COVID-19 Vaccinations: Where We Are and What We’ve Learned

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By the Numbers
United States COVID-19 Statistics

Updated May 11, 2021 @ 11:58pm EDT
POPULATION 330,756,000

CASES
32,773,387
TOTAL 9.91% PER CAPITA

DEATHS
582,791
TOTAL 0.176% PER CAPITA

NEW CASES
0
MAY 12
0% GROWTH

CASES PER DAY OVER TIME
United States — Linear Scale

Daily Cases / Avg Cases

- 2,913 Avg Cases/Day 315 Days Ago
- 2,168 Avg Cases/Day 270 Days Ago
- 1,622 Avg Cases/Day 225 Days Ago
- 1,310 Avg Cases/Day 180 Days Ago
- 1,581 Avg Cases/Day 135 Days Ago
- 1,665 Avg Cases/Day 90 Days Ago
- 1,613 Avg Cases/Day 45 Days Ago

662,754 Avg Cases/Day

Yesterday

0
<table>
<thead>
<tr>
<th>State</th>
<th>Total Cases</th>
<th>Total Deaths</th>
<th>Mortality Rate</th>
<th>Avg Cases Per/Day</th>
<th>14-Day Growth</th>
<th>Avg Deaths Per/Day</th>
<th>Avg Tests Per/Day</th>
<th>Avg Pop %</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>3,760,846</td>
<td>62,358</td>
<td>1.7%</td>
<td>5.178</td>
<td>-46.59%</td>
<td>405</td>
<td>133,186</td>
<td>9.5%</td>
</tr>
<tr>
<td>Texas</td>
<td>2,919,621</td>
<td>50,719</td>
<td>1.7%</td>
<td>7.936</td>
<td>-25%</td>
<td>212</td>
<td>76,040</td>
<td>10.1%</td>
</tr>
<tr>
<td>Florida</td>
<td>2,275,365</td>
<td>35,831</td>
<td>1.6%</td>
<td>5.711</td>
<td>-19.06%</td>
<td>132</td>
<td>64,599</td>
<td>10.6%</td>
</tr>
<tr>
<td>New York</td>
<td>2,075,539</td>
<td>52,770</td>
<td>2.5%</td>
<td>7.230</td>
<td>-15.15%</td>
<td>114</td>
<td>227,768</td>
<td>10.7%</td>
</tr>
<tr>
<td>Illinois</td>
<td>1,357,843</td>
<td>24,617</td>
<td>1.8%</td>
<td>1,805</td>
<td>-20.1%</td>
<td>41</td>
<td>68,094</td>
<td>10.7%</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>1,178,083</td>
<td>26,574</td>
<td>2.3%</td>
<td>2,517</td>
<td>-26.14%</td>
<td>51</td>
<td>52,432</td>
<td>9.2%</td>
</tr>
<tr>
<td>Georgia</td>
<td>1,111,376</td>
<td>20,391</td>
<td>1.8%</td>
<td>2,920</td>
<td>-13.94%</td>
<td>79</td>
<td>18,827</td>
<td>10.5%</td>
</tr>
<tr>
<td>Ohio</td>
<td>1,085,733</td>
<td>19,441</td>
<td>1.8%</td>
<td>1,979</td>
<td>-27.62%</td>
<td>70</td>
<td>29,289</td>
<td>9.3%</td>
</tr>
</tbody>
</table>
### Actual Number of Deaths for the Leading Causes of Death, CDC 2015-20 (Provisional Data)

