The first confirmed case of SARS-CoV-2 infection in the United States was reported on January 20, 2020

CREATURES WALK AMONG US:

Coronaviruses

The World Health Organization (WHO)

COVID-19

Vaccine review

ANTHONY OGNJAN DO FACP

Metro Infectious Disease Consultants
43134 Dequindre Rd,
Sterling Heights, Michigan, 48314
Phone: 586 446-8688

SAMSUNG
NOKIA
NOKIA
NOKIA
LG

DISCLOSURES

Anthony Ognjan

- **No Financial or corporate Relationships**
- **1983 AIDS pandemic ---> 2020 COVID Pandemic**
- **1993: MOA Education Committee ("Hotel California")**

- **2020 March-Present : +250 COVID-19 Hospital-In-Patients**

- **2021 January: Fully vaccinated (Pfizer-mRNA)**
- **2021 February (Serology) Asymptomatic COVID-19 "Survivor"**
- **2021 October: 1st "Booster" : Pfizer-mRNA**
- **2022 April: 2nd "Booster" : Pfizer-mRNA**

- **I Believe in Public Health and Vaccinations for all**
- **I don't believe in Mandatory COVID-19 Vaccination**

Improve individual expertise, and communication skills regarding COVID-19 Vaccination

- Increase Individual understanding regarding the “evolving” impact of individual and collective Immunity (Infection and vaccination) on the Covid-19 pandemic
- Basic understanding of the Role of viral variance and diversity on the severity and direction of the Covid-19 Pandemic (More Contagious, Less Morbidity and mortality)
- Introduction to available Vaccines (Primarily mRNA) Efficacy, impact, side effects, Boosting
- Provide Additional References and resources for further study and personal education

Lecture Objectives

“a thing aimed at or sought; a goal.”

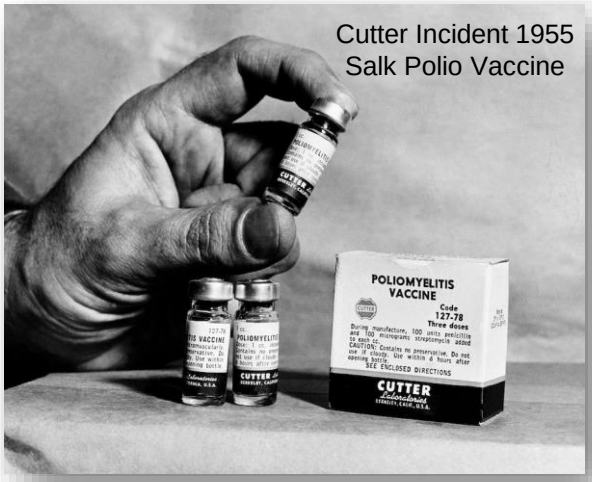
Anand P, Stahel V.P. ***The safety of Covid-19 mRNA vaccines: a review.*** Patient Saf Surg 15, 20 (2021). https://doi.org/10.1186/s13037-021-00291-9 https://pssjournal.biomedcentral.com/articles/10.1186/s13037-021-00291-9

Vaccines FAQ-Coronavirus Vaccine: Vaccines & Immunity. *Covid-19 Real time learning.* CDC and IDSA. https://www.idsociety.org/covid-19-real-time-learning-network/vaccines/vaccines-information--faq/#vaccinesimmunity

About COVID-19 Vaccination. Stay Up to Date with Your COVID-19 Vaccines. CDC. Updated May 12, 2022 https://www.cdc.gov/coronavirus/2019-ncov/vaccines/stay-up-to-date.html?s_cid=11747:covid%20vaccine%20schedule:sem.ga:p:RG:GM:gen:PTN:FY22

Build a better

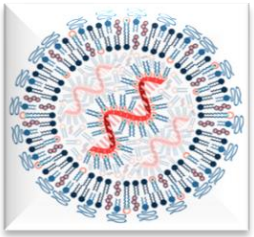
VACCINE



Cutter Incident 1955
Salk Polio Vaccine

Unlike most other medical interventions,
vaccines are given to Healthy people, and Healthy people
are far less willing to tolerate vaccine adverse effects….
….than adverse effects associated with other Medical therapies

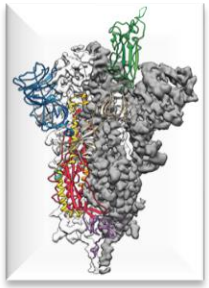
mRNA vaccines



Newly available to the public.
However, researchers have been studying and working with mRNA vaccines for decades
Ebola, zika, rabies, influenza, and cytomegalovirus virus

A piece of mRNA* corresponding to small piece of a viral protein is nano-lipid encapsulated
For example: COVID-19 “Spike Protein” **

mRNA Lipid complex is ttransported inside target cell
Using the mRNA blueprint, the cells’ ribosomes produce the associated viral protein.



As part of a normal immune response,
the immune system recognizes
the protein is foreign…
eliciting an immunological response
Antibodies / Cell mediated

***The half-life of the mRNA is short and remains in human tissues for just a few days**

****The Infectious Disease Society of America (IDSA) estimates that the spike proteins that were generated by COVID-19 vaccines last up to a few weeks, like other proteins made by the body.**

-- Anand, P., Stahel, V.P. ***The safety of Covid-19 mRNA vaccines: a review***. Patient Saf Surg 15, 20 (2021). https://doi.org/10.1186/s13037-021-00291-9

February 11, 2020
The World Health Organization (WHO) designated the disease / syndrome caused by the “novel” **coronavirus SARS-CoV-2 :**

CO = Corona
VI = Virus
D = Disease
19 = 2019

“COVID-19”

#1 Rule

"I never intend to Die

from a Contagious Infectious Disease"

Anthony Ognjan, DO FACP

Infectious Disease

95% COVID-19 Infections

ALL ages are benign…..

5% Significant illness:

2.5% Severe-Morbidity-Mortality

You've Got To Ask Yourself One Question:

'Do I Feel Lucky? ' Well, Do Ya, Punk?"

-Harry Callahan*

* "Dirty Harry" (1971) Warner Bros.

Surviving COVID-19

Immunity is KEY

What Drives a Pandemic?

What Drives Immunity?

- Antibody specific Component?
- What are “Protective” antibody concentrations?
- Is there a Cell Mediated Component ?
- Other “Components” in plasma?

Coronavirus COVID-19
Viral Human Ecology

VIRAL LOAD

Contagious ~ 8 days

COVID-19 Incubation
- ❖ **2-14 days after exposure.**
- ❖ **Average : 5.2 days**

Exposure

INCUBATION*
2-14 days
Ave 5.2 Days
(Asymptomatic)

Fever, Coughs
Myalgias

- ❖ **Shortness of breath**
- ❖ **Pneumonia**

5-7 Days

RECOVERY
Cough may persist

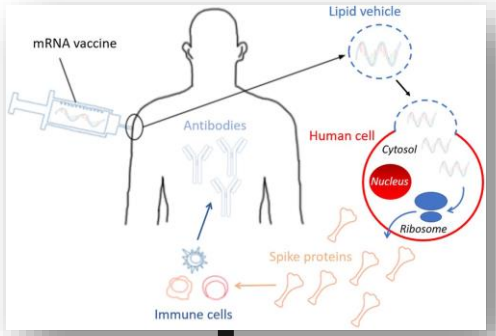
Average: 2.5 weeks

PCR???? PCR

2-6 weeks Antibody IGM & IGG

"SIMPLE IMMUNOLOGY"

ECOLOGY : What drives the Immune response?



Vaccine

Delayed Specific response

CD4
Lymphocyte Precursor
- ❖ Naive B and Naive T cells
- ❖ Effector cells
- ❖ Memory cells

TH: T-helper

Cytokines

Dendritic Cells Macrophages

Granulocyte "WBC"

FIRST RESPONDERS

Cytokines — TH 1

Cytokines — TH 2

type-1 pathway "Cellular" *

Monocyte Macrophage

NK cells, CD8+ T

IFN-γ, IL-2, IL-3, TNF-α, TNF-β

type-2 pathway "Humoral" **

B-cells Antibodies

IL-4, IL-5, IL-10, IL-13

"Memory"
- ❖ Prior infection
- ❖ Immunization

- ➢ Bacteria
- ➢ Fungi
- ➢ Protozoan
- ➢ Virus
- ➢ Cancer

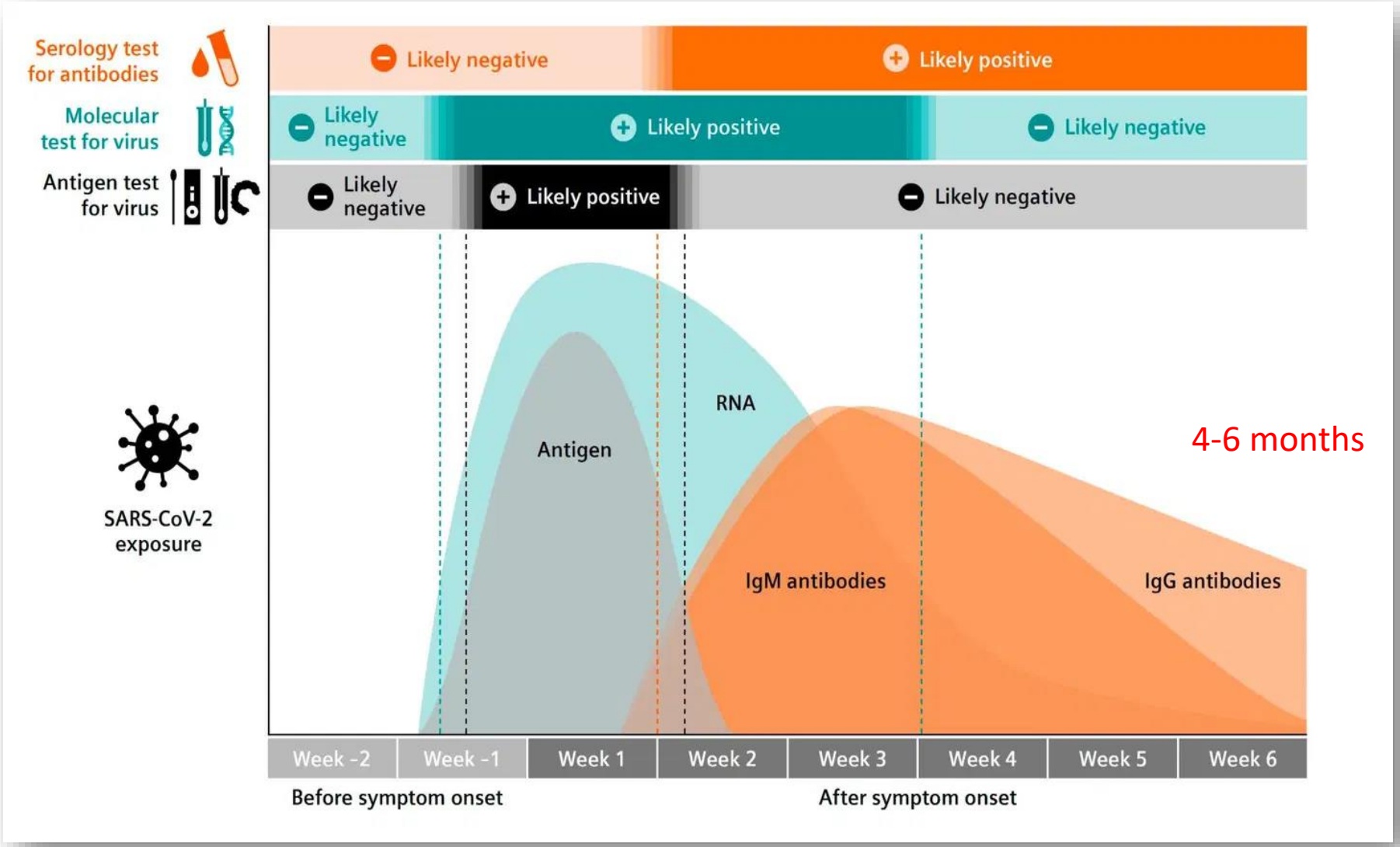
*** Cellular immunity:**
Viruses and other intracellular pathogens,
- ❖ Eliminate cancerous cells
- ❖ Stimulate delayed-type hypersensitivity (DTH) skin reactions

