Adult Vaccine Update 2025:
Pneumococcus, Shingles, COVID-19, and RSV

Kansas City Southwest Clinical Society

January 31, 2025

Joel P. McKinsey, M.D.

Kansas City, MO

MIDC
METRO INFECTIOUS DISEASE CONSULTANTS

I have no relevant financial relationships to disclose.

I will not discuss off label use or investigational use in my presentation.

Adult Vaccine Update 2025

- Types of vaccines
- Pneumococcus
- Herpes Zoster (Shingles)
- RSV
- COVID-19
- Vaccine Benefits/Myths

- Burden of disease
- Vaccine
  - Efficacy
  - Recommendations
    - General population
    - Special populations
  - Adverse effects

Vaccines Types

- Live-attenuated
  - use a weakened (or attenuated) form of the virus
  - similar to natural infection, create a strong and long-lasting immune response
- Inactivated vaccines
  - use a killed version of the virus
  - usually don't provide immunity that's as strong as live vaccines
- Subunit and polysaccharide vaccines
  - use specific pieces of the virus/bacterium — protein, sugar, or capsid
  - generate strong immune response that's targeted to key parts of the germ
  - Conjugate vaccines link antigens or toxoids from another microbe to the polysaccharides, enhancing the immune response
  - Recombinant vaccines are produced with recombinant DNA technology, insert DNA encoding an antigen (e.g. bacterial surface protein) into bacterial or mammalian cells *in vitro*, expressing the antigen in these cells and then purifying it from them
- Toxoid vaccines
  - use a toxin made by the germ that causes a disease
  - create immunity to the parts of the germ that cause a disease instead of the germ itself

Examples

Measles, mumps, rubella
Rotavirus
Chickenpox
Yellow Fever

Hepatitis A
Influenza (classic)
Rabies

Haemophilus influenzae type b
Whooping cough
Pneumococcal disease
Meningococcal disease
Hepatitis B
HPV (Human papillomavirus)
Shingles
RSV

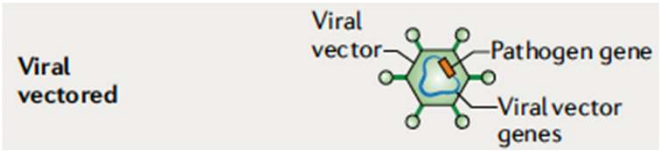
Diphtheria
Tetanus

HHS.gov

Newer Vaccine Types

- Viral vectored
  - attach a pathogen gene to a non-pathogenic virus

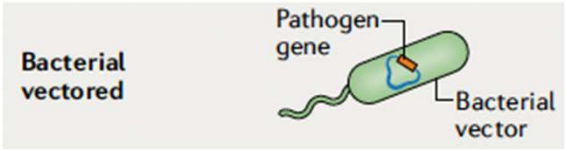
Ebola (2019)



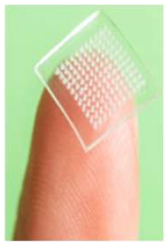
- mRNA vaccines
  - use host machinery to make antigen proteins

SARS-CoV-2 (2020)
RSV (2024)

- Experimental vaccine types
  - DNA vaccines
  - Bacterial vectored
  - Antigen presenting cell



- Experimental delivery methods
  - Microneedle patches
    - painless, no injection, do not require cold storage
    - applied to the dorsal aspect of the wrist for 5 min then removed
    - recent Phase 1-2 study of measles and rubella showed safety in adults and children in The Gambia



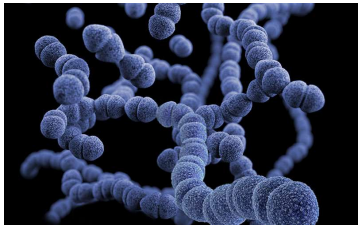
LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

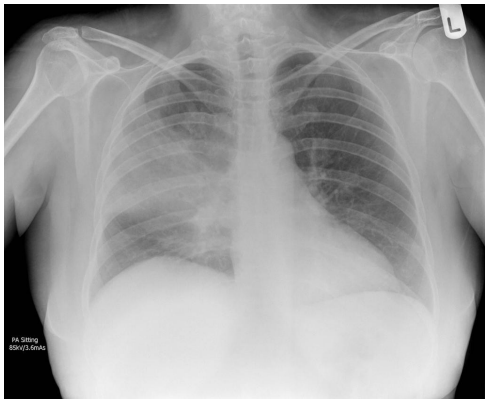
lshtm.ac.uk

Nature Rev Immunol 21, 83–100 (2021)

Lancet 2024; 403: 1879–92

Streptococcus pneumoniae "Pneumococcus"



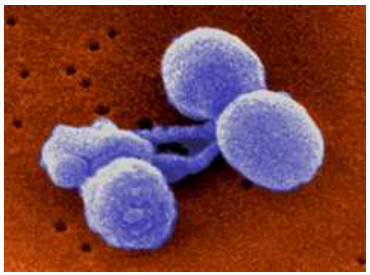


- First isolated by Pasteur in 1881
- More than 80 serotypes described by 1940 (92 by 2011, now >100)
  - Most serotypes can cause serious disease but the top 10 cause 62% (historically)
- The leading cause of respiratory tract infections
  - ~400,000 hospitalizations/year in U.S. for pneumococcal pneumonia, mortality 5-7%
  - 25-30% have bacteremia (overall mortality 20%, up to 60% in the elderly)
  - ~3,000 to 6,000 cases of pneumococcal meningitis per year (child mortality 8%, adult 22%)
- IPD: Invasive Pneumococcal Disease (infection of normally sterile sites) occurs in approximately 25% of cases
  - Risk Factors: Decreased immune function (including hematologic cancer and HIV infection), asplenia (functional or anatomic), chronic heart, pulmonary (including asthma in adults), liver or renal disease, cigarette smoking, cerebrospinal fluid (CSF) leak, and cochlear implant

Impact vaccine recommendations

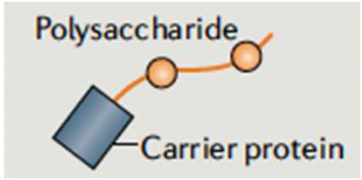
N Engl J Med 2015; 372(12):1114 - 25
CDC. *Epidemiology and Prevention of Vaccine-Preventable Diseases* 14th ed, 2021

Pneumococcal Vaccines



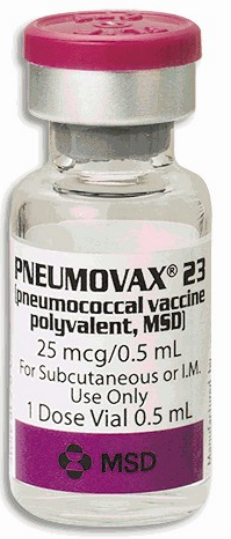
PPSV = pneumococcal polysaccharide vaccine
PCV = pneumococcal conjugate vaccine

- Polysaccharide vaccine
  - against 14 serotypes first licensed in 1977 (Pneumovax 14, PPSV14)
  - expanded to 23 serotypes in 1983 (Pneumovax 23, PPSV23)
- Conjugated vaccine
  - against 7 serotypes licensed in 2000 (Prevnar 7, PCV7)
    - conjugated to a nontoxic variant of diphtheria toxin
    - elicits a more robust immune response
  - expanded to 13 serotypes in 2010 (Prevnar 13, PCV13)



→ MORE TO FOLLOW

Polysaccharide Pneumococcal Vaccine (*Pneumovax*, PPSV23) Efficacy

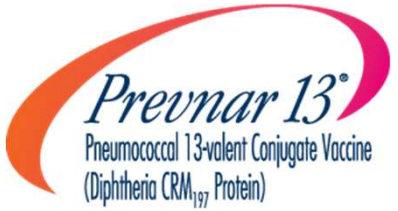


- Antibody response is poor in children <2 and adults with chronic illnesses and immunocompromise
- Efficacy results varied in multiple studies
- Overall 60%–70% effective in preventing invasive disease caused by serotypes included in the vaccine but not effective in reducing rates of pneumonia

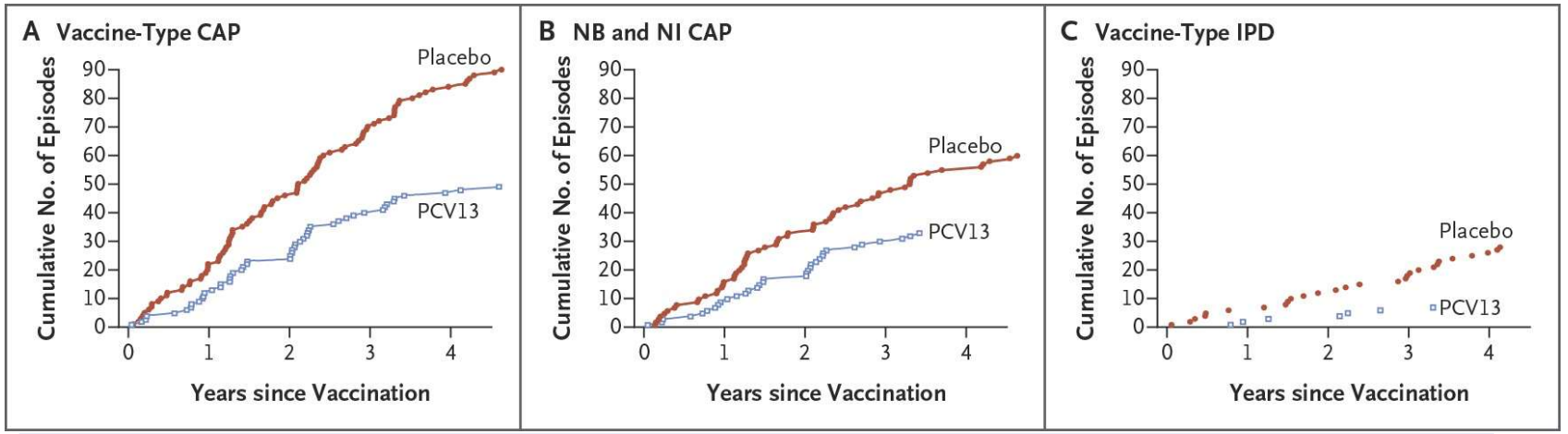
→ Good, not great

CDC. *Epidemiology and Prevention of Vaccine-Preventable Diseases* 14th ed, 2021

Conjugated Pneumococcal Vaccine (Prevnar 13) Efficacy



- >90% effective against invasive disease caused by vaccine serotypes in children, 75% effective in adults > 65
- 45% effective against vaccine-type non-bacteremic pneumococcal pneumonia in adults older than 65



CAP – Community Acquired Pneumonia NB – non-bacteremic NI – non-invasive IPD – Invasive Pneumococcal Disease

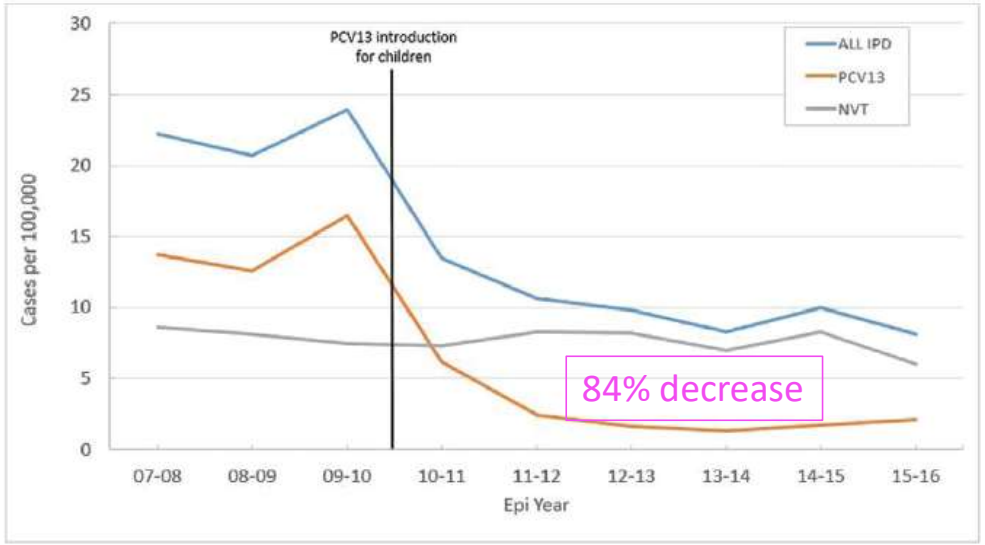
Much better protection, but fewer serotypes

N Engl J Med 2015; 372(12):1114 - 25

Impact of PCV13 (Prevnar-13)

- 2010 - Recommended for children <5
- 2012 - Recommended for high-risk adults >19
- 2014 - Recommended for all adults >65

IPD rates among children < 5 years old, July 2007 - June 2016

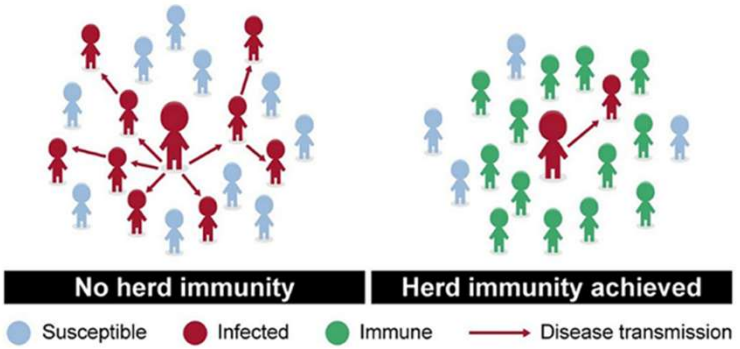


IPD – Invasive Pneumococcal Disease NVT – Non-Vaccine Types

Open Forum Infect Dis 2017 Fall; 4(Suppl 1): S66–S67

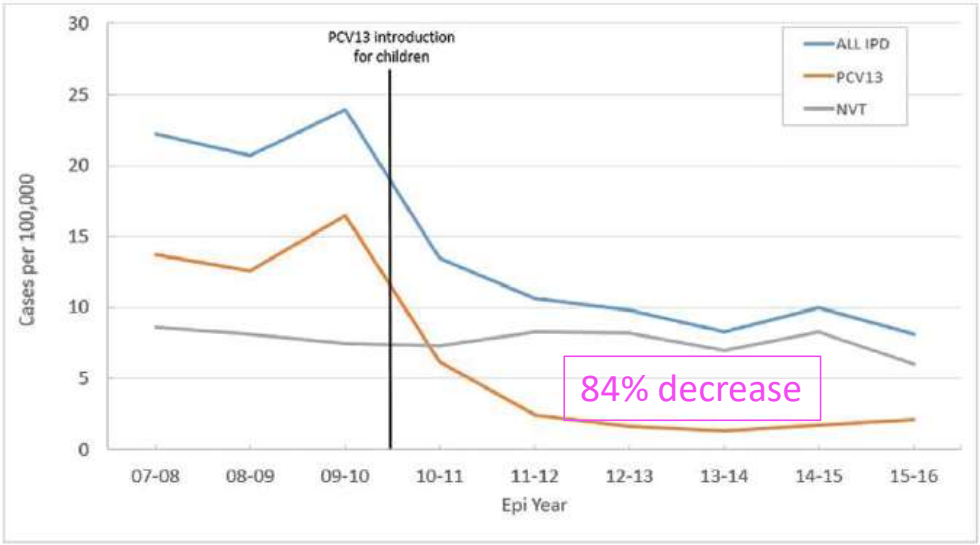
Impact of PCV13 (Prevnar-13)

