Weeks before the Covid-19 vaccine supplies were due to arrive, Mayo Clinic created a vaccine planning group to work across functions and across its facilities in five states, anticipating the many wrinkles in rolling out vaccines to thousands of health care professionals in a risk-based and ethical manner.

While it is likely that supplies of vaccines against SARS-CoV-2 will increase throughout 2021, it will be months before there is enough vaccine for everyone who wants it. Until supplies are adequate for all, we must allocate the available vaccine to priority groups.

The Advisory Committee for Immunization Practices (ACIP) to the U.S. Centers for Disease Control and Prevention (CDC) makes recommendations for vaccine implementation in the United States including which groups to prioritize for early vaccination. The ACIP considers vaccine science (e.g., vaccine effectiveness in different populations), implementation factors such as the feasibility of vaccinating certain groups, and ethics. Core ethical principles of vaccine allocation are to maximize benefits and minimize harms, promote justice, mitigate health inequities, and promote transparency.¹

On December 1, 2020, ACIP recommended that health care personnel and long-term care facility residents be offered the first Covid-19 vaccines in Phase 1a of a multiphase plan.² Three weeks later, ACIP voted to recommend that persons aged 75 years and older and “frontline essential workers” be included in Phase 1b. Phase 1c will include persons aged 65–74, persons with high risk conditions aged 16–64 years, and essential workers not covered in Phase 1b. Phase 2 would include the remaining population aged 16 and older, with a later phase presumably to include children.²
Upon adoption of ACIP recommendations by the CDC, this guidance is provided to state and territorial health departments, who may further clarify or sub-prioritize these groups, and who will direct the tempo of advancement to each next vaccination phase in their jurisdiction.

It then falls to health care providers to identify and vaccinate these priority groups. Challenges to implementation in Phase 1a include the need to sub-prioritize health care professionals (HCP) and address vaccination side effects in this group. Phases beyond 1a will require additional planning to identify other essential workers based upon data that is largely missing from electronic health records, and reach high-risk patients who do not currently receive care within health systems that have advanced health informatics capabilities.

**How Mayo Clinic Prepared for Vaccinations**

Several weeks prior to the anticipated arrival of vaccine at our institution, we created a vaccine planning group, termed the Covid-19 Vaccine Allocation and Distribution (COV-VAD) work group (Figure 1), to guide the vaccination program. Co-chaired by Occupational Medicine and Infection Diseases physicians, the group included representatives from emergency management, subject matter experts (SME), pharmacy, supply chain, nursing, informatics, data analytics, legal, security, space planning, facilities maintenance, and health systems engineering. Six functional subgroups were created: governance, vaccine site logistics, SMEs, pharmacy/supply chain, communications, and technology.
These subgroups were charged with doing rapid cycle gap analysis and problem-solving. Representatives from each of Mayo Clinic’s regional sites were included to facilitate shared learning between the regional sites, the functional subgroups, and the executive team, in order to develop a uniform approach to vaccine allocation and delivery. Administrative staff and project managers ensured that tasks assigned to the various subgroups were completed in a timely manner. Health systems engineers provided recommendations and feedback to ensure efficient operations and optimize resource utilization. The executive group engaged with experts on ethics, diversity, and inclusion, and with local public health and community liaisons to gather input about prioritization of HCP, develop strategies to mitigate or prevent inequities, and provide transparency.

"Representatives from each of Mayo Clinic’s regional sites were included to facilitate shared learning between the regional sites, the functional subgroups, and the executive team, in order to develop a uniform approach to vaccine allocation and delivery."

Source: The authors

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The COV-VAD work group was assembled in late October 2020 with executive group meetings twice weekly. All subgroups and Mayo Clinic regional sites gathered weekly at first, increasing to twice weekly by December. All subgroups met independently multiple times per week to accomplish goals for each work group and communicated across sites. Additionally, the executive leadership team met three times per week to review critical and time-sensitive issues. Communication campaigns provided education for staff about Covid-19 vaccines as well as details of the vaccination program.

**Vaccine Allocation to Health Care Personnel**

The ACIP recommendation for Phase 1a includes all HCP regardless of practice setting. Within larger organizations, early supplies of vaccine were insufficient to cover all HCP wishing to be vaccinated, so sub-prioritization was required. State public health officials provide only high-level guidance, leaving facilities faced with the complex task of allocation within their staff. Options include a lottery system, a first-come first-served approach, or some risk-based prioritization scheme.

Mayo Clinic is a large hospital system with 72,000 health care personnel in facilities across five states. We devised a risk-based plan to provide consistency in prioritizing HCP across the organization while satisfying the requirements of all applicable state plans. Our goal was equitable allocation based upon occupational exposure risk and provision of essential health services. However, occupational demographics stored in Human Resource records, such as job title and department, were inadequate to identify Covid-19 occupational risks. Therefore, we undertook an occupational risk assessment at the individual level.

All employees, contracted workers, students, and volunteers at our institution are assigned to work units. Administrators for each work unit were asked to select the occupational risk factors that applied for each person within their work unit (Table 1). Each individual was then placed into one of seven “waves” designed to distribute HCP across a spectrum of risk. This system allowed each site across the organization to broaden vaccine eligibility to the next wave, or to multiple waves, as vaccine became available to them based on allocation from their respective state plans.

