



Making Our Best Shot: Vaccine Development & Community Immunity

James H. Conway MD
Professor of Pediatrics

Pediatric Infectious Diseases – Fellowship Director
Director – SMPH Office of Global Health
Medical Director – UW Health Immunization Program



University of Wisconsin
**SCHOOL OF MEDICINE
AND PUBLIC HEALTH**



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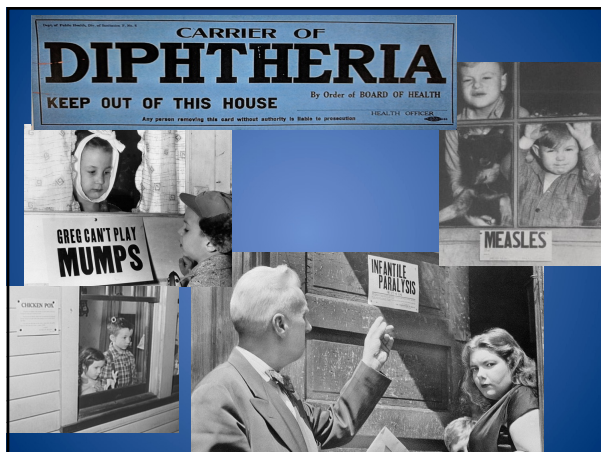
Objectives

- Discuss vaccine development & regulatory process
- Review herd immunity & transmissibility issues
- Consider source & impact of vaccine hesitancy
- Understand tactics to address vaccine refusal
- Discuss the impact & issues for immunization programs related to SARS-CoV2

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Ideal Vaccine Candidates

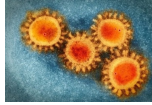


- **EFFICACY:** Produce immune protection that prevents infection
 - Long lasting & easily boosted
 - Prevents shedding & transmission to others
 - Activates both T-cells and B-cells
 - *Superiority over wild-type infection?*
- **SAFETY:**
 - Does not cause enhanced immune response during infection
 - Minimal side effects after injection
 - No long term side effects

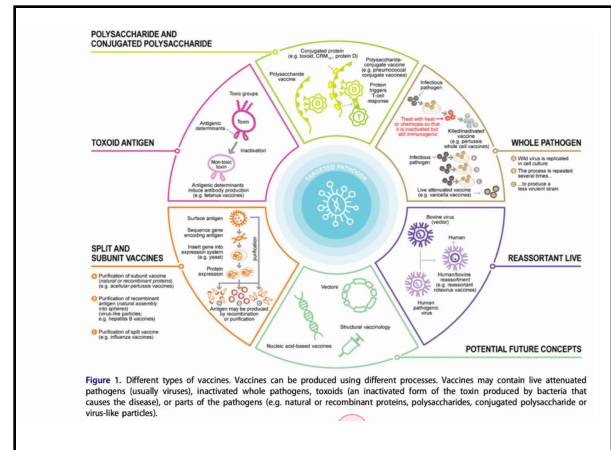
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CHALLENGES to new vaccines

- Natural immunity to some organisms appears to be short-lived
 - serum neutralizing antibodies detection $\neq$ mucosal immunity
- Unclear surrogate marker of immunity
 - Immunity is more than just antibodies
 - Real world efficacy can be difficult to measure
- Best target antigen(s)?
- Anticipating progressive mutations?
- Optimal route of delivery?
 - Oral? Intranasal?
 - Intramuscular? Intradermal? Subcutaneous?
 - Adjuvants to improve immunogenicity



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CHALLENGES to a COVID-19 vaccine

- Enhanced disease after vaccine?
- Durability of immunity? Need for boosters? Managing mutations & variants?
- Testing population vs. target population?
- Accelerating the usual progressive process for product development
- Mass manufacture & delivery
- Targeted & equitable distribution challenges



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Authorization Process for New Vaccine Use



FDA = Food and Drug Administration

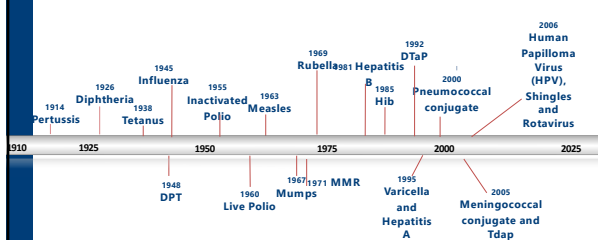
VRBPAC = Vaccines and Related Biological Products Advisory Committee