- 2010 - Recommended for children <5
- 2012 - Recommended for high-risk adults >19
- 2014 - Recommended for all adults >65



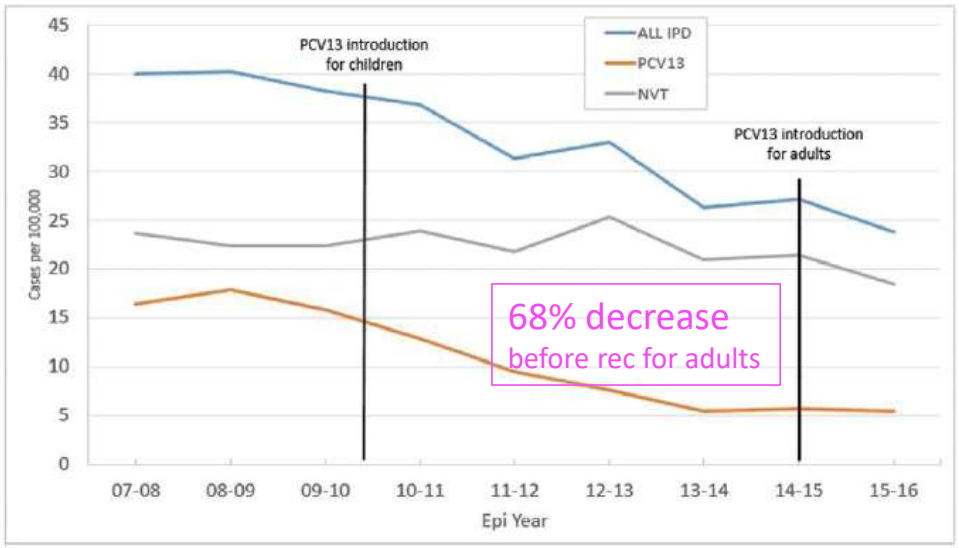
hopkinsmedicine.org

IPD rates among children < 5 years old, July 2007 - June 2016



IPD – Invasive Pneumococcal Disease NVT – Non-Vaccine Types

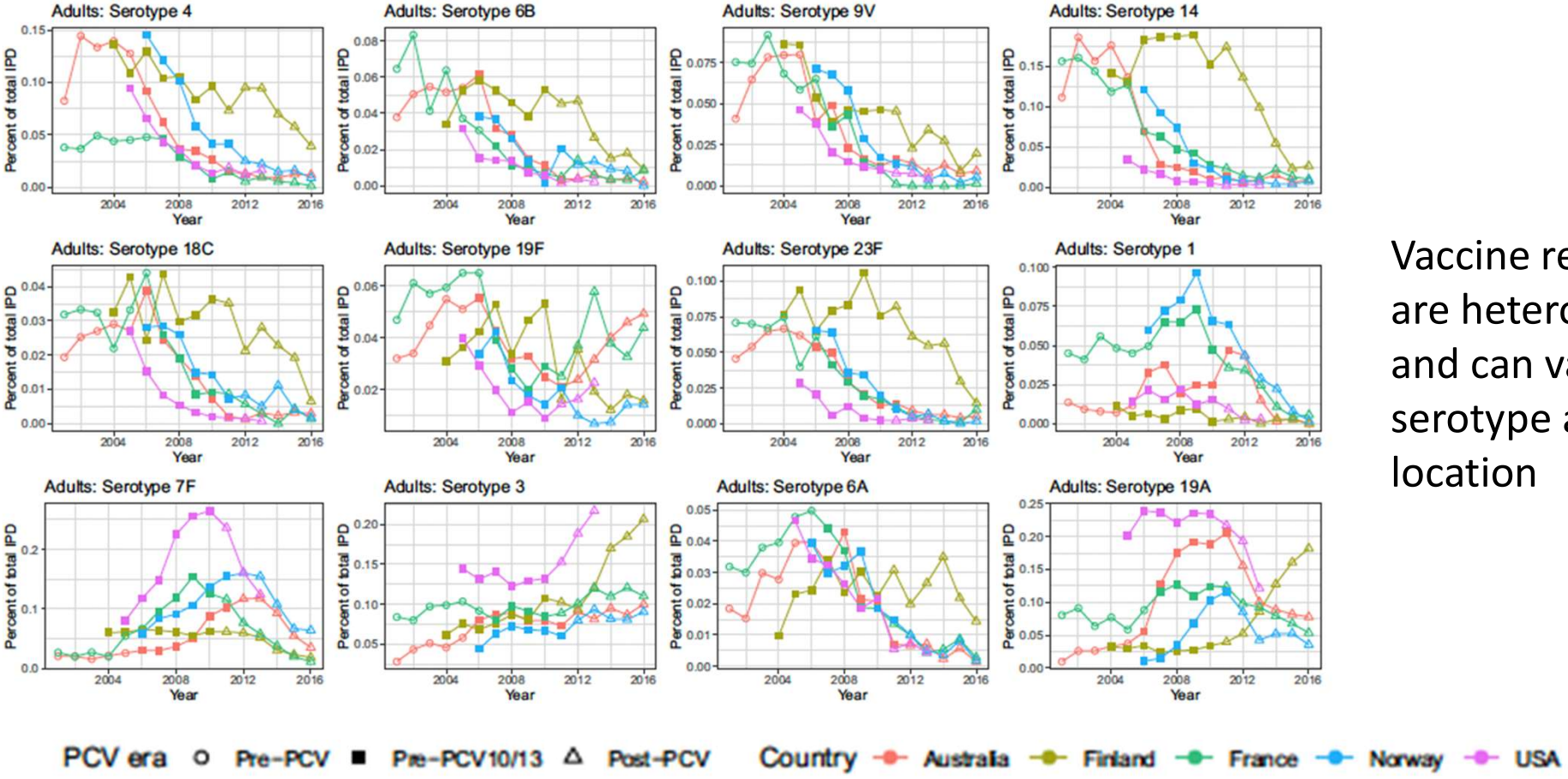
IPD rates among adults ≥65 years old, July 2007 - June 2016



"Herd Immunity"

Open Forum Infect Dis 2017 Fall; 4(Suppl 1): S66–S67

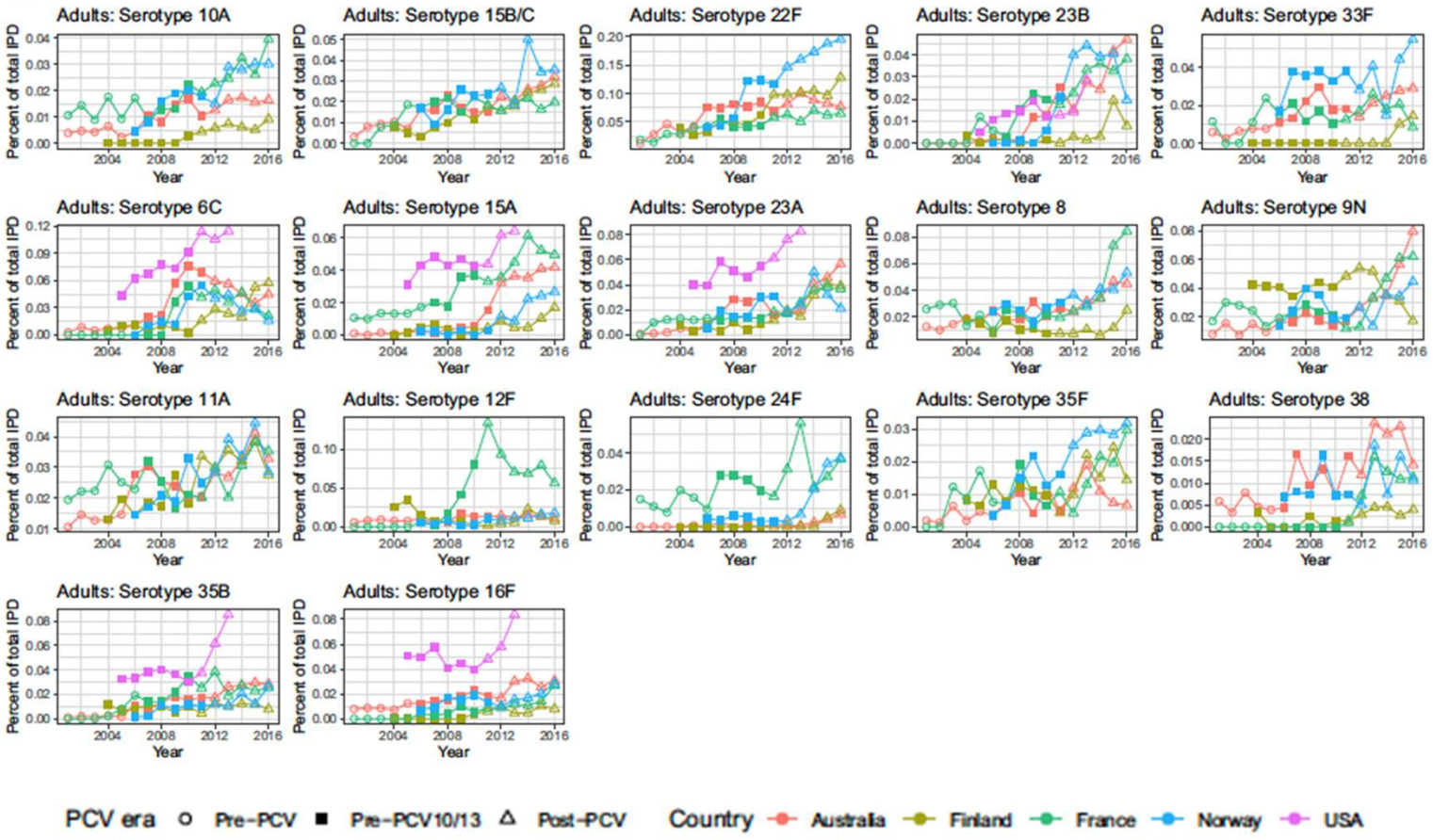
Rate of IPD by Serotype: Vaccine types



Vaccine responses are heterogeneous and can vary by serotype and by location

Nature Sci Rep **10**, 18977 (2020)

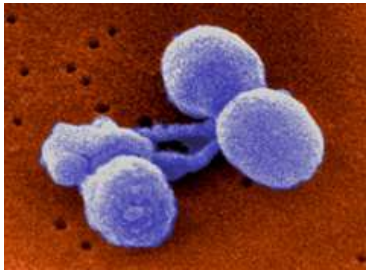
Rate of IPD by Serotype: Non-Vaccine types



As IPD from serotypes in the vaccine has waned, IPD from other serotypes has increased

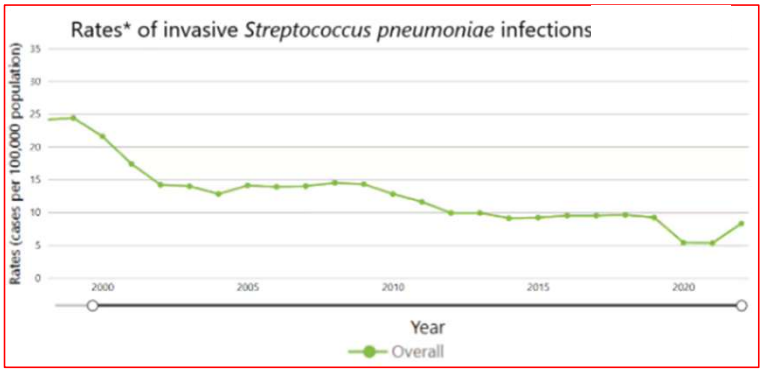
Nature Sci Rep **10**, 18977 (2020)

Pneumococcal Vaccines



PPSV = pneumococcal polysaccharide vaccine
PCV = pneumococcal conjugate vaccine

- Polysaccharide vaccine
  - against 14 serotypes first licensed in 1977 (Pneumovax 14, PPSV14)
  - expanded to 23 serotypes in 1983 (Pneumovax 23, PPSV23)
- Conjugated vaccine
  - against 7 serotypes licensed in 2000 (Prevnar 7, PCV7)
    - conjugated to a nontoxic variant of diphtheria toxin
    - elicits a more robust immune response
  - expanded to 13 serotypes in 2010 (Prevnar 13, PCV13)

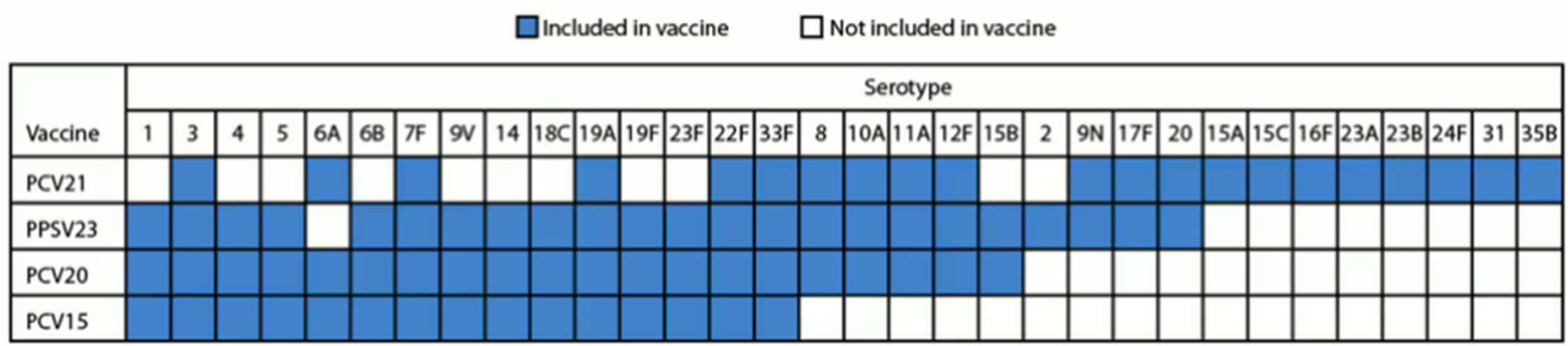


- Expanded to 15 serotypes in 2021 (adults), 2022 (children) (Prevnar 15, PCV15)
- Expanded to 20 serotypes in 2021 (adults), 2023 (children) (Prevnar 20, PCV20)
- Expanded to 21 serotypes in 2024 (adults) (Prevnar 21, PCV21)

CDC.gov

Serotypes Included in Pneumococcal Vaccines

FIGURE. Serotypes*,† included in pneumococcal vaccines currently recommended for adults — United States, 2024



Abbreviations: PCV = pneumococcal conjugate vaccine; PCV15 = 15-valent PCV; PCV20 = 20-valent PCV; PCV21 = 21-valent PCV; PPSV23 = 23-valent pneumococcal polysaccharide vaccine.

