CDC/NIOSH Update:
COVID-19 Vaccine Development

John Howard, M.D.
National Institute for Occupational Safety and Health
Centers for Disease Control and Prevention
U.S. Department of Health and Human Services

Mid-Atlantic Regional Conference
on Occupational and Environmental Medicine

10 October 2020

NOTE: Information in this power point slide set may have changed since the date of presentation due to new scientific findings.
Overview

• Pandemic $\rightarrow$ Twindemic

• Immunity

• Vaccine
  – Development
  – Approval
  – Distribution
  – Allocation
  – Distribution

• Vaccination
  – Voluntary
  – Compulsory
Pandemic → Twindemic

- Seasonal flu combined with the SARS-Cov-2 pandemic could lead to a "twindemic" with increased chances of co-infections and an overwhelmed health system. Symptoms are similar and diagnostics are not fast, people can best mitigate their risks with the flu shot plus social distancing and mask-wearing this fall and winter.
The burden of flu 2019-2020

During the 2019-2020 flu season, CDC estimates flu caused:

- 38 million flu illnesses (about the same as the population of California)
- 400,000 flu hospitalizations (about the same as the population of Miami, FL)
- 22,000 flu deaths (enough people to fill Madison Square Garden in New York City)
COVID-19 Much Deadlier Than the Flu
Community (Herd) Immunity

• What is community or “herd” immunity?
  • When enough people in a community have had COVID-19 and develop “natural immunity,” the rest of the population becomes a lot less susceptible to becoming infected because the virus cannot easily jump from an infected to a susceptible person.

• What level of infection is needed to achieve herd immunity?
  • Given SARS-CoV-2 transmissibility ($R_t = 3$), then 67% of the population would need to be infected and recover before community immunity is likely.
    • Using the formula: $P_{crit} = 1-(1/R_t)$, if the value of $R_t = 3$, then $P_{crit} = 0.67$

• Drivers of community immunity
  • Natural
  • Vaccine
Six Major Types of Vaccine Platforms

• Nucleic acid-based (10 clinical trials)
• Protein subunit (7)
• Inactivated virus (5)
• Recombinant viral-vectored (4)
• Virus-like particles (1)
• Live attenuated virus (0)
Operation Warp Speed


• DOD and HHS

• **Vaccine** Goal
  • Develop, produce and distribute 300 million doses of a SARS-CoV-2 vaccine by January 2021

• **Therapeutics**
  • Antivirals
  • Monoclonal Antibodies
<table>
<thead>
<tr>
<th>Platform</th>
<th>Developer</th>
<th>Vaccine</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nucleic Acid</strong></td>
<td>Moderna (Core)</td>
<td>mRNA-1273</td>
<td>Phase 3</td>
</tr>
<tr>
<td></td>
<td>BioNTech/Pfizer (Core)</td>
<td>mRNA BNT162b1</td>
<td>Phase 3</td>
</tr>
<tr>
<td><strong>Viral Vector</strong></td>
<td>Oxford/Astra Zeneca (Core)</td>
<td>Replication-defective simian adenovirus live-vector ChAdOx1 nCoV-19 (AZD-1222)</td>
<td>Phase 3</td>
</tr>
<tr>
<td></td>
<td>Janssen/Johnson &amp; Johnson (Core)</td>
<td>Replication-defective human adenovirus 26 live vector Ad26.COV2-S (JNJ-78436725)</td>
<td>Phase 3</td>
</tr>
<tr>
<td></td>
<td>Merck (Core)</td>
<td>Attenuated replication-competent live vector Vesicular stomatitis (VSV-S)</td>
<td>Phase 1 &amp; 2 Belgium</td>
</tr>
<tr>
<td><strong>Protein Subunit</strong></td>
<td>Novavax (Core)</td>
<td>Recombinant protein NVX-CoV2373</td>
<td>Phase 3 UK</td>
</tr>
<tr>
<td></td>
<td>Sanofi/GSK</td>
<td>Recombinant protein</td>
<td>Phase 1 &amp; 2</td>
</tr>
</tbody>
</table>
Major Vaccine Concerns