CDC = Centers for Disease Control and Prevention

ACIP = Advisory Committee on Immunization Practices (ACIP)

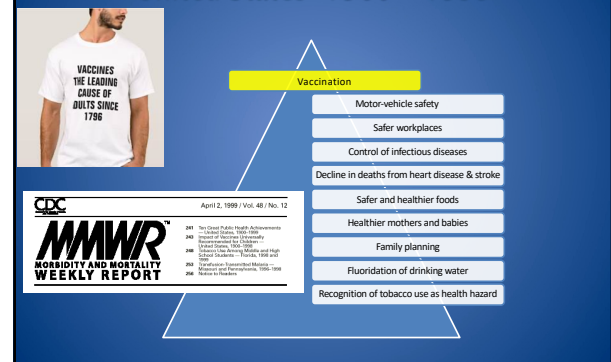
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Vaccine Timeline



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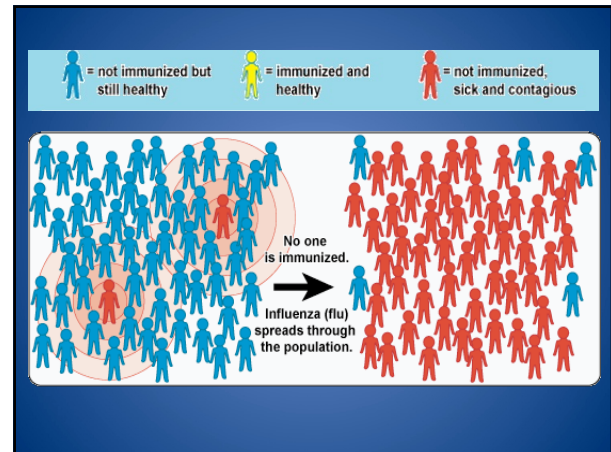
Ten Great Public Health Achievements: United States 1900 – 1999



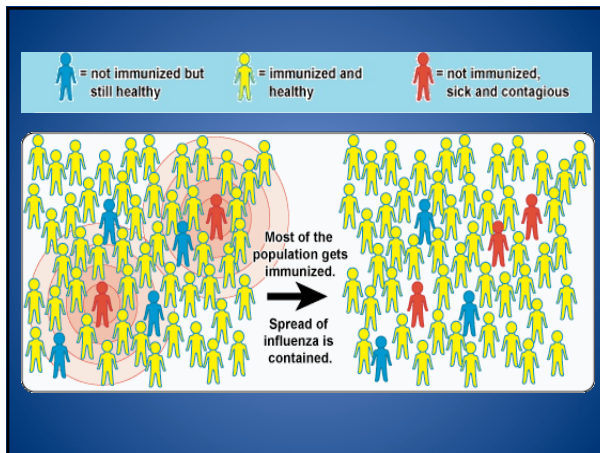
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Rates Needed for Community Immunity

> 80% → no large disease outbreaks

> 90% → eradication

Table 6 Estimated herd immunity thresholds and critical vaccination coverage using generally accepted reproductive numbers for common vaccine-preventable diseases

Vaccine-Preventable Disease	R_0 ^{59,60}	Herd Immunity Threshold (%) ³¹	Critical Vaccination Coverage ³² (%) ³¹
Diphtheria	4 to 5	75–80	79–84
Measles	11 to 18	91–94	96–99
Mumps	7 to 14	86–93	90 to 98
Rubella	6 to 14	83–94	87 to 99

³¹ R_0 values indicate the number of individuals that can be directly infected by one infectious case. Herd immunity thresholds are a function of this value.

³²herd immunity thresholds are adjusted to account for vaccine effectiveness.

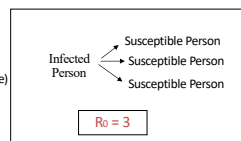
[Int Arch Otorhinolaryngol](#), 2018 Jul; 22(3): 317–329. ³⁶

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Basic Reproductive Number (R_0)

- Average number of secondary infections caused by introducing a single infected person (infectious individual) into an entirely susceptible population.
- A value that shows how an infectious disease will spread in a population

I = infected individual
S = Susceptible individual (not-immune)
→ = Transmission



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R_0 represents an epidemic threshold

- $R_0 > 1$ epidemic
- $R_0 < 1$ extinction
- $R_0 = 1$ endemic (stable disease prevalence)