<table>
<thead>
<tr>
<th>Cause of Death</th>
<th>No. of deaths by year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total deaths</td>
<td>2,712,630</td>
</tr>
<tr>
<td>Heart disease</td>
<td>633,842</td>
</tr>
<tr>
<td>Cancer</td>
<td>595,930</td>
</tr>
<tr>
<td>COVID-19</td>
<td></td>
</tr>
<tr>
<td>Unintentional injuries</td>
<td>146,571</td>
</tr>
<tr>
<td>Stroke</td>
<td>140,323</td>
</tr>
<tr>
<td>Chronic lower respiratory diseases</td>
<td>155,041</td>
</tr>
<tr>
<td>Alzheimer disease</td>
<td>110,561</td>
</tr>
<tr>
<td>Diabetes</td>
<td>79,535</td>
</tr>
<tr>
<td>Influenza and pneumonia</td>
<td>57,062</td>
</tr>
<tr>
<td>Kidney disease</td>
<td>49,959</td>
</tr>
<tr>
<td>Suicide</td>
<td>44,193</td>
</tr>
</tbody>
</table>

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*Leading causes are classified according to underlying cause and presented according to the number of deaths among US residents. For more information, see the article by Heron. Source: National Center for Health Statistics. National Vital Statistics System: mortality statistics (http://www.cdc.gov/nchs/deaths.htm). Data for 2015-2019 are final; data for 2020 are provisional.*

*Deaths with confirmed or presumed COVID-19, coded to International Statistical Classification of Diseases and Related Health Problems, Tenth Revision code U07.1 as the underlying cause of death.*
Impact of COVID on 2020 U.S. Mortality Rates

• COVID resulted in 345,323 deaths
• Actual numbers likely underestimated
  • Underreporting of COVID-19
  • Limited testing at the beginning of pandemic
• COVID responsible for the increase in deaths from 2019-2020
• Increases seen with other leading causes likely due to disruptions in healthcare
  • Heart disease- 4.8%
  • Unintentional injury- 11.1%
  • Alzheimer’s disease- 9.8%
  • Diabetes- 15.4%
• Increases in unintentional injury deaths due to drug overdose deaths

EXCLUSIVE

GOOD NEWS!
35% of Americans are fully vaccinated
46% have received at least one dose
58% of adults have received one dose
Biden’s goal: 70% of adults with at least one shot by July 4th
May 24th thru July 4th: Uber and Lyft to offer free rides
2 million COVID-19 vaccine doses have been administered in Chicago.

*As of April 27 Citywide
UI Health is utilizing Credit Union 1 Arena as a mass vaccination site
UIC College of Pharmacy also a site
As of May 7th, we’ve administered 102,000 doses
University of Illinois Hospital has a robust vaccination process for hospitalized patients
With the recent EUA of the Pfizer vaccine for children 12-15 years of age, we will add them to our inpatient protocol
The COVID-19 Vaccines:
How did we Get Here?
Roadmap for Vaccine Development

• Vaccine development takes 10-15 years on average to develop
• Mumps Vaccine marketed in 1967 took 4 years to develop (fastest)
• HHS announces “Operation Warp Speed” on March 30th
  • Billions invested by US gov’t
  • Created requisite infrastructure
  • Guaranteed manufacturing of successful candidate
  • Pre-purchased allotments of vaccine
• Mortality rate: 1.8% for U.S. vs 3.6% for the World (WHO data)
Traditional Vector Vaccine Development

• Utilizes:
  • deactivated virus or
  • Live, attenuated virus grown in a culture to weaken it

• B cells in the body synthesize and store antibodies against surface proteins found on the viral capsule

• Host immune system mounts an adaptive response in the event we encounter a live version of the virus
Traditional Vector Vaccine Development

Designing a vaccine

January – March 2020

- **January 2020:** SARS-CoV-2 sequence available
- Vaccine design commences
- SARS-CoV-2 spike protein inserted into Ad26 vector
- Multiple vaccine candidates constructed
- **March 2020:** Validated with pre-clinical testing to identify lead candidate
Messenger-RNA Vaccine Development

1. Scientists generated an mRNA sequence that codes for the virus spike protein.

2. The RNA sequence, a blueprint for making the spike, is swathed in a lipid coating for delivery.

3. Once it arrives, cells read the information in the mRNA sequence to produce millions of copies of the spike protein.

4. The protein fragments spur the immune system to produce antibodies that can protect when a real virus enters the body.
Messenger-RNA Vaccine Development