MMWR Morb Mortal Wkly Rep 2024;73:793–798

TABLE. Clinical guidance for implementing pneumococcal vaccine recommendations for adults aged ≥19 years — United States, 2024

Risk or age group	Vaccine received previously	Options for vaccination
Adults aged ≥65 years	None or PCV7 only at any age	A single dose of PCV21, PCV20, or PCV15. If PCV15 is administered, a single dose of PPSV23* should be administered ≥1 year after the PCV15 dose. A minimum interval of 8 weeks can be considered if PCV15 is used in adults with an immunocompromising condition,† cochlear implant, or CSF leak.
	PPSV23 only	A single dose of PCV21, PCV20, or PCV15 ≥1 year after the last PPSV23 dose.
	PCV13 only	A single dose of PCV21, PCV20, or PPSV23≥1 year after the PCV13 dose. When PPSV23 is used for adults with an immunocompromising condition,† cochlear implant, or CSF leak, administer PPSV23 ≥8 weeks after the PCV13 dose.
	PCV13 at any age and PPSV23 at age <65 years	A single dose of PCV21, PCV20, or PPSV23. If PCV21 or PCV20 is used, it should be administered ≥5 years after the last pneumococcal vaccine dose. If PPSV23 is used, it should be administered ≥1 year after the PCV13 dose (or ≥8 weeks since the PCV13 dose for adults with an immunocompromising condition,† cochlear implant, or CSF leak) and ≥5 years after the previous PPSV23 dose.
	PCV13 at any age and PPSV23 at age ≥65 years	Shared clinical decision-making is recommended regarding administration of either a single dose of PCV21 or PCV20 for any adult aged ≥65 years who has completed the recommended vaccination series with both PCV13 and PPSV23 (i.e., PPSV23 administered at age ≥65 years) but PCV21, PCV20 or PCV15 not yet received. If a decision to administer PCV21 or PCV20 is made, a single dose is recommended ≥5 years after the last pneumococcal vaccine dose.
Adults aged 19–64 years with an immunocompromising condition,† a CSF leak, or a cochlear implant	None or PCV7 only at any age	A single dose of PCV21, PCV20, or PCV15. If PCV15 is used, administer a single dose of PPSV23* ≥8 weeks after the PCV15 dose.
	PPSV23 only	A single dose of PCV21, PCV20, or PCV15 ≥1 year after the last PPSV23 dose.
	PCV13 only	A single dose of PCV21, PCV20, or PPSV23. If PCV21 or PCV20 is used, it should be administered ≥1 year after the PCV13 dose. If PPSV23 is used, administer PPSV23 ≥8 weeks after the PCV13 dose. When PPSV23 is used instead of PCV21 or PCV20 for these adults, a single dose of PCV21, PCV20 or PPSV23 dose is recommended ≥5 years after the first PPSV23 dose.
	PCV13 and 1 dose of PPSV23	A single dose of PCV21 or PCV20, or ≥1 dose of PPSV23. If PCV21 or PCV20 is used, it should be administered ≥5 years after the last pneumococcal vaccine dose. When a second PPSV23 dose is used instead of PCV21 or PCV20, it should be administered ≥8 weeks after the PCV13 dose and ≥5 years after the first PPSV23 dose. The pneumococcal vaccination recommendations should be reviewed again when the person reaches age 65 years. If PCV21 or PCV20 is used in place of any dose of PPSV23, the series is complete, and it need not be followed by additional pneumococcal vaccine doses.
	PCV13 and 2 doses of PPSV23	The pneumococcal vaccination recommendations should be reviewed again when the person turns age 65 years. Alternatively, a single dose of either PCV21 or PCV20 should be administered ≥5 years after the last pneumococcal vaccine dose. If PCV21 or PCV20 is used, the series is complete, and it need not be followed by additional pneumococcal vaccine doses.
Adults aged 19–64 years with chronic medical conditions§	None or PCV7 only at any age	A single dose of PCV21, PCV20, or PCV15. If PCV15 is administered, a single dose of PPSV23* should be administered ≥1 year after the PCV15 dose.
	PPSV23 only	A single dose of PCV21, PCV20, or PCV15 ≥1 year after the last PPSV23 dose.
	PCV13 only	A single dose of PCV21, PCV20, or PPSV23 ≥1 year after the PCV13 dose.
	PCV13 and 1 dose of PPSV23	The pneumococcal vaccination recommendations should be reviewed again when the person reaches age 65 years.

MMWR September 12, 2024 / 73(36);793–798

TABLE. Clinical guidance for implementing pneumococcal vaccine recommendations for adults aged ≥19 years — United States, 2024

Risk or age group	Vaccine received previously	Options for vaccination
Adults aged ≥65 years	None or PCV7 only at any age	A single dose of PCV21, PCV20, or PCV15. If PCV15 is administered, a single dose of PPSV23* should be administered ≥1 year after the PCV15 dose. A minimum interval of 8 weeks can be considered if PCV15 is used in adults with an immunocompromising condition,† cochlear implant, or CSF leak.
	PPSV23 only	A single dose of PCV21, PCV20, or PCV15 ≥1 year after the last PPSV23 dose.
	PCV13 only	A single dose of PCV21, PCV20, or PPSV23≥1 year after the PCV13 dose. When PPSV23 is used for adults with an immunocompromising condition,† cochlear implant, or CSF leak, administer PPSV23 ≥8 weeks after the PCV13 dose.
	PCV13 at any age and PPSV23 at age <65 years	A single dose of PCV21, PCV20, or PPSV23. If PCV21 or PCV20 is used, it should be administered ≥5 years after the last pneumococcal vaccine dose. If PPSV23 is used, it should be administered ≥1 year after the PCV13 dose (or ≥8 weeks since the PCV13 dose for adults with an immunocompromising condition,† cochlear implant, or CSF leak) and ≥5 years after the previous PPSV23 dose.
	PCV13 at any age and PPSV23 at age ≥65 years	Shared clinical decision-making is recommended regarding administration of either a single dose of PCV21 or PCV20 for any adult aged ≥65 years who has completed the recommended vaccination series with both PCV13 and PPSV23 (i.e., PPSV23 administered at age ≥65 years) but PCV21, PCV20 or PCV15 not yet received. If a decision to administer PCV21 or PCV20 is made, a single dose is recommended ≥5 years after the last pneumococcal vaccine dose.
Adults aged 19–64 years with an immunocompromising condition,† a CSF leak, or a cochlear implant	None or PCV7 only at any age	A single dose of PCV21, PCV20, or PCV15. If PCV15 is used, administer a single dose of PPSV23* ≥8 weeks after the PCV15 dose.
	PPSV23 only	A single dose of PCV21, PCV20, or PCV15 ≥1 year after the last PPSV23 dose.
	PCV13 only	A single dose of PCV21, PCV20, or PPSV23. If PCV21 or PCV20 is used, it should be administered ≥1 year after the PCV13 dose. If PPSV23 is used, administer PPSV23 ≥8 weeks after the PCV13 dose. When PPSV23 is used instead of PCV21 or PCV20 for these adults, a single dose of PCV21, PCV20 or PPSV23 dose is recommended ≥5 years after the first PPSV23 dose.
	PCV13 and 1 dose of PPSV23	A single dose of PCV21 or PCV20, or ≥1 dose of PPSV23. If PCV21 or PCV20 is used, it should be administered ≥5 years after the last pneumococcal vaccine dose. When a second PPSV23 dose is used instead of PCV21 or PCV20, it should be administered ≥8 weeks after the PCV13 dose and ≥5 years after the first PPSV23 dose. The pneumococcal vaccination recommendations should be reviewed again when the person reaches age 65 years. If PCV21 or PCV20 is used in place of any dose of PPSV23, the series is complete, and it need not be followed by additional pneumococcal vaccine doses.
	PCV13 and 2 doses of PPSV23	The pneumococcal vaccination recommendations should be reviewed again when the person turns age 65 years. Alternatively, a single dose of either PCV21 or PCV20 should be administered ≥5 years after the last pneumococcal vaccine dose. If PCV21 or PCV20 is used, the series is complete, and it need not be followed by additional pneumococcal vaccine doses.
Adults aged 19–64 years with chronic medical conditions§	None or PCV7 only at any age	A single dose of PCV21, PCV20, or PCV15. If PCV15 is administered, a single dose of PPSV23* should be administered ≥1 year after the PCV15 dose.
	PPSV23 only	A single dose of PCV21, PCV20, or PCV15 ≥1 year after the last PPSV23 dose.
	PCV13 only	A single dose of PCV21, PCV20, or PPSV23 ≥1 year after the PCV13 dose.
	PCV13 and 1 dose of PPSV23	The pneumococcal vaccination recommendations should be reviewed again when the person reaches age 65 years.

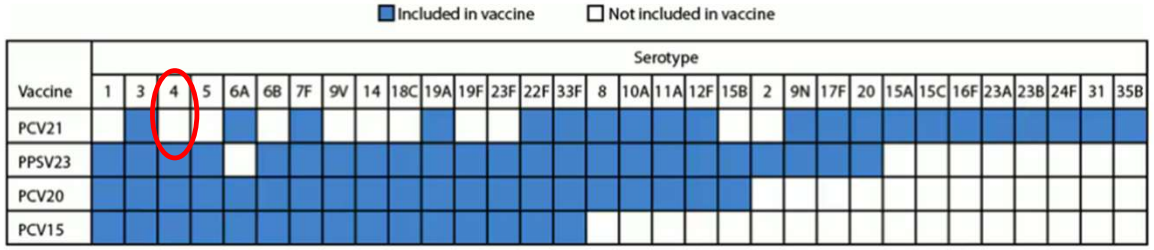
Now very complicated

↓

Complicated is not good

MMWR September 12, 2024 / 73(36);793–798

Also:



- In certain adult populations in the western United States, high percentages (i.e., ≥30%) of IPD caused by serotype 4 have occurred. The available IPD serotype data from CDC's Active Bacterial Core surveillance, as well as similar surveillance from Alaska and the Navajo Nation, indicate that these high percentages are particularly prevalent in Alaska, Colorado, the Navajo Nation, New Mexico, and Oregon. Typically, persons living within these geographic areas who develop serotype 4 IPD are adults aged <65 years with specific underlying conditions or risk factors, such as alcoholism, chronic lung disease, cigarette smoking, homelessness, and injection drug use. Importantly, these persons usually have not received a pneumococcal conjugate vaccine containing serotype 4. In such populations, other recommended pneumococcal vaccines (e.g., PCV20 alone or both PCV15 and PPSV23) are expected to provide broader serotype coverage against locally circulating strains compared with PCV21.

MMWR September 12, 2024 / 73(36);793–798

Also:

CDC Recommends Lowering the Age for Pneumococcal Vaccination from 65 to 50 Years Old

STATEMENT

For immediate release: October 23, 2024

CDC Media Relations
(404) 639-3286
media@cdc.gov
https://www.cdc.gov/media/

October 23, 2024 - Today, CDC Director Mandy Cohen endorsed the CDC Advisory Committee on Immunization Practices' (ACIP) recommendation for lowering the age for pneumococcal vaccination from 65 to 50 years old.

RELATED PAGES

Articles

There's an app for that!!

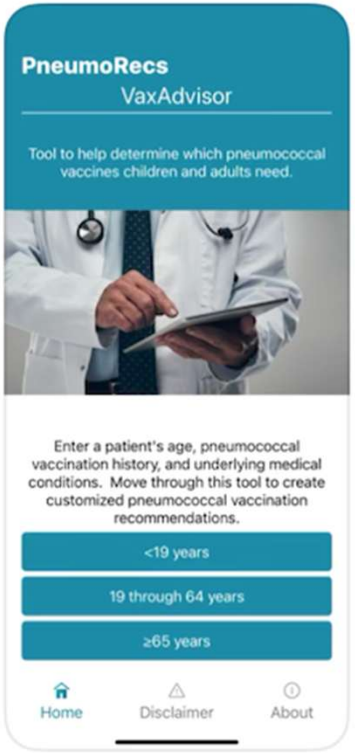
PneumoRecs VaxAd...

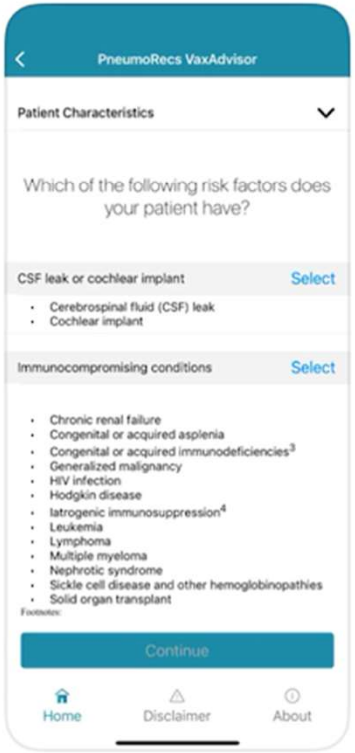
Medical

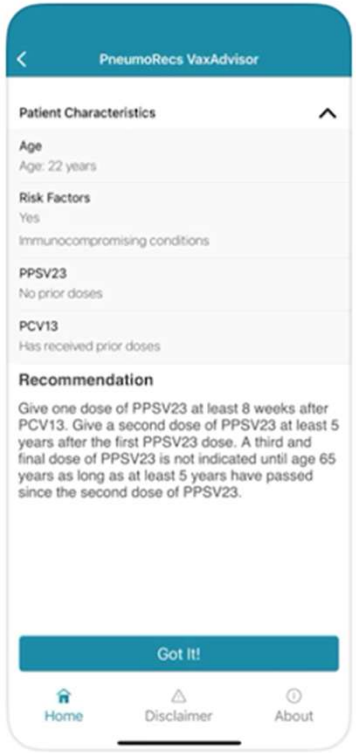
Get

★★★☆☆ 56

Medical | Centers For Disease Cont...