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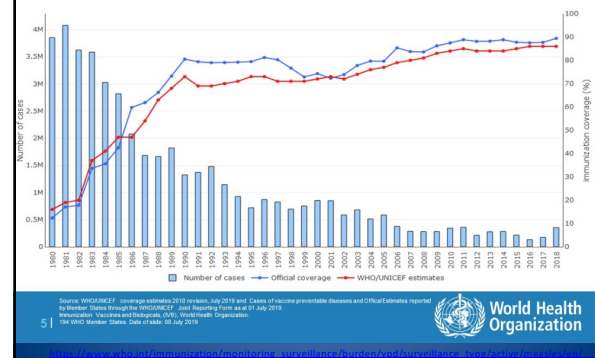
R_0 is determined by:

- Pathogen biology
- Host factors (e.g. genetics, age, comorbidities, **immune status**)
- Host behaviors (e.g. going out vs. staying in, using a mask, maintaining social distancing, cultural practices)
- Population structure (e.g. demography, contact patterns, geographic dispersion)



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Measles Global annual reported cases and MCV1 coverage 1980-2018



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Questioning the Need for Vaccines— A recurring issue



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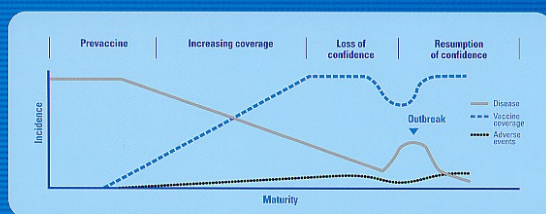
The Dawn of Vaccine Safety Concerns: As Old As Vaccines Themselves



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Interaction of Disease Reduction & Safety Concerns - "The Future is Now: History Repeats"

Chen RT. Vaccines (ed. Plotkin & Orenstein), 1998; p 1144-1163



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Why do parents refuse vaccines?

Salmon et al. Wisc Med Journal 2009;108(1):17-23

- Vaccine might cause harm 57%
 - Natural disease better than vaccine 38%
 - Child not at risk for disease 37%
 - Autism 31%
 - Thimerosal 30%
 - Vaccines overload the immune system 29%
 - Diseases not dangerous 20%
- SUBJECTS: 780 parent 'refusers'

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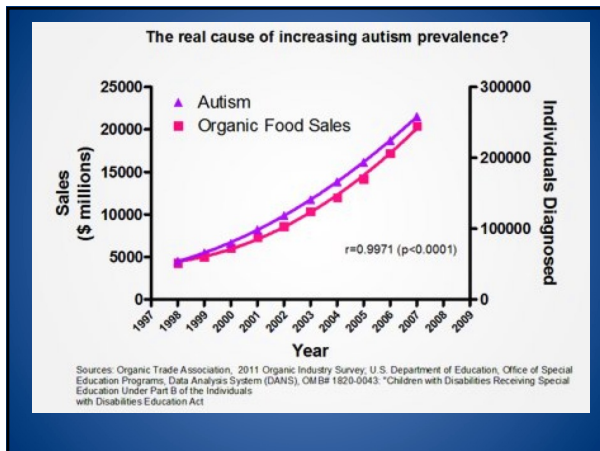


SAFETY: Causality & 'Side Effects'

ASSOCIATION $\neq$ CAUSATION

- **SEQUENCE or CON-SEQUENCE?**
- Timing of Onset
- Uniqueness of clinical syndrome
- Biological mechanism
- Epidemiological studies
- **EXAMPLES of Immunization *associations* that have been *DISPROVEN*:** asthma, diabetes, SIDS, autism, multiple sclerosis

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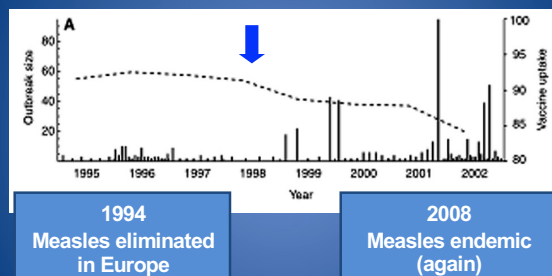
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The Effects of Vaccine Hesitancy



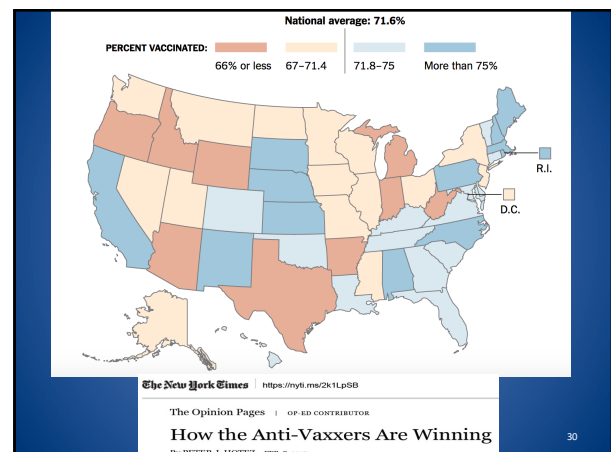
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Consequences of Public Fear on Herd Immunity and Disease Incidence