****Humoral**
- ❖ Eradication of extracellular parasites and bacterial infection

COVID-19

Vaccine review

Antibody response: Acute infection



Coronovirus
COVID -19
Vaccine Review :
Vaccine with Diagnostic testing

What tests can be used to document COVID-19 infection

▪ **Immune response to SARS-CoV-2 antigens**	➢ **Antibody Assays** (Commercially available) ➢ **T-cell responses** (Research)
▪ **Currently, only antibody assays are commercially available.**	**Antibody Assay types (2)** ❖ Spike protein antibodies ❖ Non-spike Protein antibodies (Nucleocapsid)

Receipt of a COVID-19 vaccine will not affect the result of PCR or antigen-based tests for SARS-CoV-2 infection.

OBSERVATION: Immune Memory

Declines in antibody concentrations ….

May not correlate with a decrement in immune-memory responses…

Which may be more relevant for protection against severe disease.

In a longitudinal study of humoral and cell-mediated immune responses to SARS-CoV-2 following mRNA COVID-19 vaccination (mostly the Pfizer-BioNTech COVID-19 vaccine), although anti-spike antibodies waned over 6 months….

Memory B- and T-cell responses were durable over the same time period

“Vaccine Boosters”

Vaccines FAQ-Coronavirus Vaccine: Vaccines & Immunity. Covid-19 Real time learning. CDC and IDSA. https://www.idsociety.org/covid-19-real-time-learning-network/vaccines/vaccines-information--faq/#vaccinesimmunity

Goel RR, Painter MM, Apostolici's SA et al. ***mRNA vaccines induce durable immune memory to SARS-CoV-2 and variants of concern.*** Science. 2021 Dec 3;374(6572):abm0829. doi: 10.1126/science.abm0829. Epub 2021 Dec 3. PMID: 34648302

“Novel” Virus
SARS-CoV2
COVID-19
Pandemics
Begins…

“CHANGING FACE”
COVID-19 Pandemic

What's the difference between an endemic, epidemic and pandemic disease?

ENDEMIC DISEASE
is constantly present in a certain population or region, with relatively low spread (or there may be periods when it doesn't affect people at all, if it is only present in the environment).

EPIDEMIC DISEASE
is when there is a sudden increase in cases spreading through a large population like a country (an outbreak is similar, but usually covers a smaller geographic area).

PANDEMIC DISEASE
is when there is a sudden increase in cases spreading through several countries, continents, or the whole world.

Where in the "world" Are we today?

Susceptible Population Changes:

- Immune by Disease
- Immune by Vaccination
- Immune by Disease / Vaccination

Coronovirus
COVID -19
Vaccine Review: COVID-19 Vaccinations in the United States

IMMUNE BY VACCINATION

COVID-19 Vaccinations in the United States May 5, 2022	Population 334,559,397
Distributed	728,911,015
Administered	576,940,211
Fully vaccinated	219.8 Million
People with 1st dose	100.8 Million

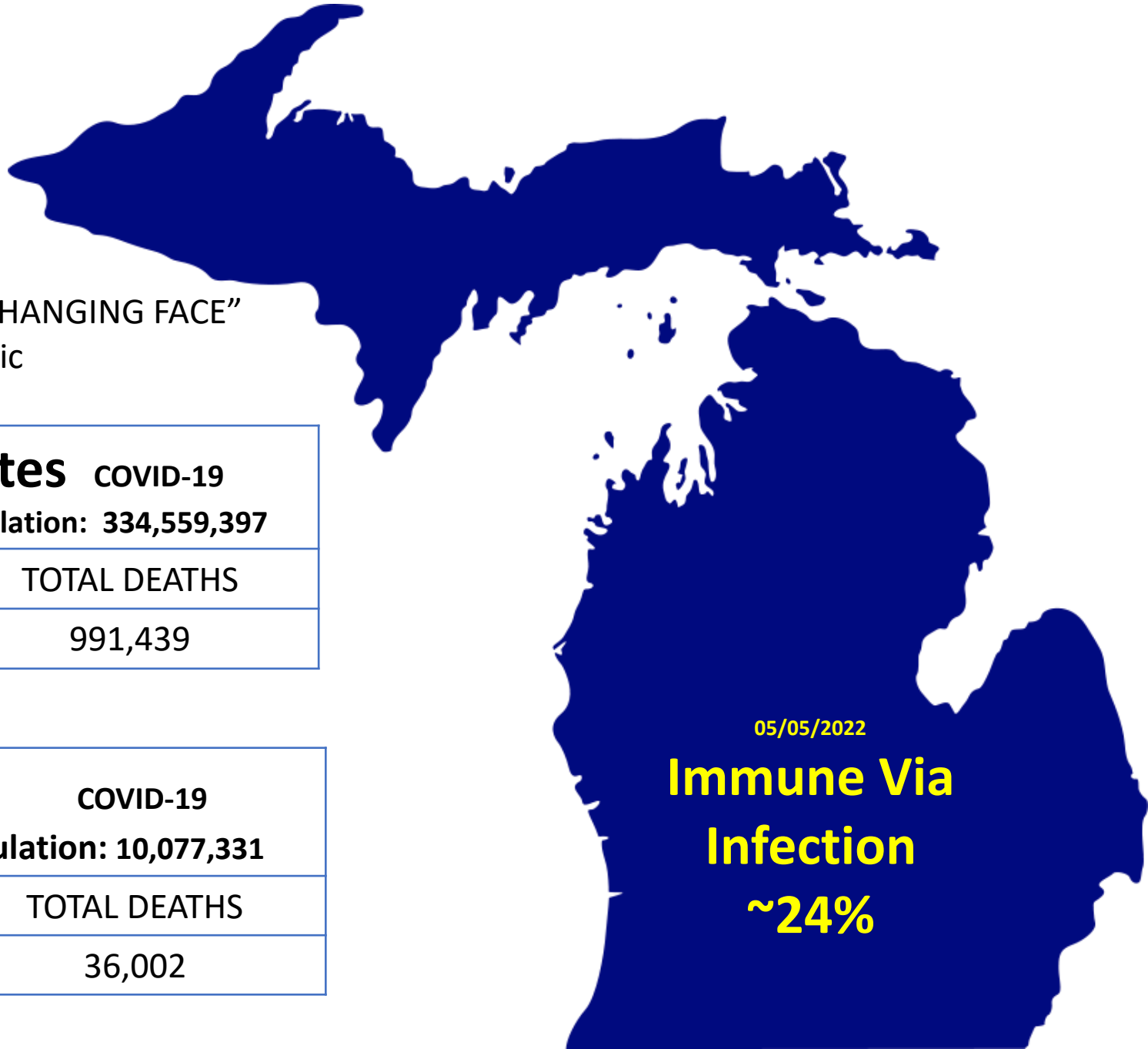
COVID-19 Vaccinated US Population By age		
Vaccinated People	**Count**	**Percent US Population**
TOTAL	257,823,699	**77.7%**
≥ 5 years age	257,712,835	**82.5%**
≥ 12 years age	247,561,682	**87.3%**
≥ 18 years age	230,060,373	**89.1%**
≥ 65 years age	56,804,203	**95.0%**

Daily Trends in Number of COVID-19 Cases in Michigan Reported to CDC. Trends in Number of COVID-19 Cases and Deaths in the US Reported to CDC, by State/Territory Reported to the CDC by State or Territory; Maps, charts, and data provided by CDC, updates Mon-Sat by 8 pm E. https://covid.cdc.gov/covid-data-tracker/#trends_dailycases