• **Safety**
  - Phase 3 vaccine studies normally last for many years
    - Cutting short Phase 3 trial may not uncover rare and longer term adverse effects

• **Efficacy**
  - Intermediate surrogates like antibody titers appear early, but
  - Actual efficacy goal is disease prevention in real world settings
    - Takes longer to discern

• **Durability**
  - Will the immunity profile be like coronaviruses that cause the common cold?
    - One year
  - If lifelong immunity is not possible, how often will re-vaccination be needed?
Seasonal Influenza Vaccine Efficacy: 2005 – 2019 Seasons

*Vaccine effectiveness estimates for 2018-2019 were presented to ACIP on June 27, 2019.

Source: https://www.cdc.gov/flu/professionals/vaccination/effectiveness-studies.htm
Vaccination Will Not Replace Other Interventions

- COVID-19 vaccination will not be 100% protective.

- At first, there will be much uncertainty about the level and duration of protection provided by vaccination.

- In view of this, it will be important to continue the range of protective workplace interventions from across the hierarchy of COVID-19 controls.
COVID-19 Vaccines

FDA has rigorous scientific and regulatory processes in place to facilitate development and ensure the safety, effectiveness and quality of COVID-19 vaccines.

Vaccine Status: Currently, there is no FDA-approved or authorized vaccine for the prevention of COVID-19.

On this page:
- FDA COVID-19 Vaccine Information
- FDA Leaders on Vaccines
- Podcasts & Publications
- Upcoming Events
- General Vaccine Basics
- Information for Vaccine Developers

“We are committed to expediting the development of COVID-19 vaccines, but not at the expense of sound science and decision making. We will not jeopardize the public's trust in our science-based, independent review of these or any vaccines. There's too much at stake.”

— Stephen M. Hahn, M.D., FDA Commissioner, and Peter Marks, M.D., Ph.D., Director, Center for Biologics Evaluation and Research
FDA EUA for COVID-19 Vaccines:  
Guidance for Industry  
October 2020

• Specifies at a high level some of the key information that manufacturers need to provide to the FDA in seeking an EUA for their vaccine candidates.

• Data from Phase 3 clinical trials should include a “median follow-up duration of at least [2] months” to assess both safety and efficacy.

• “FDA does not intend to make a favorable determination” unless “well over 3,000 vaccine recipients” are monitored for serious adverse events or adverse events of special interest for at least 1 month after vaccination.

• Total of 5 or more severe COVID-19 cases in the placebo group would “generally be sufficient” to evaluate the vaccine’s efficacy.

Operation Warp Speed


IN SUPPORTING THE DISTRIBUTION & ADMINISTRATION OF COVID-19 VACCINES, OWS HAS FOUR KEY GOALS, TENETS, AND ARCHITECTURE

- Ensure safety and effectiveness of COVID-19 vaccines
- Reduce morbidity and mortality of COVID-19 disease through effective and efficient distribution of COVID-19 vaccines
- Support rapid vaccine distribution based on CDC guidance for states immunizations services
- Assist with the return to pre-pandemic quality of life
**TRIALS**

**FDA**
- Based on data from clinical trials, vaccine candidate is submitted for Emergency Use Authorization (EUA) or Biologics License Application (BLA)
  - Reviews EUA/BLA application
  - Approves EUA/BLA application
  - Oversees ongoing reporting
  - Pharmacovigilance

**MANUFACTURING**

**MANUFACTURER**
- Vaccine is being manufactured concurrent with clinical trials, and upon EUA/BLA and CDC recommendation, vaccine is ready to ship

**OWS & CDC**
- Allocation of initial/limited doses will be based on CDC prioritization models
  - Independent advisory panel (Advisory Committee on Immunization Practices with input from Nat’l Academies of Science) informs CDC prioritization
  - Initial/limited doses will be allocated for specific groups
    - Oversees distribution of vaccine
    - Tracks product that is delivered/administered