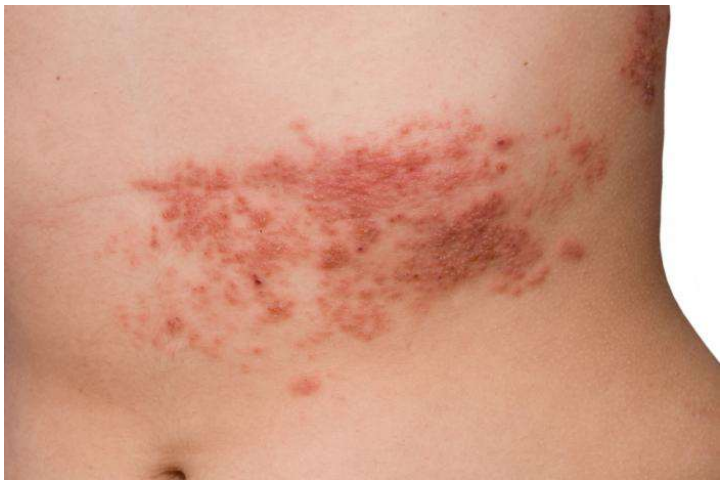
Pneumococcal Vaccine Adverse Events

	Polysaccharide	Conjugate
Local Reactions	30-50%	5-49%
Fever, Myalgia	<1%	24-35%
Febrile Seizures in children		1.2-13.7/100,000 4-44.9/100,000 with TIV → Flu vaccine same visit

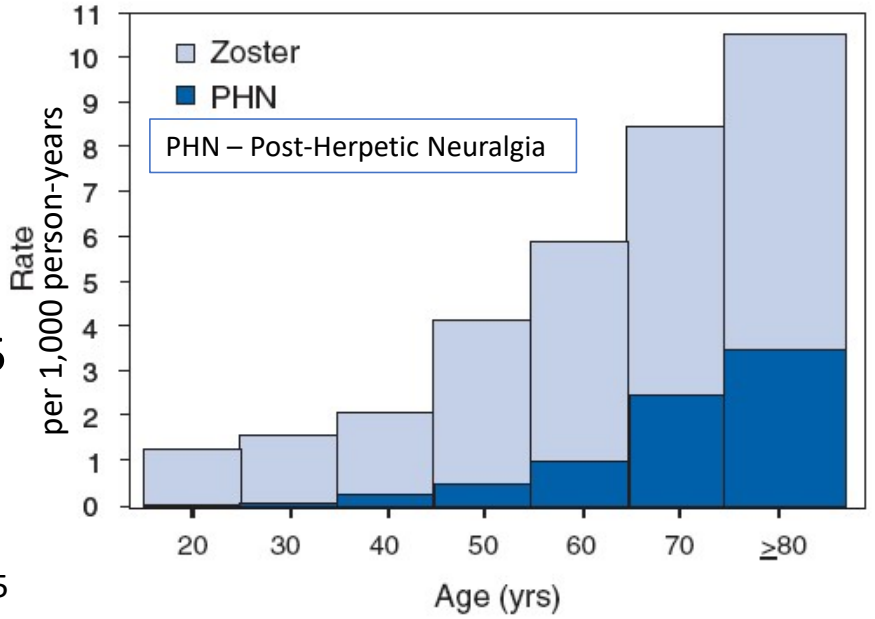
After evaluating the data on febrile seizures and taking into consideration benefits and risks of vaccination, ACIP made no change in its recommendations for use of TIV or PCV13.

CDC. *Epidemiology and Prevention of Vaccine-Preventable Diseases* 13th ed, 2015

Herpes Zoster (Shingles)



- ”Shingles” from the Latin word cingulum, for belt or girdle
- Reactivation of varicella zoster virus (VZV)
  - More than 99% of Americans born before 1980 have had varicella, even if they don’t remember it
- 500,000 to 1 million episodes per year (U.S.)
- Lifetime risk of zoster estimated to be 32%
  - Risk increases with age
  - 50% of (unvaccinated) persons living until age 85 years will develop zoster

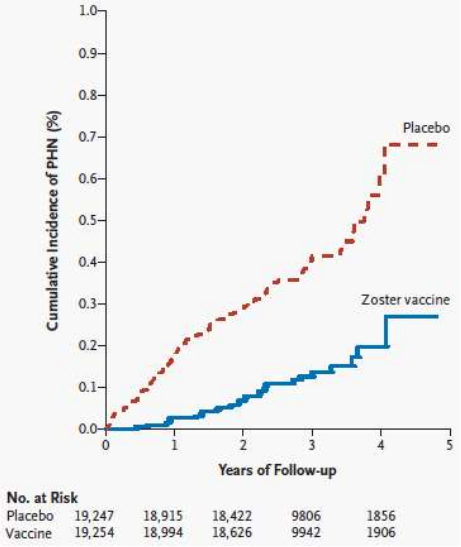


MMWR 2008; 57(05);1-30

CDC. *Epidemiology and Prevention of Vaccine-Preventable Diseases* 13th ed, 2015

Zoster Vaccines

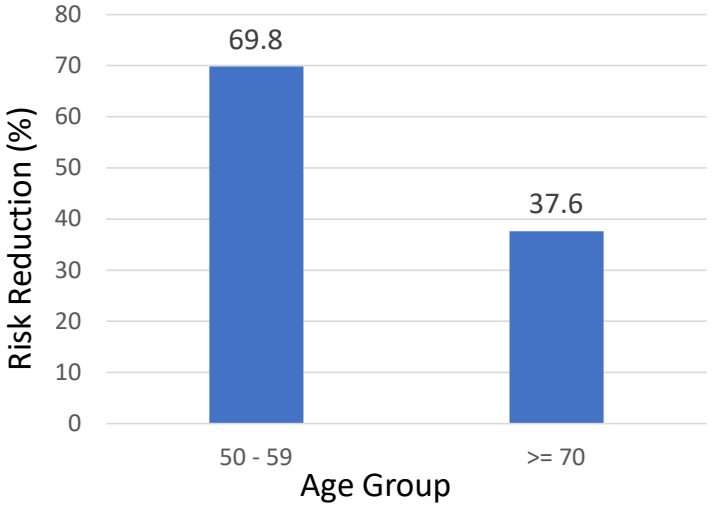
- First herpes zoster vaccine (*Zostavax*) approved by FDA in 2006 for use in persons 60 years of age and older
  - In 2011, approved for persons 50-59 years of age
  - A live-attenuated viral vaccine
  - Contains the same varicella zoster virus used in varicella vaccine but at a much higher titer
- Vaccine recipients 60-80 years of age had 51% fewer episodes of zoster
  - reduced the risk of postherpetic neuralgia by 66.5%



N Engl J Med 2005; 352:2271-2284

Zostavax Caveats

- Efficacy declines with increasing age



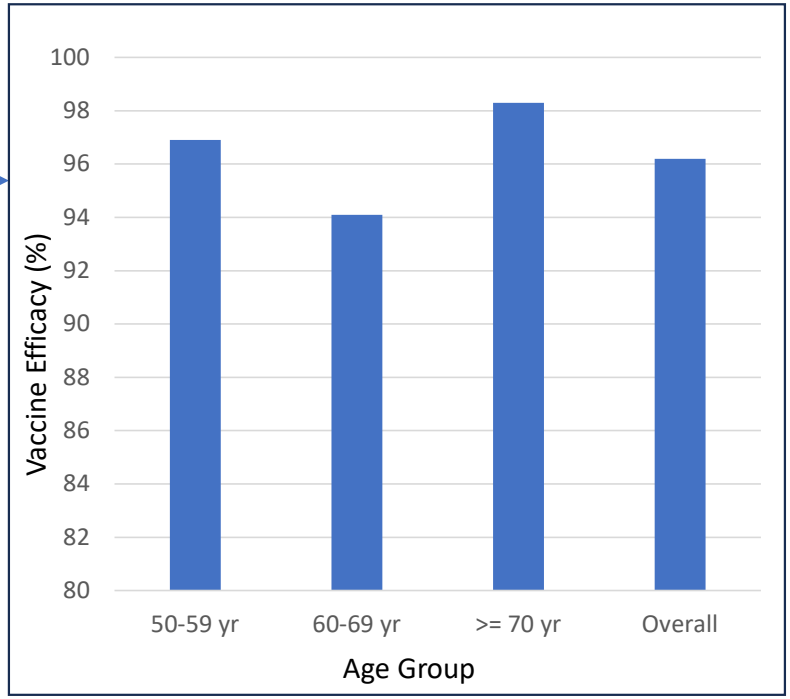
- Not recommended for people:
  - with HIV/AIDS or another disease that affects the immune system
  - on treatment with drugs that affect the immune system, such as steroids
  - with cancer treatment such as radiation or chemotherapy
  - with leukemia or lymphoma
  - who are or might be pregnant

N Engl J Med 2015;372:2087-96

CDC. *Epidemiology and Prevention of Vaccine-Preventable Diseases* 13th ed, 2015

Zoster Vaccines

- Second zoster vaccine (*Shingrix*) approved October, 2017
- Recombinant, adjuvanted zoster vaccine against Varicella surface glycoprotein E (not a live virus)
- >90% reduction in zoster and PHN
  - no reduced efficacy with age



Protection stays above 85% for at least four years, 82% at 11 years[2]

→ Zostavax was discontinued in 2020
Shingrix is "The Shingles Vaccine"

N Engl J Med 2015;372:2087-96

[2]Diez-Domingo J, et al. Abstract presented at European Society of Clinical Microbiology and Infectious Diseases (ESCMID); 27–30 April 2024, Barcelona, Spain

Recombinant Zoster Vaccine (RZV) Recommendations

- Healthy adults >=50 years old and adults >= 19 years old who are or will be immunosuppressed should get two doses of RZV (Shingrix), 2 to 6 months apart
  - If pt waits more than 6 months, give the second dose but don't restart the series
- People should get RZV even if they:
  - had shingles in the past
  - received Zostavax
  - are unsure if had chickenpox
  - received varicella (chickenpox) vaccine
- Do not give Shingrix if:
  - tested negative for immunity to varicella zoster virus (should get chickenpox vaccine)
  - currently have shingles (no benefit)
  - moderate or severe acute illness (risk of poor response to vaccine)
- Pregnancy
  - No ACIP recommendation for RZV use in pregnancy
  - Providers should consider delaying RZV until after pregnancy (risk of poor response to vaccine)
  - There is no recommendation for pregnancy testing prior to vaccination
- Breastfeeding - no known risk for mothers who are breastfeeding or their infants

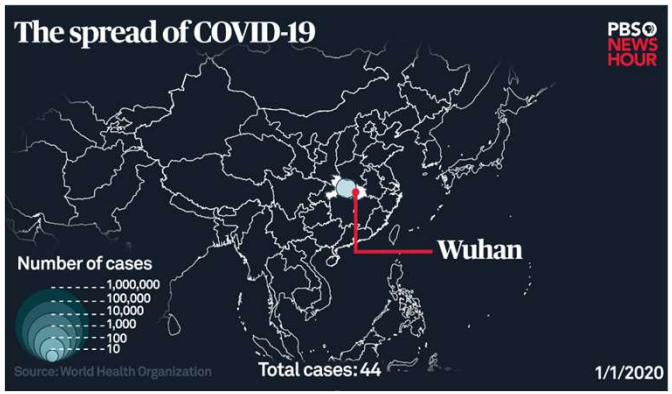
CDC.gov

Shingrix Adverse Effects

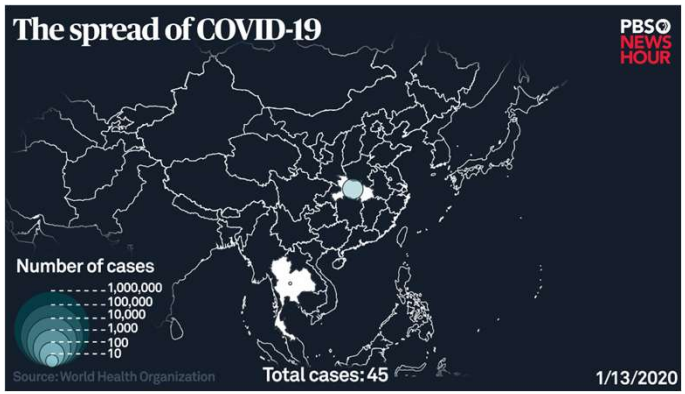
- Sore arm with mild or moderate pain (80%)
- Redness and swelling at injection site (~30%)
- Fatigue, myalgia, headache, fever, stomach pain, nausea (20-40%)
- About 15% experience side effects that prevent them from doing regular activities
- Symptoms resolve in about 2 to 3 days
- Side effects more common in younger people

N Engl J Med 2015;372:2087-96 CDC.gov

COVID-19

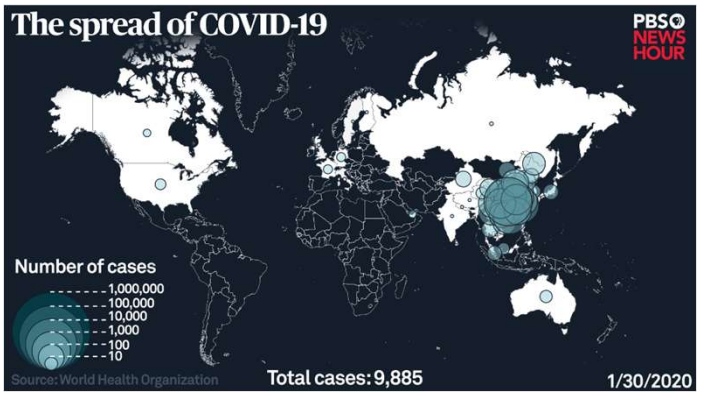


Dec 31: China alerts WHO on a cluster of cases of pneumonia with unknown cause in Wuhan



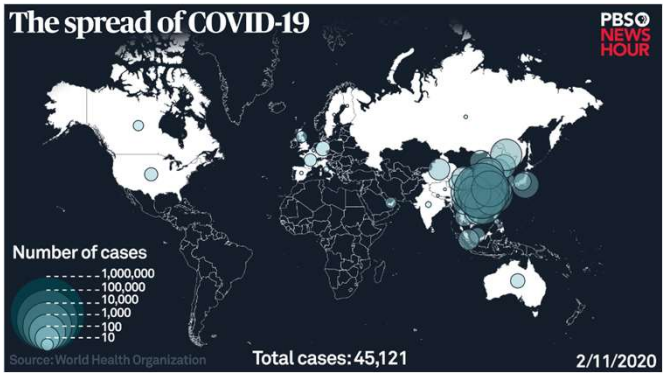
Jan 7: WHO officials announce they have identified a new coronavirus initially named 2019-nCoV

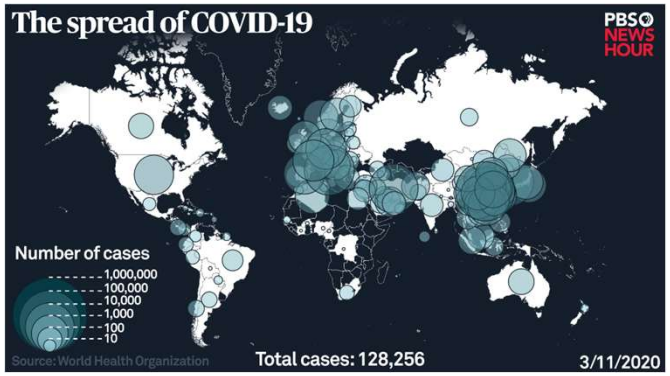
Jan 13: First confirmed case outside of China (Thailand) in a traveler who has visited Wuhan

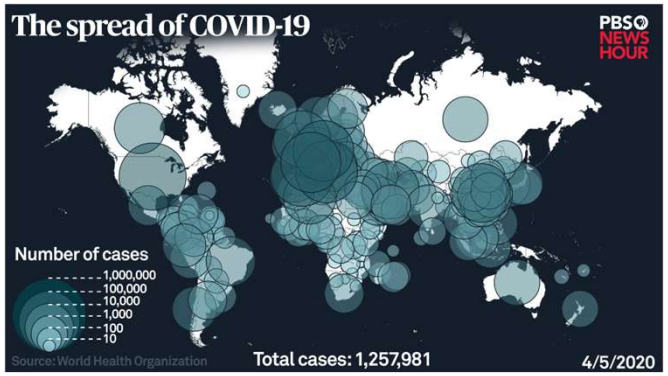


Jan 21: First confirmed case in the U.S.