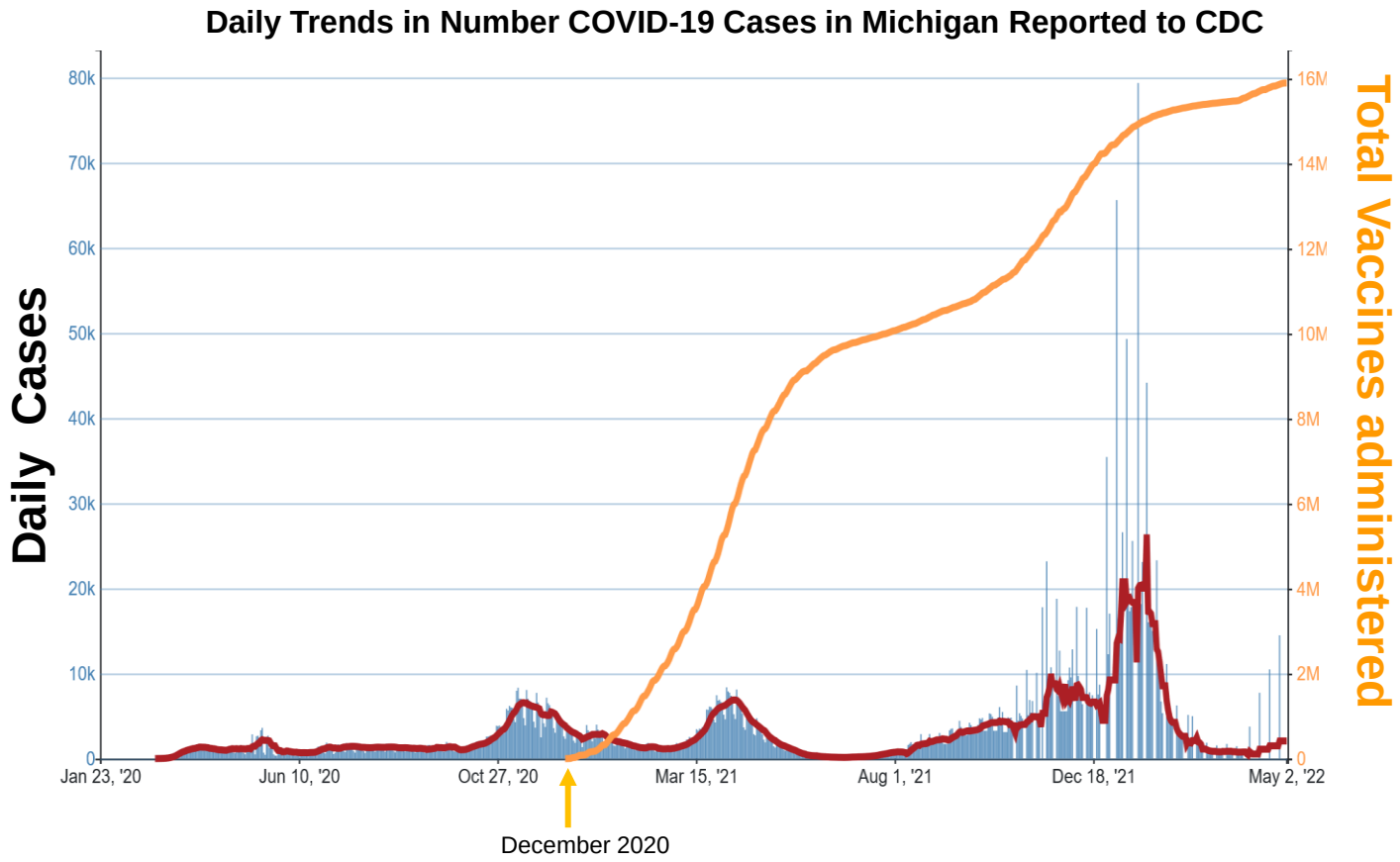
Coronovirus
COVID -19
Vaccine Review "CHANGING FACE"
COVID-19 Pandemic

United States COVID-19 **May 5, 2022: Population: 334,559,397**	
Total Cases	TOTAL DEATHS
81,307,595	991,439

Michigan COVID-19 **May 5, 2022: Population: 10,077,331**	
Total Cases	TOTAL DEATHS
2,425,946	36,002



Coronovirus
COVID -19
Vaccine Review
Michigan: Immune: Vaccine / Infection

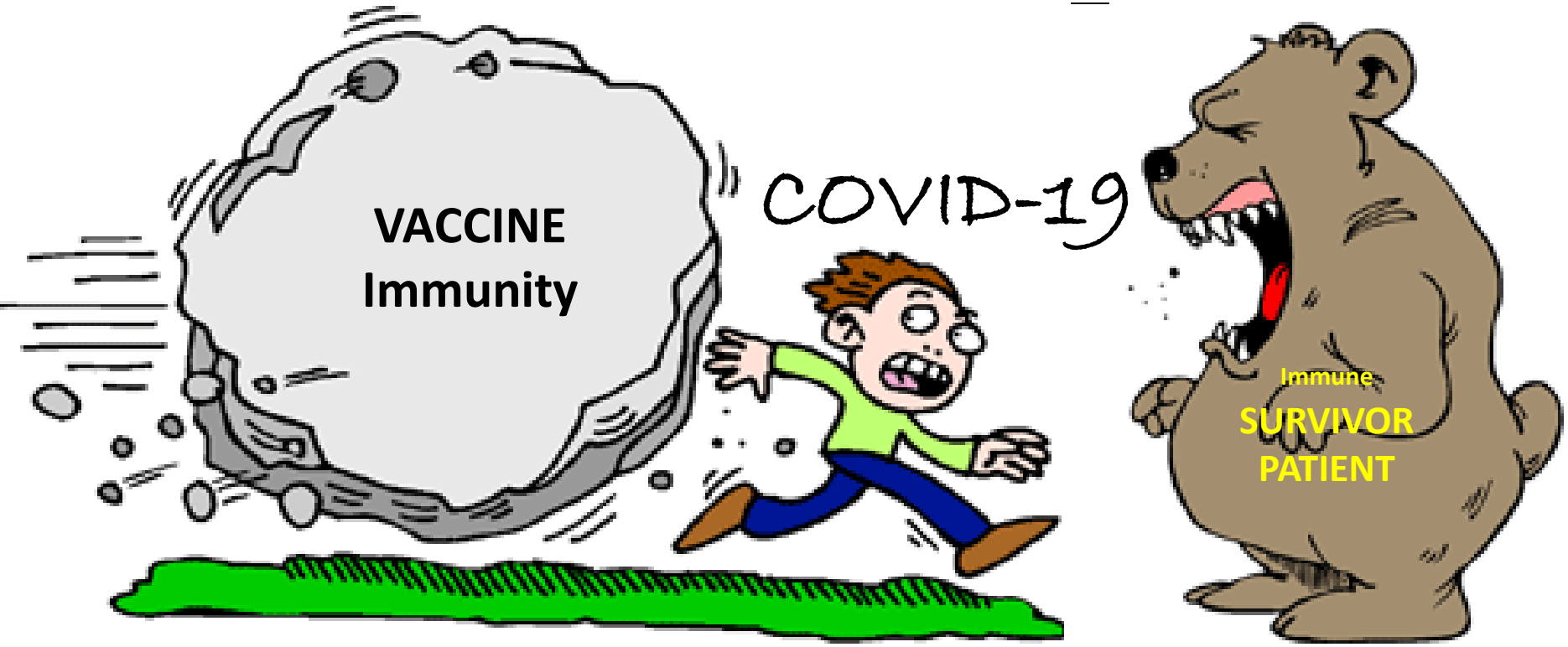


COVID-19 Virus Species Survival

"CHANGING FACE"
COVID-19"Pandemic

Trapped:

"Between a Rock and a Hard place"



Immune from vaccine
(+/- Infection)

Survival:
More contagious : Less Virulent
"Genetic Variance"

Immune from Infection
(+/- vaccine)

COVID-19 VIRUS

Variance

Viruses constantly change through mutation
Occasionally these mutations result in a “new viral variant”
Some variants emerge and disappear while others persist.
New variants will continue to emerge.

COVID-19 Viral genetic observations:

SARS-CoV-2 a coronavirus with a large, unusually stable RNA genome

The genome changes very slowly….

- **Historically COVID-19 Mutations mostly "random genetic drift" rather than virus adaptation**
  Mutation rate remains is low and steady ~2 mutations per lineage per month

Over time, Mutations have given rise to thousands of different lineages:

- **More than 4,000 different versions of the spike protein ("Target" of most vaccines) exist**
  Most of the surviving mutations are of no medical significance

Up until now,

- **COVID-19 has been circulating unhindered in a large host population with little immunity, hence has encountered minimal resistance, or selection pressure as evolutionary biologists call it.**

Covid-19

Genetic Drifting

Interestingly:

- **Recent mutations seem to be induced by the human immune system rather than by RNA replication errors…**

COVID-19
Vaccine review
CDC: SARS-CoV-2 Variant Classifications and Definitions

3 CDC Classifications

- **Variants Being Monitored (VBM)**
- **Variant of Interest (VOI)**
- **Variant of Concern (VOC)**

Variants Being Monitored (VBM)

- **Alpha** (B.1.1.7 and Q lineages)
- **Beta** (B.1.351 and descendent lineages)
- **Gamma** (P.1 and descendent lineages)
- **Epsilon** (B.1.427 and B.1.429)
- **Eta** (B.1.525)
- **Iota** (B.1.526)
- **Kappa** (B.1.617.1)1.617.3
- **Mu** (B.1.621, B.1.621.1)
- **Zeta** (P.2

Variant of Interest (VOI)

- Associated with changes to receptor binding
- Reduced neutralization by antibodies generated against previous Infection or vaccination
- Reduced efficacy of treatments
- Potential diagnostic impact
- Predicted increase in transmissibility or disease severity

Variant Of Concern (VOC)

- Evidence of an increase in transmissibility
- More severe disease
- Significant reduction in neutralization by antibodies generated during previous infection or vaccination,
- Reduced effectiveness of treatments or vaccines, or diagnostic detection failures

SARS-CoV-2 Variant Classifications and Definitions.COVID-19. CDC Updated Dec. 1, 2021
https://www.cdc.gov/coronavirus/2019-ncov/variants/variant-classifications.html (Accessed 04/24/2022)

Pandemic Strains "To date"

Date	Varient	#Spike Protein Mutations	R_0 *	First found
❖ December 2019:	COVID-19 "Novel"	--	~2.79	Wuhan City, China
❖ October 2020:	COVID-19 "Beta"	10	0.93 -1.23	South Africa
❖ November 2021:	**COVID-19 "Delta"	9	~ 5-7.0	India
❖ November 2021:	**COVID-19 B.1.1.529 (omicron)	37	~10.0	South Africa, Botswana
❖ November 2021:	COVID-19 BA.2 (Stealth omicron)	>50	~12.0	New Jersey (USA)

- As far as treatments, both BA.1 and BA.2 have shown an ability to **evade most monoclonal antibody** treatments authorized by the Food and Drug Administration.
- The antiviral drugs Paxlovid, molnupiravir and remdesivir have been effective against severe disease from both BA.1 and BA.2
- Clinical observations Omicron variant is associated with less severe disease (decreased risk of hospitalization and death, reduced length of stay, etc.

Coronovirus

COVID -19

Vaccine Review

The national commercial laboratory seroprevalence study * is a repeated, cross-sectional, national survey that estimates the proportion of the population in 50 U.S. states, the District of Columbia, and Puerto Rico that has infection-induced antibodies to SARS-CoV-2.

The national commercial laboratory seroprevalence study (COVID-19 Infection)

September 2021–January 2022, Sample ~200,000		
❖ **September 2021–January 2022,**	4-week period : Medium 73,869 (range = 64,969–81,468);	
❖ **February 2022**	Sample size 45,810	
December 2021: B.1.1.529 (Omicron) variant of SARS-CoV-2, became predominant in United States		
Sept 2021→ Dec 2021	❖ **Infection Rate all age groups**	**34%**
February 2022 *	❖ **Infection Rate all age groups**	**58%**
	❖ **Children 17 years younger**	**75%**
	❖ **Adults 65 years and older**	**35%**

OBSERVATIONS *

- Antibodies (Infection) were more common in age groups with the lowest vaccination numbers.
- High infection rate for the Omicron variant, especially among children.
- Seropositivity **should not** be interpreted as protection from future infection.
- Vaccination remains the safest strategy for preventing complications from COVID-19 infection, including hospitalization among children and adults
- COVID-19 vaccination following infection provides additional protection against severe disease and hospitalization
- Staying up to date with vaccination is recommended for all eligible persons, including those with previous COVID-19

* The survey included blood specimens tested for COVID-19 viral antibodies reasons unrelated to COVID-19, such as for routine medical care or a sick visit

Clarke KE, Jones JM; Deng Yet al. ***Seroprevalence of Infection-Induced SARS-CoV-2 Antibodies — United States, September 2021–February 2022***. MMWR Weekly / April 29, 2022 / 71(17);606-608 April 26, 2022, this report was posted online as an MMWR Early Release (accessed 04/30/2022)

Vaccines:
Staying current with vaccines
Vaccine Definition

Vaccine:

Is a biological preparation that improves immunity to a particular disease.