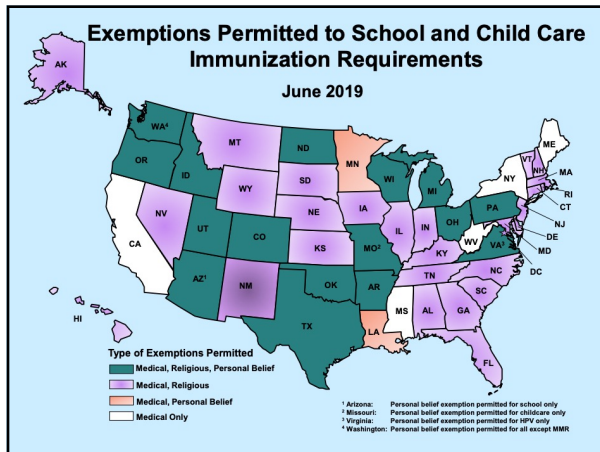


Jansen. Science 2003;301:804; www.eurosurveillance.org/viewarticle.aspx?articleid=18919

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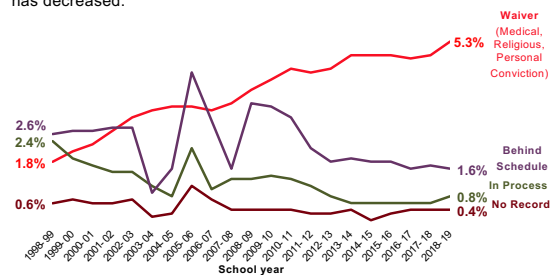
Personal Conviction Waivers

- Written statement to the school signed by parent or guardian stating "For personal conviction reasons this student should not be immunized"
 - Originally conceived as 'a deeply held belief tantamount to religious conviction'
- Incompletely immunized students may be excluded from school if an outbreak of one of these diseases occurs

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WISCONSIN & SCHOOL ENTRY WAIVERS for IMMUNIZATIONS

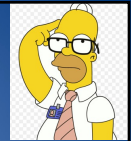
The percent of students claiming a **waiver** has increased while the percent of students **behind schedule**, **in process**, and with **no record** has decreased.



Note: 1.1% of students waived all vaccines in 2018-19, a 0.1% increase from last year.

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Our ultimate PUBLIC HEALTH goal



Inconvenience
Waivers
Myths



Access
Acceptance
Facts

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Vaccine Hesitancy ≠ Anti-Vaccine?



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Vaccine Seeking - Decision Making: Promoters of Accepting Vaccination



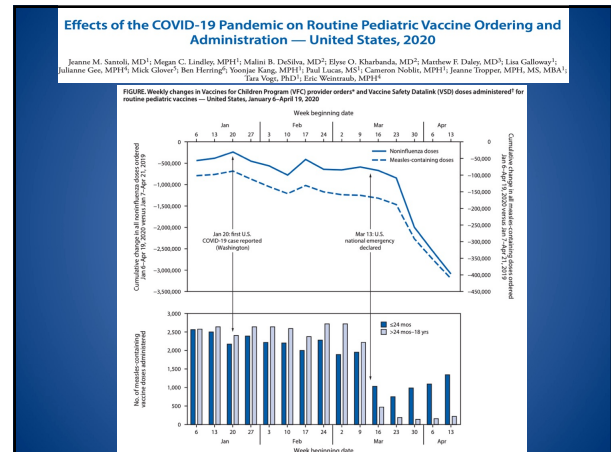
- Trust in the health provider
- Feeling satisfied by the discussion
- Feeling that vaccination = cultural norm
- Believing in the social contract
- Having positive past experiences with vaccines
- Wanting to prevent disease

Benin et al. Qualitative Analysis of Mothers' Decision Making About Vaccines for Infants: The Importance of Trust. *Pediatrics* 2006; 117:1532-1541