Jan 30: WHO declares coronavirus a global emergency with cases reported in US, Japan, Nepal, France, Australia, Malaysia, Singapore, South Korea, Vietnam, and Taiwan





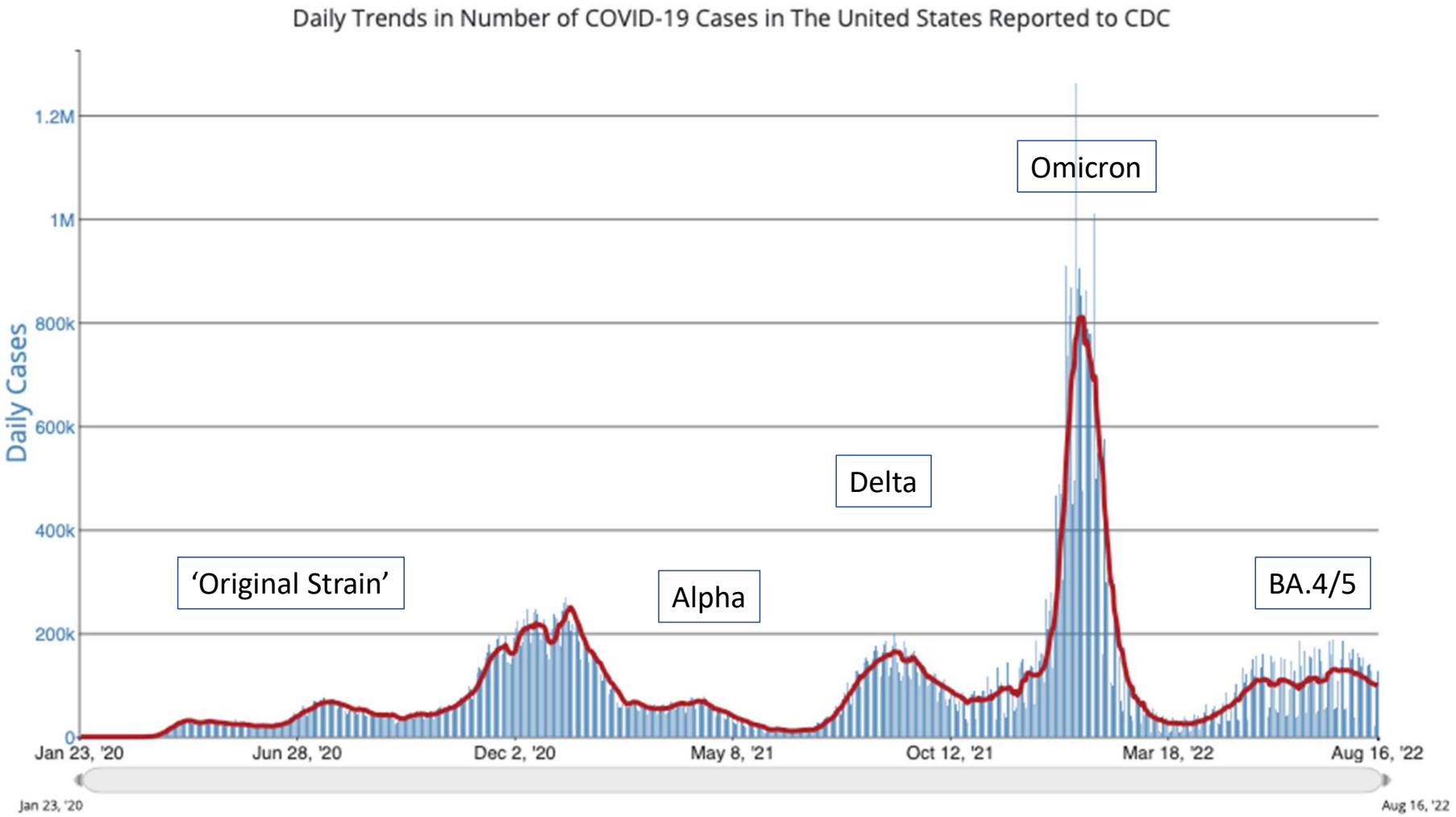


JAMA. doi:10.1001/jama.2020.12839
Published online July 10, 2020
PBS.org

Feb 11: WHO announces that the new disease caused by SARS-CoV-2 is named "COVID-19"

Mar 11: WHO declares the coronavirus outbreak a pandemic

Apr 5: Cases reported in every country on the planet


Daily Trends in Number of COVID-19 Cases in The United States Reported to CDC
Daily Cases
1.2M
1M
800k
600k
400k
200k
0
Omicron
Delta
'Original Strain'
Alpha
BA.4/5
Jan 23, '20
Jun 28, '20
Dec 2, '20
May 8, '21
Oct 12, '21
Mar 18, '22
Aug 16, '22
Jan 23, '20
Aug 16, '22

CDC.gov

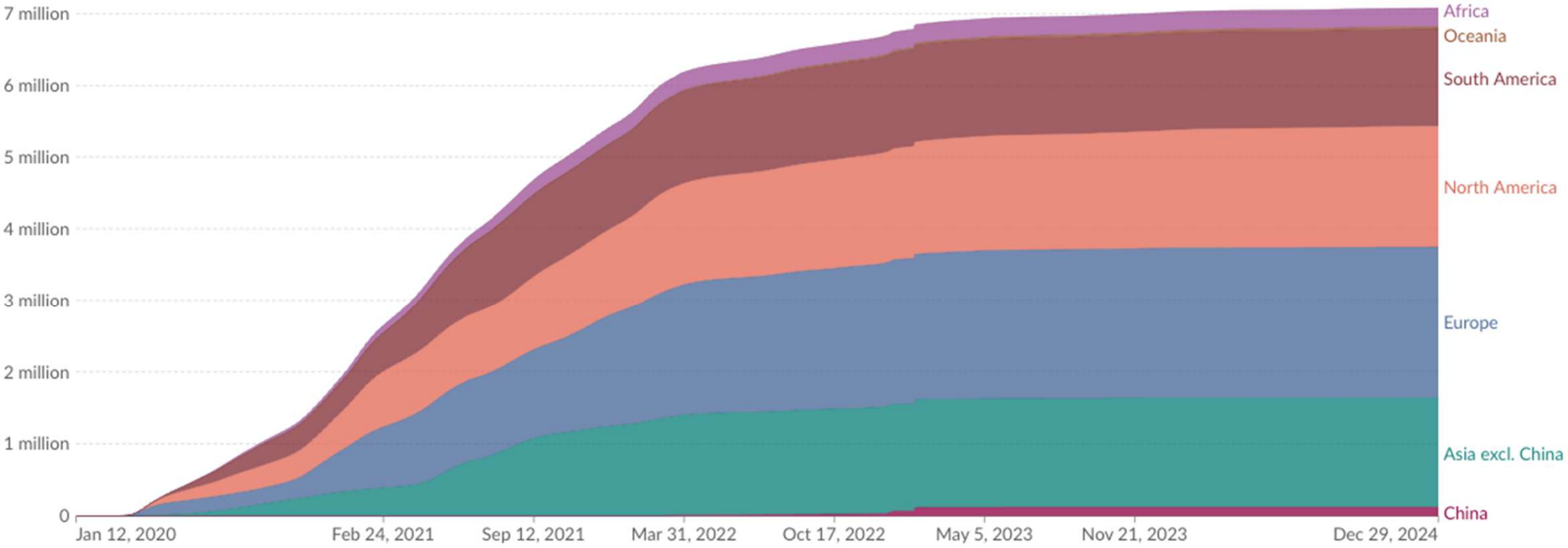
Cumulative confirmed COVID-19 deaths by world region

Due to varying protocols and challenges in the attribution of the cause of death, the number of confirmed deaths may not accurately represent the true number of deaths caused by COVID-19.

Our World in Data

Table | Chart

Settings

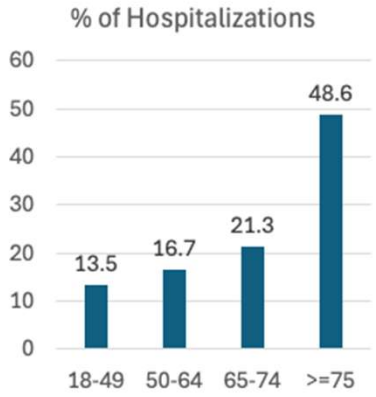


ourworldindata.org

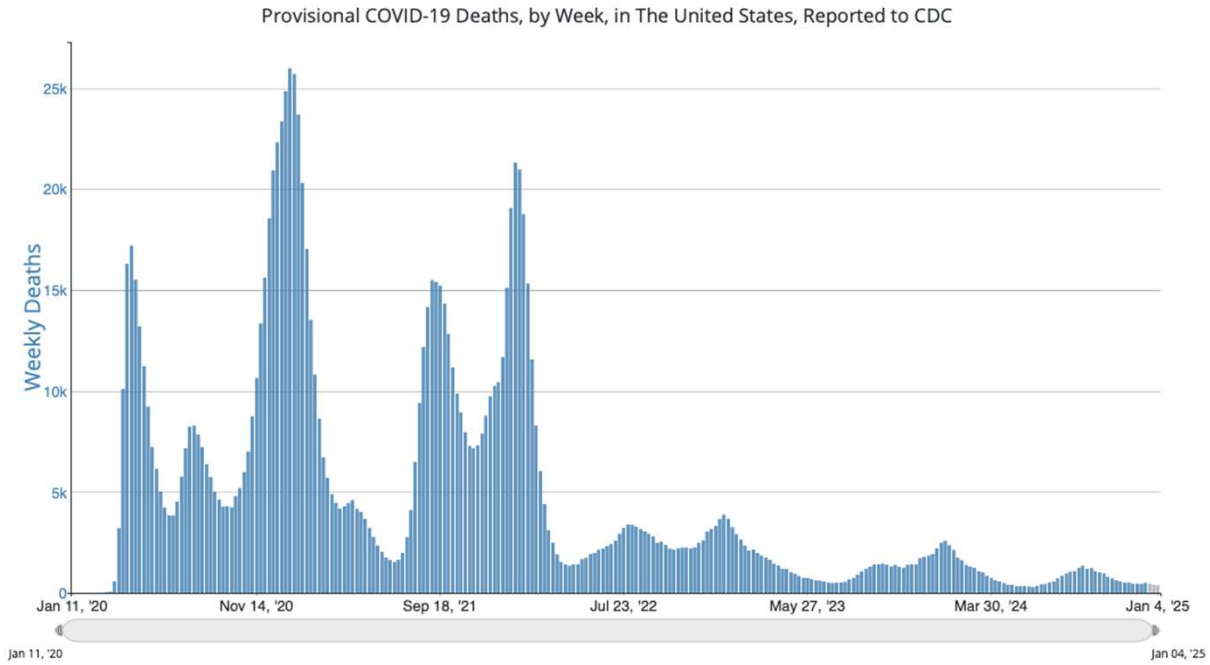
COVID-19 Hospitalizations and Deaths

From October 2023 – April 2024

- Adults aged ≥65 years accounted for 70% of all COVID-19–associated hospitalizations among adults
- Most hospitalized adults had multiple underlying medical conditions
- Only 12% had received the recommended COVID-19 2023–2024 formula vaccine (88% had not)