A vaccine typically contains an agent that resembles a disease-causing microorganism

Definition

Vaccine Preventable Disease

Vaccine-preventable disease

- Is an infectious disease for which an effective preventive vaccine exists….

- If a person acquires a vaccine-preventable disease and dies from it…

…The death is considered a vaccine-preventable death.

Coronovirus
COVID -19
Vaccine Review:
Generally Available Vaccine Platforms

VIRAL VACCINES

EXAMPLES

Live-attenuated vaccines:

- Measles, Mumps, Rubella
- Rotavirus
- Smallpox
- Chickenpox
- Yellow fever

Inactivated vaccines:

- Hepatitis A
- Influenzas
- Polio (IM)
- Rabies

PROTEIN BASED

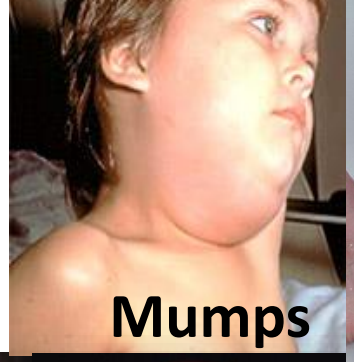
EXAMPLES

Subunit, Recombinant, Polysaccharide, and Conjugate vaccines

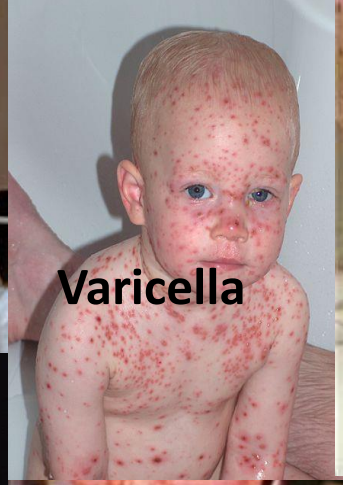
- Hib (H influenzae type b)
- Hepatitis B
- HPV (Human papillomavirus)
- Whooping cough (DTaP)
- Pneumococcal disease
- Meningococcal disease
- Shingles

Vaccine

Preventable Disease

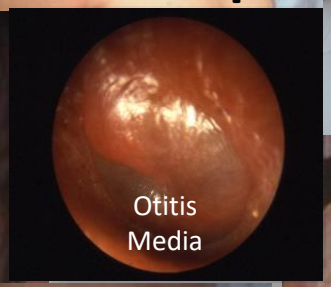


Mumps



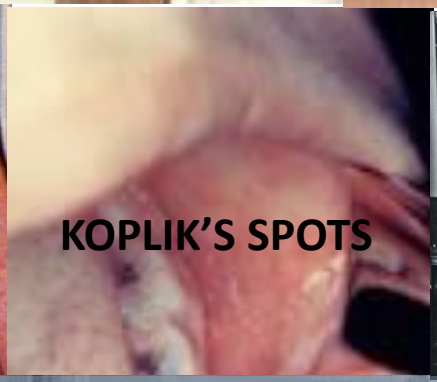
Varicella

Meningococcus



Otitis Media

H. Influenza Cellulitis



KOPLIK'S SPOTS

Diphtheria

Measles

1937

Charles Armstrong isolated (In monkeys) from the brain stem and spinal cord of a fatal case of bulbar poliomyelitis in Lansing Michigan (Sparrow Hospital)

1999

Polio virus type II Strain (Lansing strain) eradicated

POLIO

Vaccine History

Smallpox Vaccination

Edward Jenner* Smallpox Vaccination

Edward Jenner

- Born the eighth of nine children.
- Father was the Vicar of Berkeley
- Jenner trained Chipping Sodbury, South Gloucestershire
- Beginning at the age of 13 and for 8 years as an Apprentice to a surgeon **Daniel Ludlow**
- **In 1770 Jenner studied surgery and anatomy under the surgeon….**

John Hunter

and others at St George's Hospital…..

Edward Jenner
May 17, 1749 – 26 January 26, 1823

* http://en.wikipedia.org/wiki/Edward_Jenner (Accessed 9/27/2011)

Vaccine History

Small Pox Vaccination

Edward Jenner : Cow pox vaccination

May 14 1796 :

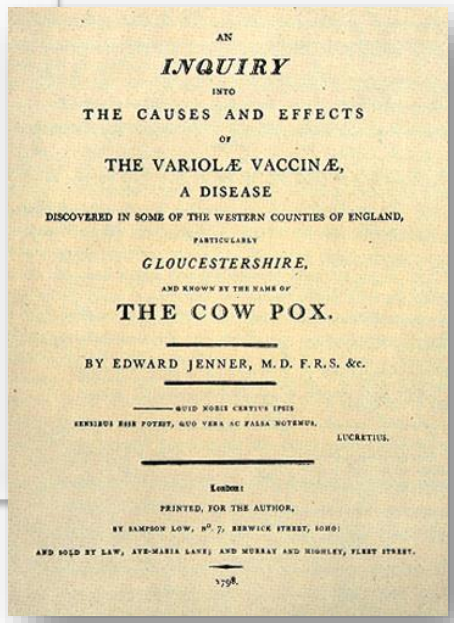
- Jenner inoculated **James Phipps**, the 8 year old son of his gardener
  With material from the "Cowpox blisters" from **Sarah Nelmes**,
  A milkmaid, who had caught **Cowpox** from a cow called **"Blossom".**

Procedure:

- Scrapping pus from **Nelmes'** Cowpox blisters onto a piece of wood…
  Transferring material on to **Phipps'** arms…
  Resulted with a fever and some uneasiness, but no great illness.

- Later, Jenner attempted **Small-Pox variolation** on young **Phipps**
  No disease had followed

Jenner reported that later,
the boy was again challenged with variolous material,
showed no sign of infection.


AN
INQUIRY
INTO
THE CAUSES AND EFFECTS
OF
THE VARIOLÆ VACCINÆ,
A DISEASE
DISCOVERED IN SOME OF THE WESTERN COUNTIES OF ENGLAND,
PARTICULARLY
GLOUCESTERSHIRE,
AND KNOWN BY THE NAME OF
THE COW POX.
BY EDWARD JENNER, M.D. F.R.S. &c.
LUCRETIUS.
London:
PRINTED, FOR THE AUTHOR,
1798.

Published in 1798

Vaccine History

Small-Pox Vaccine 1796

Small-Pox Vaccine: Anti -Vaxers: 1804

This 1804 cartoon is a caricature of the Smallpox and Inoculation Hospital in St. Pancras, London.

On the left, **the poor** are brought in with free food; then they are inoculated and sprout cow parts!

The doctors look severe and unfeeling, and the inoculation process itself appears harsh and bloody.

The woman in the center being inoculated appears frightened… though unaware of the people behind her **growing cows from their appendages**.

"The Cow-Pock—or—the Wonderful Effects of the New Inoculation!—Vide . . . the Publications of y Anti-Vaccine Society."

"The cow-pock - or - the wonderful effects of the new inoculation / Js. Gillray, del. & ft.," James Gillray (London: H. Humphrey, 12 June 1802). Cow-Pock Cartoon Primary Source of the Month Education : e-Newsletter.Coloninal Williamsburg Education http://www.history.org/History/teaching/enewsletter/volume14/sept15/primsource.cfm

Faces of Vaccine Denialism

Anti-Vaccination Movement - Faces of Anti-Vaccination . Know your meme. https://knowyourmeme.com/photos/911556-anti-vaccination-movement

Autism Andy

Andy is convinced vaccines cause autism. No amount of per review will dissuade him from that one article her read in 1998. To him Dr. Wakefield is a martyr

Poisonous Pete

Pete is terrified by all the words he can't pronounce on the vaccine ingredient list. He doesn't know much about chemistry, but he does know formaldehyde is used In embalming and mercury is bad

Loony Lucy

All antivaxers are a bit conspiratorial, but Lucy takes the cake. Vaccines are not just a ploy to make money they are tools of the Illuminati. Vaccines were invented by the rich to sterilize poor children and depopulate the earth

Hoaxy Holly

Holly know the real reason for vaccines; PROFIT. Everyone from the local doctor to the World Health Organization is in on it. Vaccines don't work and never did. Parents who vaccinate their children are just lining the pockets of big of Pharma.

Hygienic Helen

Unlike mot denialists Helen actually believes Vaccines are safe and effective, she just doesn't think they are needed. Disease was eradicated by soap and clean water. Vaccines had nothing to do with it, they just happened to be invented around the same time

Naturalist Nancy

Nancy is sure all this modern medicine is killing us. If we all went back to nature we would have eternal life. Natural immunity is the way to go (even if 2 in 1000 cases of measles is fatal). Just don't tell her life expectancy before modern medicine was around 40

COVID-19

Vaccines Myths

FACTS

MYTH: COVID-19 mRNA Vaccines	FACT
❖ The ingredients in COVID-19 vaccines are dangerous	Nearly all the ingredients in COVID-19 vaccines are also ingredients in many foods – fats, sugars, and salts
❖ The natural immunity I get from being sick with COVID-19 is better than the immunity I get from COVID-19 vaccination.	Getting a COVID-19 vaccination is a safer and more dependable way to build immunity to COVID-19 than getting sick with COVID-19.
❖ COVID-19 vaccines cause viral variants.	COVID-19 vaccines do not create or cause variants of the COVID-19 virus…Instead, COVID-19 vaccines can help prevent new variants from emerging
❖ The mRNA vaccine is not considered a vaccine.	mRNA vaccines, Pfizer-BioNTech and Moderna, work differently than other types of vaccines, but they still trigger an immune response
❖ COVID-19 vaccines contain microchips.	COVID-19 vaccines do not contain microchips. Vaccines are developed to fight against disease and are not administered to track your movement