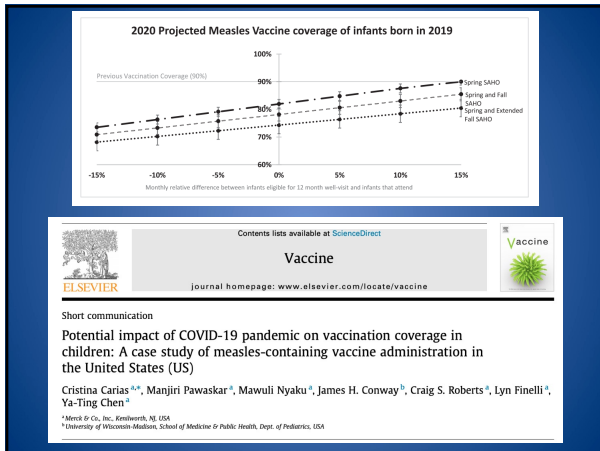
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Global Health FREE

January 19, 2021

Drop in Vaccination Causes Surge in Global Measles Cases, Deaths

Bridget M. Kuehn, MSJ

JAMA. 2021;325(3):213. doi:10.1001/jama.2020.26586

Failure to vaccinate children against measles has led to a 556% surge in the number of reported cases and a 50% increase in deaths from the disease since 2016, according to the World Health Organization (WHO).

10/7/2013 Addressing Vaccine Hesitancy 46

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AP **NORC**
at the UNIVERSITY of CHICAGO

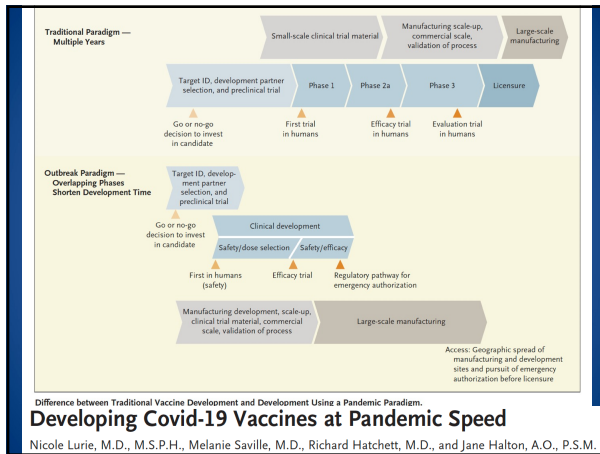
Home » Projects+Programs » Expectations for a COVID-19 Vaccine

The Associated Press-NORC Center for Public Affairs Research

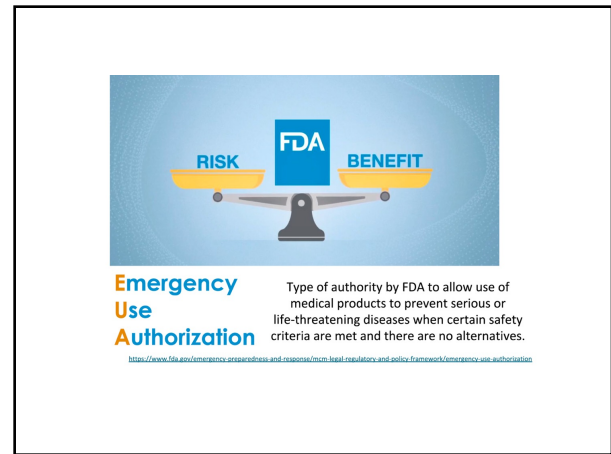
Expectations for a COVID-19 Vaccine

Most Americans expect a vaccine against COVID-19 to be available by some point in 2021, but only half say they will get vaccinated and many are unsure, according to the AP-NORC survey conducted in May 2020.