MMWR October 3, 2024 / 73(39);869–875

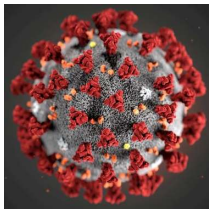


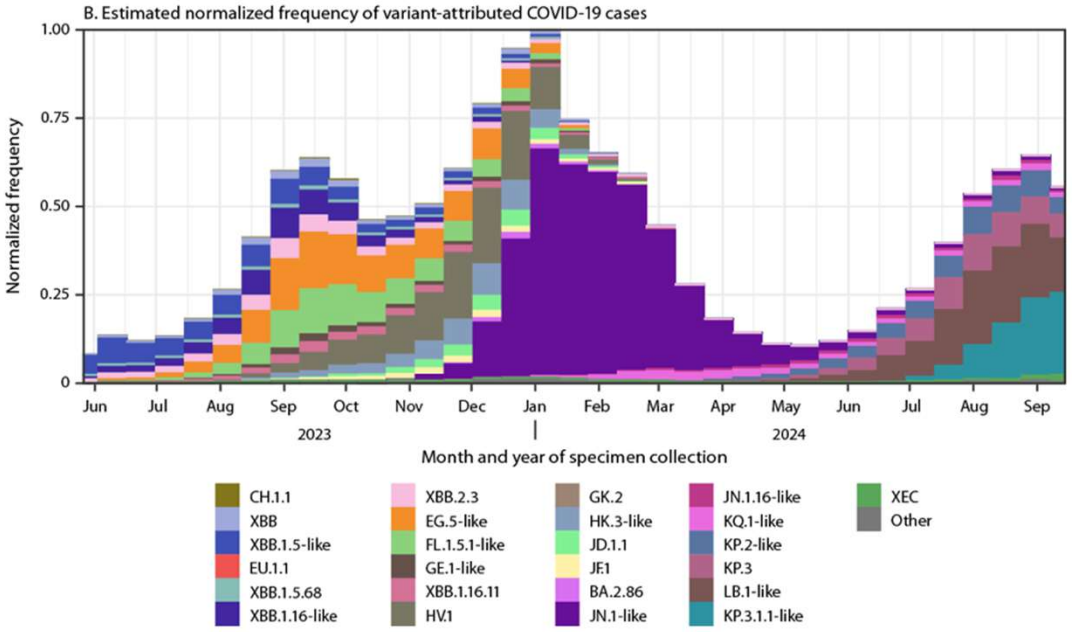
Est. 46,582 deaths in the U.S. in 2024

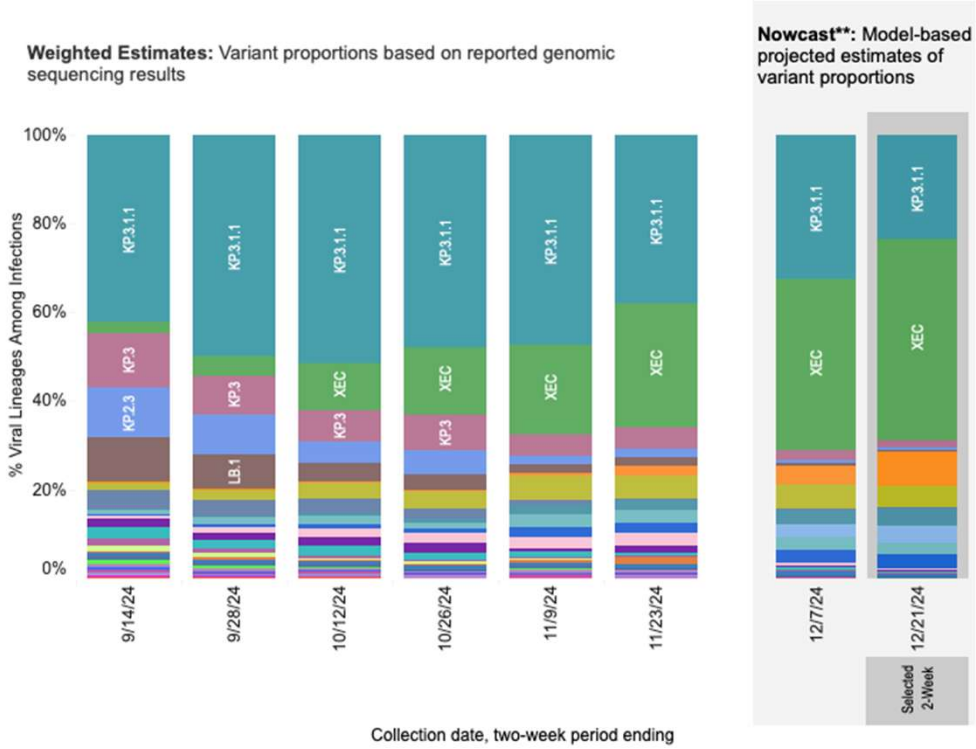
In at least 66% of these deaths, COVID-19 was listed as the underlying cause of death. For the remaining deaths, COVID-19 was listed as a contributing cause of death.

Est. 28,000 deaths from Influenza 2023 – 2024

SARS-CoV-2 Continues to Evolve





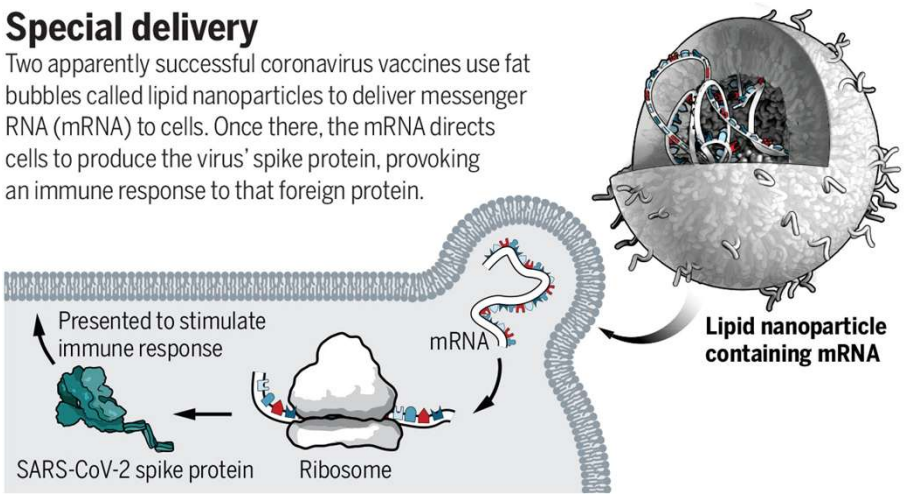


MMWR October 24, 2024 / 73(42);938–945 CDC.gov

COVID-19 Vaccines

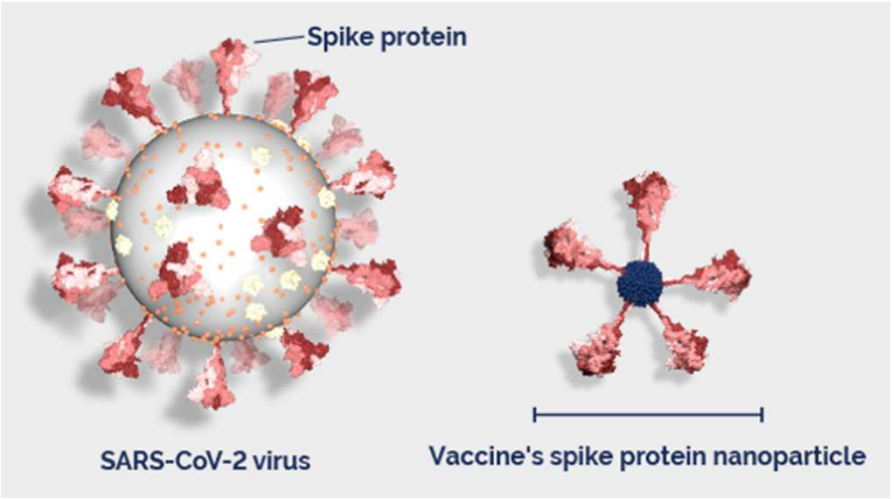
Currently available in the U.S.

Pfizer and Moderna mRNA vaccines



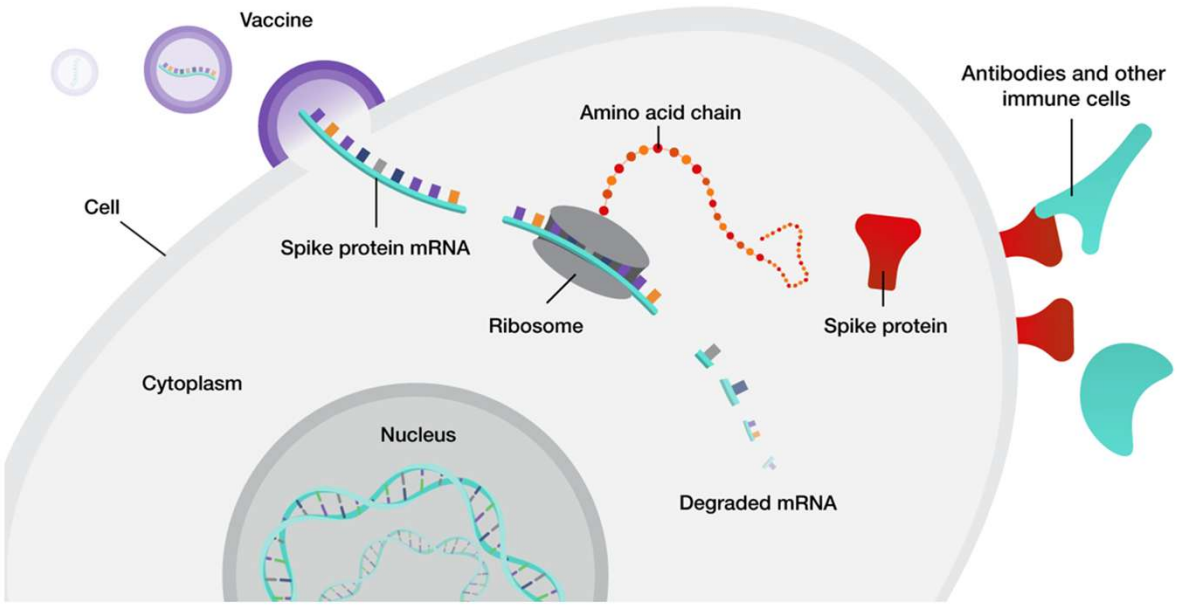
Science 27 Nov 2020:
Vol. 370, Issue 6520, pp. 1022
DOI: 10.1126/science.370.6520.1022

Novavax adjuvanted recombinant vaccine with nanoparticle technology



novavax.com

COVID-19 mRNA Vaccine Basics

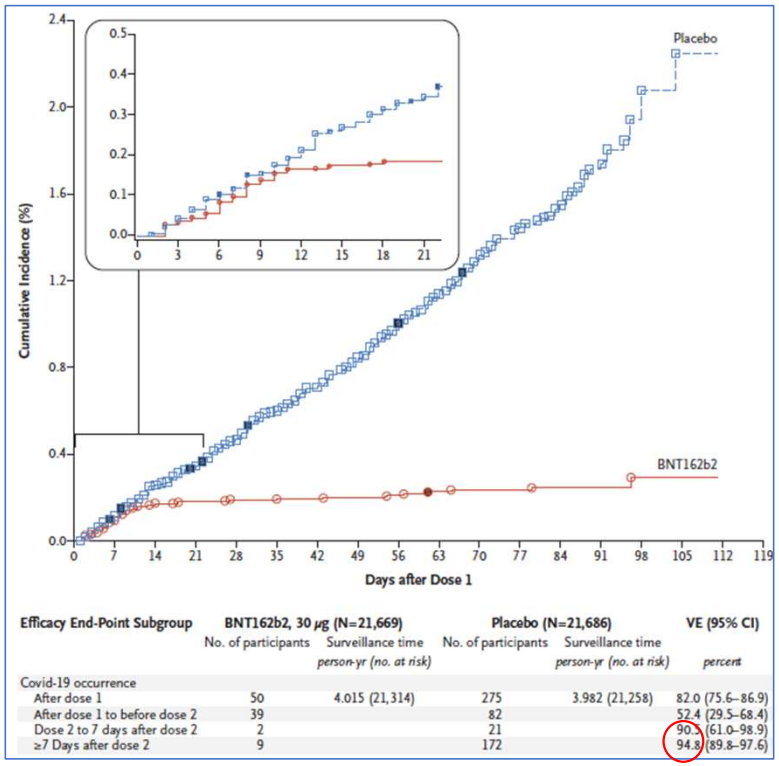


- mRNA vaccines inject cells with instructions to generate the SARS-CoV-2 spike protein
- The protein made in response to the vaccine elicits an immune response. Later, if the person is exposed to the virus, their immune system will recognize and respond to it
- mRNA vaccines are safe and cannot alter your DNA, and you cannot get COVID-19 from the vaccine
- mRNA vaccines may seem to have arrived quickly, but this technology is built on decades of scientific research

genome.gov

COVID-19 Vaccine Efficacy

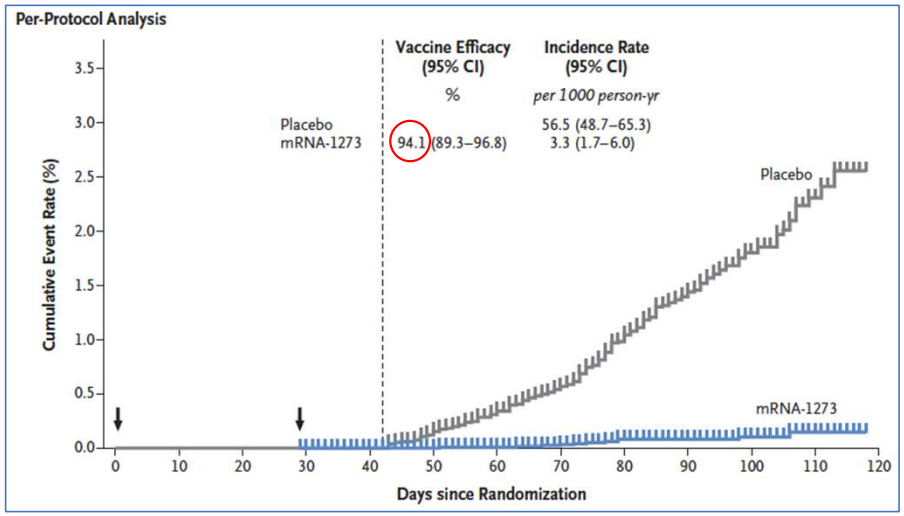
Pfizer



Efficacy End-Point Subgroup	BNT162b2, 30 μg (N=21,669) No. of participants	BNT162b2, 30 μg (N=21,669) Surveillance time person-yr (no. at risk)	Placebo (N=21,686) No. of participants	Placebo (N=21,686) Surveillance time person-yr (no. at risk)	VE (95% CI) percent
Covid-19 occurrence					
After dose 1	50	4.015 (21,314)	275	3.982 (21,258)	82.0 (75.6–86.9)
After dose 1 to before dose 2	39		82		52.4 (29.5–68.4)
Dose 2 to 7 days after dose 2	2		21		90.5 (61.0–98.9)
≥7 Days after dose 2	9		172		94.8 (89.8–97.6)

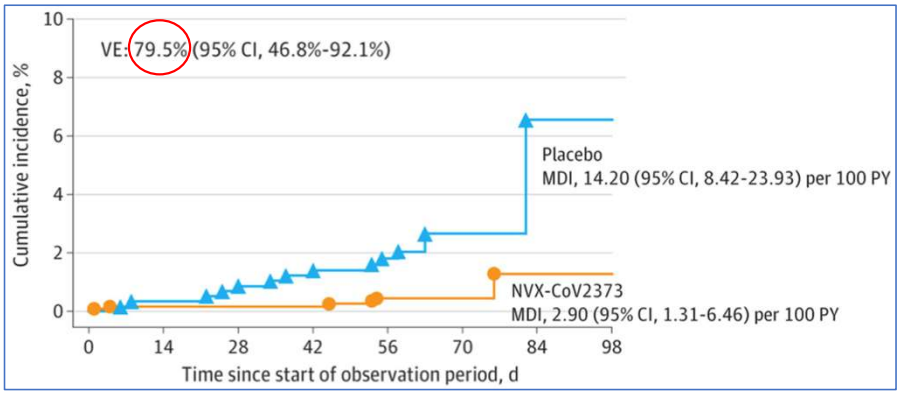
NEJM 383;27 December 31, 2020

Moderna



NEJM 384;5 February 4, 2021

Novavax



JAMA Netw Open. 2023 Apr 3;6(4):e239135

COVID-19 Vaccines

- Estimated to have prevented[1]
  - 27 million infections
  - 1.6 million hospitalizations
  - 235,000 deaths

  from 12/1/2020 to 9/30/2021 in the U.S.