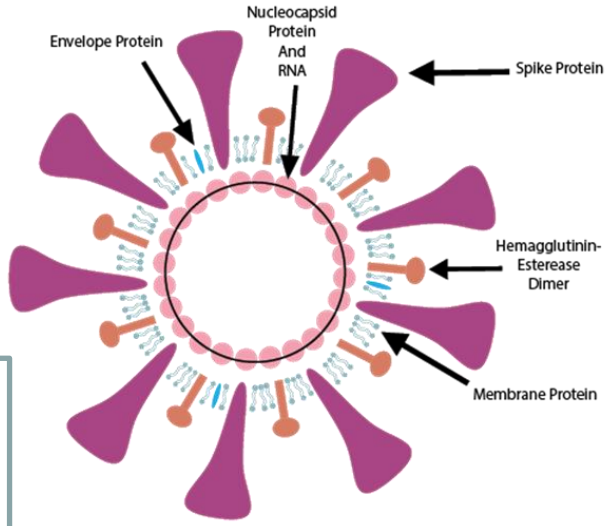
MYTH: COVID-19 Vaccine	FACTS
Receiving a COVID-19 vaccine can make you magnetic.	Receiving a COVID-19 vaccine will not make you magnetic, including at the site of vaccination which is usually your arm
COVID-19 vaccines can alter my DNA.	COVID-19 vaccines do not change or interact with your DNA in any way.
COVID-19 vaccine can make me sick with COVID-19.	None of the authorized COVID-19 vaccines in the United States contain live virus the vaccine cannot make you sick with COVID-19.
Covid Vaccine will affect my fertility	Currently no evidence shows that any vaccines, including COVID-19 vaccines, cause fertility problems (problems trying to get pregnant) in women or men.
Getting a COVID-1 Vaccine will cause me to test positive on a viral test	None of the authorized and recommended COVID-19 vaccines can cause you to test positive on viral tests, which are used to see if you have a current infection

Anand P, Stahel V.P. ***The safety of Covid-19 mRNA vaccines: a review.*** Patient Saf Surg 15, 20 (2021). https://doi.org/10.1186/s13037-021-00291-9 https://pssjournal.biomedcentral.com/articles/10.1186/s13037-021-00291-9

Vaccines FAQ-Coronavirus Vaccine: Vaccines & Immunity. *Covid-19 Real time learning.* CDC and IDSA. https://www.idsociety.org/covid-19-real-time-learning-network/vaccines/vaccines-information--faq/#vaccinesimmunity

About COVID-19 Vaccination. Stay Up to Date with Your COVID-19 Vaccines. CDC. Updated May 12, 2022 https://www.cdc.gov/coronavirus/2019-ncov/vaccines/stay-up-to-date.html?s_cid=11747:covid%20vaccine%20schedule:sem.ga:p:RG:GM:gen:PTN:FY22

Coronovirus
COVID -19
Vaccine Review
GENERAL: Vaccine targets



Regarding COVID-19 vaccines
Presently *All* approved vaccines
Target the "Spike protein antigen"

Review:

Virus "Spike protein" Binds & fuses the virus, to "ACE receptor of the target Cell initiating cell Infection

The Spike Protein's location on the outside of the virus allows easy immunological recognition for the Stimulation of an immunological response
(Antibody and Cell mediated Immunity)

VACCINEs

Coronovirus
COVID -19
Vaccine Review

General Available

Vaccine Platforms

Types *

- **Inactivated Virus**
- **Live Attenuated Virus**
- **Subunit virus**
- **Viral Vector**
- **mRNA**

*The Advisory Committee on Immunization Practices/CDC preferentially recommend **mRNA COVID-19 vaccines** for primary series and booster dose; however, the Janssen COVID-19 Vaccine may be considered in some situations and is preferable to no COVID-19 vaccine (CDC 2022a).

Coronovirus

COVID -19

Vaccine Review

TimeLine

Date	EVENT
December 20, 2020 **Covid-19 messenger RNA (mRNA) vaccine, BNT162b2**	**VACCINE INTRODUCTION** ❖ Pfizer : 36,000-person ❖ 2-dose prospective, placebo-controlled ❖ 95% effective at preventing severe illness in all age groups, ❖ **6 MONTHS VACCINE DURIBILITY** (T&B lymphocyte Studies)
September 10, 2021 **Covid-19 messenger RNA (mRNA) Israeli researchers -1st Booster**	**COVID-19 Booster** ❖ 10 months after the BNT162b2 Primary vaccine Series ❖ Protection against severe illness in people 60 years of age or older was enhanced by a third dose.
April 13, 2022 **Covid-19 messenger RNA (mRNA) Israeli Researchs-2nd Booster**	**COVID-19 B.1.1.529 (omicron) variant** ❖ Population median age 72 years ❖ Enhanced protection against severe disease ❖ CDC Recommendations additional booster dose of mRNA vaccine for people 50 years of age or older.

Coronovirus
COVID -19
Vaccine Review:
Generally Available COVID-19 Vaccine Platforms

VACCINE TYPES	Company Researching
Inactivated virus vaccines	❖ Sinovac Biotech ❖ Sinopharm ❖ Wuhan Institute of Biological Products ❖ Bharat Biotech
Virus Subunit	❖ Novavax, Sanofi and GlaxoSmithKline, ❖ SpyBiotech ❖ And others
Viral vector vaccines **(e.g. Adenovirus 5; 26)**	❖ AstraZeneca with the University of Oxford, **Johnson & Johnson,** ❖ CanSino Biologics, ❖ Gamaleya Research Institute Russia's Ministry of Health.
Genetic RNA / DNA	❖ **Moderna** ❖ **BioNTec with Pfizer** ❖ CureVac

*The Advisory Committee on Immunization Practices/CDC preferentially recommend **mRNA COVID-19 vaccines** for primary series and booster dose; however, the Janssen COVID-19 Vaccine may be considered in some situations and is preferable to no COVID-19 vaccine (CDC 2022a).

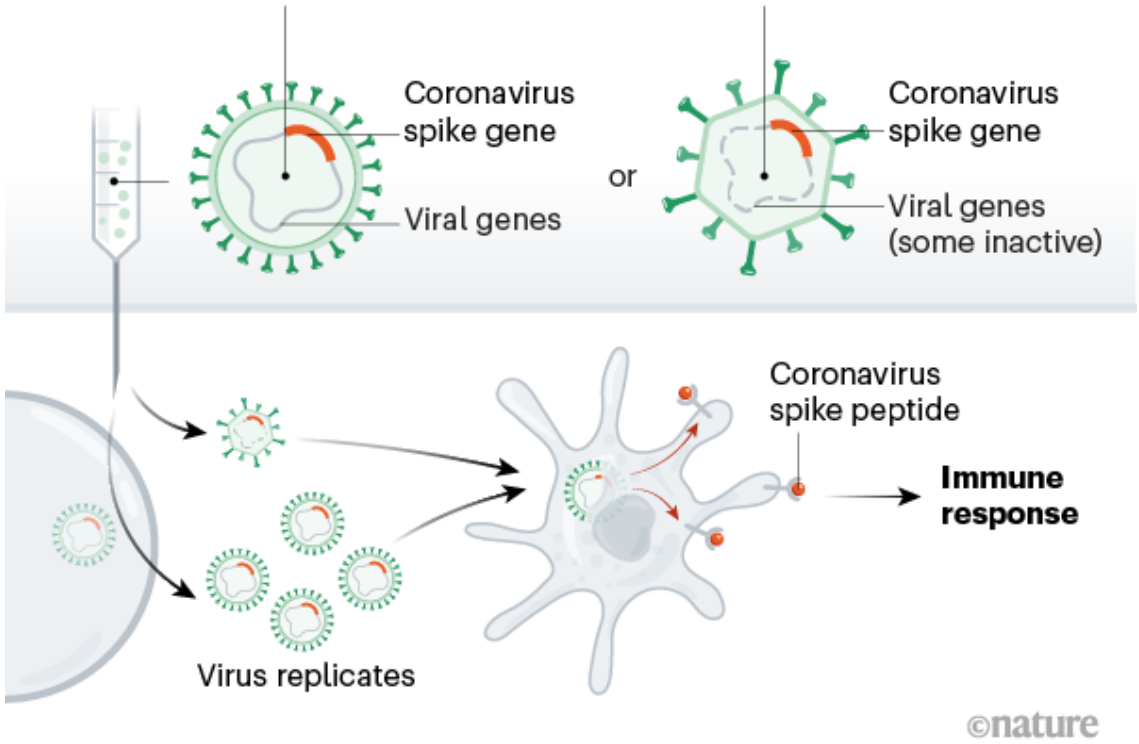
VIRAL-VECTOR VACCINES

Replicating viral vector (such as weakened measles)

The newly approved Ebola vaccine is an example of a viral-vector vaccine that replicates within cells. Such vaccines tend to be safe and provoke a strong immune response. Existing immunity to the vector could blunt the vaccine's effectiveness, however.

Non-replicating viral vector (such as adenovirus)

No licensed vaccines use this method, but they have a long history in gene therapy. Booster shots can be needed to induce long-lasting immunity. US-based drug giant Johnson & Johnson is working on this approach.



Attenuated or inactivated viruses.
An upside of using vectored vaccines is that they are easy and relatively cheap to make.

- **Human Adenovirus vectors**
  Russian Sputnik V ® vaccine
- **Chimp Adenoviruses**
  (Malaria)
- **Measles vector**

Johnson & Johnson

COVID-19:

GENERAL: Therapeutic Considerations

Vaccines:

Progress on mRNA vaccines*

Vaccine		Advantage	Disadvantage
Viral Vectored Vaccine		❖ Stimulation of innate immune response ❖ Induction of T&B cell response	❖ Induction of "anti-vector Immunity" ❖ Cell based Manufacturing
NANO Lipid Vaccines	DNA Vaccines	❖ Non-infectious ❖ Stimulation Innate Immune response ❖ Egg free / Stable / Rapid →Production ❖ T&B cell response	❖ Potential integration into Human Geneome ❖ Poor immunogenicity in Humans
	mRNA Vaccines	❖ Non-infectious ❖ Non-integrating ❖ Natural degradation ❖ Egg & Cell free / Rapid-→production ❖ Stimulation of Innate immune response ❖ Induction of T&B cell immune response	❖ Concerns with instability and low Immunogenicity

*Cuiling Zhang, Giulietta Maruggi Hu Shan, Junwei Li. ***Review ARTICLE Advances in mRNA Vaccines for Infectious Diseases*** Front. Immunol., 27 March 2019 | https://doi.org/10.3389/fimmu.2019.00594 https://www.frontiersin.org/articles/10.3389/fimmu.2019.00594/full

COVID-19 Vaccines

COVID-19 mRNA Vs COVID-19 Vector Vaccine

None of the COVID-19 vaccines have been directly compared head-to-head in the same population

So the “point estimates” of vaccine efficacy for the mRNA vaccines and viral vector vaccines cannot be directly compared with each other

Vaccines FAQ-Coronavirus Vaccine: Vaccines & Immunity. Covid-19 Real time learning. CDC and IDSA. https://www.idsociety.org/covid-19-real-time-learning-network/vaccines/vaccines-information--faq/#vaccinesimmunity

COVID-19 Vaccine

Waning immunity

Iindividual initial immune response to a vaccine
diminishes over time increasing vulnerability to natural infection
(despite vaccination)

Increasing evidence COVID-19 vaccine-induced antibodies
decrease over time.
With accumulating evidence neutralizing antibody concentrations correlate with
the risk for symptomatic COVID-19 infection

To date

data suggest that most breakthrough infections are associated
with mild illness or are asymptomatic.