• Only two companies

• Utilizes:
  • mRNA technology
  • DOES NOT use altered whole or weakened virus
  • Encode a messenger RNA with the information to produce the SARS CoV-2 spike protein
  • Ribosomes inside our cells translate these mRNA’s into an excretable version of spike protein

• Spike protein:
  • Abundant on the surface of SARS-Cov2 virus
  • Necessary to gain entry into host cells
  • Excellent target for memory B cells to produce antibodies against
Messenger-RNA Vaccine Development

• Phase I/II clinical trial data published
  • Moderna: July 14th, 2020
  • Pfizer: August 12th, 2020
  • Both proved effective in vaccinated animals

• Phase III
  • Pfizer:
    • 170 total confirmed COVID-19 cases: 8 in treatment arm
    • Efficacy rate: 95.3%
  • Moderna:
    • 196 total symptomatic confirmed COVID-19 cases: 11 in the treatment arm
    • Efficacy rate: 94.5%
    • Required hospitalization: 30/185 vs NONE
How do the Vaccines Compare?
# COVID-19 Vaccine Comparison

## COVID-19 Vaccines: What You Need to Know
The U.S. now has three vaccines in its arsenal against the coronavirus. Here’s how they compare.

<table>
<thead>
<tr>
<th></th>
<th>Johnson &amp; Johnson</th>
<th>Pfizer</th>
<th>Moderna</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of vaccine</strong></td>
<td>Viral vector</td>
<td>RNA</td>
<td>RNA</td>
</tr>
<tr>
<td><strong>How it works</strong></td>
<td>Teaches the immune system to attack the protein the virus uses to infect other cells. The instructions are carried by a non-dangerous virus.</td>
<td>Uses RNA to teach the immune system to target the virus’s surface, preventing infection.</td>
<td>Uses RNA to teach the immune system to target the virus’s surface, preventing infection.</td>
</tr>
<tr>
<td><strong>Effectiveness</strong></td>
<td>66%</td>
<td>95%</td>
<td>94.5%</td>
</tr>
<tr>
<td><strong>Storage conditions</strong></td>
<td>At least three months at refrigerator temperatures</td>
<td>Two weeks at freezer temperatures (-4°F), five days in the refrigerator (36° to 46°F)</td>
<td>One month at refrigerator temperatures</td>
</tr>
<tr>
<td><strong>Doses needed per person</strong></td>
<td>One shot</td>
<td>2 shots, three weeks apart</td>
<td>2 shots, four weeks apart</td>
</tr>
<tr>
<td><strong>Status of availability</strong></td>
<td>FDA authorized</td>
<td>FDA authorized</td>
<td>FDA authorized</td>
</tr>
</tbody>
</table>

*Note: The Johnson & Johnson vaccine was tested at a time when faster-spreading viral variants were common and in countries where these strains are known to exist.

