end-of-day waste.

Throughout the process, the goal was to stay slightly ahead of demand and prevent a complete work stoppage. As the

**TABLE I.** Summary Data for Task Force-Houston; Vaccine Adverse Event Reporting System (VAERS)

Vaccinations	Total: 241,248	No-shows	Total: 17,871
Dose 1 vaccinations	126,257 (52%)	Dose 1	16,558 (93%)
Dose 2 vaccinations	114,991 (48%)	Dose 2	1,313 (7%)
Unique patients	126,257		
		Offsite emergency medical services transports	Total: 43
VAERS	Total: 402	Dose 1 transport	34 (79%)
Dose 1 reactions	308 (77%)	Dose 2 transport	9 (21%)
Dose 2 reactions	94 (23%)		
		Wasted doses	Total: 264 (0.11%)
Epinephrine	Total: 8	Wrong dose	54 (20%)
Dose 1 epinephrine	7 (88%)	Particulate	49 (19%)
Dose 2 epinephrine	1 (12%)	Syringe malfunction	37 (14%)

arrival rate of vehicles decreased, open lanes were closed to simplify the continual inventory and stocking of lanes. Due to counting vehicles instead of total appointments per vehicle, the total inventory eventually reached zero. This forced a second pause where all vehicles in the system were counted and another bulk sum was provided to determine a draw amount. At that point, the VOM would count the specific number of patients in cars to aid with the final dose need. In most cases, less than five doses would remain after the final vial was drawn for vehicles. For the remaining doses, HCPH managed a volunteer pool to ensure no vaccine dose was wasted.

#### **Lesson 4: Medical Safeguards**

Vaccine recipients who developed presyncopal and syncopal symptoms while simultaneously operating their motor vehicle represented a unique challenge for the mass vaccination site. Patients who screened positive at registration for a history of syncope were encouraged to transition into a passenger role if another capable driver was present in the vehicle. If not, drivers with a history of syncopal episodes were annotated with an “S” on their windshield and directed into a designated area at the start of the observation area with concrete barriers in front and behind the vehicle. They were directed to place their vehicle in park while the vaccination team administered the vaccine. This ensured those patients did not operate their vehicle until the conclusion of their observation time. These safeguards were implemented in the observation area to minimize potential risks for recipients who may experience syncope, become unable to alert medical personnel of their

need for care, or become a danger to themselves or others by inadvertently losing control of their vehicle.

#### **Lesson 5: Keep It Simple—A Unified Registration System**

At the start of operations, there were two disparate registration systems in place, one for the City of Houston and one for the Harris County. These two systems required a manual process to import registration codes from the City of Houston to the Harris County system. Registration code errors represented a significant source of process delay throughout the site operation and resulted in longer wait times for patients while increasing IT staffing requirements. Utilization of a single registration system will be beneficial in reducing the number of IT issues, decreasing staffing requirements in this area, and maximizing efficient throughput of patients. Implementation and enforcement of a strict policy which denied walk-in patients (even if from the same family) was essential in optimizing our zero-waste goal for daily vaccine administration as well as our adherence to the local tiered vaccine eligibility system designed to capture the most at-risk populations first. The walk-in policy combined with the change to a unified registration system was instrumental in improving efficiency for TF-Houston.

#### **Lesson 6: Communicating in a Pandemic—A Unified Command Group**

Task Force-Houston utilized a unified command group structure at the outset of mission operations. All agencies were present at twice-daily meetings where challenges were addressed. Collaboration between city, county, state, and federal agencies about logistics, supply, and access issues ensured all agencies were engaged and committed to the solution. This manner of teamwork was vital to the ultimate success of important medical missions.

#### **CONCLUSION**

This article seeks to impart the insight and knowledge gleaned by the authors from their collective experience at TF-Houston over a 6-week period in early 2021. This review of a joint military and civilian public health initiative for large-scale vaccination administration may provide guidance for the planning and execution of major medical operations that might arise in the future.

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#### **CONFLICT OF INTEREST STATEMENT**

None declared.

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