**ADMINISTRATION SITES**
- Vaccines, upon EUA/BLA, are ready to ship to:
  - Pharmacies
  - Nursing homes
  - Public Clinics
  - Hospitals
  - Doctor’s offices and Mobile Clinics
  - Military Treatment Facilities

**DISTRIBUTION FACILITIES**
- Vaccines & associated ancillary kits (syringes, needles, and alcohol swabs) will be shipped concurrently to distribution depots and facilities

**DISTRIBUTOR**
- Maximize use of existing pharmaceutical distribution infrastructure
- Central Distributor established for kitting & distribution operations
- IT infrastructure supports ordering, distribution, administration, and tracking end-to-end

**PHARMACOVIGILANCE (FDA & CDC)**
- 24 month post trial monitoring for adverse effects/additional safety feature
Illustrative scenario for planning purposes; will be adapted based on the clinical/manufacturing information on all OWS candidates and vaccine prioritization.

Distribution will adjust as volume of vaccine doses increases, moving from targeted to broader populations reached (phased approach).

**Limited Doses Available**
- Constrained supply
- Highly targeted administration required to achieve coverage in priority populations

**Large Number of Doses Available**
- Likely sufficient supply to meet demand
- Supply increases access
- Broad administration network required including surge capacity
- Expand **beyond initial populations**
- Administer through **commercial and private sector partners** (pharmacies, doctors offices, clinics)
- Administer through **public health sites** (mobile clinics, FQHCs, targeted communities)

**Continued Vaccination, Shift to Routine Strategy**
- Likely excess supply
- Broad administration network for increased access
- Open vaccination
- Administer through **commercial and private partners**
- Maintain PH sites where required

Doses available per month (baseline as of 07/16)

Illustrative ramp-down, not based on OWS decisions or candidate projections

~660M cumulative doses available
Frameworks for COVID-19 Vaccine Allocation

- World Health Organization (WHO) Strategic Advisory Group of Experts (SAGE)
- Johns Hopkins Bloomberg School of Public Health
- The National Academies of Sciences, Engineering, and Medicine (National Academies)
- Advisory Committee on Immunization Practices (ACIP)
National Academies
Vaccine Allocation Framework (2 October 2020)

Phase 1
- Phase 1a "Jumpstart Phase"
  - High-risk health workers
  - First responders
- Phase 1b
  - People of all ages with comorbid and underlying conditions that put them at significantly higher risk
  - Older adults living in congested or overcrowded settings

Phase 2
- K–12 teachers and school staff and child care workers
- Critical workers in high-risk settings—workers who are in industries essential to the functioning of society and at substantially higher risk of exposure
- People of all ages with comorbid and underlying conditions that put them at moderately higher risk
- People in homeless shelters or group homes for individuals with disabilities, including serious mental illness, developmental and intellectual disabilities, and physical disabilities or in recovery, and staff who work in such settings
- People in prisons, jails, detention centers, and similar facilities, and staff who work in such settings
- All older adults not included in Phase 1

Phase 3
- Young adults
- Children
- Workers in industries and occupations important to the functioning of society and at increased risk of exposure not included in Phase 1 or 2

Phase 4
- Everyone residing in the United States who did not have access to the vaccine in previous phases

Equity is a crosscutting consideration: In each population group, vaccine access should be prioritized for geographic areas identified through CDC's Social Vulnerability Index or another more specific index.
CDC Vaccine Prioritization
Advisory Committee on Immunization Practices

ACIP COVID-19 Vaccine Work Group: Proposed Guiding Principles

- **Safety is paramount.** Vaccine safety standards will not be compromised in efforts to accelerate COVID-19 vaccine development or distribution.

- **Inclusive clinical trials.** Study participants should reflect groups at risk for COVID-19 to ensure safety and efficacy data are generalizable.

- **Efficient Distribution.** During a pandemic, efficient, expeditious and equitable distribution and administration of approved vaccine is critical.