Sources: Pfizer; Moderna; Johnson & Johnson; U.S. Food and Drug Administration; World Health Organization
What are the COVID-19 Vaccine Ingredients?
Vaccine Side Effects
<table>
<thead>
<tr>
<th>Description</th>
<th>Pfizer-BioNTech COVID-19 vaccine</th>
<th>Moderna COVID-19 vaccine</th>
</tr>
</thead>
<tbody>
<tr>
<td>mRNA</td>
<td>Nucleoside-modified mRNA encoding the viral spike (S) glycoprotein of SARS-CoV-2</td>
<td>Nucleoside-modified mRNA encoding the viral spike (S) glycoprotein of SARS-CoV-2</td>
</tr>
<tr>
<td>Lipids</td>
<td>2[(polyethylene glycol)-2000]-N,N-ditetradecylacetamide</td>
<td>PEG2000-DMG: 1,2-dimyristoyl-rac-glycerol, methoxypolyethylene glycol</td>
</tr>
<tr>
<td></td>
<td>1,2-distearoyl-sn-glycero-3-phosphocholine</td>
<td>1,2-distearoyl-sn-glycero-3-phosphocholine</td>
</tr>
<tr>
<td></td>
<td>Cholesterol</td>
<td>Cholesterol</td>
</tr>
<tr>
<td></td>
<td>(4-hydroxybutyl)azanediyl)bis(hexane-6,1-diyl)bis(2-hexyldecanoate)</td>
<td>SM-102: heptadecan-9-yl 8-((2-hydroxyethyl) (6-oxo-6-(undecyloxy) hexyl) amino) octanoate</td>
</tr>
<tr>
<td>Salts, sugars, buffers</td>
<td>Potassium chloride</td>
<td>Tromethamine</td>
</tr>
<tr>
<td></td>
<td>Monobasic potassium phosphate</td>
<td>Tromethamine hydrochloride</td>
</tr>
<tr>
<td></td>
<td>Sodium chloride</td>
<td>Acetic acid</td>
</tr>
<tr>
<td></td>
<td>Dibasic sodium phosphate dihydrate</td>
<td>Sodium acetate</td>
</tr>
<tr>
<td></td>
<td>Sucrose</td>
<td>Sucrose</td>
</tr>
</tbody>
</table>

*Neither vaccine contain eggs, gelatin, latex, or preservatives*
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<th>Characteristic</th>
<th>Immediate allergic reactions (including anaphylaxis)</th>
<th>Vasovagal reaction</th>
<th>Vaccine side effects (local and systemic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timing after vaccination</td>
<td>Most occur within 15-30 minutes of vaccination</td>
<td>Most occur within 15 minutes</td>
<td>Median of 1 to 3 days after vaccination (with most occurring day after vaccination)</td>
</tr>
</tbody>
</table>

**Signs and symptoms**

<table>
<thead>
<tr>
<th>Constitutional</th>
<th>Feeling of impending doom</th>
<th>Feeling warm or cold</th>
<th>Fever, chills, fatigue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutaneous</td>
<td>Skin symptoms present in ~90% of people with anaphylaxis, including pruritus, urticaria, flushing, angioedema</td>
<td>Pallor, diaphoresis, clammy skin, sensation of facial warmth</td>
<td>Pain, erythema or swelling at injection site; lymphadenopathy in same arm as vaccination</td>
</tr>
<tr>
<td>Neurologic</td>
<td>Confusion, disorientation, dizziness, lightheadedness, weakness, loss of consciousness</td>
<td>Dizziness, lightheadedness, syncope (often after prodromal symptoms for a few seconds or minutes), weakness, changes in vision (such as spots of flickering lights, tunnel vision), changes in hearing</td>
<td>Headache</td>
</tr>
<tr>
<td>Characteristic</td>
<td>Immediate allergic reactions (including anaphylaxis)</td>
<td>Vasovagal reaction</td>
<td>Vaccine side effects (local and systemic)</td>
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<tr>
<td>Signs and symptoms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respiratory</td>
<td>Shortness of breath, wheezing, bronchospasm, stridor, hypoxia</td>
<td>Variable; if accompanied by anxiety, may have an elevated respiratory rate</td>
<td>N/A</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>Hypotension, tachycardia</td>
<td>Variable; may have hypotension or bradycardia during syncopal event</td>
<td>N/A</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>Nausea, vomiting, abdominal cramps, diarrhea</td>
<td>Nausea, vomiting</td>
<td>Vomiting or diarrhea may occur</td>
</tr>
<tr>
<td>Musculoskeletal</td>
<td>N/A</td>
<td>N/A</td>
<td>Myalgia, arthralgia</td>
</tr>
<tr>
<td>Vaccine recommendations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recommended to receive 2nd dose of mRNA COVID-19 vaccine?</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
COVID-19 Vaccines and Anaphylaxis
CDC: Anaphylaxis Rate With COVID Vax 10 Times Greater Than for Flu Shots
— But events still rare and nonfatal, and benefits outweigh risks, officials say

by Molly Walker, Associate Editor, MedPage Today January 6, 2021

While rare, the rate of anaphylaxis following COVID-19 mRNA vaccines appeared about 10 times that documented for flu shots, CDC officials said on Wednesday.