COVID-19 Vaccine

Waning immunity

Respectfully

Presently insufficient published data
to be able to draw definitive conclusions regarding risks
concerning the virologic and immunologic aspects of breakthrough infections :

Specifically,
transmissibility of a breakthrough infection (symptomatic or asymptomatic)
or appropriate management of these infection.

Vaccines FAQ-Coronavirus Vaccine: Vaccines & Immunity. Covid-19 Real time learning. CDC and IDSA. https://www.idsociety.org/covid-19-real-time-learning-network/vaccines/vaccines-information--faq/#vaccinesimmunity

VACCINE SCHEDULING
CDC guidelines

About COVID-19 Vaccination. Stay Up to Date with Your COVID-19 Vaccines. CDC. Updated May 12, 2022 https://www.cdc.gov/coronavirus/2019-ncov/vaccines/stay-up-to-date.html?s_cid=11747:covid%20vaccine%20schedule:sem.ga:p:RG:GM:gen:PTN:FY22

Coronovirus
COVID -19
Vaccine Review GENERAL Vaccine schedule

Primary series for people who are not moderately or severely immunocompromised

Primary series Vaccine	Age group	Number of doses in Primary series	Number of Booster doses	Interval between 1st and 2 nd dose	Interval between primary series and booster dose
Pfizer-BioNTech	5-11 years	2	NA	3 weeks	NA
Pfizer-BioNTech	>12 years	2	1	3-8 weeks	At least 5 months
Moderna	>18 years	2	1	4-8 weeks	At least 5 Months
Janssen	>18 years	1	1	NA	At least 2 months

COVID-19 vaccination schedule for people who are moderately or severely immunocompromised*

Primary series Vaccine	Age group	Number of doses in Primary series	Number of Booster doses	Interval between 1st And 2nd dose	Interval between 2nd & 3rd	Interval 3rd & 4th dose
Pfizer-BioNTech	5-11 years	3	NA	3 weeks	≥ 4 weeks	NA
Pfizer-BioNTech	≥12 years	3	1	3 weeks	≥4 weeks	≥ 3 months
Moderna	≥18 years	3	1	≥4 weeks	>4 weeks	≥ 3 months
Janssen	≥18 years	1 Jansen 1mRNA	1	4 weeks	≥8weeks	NA

Interim Clinical Considerations for Use of COVID-19 Vaccines Currently Approved or Authorized in the United States. Vaccines and

Coronovirus
COVID -19
Vaccine Review :
CDC Defined Immunocompromised : Vaccine recipients

Immunocompromised: CDC Definition
❖ Been receiving active cancer treatment for tumors or cancers of the blood
❖ Received an organ transplant and are taking medicine to suppress the immune system
❖ Received chimeric antigen receptor (CAR)-T-cell therapy (a treatment to help your immune system attach to and kill cancer cells) or received a stem cell transplant (within the last 2 years)
❖ Moderate or severe primary immunodeficiency (such as DiGeorge syndrome, Wiskott-Aldrich syndrome)
❖ Advanced or untreated HIV infection
❖ Active treatment with high-dose corticosteroids or other drugs that may suppress their immune response

Coronovirus

COVID -19

Vaccine Review

TimeLine

What about a booster dosing for persons who are younger?	
One year after the BNT162b2 vaccine Became available	❖ United States Studies showed : 3rd dose of vaccine ❖ Enhanced protection against severe disease for 18 years+
The studies did not stratify patients for coexisting conditions.	Therefore, it was unclear who among these younger age groups most benefited from an additional dose.
CDC regardless recommended that everyone 12 years of age or older should receive three vaccine doses of regardless of whether risk factors were present	This universal booster recommendation led some summer camps, high schools, universities, hospitals, and businesses to require three doses of mRNA vaccine

February 2022,
A study that did not support the booster recommendation for children,
CDC researchers found that two doses of BNT162b2 induced long-lived protection against serious illness in children 12 to 18 years of age.

Coronovirus

COVID -19

Vaccine Review

NAME	TYPE	Full immunity	Booster	Age 18 +	Age 12-17	Age 5-11
Pfizer / BioNTech	**mRNA**	**X2 vaccines**	Yes 1st , 2nd	**X**	**X**	**X**
Moderna	**mRNA**	**X2 Vaccines**	YES	**X**		
Johnson & Johnson	**Adenovirus Vector Vaccine**	**X1 (2 weeks)**	See below **	**X**		
Mixing	**CDC does not recommend mixing products for your primary vaccine series.**					

Johnson & Johnson * Booster

- **1 booster mRNA recommended ~2 months**
- **Anyone who received J&J primary AND or J&J Booster: Second booster (mRNA) >4 month**
- **Adults ages >50 years :can choose to receive a 2nd booster (mRNA) At least 4 months after the 1st booster**

Timing of COVID-19 Vaccination After Infection	❖ People who have COVID-19 should wait to until after they recover and complete their isolation period. ❖ Recent COVID-19 consider delaying next booster by 3 months from resolution of symptoms ❖ OR: "ASYMPTOMATIC INFECTION: 3 months when they first received a positive test. →Reinfection is less likely in the weeks to months after infection. ❖ However, certain factors,(personal risk of severe disease, local COVID-19 community level, and the dominant COVID-19 variant, could be reasons to get a vaccine sooner rather than later.

COVID-19. Your Health. Stay Up to Date with Your COVID-19 Vaccines CDC Updated Apr. 21, 2022. https://www.cdc.gov/coronavirus/2019-ncov/vaccines/stay-up-to-date.html?s_cid=11304:covid%20vaccine%20types:sem.ga:p:RG:GM:gen:PTN:FY21. (Accessed 4/23/2022)

Coronovirus
COVID -19
Vaccine Review COVID-19

Vaccination: Pregnancy

COVID-19 Vaccine Pregnancy
❖ Evidence continues to build showing that COVID-19 vaccination before and during pregnancy **is safe and effective**
❖ **Scientists have not found an increased risk for miscarriage among people** who received an mRNA COVID-19 vaccine just before and during early pregnancy (before 20 weeks of pregnancy
❖ Data show that receiving an mRNA COVID-19 vaccine **during pregnancy reduces the risk for infection and severe illness** for people who are pregnant
❖ Vaccination during pregnancy **builds antibodies that might protect the baby.**
❖ completing a two-dose primary mRNA COVID-19 vaccine series during pregnancy **can help protect babies younger than 6 months old from hospitalization due to COVID-19**

COVID-19 Vaccines While Pregnant or Breastfeeding, CDC. Centers for Disease control and Prevention
Updated Mar. 3, 2022 https://www.cdc.gov/coronavirus/2019-ncov/vaccines/recommendations/pregnancy.html#anchor_1628692520287

“People are now confused about what it means to be fully vaccinated”

- Arguably, the most disappointing error surrounding the use of Covid-19 vaccines was the labeling of mild illnesses or asymptomatic infections after vaccination as “breakthroughs.”

- As is true for all mucosal vaccines, the goal is to protect against serious illness — to keep people out of the hospital, intensive care unit, and morgue.

- The term “breakthrough,” which implies failure, created unrealistic expectations and led to the adoption of a zero-tolerance strategy for this virus.

- **If we are to move from pandemic to endemic, at some point we are going to have to accept that vaccination or natural infection or a combination of the two will not offer long-term protection against mild illness.**

Paul A. Offit, M.D

BERLIN Germany April 2022

While people remain reluctant to take even a single vaccine shot, elsewhere a 60-year-old man has vaccinated himself 90 doses….

The man vaccinated himself *in order to sell forged vaccination certificates* with real batch numbers to those people not wanting to get vaccinated The accused was caught at a vaccination centre in Eilenburg of Saxony, as he came to take vaccines for the second day in a row

Similar incidents have occurred in various parts of the world India, an 84-year-old man from Bihar was reported to have taken 11 vaccine doses

Adverse reaction:

In pharmacology, any unexpected or dangerous reaction to a drug.
An unwanted effect caused by the administration of a drug. ..

CDC Is Monitoring Reports of Severe Allergic Reactions

If someone has a severe allergic reaction after getting vaccinated, their vaccination provider will send a report to the Vaccine Adverse Event Reporting System (VAERS).

Vaccine Adverse Event Reporting System ("VARES")

https://vaers.hhs.gov/index.html

About VAERS

VAERS
is the nation's early warning system that monitors the safety of vaccines after they are authorized or licensed for use by the U.S. Food and Drug Administration (FDA).

VAERS is part of the larger vaccine safety system in the United States that helps make sure vaccines are safe. The system is co-managed by CDC and FDA.

VAERS
Accepts and analyzes reports of possible health problems—also called "adverse events"—after vaccination. As an early warning system, VAERS cannot prove that a vaccine caused a problem. Specifically, a report to

VAERS does not mean that a vaccine caused an adverse event.

VAERS
Can give CDC and FDA important information.
If it looks as though a vaccine might be causing a problem, FDA and CDC will investigate further and take action if needed.