- **Flexibility.** Within national guidelines, state and local jurisdictions should have flexibility to administer vaccine based on local epidemiology and demand.
COVID-19 Vaccination Program

- Serves as interim playbook for state, territorial and public health agencies on how to plan and operationalize a vaccination response to COVID-19 within their jurisdictions.

- Allocation, ordering, storage, distribution, handling, inventory management, communication, and second-dose reminders

Vaccine ≠ Vaccination

- Achieving community immunity depends on:
  - Vaccine efficacy
  - Vaccine acceptance

- Barriers to acceptance
  - Vaccine hesitancy
  - Vaccine refusal

“Vaccine communication science”
4 Scenarios for Herd Immunity

based on

Vaccine Efficacy & Vaccine Adoption


Probability of Reaching Herd Immunity


Probability of functional end\(^1\) to COVID-19 pandemic in US by quarter (illustrative)

- **Early (Q2 2021)**
  - COVID-19 vaccine with high efficacy arrives sooner than expected
  - Timeline of manufacturing, distribution, and administration of COVID-19 vaccine is shorter than expected
  - Cross-immunity from other coronaviruses proves significant
  - There is broad-based willingness to be vaccinated

- **Most likely (03/04 2021)**
  - \(\geq 1\) COVID-19 vaccine is authorized by end of 2020 or early 2021
  - COVID-19 vaccine is distributed to a sufficient portion of population in \(\sim 6\) months
  - There is broad-based willingness to be vaccinated

- **Late (2022 or later)**
  - Early COVID-19-vaccine candidates have low efficacy or low coverage (eg, side effects slow adoption)
  - Timeline of manufacturing, distribution, and administration of COVID-19 vaccine is longer than expected
  - Immunity duration is very short

---

\(^1\)Timeline to functional end is likely to vary somewhat based on geography.
Source: Expert interviews; press search; McKinsey analysis
Vaccinate with Confidence

CDC’s strategic framework for strengthening vaccine confidence and preventing outbreaks of vaccine preventable diseases.

**Strategy: Protect communities at risk from under-vaccination**
- Leverage immunization data to find and respond to communities at risk
- Work with trusted local partners to reach at-risk communities before outbreaks
- Ensure vaccines are available, affordable, and easy-to-get in every community

**Strategy: Get providers and parents effective information resources**
- Expand resources for health care professionals to help them have effective vaccine conversations with parents
- Work with partners to start conversations before the first vaccine appointment
- Help providers foster a culture of immunization in their practices

**Strategy: Stop misinformation from eroding public trust in vaccines**
- Work with local partners and trusted messengers to improve confidence in vaccines among key, at-risk groups
- Establish partnerships to contain the spread of misinformation
- Educate key new stakeholders (e.g., state policy makers) about vaccines
## Promoting Vaccination in the Workplace

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Senior Management Support</td>
<td>Get senior management support and set an example.</td>
</tr>
<tr>
<td>Vaccine Coordinator</td>
<td>Identify a vaccine coordinator to plan for workplace sponsored vaccination.</td>
</tr>
<tr>
<td>Resource Allocation</td>
<td>Gauge need and demand among workers for vaccination. Provide sufficient and accessible vaccination in as many business locations as possible.</td>
</tr>
<tr>
<td>Expertise</td>
<td>Determine whether you will need to contract with an experienced outside provider for vaccination services</td>
</tr>
<tr>
<td>Scheduling and Location</td>
<td>Schedule vaccination at a time (e.g. during work hours) and place (e.g. at the worksite) that is convenient for workers</td>
</tr>
<tr>
<td>Set a goal</td>
<td>Set a goal and show workers how their participation matters. Try to improve upon the percentage of employees vaccinated in previous vaccination events.</td>
</tr>
<tr>
<td>Human Resource Policies</td>
<td>Be flexible in your human resources (HR) policies. Establish policies that allow employees to take an hour or two to seek vaccinations in the community if not attending a workplace vaccination event.</td>
</tr>
</tbody>
</table>

Legal Aspects of Workplace Vaccination: Federal

https://www.eeoc.gov/coronavirus

• **Federal Laws**

• **Current Equal Employment Opportunity Commission (EEOC) Position**
  - EEOC acknowledges that currently there is no vaccine for COVID-19
  - EEOC has no existing position on a COVID-19 vaccine.