HCP who were eligible for vaccination based on their designated wave received an email invitation to opt in to the vaccination process, along with links to education on vaccination that could be completed prior to the appointment. Once they opted in, a process to create an order for the vaccine was set into motion. These orders were placed in bulk twice a day within the electronic health record by a panel of primary care physicians. Individuals then received instructions to self-schedule their vaccine appointment via the electronic health portal. Once invited, the HCP’s order to allow self-scheduling remains open and available for up to 365 days for deferred self-scheduling if the HCP so desires.

We chose not to incorporate individual health risk into our prioritization system. Privacy protections under the Americans with Disabilities Act Amendments Act and Genetic Information Nondiscrimination Act laws prohibit employers from having access to this information without
specific authorization. Thus, information was not readily available with which to identify workers with specific conditions or medications.

“Within larger organizations, early supplies of vaccine were insufficient to cover all HCP wishing to be vaccinated, so sub-prioritization was required.”

While voluntary self-identification of comorbidities could be facilitated for purposes of vaccine planning, it would be labor-intensive and could have unintended adverse consequences. Allowing prioritization based upon self-identification of risk factors would spread the early doses across all occupational risk groups, preferentially to those best able to self-advocate. This could exacerbate health disparities while potentially contributing to low vaccination rates in the highest occupational risk areas. While numerous HCP raised questions on this topic, this decision was accepted readily once the rationale was explained.

The largest hospital in our system initially maintained designated Covid-19 inpatient units for intensive care as well as general medical care. As community rates increased, these units reached capacity and Covid-19 patients overflowed into other patient care units. This resulted in a larger-than-expected number of HCP being identified as working on a Covid-19 unit. We decided to extend the duration of Wave 1 to 2 weeks to allow all such designated workers the opportunity to sign up for vaccination rather than the initially planned 1 week.

Some risk groups surfaced after the initial prioritization process. For example, dialysis units were identified by the Minnesota Department of Health as a high-priority setting, so both inpatient and outpatient dialysis managers were advised to mark their HCPs as inpatient staff to ensure they were appropriately prioritized. Given the massive scale of the initial prioritization exercise, it became

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**Table 1. Waves of Covid-19 Vaccine Program Eligibility. Sub-Prioritization of Advisory Committee on Immunization Practices Recommended for Phase 1a.**

| Wave 1 | • Designated Covid-19 cohort units (ICU and general medical)  
         | • Emergency and urgent care  
         | • Emergency Medical Services  
         | • Long-term care  
         | • Morgue  
|-------|-----------------------------------------------------------------|
| Wave 2 | • Outpatient Covid-19 care (infusion therapy and respiratory care)  
         | • Present during aerosol-generating procedures on Covid-19 patients  
| Wave 3 | • Covid-19 test collectors  
         | • Remaining inpatient units  
| Wave 4 | • Covid-19 vaccinators  
         | • Outpatient clinics  
         | • Procedural areas  
         | • Home care  
| Wave 5 | • Clinical support staff without direct patient contact who cannot telework  
| Wave 6 | • Other support staff who cannot telework  
| Wave 7 | • Exclusive teleworkers  

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*Long-term care staff, while not at the highest risk of occupational exposure, were prioritized in the first wave as a national priority group. Morgue staff were prioritized due to their crucial role in pandemic response and their low numbers, which make individual absences highly impactful. When the number of hospitalized patients with asymptomatic, incidentally discovered Covid-19 infection exceeded the capacity of the designated Covid-19 cohort units, Covid-19 patients were placed in the most appropriate unit based on their clinical needs. Source: The authors.*
more feasible to instruct affected groups to indicate an equivalent risk factor rather than revising the occupational risk template.

Sporadic errors and omissions did occur, causing administrators to correct an individual’s risk assessment. Additionally, because the program rolled out over several weeks, newly hired staff needed to be continually added. We set up a process for assessing newly hired HCP and amending prior assessments, with all additions sent to a central email inbox monitored by the vaccination program staff.

The vaccine program goals include equitable allocation and transparency. The risk criteria, waves, and procedures were presented at numerous department meetings and at institutional grand rounds. This information was posted on the organization’s intranet site for all personnel to review. A vaccine program dashboard was designed for leadership to monitor vaccination rates by department, job family, and program wave. A summary of this dashboard was accessible to all HCP, so that individuals had access to information about the program’s progress, the wave(s) currently being vaccinated at their site, and the risk groups included in each wave.

HCP vaccination is typically recorded in the occupational health record and does not transfer directly into the patient record. With the Covid-19 vaccines, however, there were complex reporting requirements to state registries and also to the National Healthcare Safety Network (NHSN), as well as an internal need to monitor vaccination rates for occupational subgroups. We therefore decided to have all Covid-19 vaccines recorded in the patient record to facilitate reporting to the state registries. HCP were notified that their Covid-19 vaccine record would be shared with Occupational Health. Currently approved Covid-19 vaccines require a second dose at a specified time interval. The electronic health record (EHR) was programmed to send reminders about the second dose.