Anyone can submit a report to VAERS:

Healthcare professionals, vaccine manufacturers, and the general public. VAERS welcomes all reports, regardless of seriousness, and regardless of how likely the vaccine may have been to have caused the adverse event

Coronovirus

COVID -19

Vaccine Review

COMMON COVID-19 "Reactions" : VARES

Local	Systemic	SEVERE
Vaccine Injection site	General	Allergic Reactions
• Pain • Redness • Swelling	• Fatigue • Cephalgia • Myalgias • Chills • Fever • Nausea	• Difficulty breathing or wheezing • Hypotension • Oral swelling of the tongue or throat • Generalized rash or hives • Enanthem : Mucus membranes

- ❖ Reactions after getting a COVID-19 vaccine can vary from person to person.
- ❖ Most people in clinical trials experienced only mild side effects
- ❖ Some of them had no side effects at all

- ❖ Side effects after the second shot may be more intense than the ones experienced after the first shot.
- ❖ These side effects are normal signs that the body is building protection and should go away within a few days

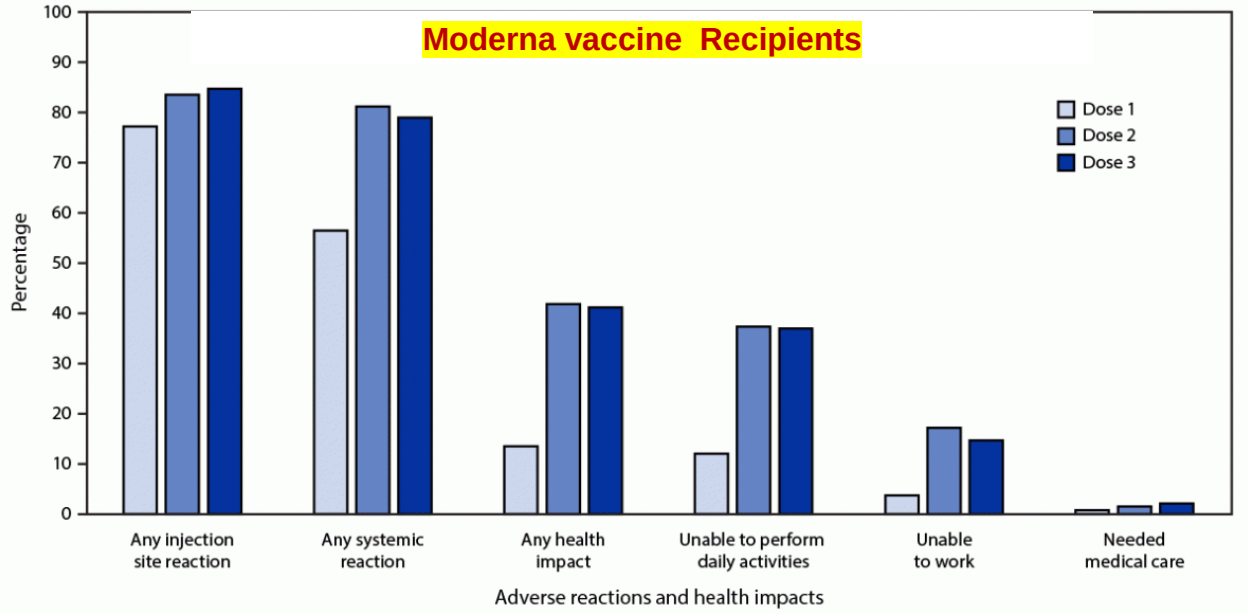
Coronovirus

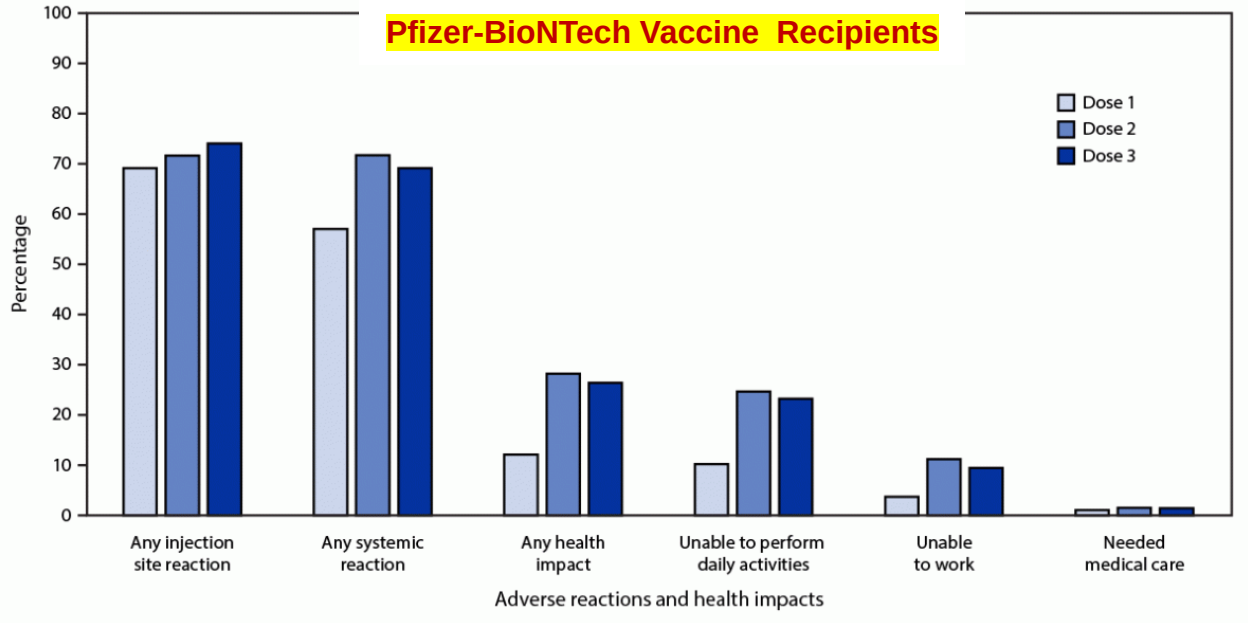
COVID -19

Vaccine Review

Adverse Reactions

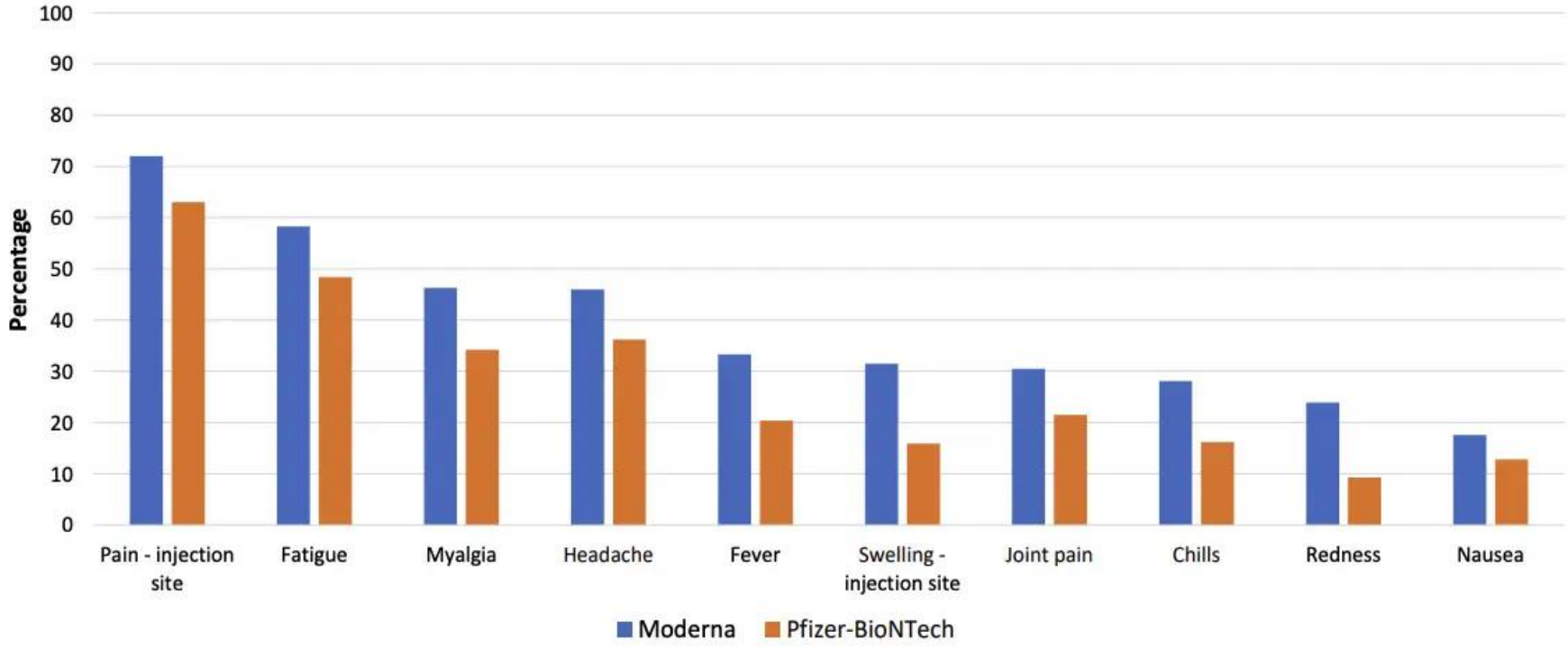
Possible Side Effects After Getting a COVID-19 Vaccine CDC Updated Jan. 12, 2022	
Vaccine	# Vaccine Recipients
Moderna mRNA	6,283
Pfizer-BioNTech (mRNA)	6,308





Coronovirus
COVID -19
Vaccine Review
Adverse Reactions VARES

Most common Solicited reactions reported at least once 0-7 days
After dose 3 of Moderna or Pfizer-BioNTech vaccine



Includes 21,413 participants who completed at least one survey in the first week after additional dose, data collected during August 12–September 19, 2021

Coronovirus
COVID -19
Vaccine Review
Adverse Reactions:

Vaccination Associated Anaphylaxis

Reports of Anaphylaxis After Receipt of mRNA COVID-19 Vaccines in the US December 14, 2020 - January 18, 2021

Vaccine	Number doses	# Reactions *	Incidence / per million
TOTAL mRNA	17,524,676	66	3.7
Pfizer-BioNTech	9,943,247	47	4.7
Moderna	7,581,429	19	2.2

- **Clinical characteristics of anaphylaxis cases following both vaccines were similar.**
- **No apparent clinical differences between anaphylaxis cases with symptom onset within 30 minutes and those with symptom onset after 30 minutes**
- **Common signs and symptoms in anaphylaxis cases urticaria, diffuse erythematous rash, angioedema, respiratory and airway obstruction symptoms, and nausea**

*Reports received by VAERS that met Brighton Collaboration case definition criteria for anaphylaxis (levels 1, 2 or 3)

-Shimabukuro TT, Cole M, Su JR. **Reports of Anaphylaxis After Receipt of mRNA COVID-19 Vaccines in the US—December 14, 2020-January 18, 2021.** JAMA . 2021;325(11):1101–1102. doi:10.1001/jama.2021.1967

-Anaphylaxis: Case Definition Companion Guide. Brighton Collaboration, The task force for Global Health. March 5, 2021 https://brightoncollaboration.us/anaphylaxis-case-definition-companion-guide/

COVID -19
Vaccine Review
Adverse Reactions

COVID-19 Vaccine Cardiomyopathies

Myopericarditis (inflammation of the cardiac lining and/or muscle) is a known, rare complication of vaccination that was best recognized in the pre-COVID-19 era following immunization against smallpox

Bozkurt B, Kamat I, Hotez P. Myocarditis With COVID-19 mRNA Vaccines Originally published20 Jul 2021https://doi.org/10.1161/CIRCULATIONAHA.121.056135Circulation. 2021;144:471–48

COVID -19
Vaccine Review
Adverse Reactions

COVID-19 Vaccine Cardiomyopathies

Mechanisms underlying vaccine-associated myopericarditis are uncertain…

But favored to represent **non-allergic, immune-mediated** effects in the setting of post-vaccination inflammatory milieu…