- IF all adults 18 and older in the U.S. had received the vaccine[2] from 1/1/2021 to 4/30/2022
  - estimated additional 320,000 deaths would have been averted

[1] *JAMA Network Open* 2022;5(7):e2220385

[2] *Journal of Pharmacy and Pharmacology Research* 7 (2023): 163-167

COVID-19 Vaccine Adverse Effects

Common Side Effects

- Pain, soreness, redness at injection site
- Fatigue
- Headache
- Muscle pain
- Joint pain
- Chills
- Fever
- Nausea/vomiting (Moderna)

→ Less common with successive doses

CDC.gov

Rare Side Effects

- Anaphylaxis occurs at a rate of approximately 5 cases per one million vaccine doses administered
- Myocarditis and pericarditis after COVID-19 vaccination are rare
  - Most people with myocarditis or pericarditis after COVID-19 vaccination respond well to treatment and rest and feel better quickly
  - Myocarditis has been most frequently seen in adolescent and young adult males within 7 days of their second mRNA COVID-19 vaccine dose. (Cases have also been observed in females, in other age groups, and after other vaccine doses.)

The risk of myocarditis was more than seven-fold higher in persons who were infected with the SARS-CoV-2 than in those who received the vaccine

Front Cardiovasc Med. 2022 Aug 29;9:951314

COVID-19 Vaccine Recommendations

Everyone age 6 months and older should get a 2024–2025 COVID-19 vaccine

People ages 12–64 years

- You are up to date when you have received:
  - 1 dose of the 2024–2025 Moderna COVID-19 vaccine **OR**
  - 1 dose of the 2024–2025 Pfizer-BioNTech COVID-19 vaccine **OR**
  - 1 dose of the 2024–2025 Novavax vaccine unless you are receiving a COVID-19 vaccine for the very first time. If you have never received any COVID-19 vaccine and get Novavax, you need 2 doses of 2024–2025 Novavax COVID-19 vaccine to be up to date.

People ages 65 years and older

You are up to date when you have received:

New!

- 2 doses of any 2024–2025 COVID-19 vaccine 6 months apart.
  - While it is the *recommended* to get 2024-2025 COVID-19 vaccine doses 6 months apart, the *minimum* time is 2 months apart, which allows flexibility to get the second dose prior to typical COVID-19 surges, travel, life events, and healthcare visits

Vaccine recommendations for people who are moderately or severely immunocompromised

Already completed initial series

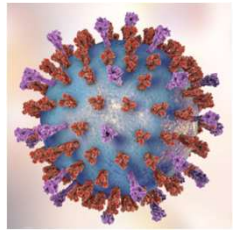
- **People ages 12 years and older:** Get 2 doses of 2024–2025 COVID-19 vaccine from any brand (Moderna, Pfizer-BioNTech, or Novavax) spaced 6 months apart.*

Never received a COVID-19 vaccine

- **People ages 12 years and older:** Get initial series of 2024–2025 COVID-19 vaccines from the same brand (Moderna, Pfizer-BioNTech, or Novavax), followed by 1 dose from any brand 6 months later.*

CDC.gov

Respiratory Syncytial Virus



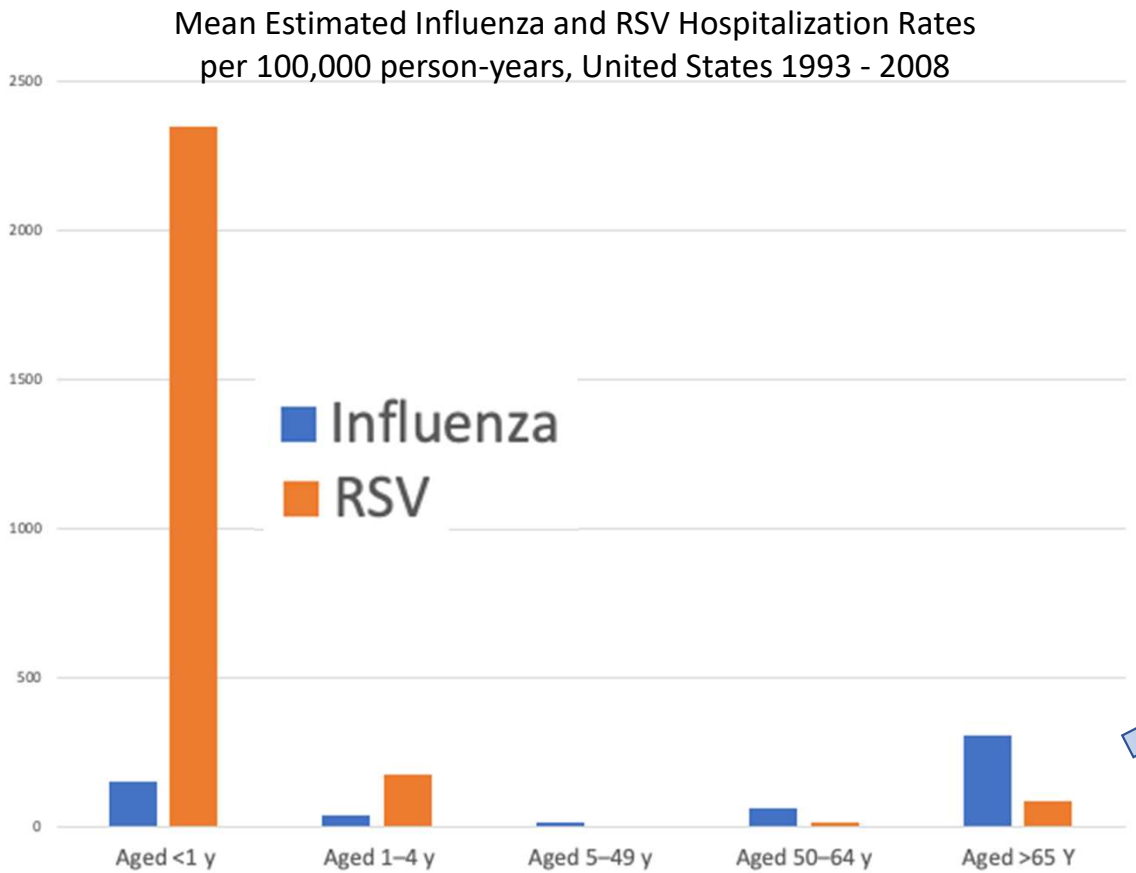
- In children:
  - RSV is the most common cause of bronchiolitis and pneumonia in children under 12 months of age
  - In the U.S. there are between 75,000 and 125,000 children hospitalized each year due to complications of RSV infection
  - Est. globally there are 64 million cases of RSV annually that result in 253,500 deaths
  - Almost all children will have had an RSV infection by their second birthday
- In adults:
  - RSV is associated with up to 12% of medically attended acute respiratory illnesses
  - <1% require hospitalization
  - RSV is the third most commonly identified virus in adults hospitalized with pneumonia (pre-COVID-19 pandemic) after Rhinovirus and Influenza
- In adults >65 with moderate-to-severe ILI* episodes, those with RSV are about twice as likely to be hospitalized than those with any other virus (19.5% vs. 8.6%) and 5-fold more likely than Influenza A (3.8%)

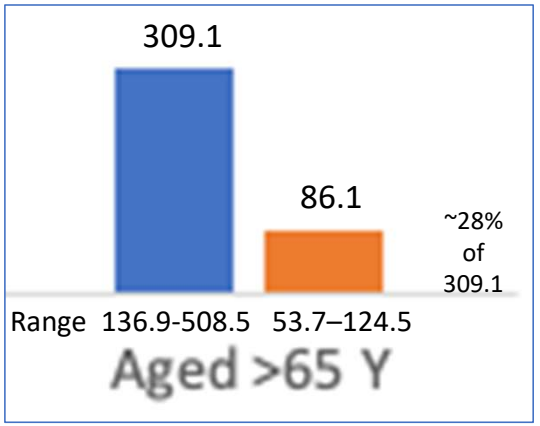
*Influenza-Like Illness with pneumonia, hospitalization, or maximum daily influenza symptom severity score (ISS) >2

J Virology July 2014 88(13): 7602–7617 CDC.gov PLoS ONE 2017 12(8): e0182321 *Influenza Other Resp Viruses* 2022;16:1133–1140 *J Infectious Diseases* 2014 Jun 15; 209(12): 1873–1881

Most adult RSV hospitalizations occur in older adults

est 60,000 – 160,000 hospitalizations and 6,000 – 10,000 deaths annually among adults aged ≥65 years (U.S.)





The overall rate of hospitalization for RSV is lower than for Influenza because of the lower rate of infection

data from *Clinical Infectious Diseases* 2012;54(10):1427–36

Morbidity and Mortality in Older Adults (aged ≥60 years) Hospitalized with RSV

Characteristics of a random sample of patients aged ≥60 years hospitalized with laboratory-confirmed RSV infection (N = 1,634), RSV–Associated Hospitalization Surveillance Network, 12 states, October 2022–April 2023

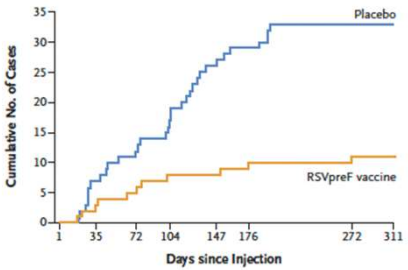
Characteristic	Overall No.	Overall Weighted % (95% CI)
Underlying medical condition		
≥1 underlying medical condition***	1,584	95.5 (93.2–97.2)
Chronic lung disease	813	49.2 (45.7–52.7)
COPD	552	33.7 (30.5–37.0)
Asthma	332	19.1 (16.6–21.8)
Other†††	72	5.4 (3.8–7.3)
Cardiovascular disease	1,108	67.1 (63.7–70.5)
CHF§§§	545	33.2 (30.0–36.5)
CAD¶¶¶	435	26.4 (23.5–29.5)
CVA****	253	13.7 (11.7–15.9)
Immunocompromising condition	292	18.6 (16.0–21.4)
Diabetes mellitus	553	32.6 (29.5–35.8)
Neurologic condition	439	27.3 (24.3–30.5)
Dementia††††	183	12.4 (10.1–15.0)
Other	256	14.9 (12.6–17.4)
Kidney disorder	477	29.3 (26.3–32.5)
Obesity	572	37.8 (34.3–41.4)

Hospitalization outcome§§		%
Hospital stay, days, median (IQR)	4.1 (2.2–7.6)	—
BiPAP/CPAP	339	19.8 (17.3–22.6)
High-flow nasal cannula	80	4.3 (3.2–5.7)
≥1 severe outcome¶¶	332	18.5 (15.9–21.2)
ICU admission	297	17.0 (14.5–19.7)
Invasive mechanical ventilation	94	4.8 (3.5–6.3)
In-hospital death	98	4.7 (3.6–6.1)

¶¶ Severe outcome is defined as requiring ICU admission or mechanical ventilation or experiencing in-hospital death

*** Defined as one or more of the following: chronic lung disease, including asthma; chronic metabolic disease including diabetes mellitus; blood disorder or hemoglobinopathy; cardiovascular disease; neurologic disorder; immunocompromising condition; renal disease; gastrointestinal or liver disease; rheumatologic, autoimmune, or inflammatory condition; obesity; feeding tube dependency; and wheelchair dependency

MMWR October 6, 2023 Vol. 72 No. 40 pages 1075-1082



Efficacy of RSV Vaccines

TABLE 1. Efficacy of 1 dose of GSK respiratory syncytial virus RSVpreF3 vaccine against respiratory syncytial virus–associated disease among adults aged ≥60 years — multiple countries, 2021–2023

Efficacy evaluation period	Vaccine efficacy against outcome*	
	RSV-associated LRTD†	RSV-associated medically attended LRTD§
Season 1¶	82.6 (57.9–94.1)**	87.5 (58.9–97.6)††
Season 2§§	56.1 (28.2–74.4)††	—¶¶
Combined seasons 1 and 2 (interim)***	74.5 (60.0–84.5)†††	77.5 (57.9–89.0)††

LRTD = lower respiratory tract disease

† LRTD defined as two or more lower respiratory symptoms (new or increased sputum, cough, and dyspnea) or signs (new or increased wheezing, crackles or rhonchi detected during chest auscultation, respiratory rate ≥20 respirations per minute, low or decreased oxygen saturation [<95% or ≤90% if baseline was <95%] and need for oxygen supplementation) for ≥24 hours, including one or more lower respiratory signs, or three or more lower respiratory symptoms for ≥24 hours.

§ Medically attended RSV-associated LRTD defined as LRTD plus attention at one or more inpatient or outpatient health care service. Estimates were not included in per-protocol assessments.

N Engl J Med 2023;388:1465-77

MMWR July 21, 2023 Vol. 72 No. 29 pages 793-801

TABLE 3. Efficacy of 1 dose of Pfizer respiratory syncytial virus RSVpreF vaccine against respiratory syncytial virus–associated disease among adults aged ≥60 years — multiple countries, 2021–2023

Efficacy evaluation period	Vaccine efficacy against outcome, % (95% CI)*	
	RSV-associated LRTD†	RSV-associated medically attended LRTD§
Season 1¶	88.9 (53.6–98.7)	84.6 (32.0–98.3)
Season 2 (interim)**	78.6 (23.2–96.1)	—††
Combined seasons 1 and 2 (interim)§§	84.4 (59.6–95.2)	81.0 (43.5–95.2)

Neither of the two clinical trials that led to FDA approval of RSV vaccines for older adults was powered to assess protection against hospitalization, though both trials showed moderate to high efficacy of RSV vaccination against LRTD, which is in the causal pathway leading to severe disease

RSV Vaccine in Adults

- On June 21, 2023, ACIP voted to recommend that adults aged ≥60 years may receive a single dose of an RSV vaccine (either GSK or Pfizer), using shared clinical decision-making. ("Talk to your doctor.")