Overall, 21 cases of anaphylaxis following COVID vaccination were reported out of about 1.9 million doses given as of Dec. 23, according to an early Morbidity and Mortality Weekly Report release. That amounts to 11.1 cases per million versus an estimated 1.3 cases per million following inactivated influenza vaccine, agency officials said on a call with the media.
What about Vaccine Induced Thrombotic Thrombocytopenia?
Blood Clots and the Johnson & Johnson Vaccine: What We Know So Far

Infectious disease physician-scientist Wilbur Chen discusses the rare cases of blood clots linked to the immunization

By Jim Daley on April 23, 2021
Vaccine-Induced Immune Thrombotic Thrombocytopenia

• Also known as VITT
• Seen with viral vector vaccines
  • Astra-Zeneca
  • Johnson & Johnson
• Characterized by immune-mediated platelets and clotting
• Incidence: 1 in 100,000 for J&J
  • 6 cases out of 6.8 million doses administered
  • All were women
  • One woman died
How long do the COVID vaccines provide protection?
Pfizer Says Its COVID Vaccine Remains Highly Effective For At Least 6 Months After 2nd Dose

By Dr. Malika Marshall    April 1, 2021 at 5:33 pm    Filed Under: Coronavirus, Coronavirus Vaccine, Dr. Malika Marshall

**Modernova says protection from its COVID-19 vaccine still strong six months on**

FILE PHOTO: A nurse draws a Moderna coronavirus disease (COVID-19) vaccine, at East Valley Community Health Center in La Puente.

Michael Erman
April 13, 2021    2 min read
Are the COVID Vaccines effective against variant strains?
Early study suggests Pfizer vaccine effective against coronavirus mutations
Will we need a 3rd dose?
Pfizer CEO says third Covid vaccine dose likely needed within 12 months

Published Thu, Apr 15 2021 1:23 PM EDT | Updated Thu, Apr 15 2021 3:13 PM EDT

Berkeley Lovelace Jr.

Will Moderna COVID vaccine need a third dose? Here’s what we know so far

By Katie Camero

April 23, 2021 10:15 AM, Updated April 24, 2021 11:09 AM

There are three COVID-19 vaccines authorized for emergency use in the U.S.: Pfizer-BioNTech, Moderna and Johnson & Johnson. All three prevent severe disease and death but there are some differences on how each vaccine works. Here’s what to know. By Daniel A. Varella  |  Michelle Marchante
Another Vaccine Booster? Possibly

• 76 million Americans fully vaccinated
• Vaccines currently indicated for everyone 16 years and older
• With some vaccines (e.g. polio), one dose is enough
• With others (e.g. flu vaccine), must receive dose annually
• Pfizer began new trial in February of 2021 to test whether a booster is necessary after 6-12 months; Moderna announces booster development plans also
• Rationale for a booster:
  1) 5,800 cases of COVID from fully vaccinated persons
  2) Increase titers of neutralizing antibodies
  3) Incorporate protection against variants
     • B.1.1.7 (UK)
     • B.1.351 (South Africa)
     • P.1 (Brazil)
New CDC COVID-19 Vaccine Recommendations
Age

• On April 21st, Biden announced that everyone over 16 is eligible for a COVID-19 vaccine

• This week, the FDA authorized the use of the vaccines for 12-15 year olds

• Pfizer and Moderna currently conducting trials children as young as 6 months old
Pregnancy

• On April 27th, the CDC released statement about “growing evidence” confirming safety of COVID vaccines during pregnancy

• January 28th issue of Obstetrics and Gynecology: “Helpful antibodies” found in cord blood
  • 99% of babies after mother received 2 doses
  • 44% of babies who’s mothers received 1 dose
Questions