Including possible antibody **cross-recognition of cardiac tissue antigens**

Bozkurt B, Kamat I, Hotez P. Myocarditis With COVID-19 mRNA Vaccines Originally published20 Jul 2021https://doi.org/10.1161/CIRCULATIONAHA.121.056135Circulation. 2021;144:471–48

Coronovirus

COVID -19

Vaccine Review

COVID-19 Vaccine associated Myo-Pericarditis

Incidences of Cardiac complications after SARS-CoV-2 infection or mRNA COVID-19 vaccination Analysis of EHR data From 40 U.S Health care systems		
SEX	**AGE**	**Incidence / 100,000**
MALES	12-17	0-35.9
FEMALES	12-17	0-10.9

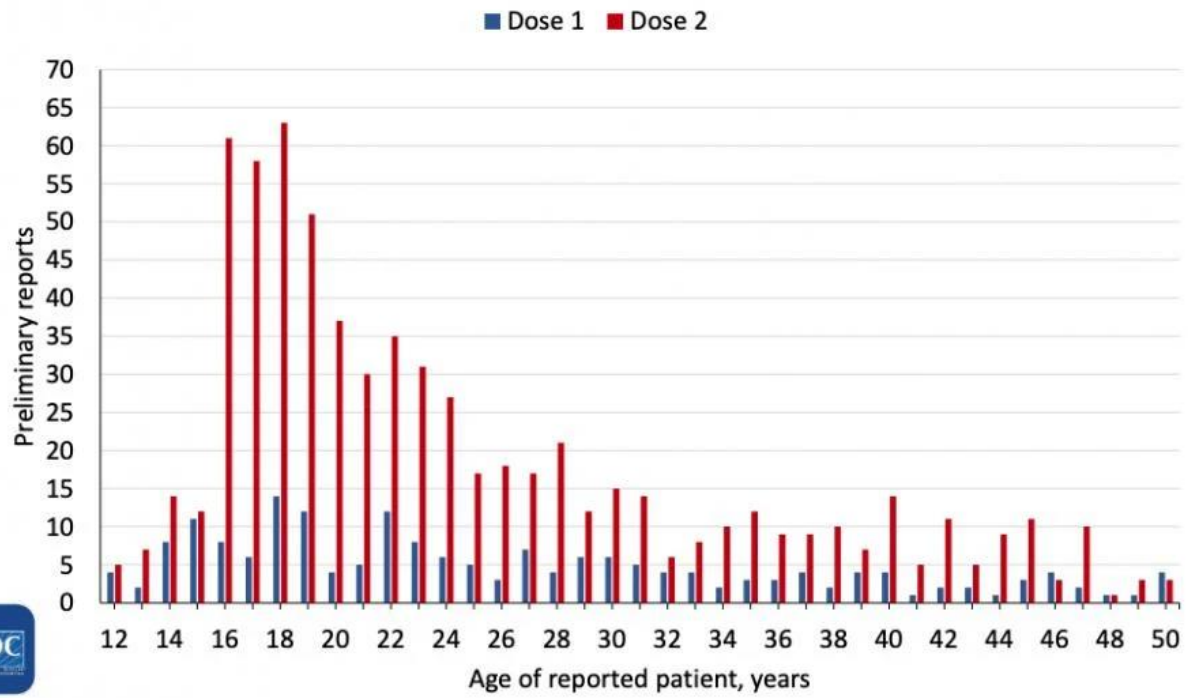
- Incidences of cardiac complications after SARS-CoV-2 infection or mRNA COVID-19 vaccination **were low overall**
- But were **higher after infection than after vaccination** for both males and females in all age groups**.**
- Highest risk for post-vaccination myocarditis among males aged 16–17 years (10.6 per 100,000)
- During a 7-day risk window →after receipt of a second mRNA COVID-19 vaccine dose

* “EHR Electronic Health Records

Myocarditis is inflammation of the heart muscle, and pericarditis is inflammation of the outer lining of the heart

Preliminary reports of myocarditis/pericarditis to VAERS after mRNA COVID-19 vaccination by age and dose number*

(as of Jun 11, 2021)



* Age truncated at >50yr: Reports of persons >50yr of age include 70 after Dose 1, 119 after Dose 2

COVID -19
Vaccine Review
Adverse Reactions

COVID-19 Vaccine Cardiomyopathies

Outcomes

The characteristic clinical course of vaccine-associated myopericarditis includes

Bozkurt B, Kamat I, Hotez P. Myocarditis With COVID-19 mRNA Vaccines Originally published20 Jul 2021https://doi.org/10.1161/CIRCULATIONAHA.121.056135Circulation. 2021;144:471–48

- **Brief hospitalization and significant symptom improvement occurring within a week of onset**
- **Whout need for higher-level care or readmission.**

COVID -19
Vaccine Review
Adverse Reactions

Vaccine-Induced Thrombotic Thrombocytopenia (VITT) *

Blood Clots (TTS) and the **Johnson & Johnson Vaccine**
CDC Recommendations December 2021

The risk of **VITT is still lower after vaccination**
Oxford-AstraZeneca or Johnson & Johnson /Janssen COVID-19 vaccines,
Compared to the risk of blood clot with COVID-19 infection.

*Pathogenesis may be associated with platelet-activating antibodies against platelet factor-4 (PF4)
While Heparin is used to treat Blood clots, Heparin in these individuals can be harmful

Bussel JB, Connors JM, Douglas B. Cines DB ***Vaccine-induced Immune Thrombotic Thrombocytopenia,***
COVID-19 Resources. Thrombosis with Thrombocytopenia syndrome. American Society of Hematology
https://www.hematology.org/covid-19/vaccine-induced-immune-thrombotic-thrombocytopenia

COVID -19
Vaccine Review
Adverse Reactions

Vaccine-Induced Thrombotic Thrombocytopenia (VITT) *

Blood Clots (TTS) and the Johnson & Johnson Vaccine
CDC Recommendations December 2021

Definitive Diagnosis (must meet all five criteria)

- COVID vaccine 4 -42 days prior to symptom onset
- Any venous or arterial thrombosis
  (often cerebral or abdominal)
- Thrombocytopenia (platelet count < 150 x 109/L)*
- Positive PF4 “HIT”
  (heparin-induced thrombocytopenia) ELISA
- Markedly elevated D-dimer (> 4 times upper limit of normal

Bussel JB, Connors JM, Douglas B. Cines DB ***Vaccine-induced Immune Thrombotic Thrombocytopenia,*** COVID-19 Resources. Thrombosis with Thrombocytopenia syndrome. American Society of Hematology https://www.hematology.org/covid-19/vaccine-induced-immune-thrombotic-thrombocytopenia

Coronovirus

COVID -19

Vaccine Review

Blood clots: J&J COVID-19 vaccine

Blood Clots (TTS) and the Johnson & Johnson Vaccine CDC Recommendations December 2021	
March 2022 3.83 cases / million Janssen dose	Occurrence : 60 cases: 9 fatal
Women: 30-49	❖ Women ages 30-49 years: should be aware of the increased risk of this rare adverse event
Post Vaccine 3 weeks	❖ **Monitor for possible symptoms of TTS and get medical help immediately**
	❖ Severe or persistent headaches or blurred vision ❖ Shortness of breath ❖ Chest pain ❖ Leg swelling ❖ Persistent abdominal pain ❖ Easy bruising or tiny blood spots under the skin near

Bussel JB, Connors JM, Douglas B. Cines DB ***Vaccine-induced Immune Thrombotic Thrombocytopenia,*** COVID-19 Resources. Thrombosis with Thrombocytopenia syndrome. American Society of Hematology https://www.hematology.org/covid-19/vaccine-induced-immune-thrombotic-thrombocytopenia

COVID -19
Vaccine Review
Adverse Reactions

Blood Clots (TTS) and the Johnson & Johnson Vaccine CDC Recommendations May 2022

RESPECTFULLY

Given the high availability of mRNA vaccines in the U.S.

RECOMMENDATIONS

As result of rare reports of VITT, CDC's Advisory Committee on Immunization Practices preferentially recommends an mRNA vaccine over the Johnson & Johnson/Janssen vaccine,

Bussel JB, Connors JM, Douglas B. Cines DB ***Vaccine-induced Immune Thrombotic Thrombocytopenia,*** COVID-19 Resources. Thrombosis with Thrombocytopenia syndrome. American Society of Hematology https://www.hematology.org/covid-19/vaccine-induced-immune-thrombotic-thrombocytopenia

CONCLUSIONS

"As far as COVID-19 Variants are concerned, we don't need to overreact," Bollinger says. "But, as with any virus, changes are something to be watched, to ensure that testing, treatment and vaccines are still effective. The scientists will continue to examine new versions of this coronavirus's genetic sequencing as it evolves."

- **PRESENTLY SARS-CoV-2 Virus is changing gradually "Drifting" (Much less genetically diverse than influenza)**
- **PRESENTLY Genetically Covid-19 seems to have some limitations in its evolution, as the advantageous mutations are drawn from a relatively limited genetic makeup**
- **TO DATE Most COVID-19 genetic changes have no great significance or functional role "Drifting Not Shifting" (Some hope that we might not see variants that fully escape vaccination)**
- **PRESENTLY Updated versions of the current vaccines are being evaluated, but there is no clinical trial evidence yet that variant-specific vaccines would provide significantly greater protection**.

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Vaccines:

Staying current with vaccines

Random thoughts

Admittedly, some physicians aren't well versed in the science or technology of vaccines….

This opens the attacks, and fuels the controversy upon vaccine medicine by opponents of vaccinations…

"Celebrity scientists", "Free choice advocates", Alternate Medical, and certain Religious groups…

But Vaccine technology does not function in a vacuum…

Vaccine science has come a long way since Edward Jenner and others first immunized people with the Cowpox virus to protect against Smallpox…

Vaccines:

Staying current with vaccines

Random thoughts

Today‘s vaccines are created using modern technology, and involve many *scientific disciplines including :*
Microbiology, Microbial Genetics, Biochemistry, Pharmacology, Pathophysiology, Computer Science, Epidemiology, Immunology Statistics and on and on….

AND…..The safety and effectiveness of vaccines are “time tested” and “clinically” validated by the Millions of vaccine recipients

Vaccinations are scrutinized on a continuous basis **(“VAERS”*) …** and, I might add… by the most modern and most sophisticated system of statistical analysis ever developed….

Vaccine Adverse Event Reporting System

Vaccines:

Staying current with vaccines

Random thoughts

Our patients and their families should feel confident that the "How to, and Wherefores" of vaccine administration is greatly understood….

...And the techniques involved, for safe and effective vaccination delivery, have been simplified for the average physician by consensus, of multiple, and an incredibly large, and diverse groups of Scientists, Physicians and Clinical Practitioners

- Anthony F. Ognjan, D.O., FACP

You are in good hands

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