• **EEOC Guidance October 9, 2009**
  - Updated March 21, 2020 and is the only current EEOC guidance on pandemic vaccination.
  - EEOC position on mandatory (“H₁N₁ influenza”) vaccination program in Question 13.
    - “May an employer covered by the ADA and Title VII of the Civil Rights Act of 1964 compel all of its employees to take the influenza vaccine regardless of their medical conditions or their religious beliefs during a pandemic?”
    - “No”
Employer Accommodation of an Employee Refusal

https://www.eeoc.gov/coronavirus

• Disability
  • Based on a disability as defined by the Americans with Disability Act (ADA), the employer may need to grant an employee a reasonable accommodation and permit an employee to be exempt from a mandatory vaccination unless the employer can show undue hardship.

• Religion
  • An employer may also need to grant an employee a religious accommodation and excuse the employee from a mandatory vaccinations based on the employee's sincerely held religious belief, practice or observance unless the employer can show that doing so would cause the employer undue hardship or more than a de minimis cost to the employer's business operations.

• Pregnancy
  • Refusing to accommodate a pregnant individual's request to not be vaccinated could result in a disparate treatment (discrimination) claim. Further, impairments resulting from pregnancy may be considered disabilities under the ADA and entitle the employee to a reasonable accommodation.
EEOC: Position on [Influenza] Pandemic Vaccination
https://www.eeoc.gov/coronavirus

• Vaccination
  • Should employer mandate or simply encourage vaccination?
    • “Generally, ADA-covered employers should consider simply encouraging employees to get the influenza vaccine rather than requiring them to take it.” October 9, 2009 (updated March 21, 2020).

• EEOC Resources
  • What you should know about COVID-19 and the ADA, the Rehabilitation Act, and Other EEO Laws (September 8, 2020)

  • Pandemic Preparedness in the Workplace and the ADA (Updated March 19, 2020)
    • https://www.eeoc.gov/sites/default/files/2020-04/pandemic_flu.pdf
State Healthcare Worker and Patient Vaccination

https://www.cdc.gov/phlp/publications/topic/vaccinationlaws.html
https://www.cdc.gov/vaccines/imz-managers/laws/state-reqs.html

• State vaccination laws include vaccination requirements for children in public and private schools and daycare settings, college/university students, and healthcare workers and patients in certain facilities.

• State laws also affect access to vaccination services by determining whether providing vaccinations to patients is within the scope of practice of certain healthcare professionals.

• Healthcare facilities across the country are increasingly requiring healthcare workers to be vaccinated for certain diseases in an effort to reduce outbreaks of vaccine-preventable diseases.

• In some instances, facilities are establishing these requirements due to mandates in state statutes and regulations.
State-Based COVID-19 Vaccination Mandate?

Mello MM et al. New Eng J Med. 382;14:1296-1299 (1 October 2020)

- State compulsory vaccination mandates are usually tied to school and day care entry

- State vaccination policy
  - Transparency
  - Trust

- Should vaccine refusal lead to penalties?
  - Stay-at-home orders
  - Employment suspension


- Covid-19 is not adequately contained in the state.
- The Advisory Committee on Immunization Practices has recommended vaccination for the groups for which a mandate is being considered.
- The supply of vaccine is sufficient to cover the population groups for which a mandate is being considered.
- Available evidence about the safety and efficacy of the vaccine has been transparently communicated.
- The state has created infrastructure to provide access to vaccination without financial or logistic barriers, compensation to workers who have adverse effects from a required vaccine, and real-time surveillance of vaccine side effects.
- In a time-limited evaluation, voluntary uptake of the vaccine among high-priority groups has fallen short of the level required to prevent epidemic spread.
Thank You!