The mRNA vaccines are known to be reactogenic, with a significant proportion of recipients reporting local injection site pain and systemic side effects such as fever, myalgia, and headache. These typically occur on the day of vaccination or the following two days, and resolve in 24 to 48 hours. These side effects are more pronounced after the second dose and could result in absences from work. We attempted to stagger vaccination within work units, so that not everyone on the unit would potentially feel side effects at the same time. We encouraged HCP to self-schedule their appointments prior to planned time off if possible.

"Allowing prioritization based upon self-identification of risk factors would spread the early doses across all occupational risk groups, preferentially to those best able to self-advocate. This could exacerbate health disparities while potentially contributing to low vaccination rates in the highest occupational risk areas."

We created educational material on the potential side effects, which was provided to every vaccine recipient at the time of vaccination and was also accessible on the intranet. Additionally, we provided education on how to distinguish side effects from signs and symptoms of Covid-19.
infection. HCP also had access to phone lines to report significant side effects and obtain guidance on management of symptoms and whether Covid-19 testing was appropriate. To remove barriers to vaccination, we also implemented a mechanism for staff to receive pay for a limited number of days if they needed to be absent due to side effects.

We needed to balance the need to administer vaccines in a timely manner with continued social distancing at the vaccination sites. One strategy we used was providing education on the vaccines to HCP prior to their scheduled appointment. This information was delivered in multiple ways to account for different learning styles, including as a brief video, online materials, and printed material. We emphasized the need for continued adherence to masking and social distancing until a large proportion of the local community has been vaccinated and herd immunity has been achieved.

**Navigating the Next Steps**

The next phases of vaccination promise to be even more daunting. In the United States, an estimated 21 million health care personnel are employed in hospitals and clinics, long-term care facilities, pharmacies, emergency medical services, and public health agencies. All fall into Phase 1a, along with approximately 3 million individuals residing in long-term care facilities. Phase 1b includes an estimated 30 million individuals who are classified as “frontline essential workers,” as they are employed in industries that are considered critical to the infrastructure of society, along with 21 million individuals older than 75 years. Phase 1c is estimated to include 32 million individuals between 65 and 74 years of age, approximately 110 million between the ages of 16 and 64 years with high-risk conditions, and an additional 57 million essential workers not covered in Phase 1a and 1b. These numbers include American Indian, African American, Hispanic and Latinx, and other races and ethnicities at disproportionate risk for severe Covid-19 infection. In the face of the large numbers of this high-risk population that needs to be vaccinated, further sub-prioritization will need to occur to ethically and logically distribute the limited vaccine supply anticipated in the early part of 2021.

The absence of consistent data on industry and occupation within the EHR poses a challenge for health care systems to prioritize vaccination for essential workers in phases 1b and 1c. It is not common for patient occupation to be systematically recorded in the EHR. When occupation is noted, it often is insufficient to determine if a patient is employed in a critical infrastructure industry. Incorporating tools to support accurate identification of essential workers would be of benefit to vaccine distribution and prioritization.

"In the face of the large numbers of this high-risk population that needs to be vaccinated, further sub-prioritization will need to occur to ethically and logically distribute the limited vaccine supply anticipated in the early part of 2021."
For patients already receiving care within health systems, vaccine allocation and distribution can be deployed by utilizing registries of empaneled patients within EHR systems. These registries could be further categorized based on Covid-19 severity risk. Mayo Clinic developed a severity score in Epic during the early part of the pandemic to assist in testing and management strategies. This same scoring system can now be used to identify patients at highest risk and invite them for vaccination accordingly. EHRs will need to play a central role for identification, notification, and completion of the vaccination process for patients who are already within a health system. Otherwise, this effort may become a manual and difficult process. Some EHRs will be able to provide this type of information with more flexibility and capability, while other EHRs will be significantly challenged. Billing and revenue cycle information may be another source to obtain lists of patients to be sub-prioritized and invited for vaccination.

For patients who have limited or no access to health care, access to the vaccine may be challenging. They will need to be reached via regional collaborative efforts among health systems, public health agencies, and community organizations, with clear and frequent communication about all aspects of the vaccine including planning/distribution, adverse effects, and efficacy.

It is critical that the health care community shares a unified, transparent message to the patients they serve to prevent confusion about vaccines, address vaccine hesitancy, and promote community engagement in the vaccine rollout. Vaccine misinformation and hesitancy could be addressed by disseminating information via leaders and trusted voices within local ethnic or religious communities, community health workers, translation centers, Chambers of Commerce, nonprofit organizations, and diversity councils, collaborating with local health care providers to ensure consistent messaging. Providing user-friendly information via multiple modalities will be required to reach patients who are not associated with a health care provider or system.

Implementing a Covid-19 vaccination program at a large medical system on a short time frame is a complex undertaking. At Mayo Clinic, a multidisciplinary group with coordination across multiple functional work groups and sites was key to navigating the challenges and successfully initiating HCP vaccination. The next phases of vaccination will bring new challenges.

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