MMWR July 21, 2023 Vol. 72 No. 29 pages 793-801

Safety of RSV Vaccines

TABLE 2. Safety* of 1 dose of GSK respiratory syncytial virus RSVPreF3 vaccine in adults aged ≥60 years — multiple countries, 2021–2023

Safety event	Risk for event: RSVPreF3 recipients no./No. (%)†	Placebo recipients no./No. (%)§	Relative risk (95% CI)¶
Serious AE**	549/12,570 (4.4)	540/12,604 (4.3)	1.02 (0.91–1.15)
Severe reactogenicity events††	37/979 (3.8)	9/976 (0.9)	4.10 (1.99–8.45)
Inflammatory neurologic events§§	3 events in trials without placebo recipients¶¶	—¶¶	—¶¶

One case of GBS and two cases of acute disseminated encephalomyelitis in 17,922 doses given over all trials

TABLE 4. Safety* of 1 dose of Pfizer respiratory syncytial virus RSVpreF vaccine in adults aged ≥60 years — multiple countries, 2021–2023

Safety event	Risk for event: RSVpreF recipients no./No. (%)†	Placebo recipients no./No. (%)§	Relative risk (95% CI)¶
Serious AE**	792/18619 (4.3%)	749/18334 (4.1%)	1.04 (0.94–1.15)
Severe reactogenicity events††	36/3673 (1.0%)	24/3491 (0.7%)	1.43 (0.85–2.39)
Inflammatory neurologic events§§	3/18622 (—)¶¶	0/18335 (—)	—¶¶

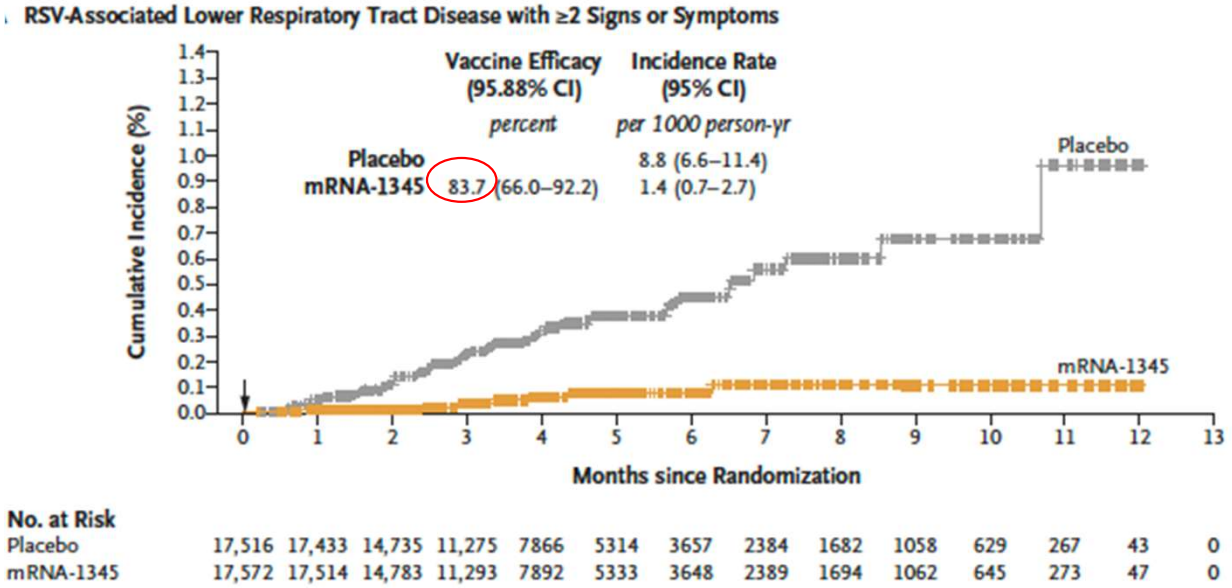
One case each of GBS, Miller Fisher syndrome (a GBS variant), and undifferentiated motor-sensory axonal polyneuropathy

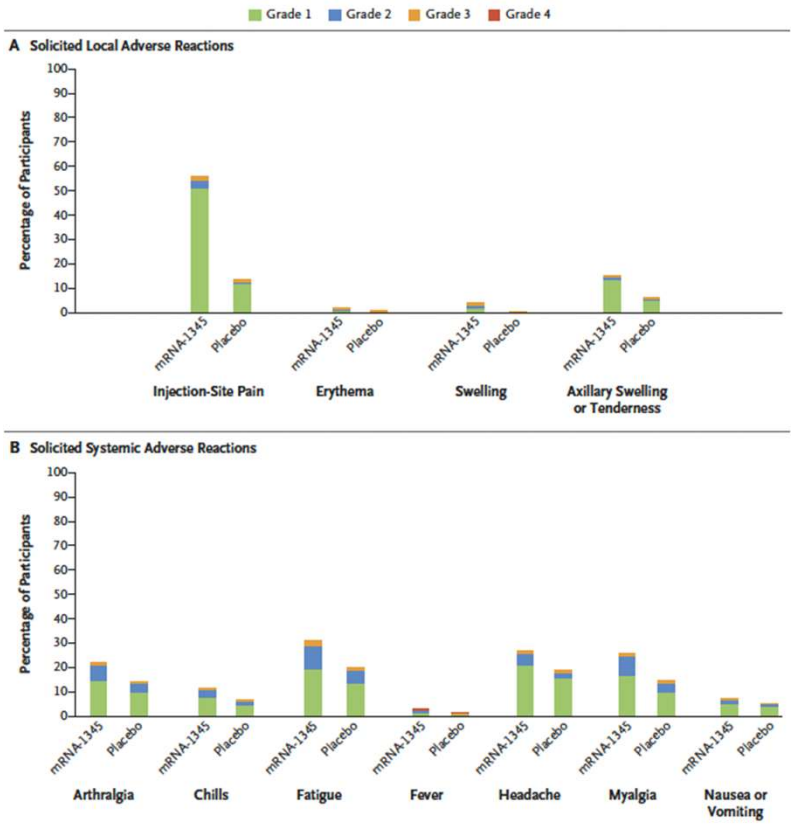
GBS = Guillain-Barre Syndrome

Whether these events occurred due to chance, or whether RSV vaccination increases the risk for inflammatory neurologic events is currently unknown. Until additional evidence becomes available, RSV vaccination in older adults should be targeted to those who are at highest risk for severe RSV disease and therefore most likely to benefit from vaccination.

MMWR July 21, 2023 Vol. 72 No. 29 pages 793-801

Moderna mRNA RSV Vaccine





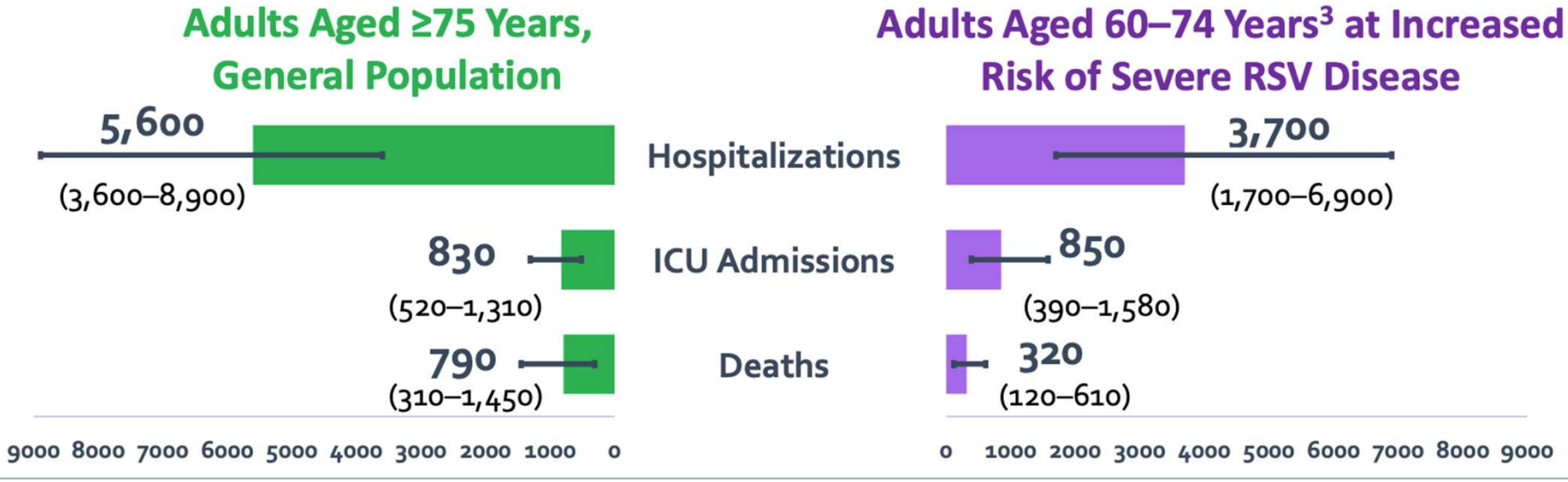
0 reports of inflammatory neurologic events in this trial, post-licensure safety data are not yet available

N Engl J Med. 2023 Dec 14;389(24):2233-2244

FDA approval May 2024

Estimated RSV-Associated Outcomes[1] Preventable over 3 RSV Seasons vs. attributable risk of GBS estimated from self-controlled case series analysis through FDA-CMS partnership, 42-day risk interval[2]

Per 1 Million Persons Vaccinated with Protein Subunit RSV Vaccine:



CDC.gov ACIP Presentation 10/24/2024

0–18[4] attributable cases of GBS

FDA Requires Guillain-Barré Syndrome (GBS) Warning in the Prescribing Information for RSV Vaccines Abrysvo and Arexvy: FDA Safety Communication

[Posted 1/7/2025]

fda.gov

Current RSV Vaccine Recommendation

- As of June 26, 2024,
  - all adults aged ≥75 years and adults aged 60–74 years who are at increased risk for severe RSV disease should receive a single dose of RSV vaccine*

For pregnant people (maternal RSV vaccine)

- FDA approved Pfizer RSV vaccine (Abrysvo) in 2023. Pfizer RSV vaccine is approved for pregnant people at 32 through 36 weeks gestational age to protect their babies from LRTD caused by RSV.
- Pfizer is the only RSV vaccine approved and recommended for use in pregnant people. GSK (Arexvy) and Moderna (mResvia) RSV vaccines are not recommended for pregnant people.

*

Chronic underlying medical conditions associated with increased risk

- Lung disease (such as chronic obstructive pulmonary disease and asthma)
- Cardiovascular diseases (such as congestive heart failure and coronary artery disease)
- Moderate or severe immune compromise*
- Diabetes mellitus
- Neurologic or neuromuscular conditions
- Kidney disorders
- Liver disorders
- Hematologic disorders
- Other underlying conditions that a health care provider determines might increase the risk for severe respiratory disease

Other factors associated with increased risk

- Frailty†
- Advanced age§
- Residence in a nursing home or other long-term care facility
- Other underlying factors that a health care provider determines might increase the risk for severe respiratory disease

- A single dose provides protection for at least two RSV seasons. The need for additional RSV vaccine doses will be evaluated by ACIP in the future; ACIP will update recommendations as needed

CDC.gov

Vaccine Benefits

TABLE. Estimated number of illnesses, hospitalizations, and deaths prevented by routine childhood immunization for selected vaccine-preventable diseases among children born during the Vaccines for Children era — United States, 1994–2013

Vaccine-preventable disease*	Cases prevented (in thousands)		
	Illnesses	Hospitalizations	Deaths
Diphtheria	5,073	5,073	507.3
Tetanus	3	3	0.5
Pertussis	54,406	2,697	20.3
Haemophilus influenzae type B	361	334	13.7
Polio	1,244	530	14.8
Measles	70,748	8,877	57.3
Mumps	42,704	1,361	0.2
Rubella	36,540	134	0.3
Congenital rubella syndrome	12	17	1.3
Hepatitis B	4,007	623	59.7
Varicella	68,445	176	1.2
Pneumococcus-related diseases†	26,578	903	55.0
Rotavirus	11,968	327	0.1
Total	**322,089**	**21,055**	**731.7**

* Vaccines were considered as preventing disease for birth cohorts born in all years during 1994–2013 except for the following, which were only in use for part of the 20-year period: varicella, 1996–2013; 7-valent and 13-valent pneumococcal conjugate vaccines, 2001–2013; and rotavirus, 2007–2013.

† Includes invasive pneumococcal disease, otitis media, and pneumonia.

MMWR 2014; 63(16):351-55

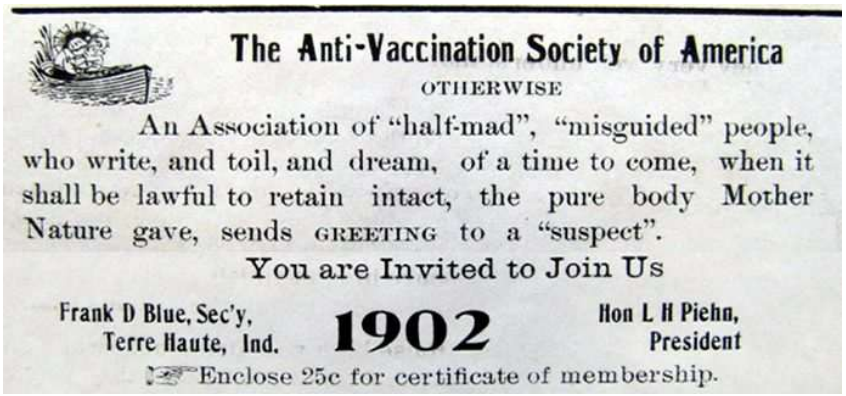
Anti-vaxers

- Antivaccination protests are as old as vaccines
- Today's antivaccine movement was heavily influenced by a 1998 paper by Andrew Wakefield published in the *Lancet* that purported a link between autism and the MMR (measles, mumps, rubella) vaccine
- Wakefield had applied for a patent on his own measles vaccine and had received money (>$600,000) from a lawyer trying to sue companies making the MMR vaccine
- The article was later retracted, and Wakefield's medical license was revoked by the U.K.
- Numerous studies have refuted any link between vaccines and autism or neurodevelopmental disorders

www.sciencemag.org

Dialogues Clin Neurosci 2017 Dec; 19(4): 403–407

Vaccine Myths



- MMR causes autism
- Giving an infant multiple vaccines can overwhelm their immune system
- Thimerosal causes autism
- Spreading out vaccines can be safer for kids
- Vaccines are harmful to people who are sick
- The flu shot causes influenza
- COVID-19 vaccines contain alter your DNA, affect fertility, and/or contain microchips

Vaccines Bottom Line

- Pneumonia vaccine for all ≥ 50 years
  - and high-risk ≥ 19 years
- Shingles vaccine for all ≥ 50 years
  - and immunocompromised ≥ 19 years
- COVID-19 for all ≥ 6 months
  - Two doses for immunocompromised or >=65 years
- RSV for all ≥75 years
  - and 60–74 years at increased risk for severe RSV disease

Adult Vaccine Update 2025:
Pneumococcus, Shingles, COVID-19, and RSV

Kansas City Southwest Clinical Society

January 31, 2025

Joel P. McKinsey, M.D.

Kansas City, MO

MIDC
METRO INFECTIOUS DISEASE CONSULTANTS