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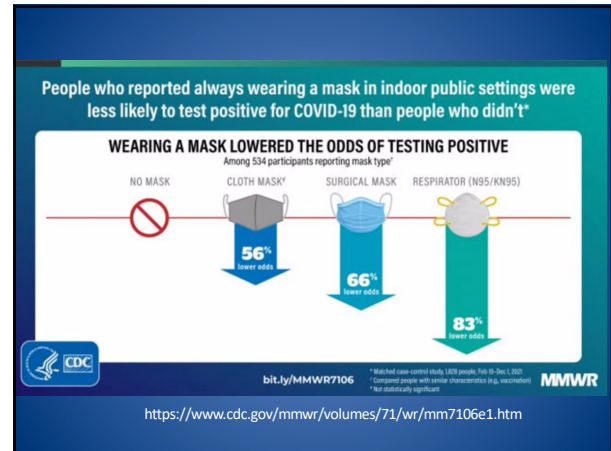
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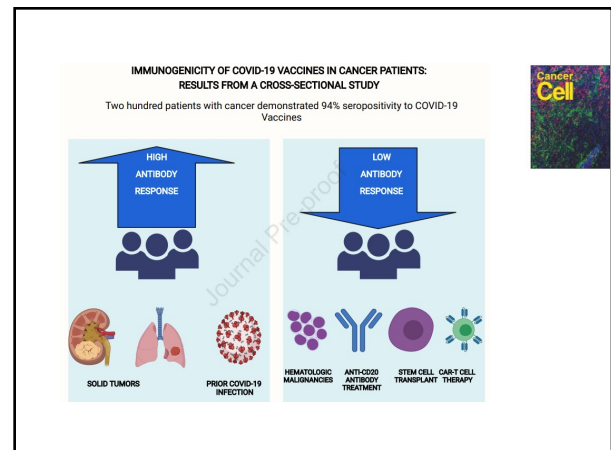
Covid vaccine effectiveness wanes over time

Prevention of emerg. dept., urgent care, or hospitalization with + Covid test

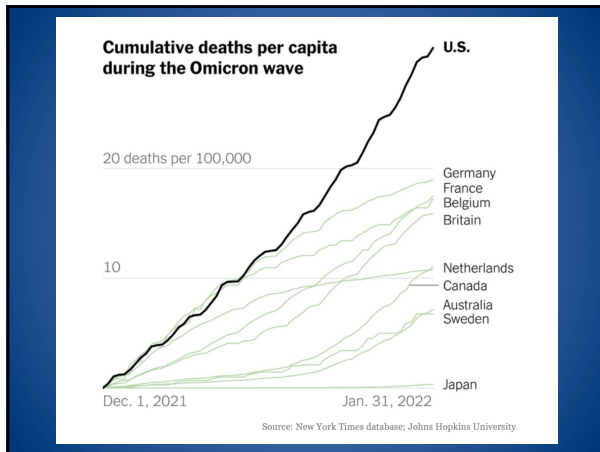
mRNA doses	at <2 mos	at 2-3 mos	at 4 mos	at 5+ mos
Delta: before late December 2021				
2	92%	88%	85%	77%
3	97%	93%	89%	
Omicron: after late December 2021				
2	69%	50%	48%	37%
3	87%	81%	66%	

adults aged ≥18 years, VISION Network, 10 states, August 2021–January 2022
https://www.cdc.gov/mmwr/volumes/71/wr/mm7107e2.html#t2_down

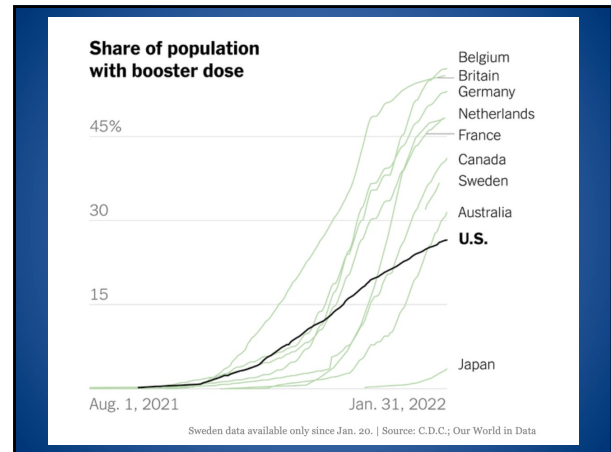
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What Can You Do?

- Normalize: Talk about the importance of vaccines & what *you* have done
- Encourage questions & discussion
- Support science & scientific literacy
- Understand that misinformation still appears to be information to many...engage, don't mock
- Provide reliable & accurate resources

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IAC Home | Vaccines | COVID-19

Vaccines: COVID-19

- This page provides links to key COVID-19 vaccine resource pages from IAC, CDC, and other partners.
- For the most current COVID-19 vaccine information, subscribe to IAC's weekly e-newsletter, IAC Express.
- For information about routine and catch-up vaccination during the COVID-19 pandemic, visit IAC's Vaccination and COVID-19 page.

Key COVID-19 Vaccine Resources

- ACIP Recommendations – COVID-19
- CDC COVID-19 Vaccination (CDC) Main page to all CDC COVID-19 vaccine information
- Information about COVID-19 Vaccine Products Vaccine-specific information and Vaccine Fact Sheets for Providers
- Vaccine Fact Sheets for Recipients and Caregivers (EUA Vaccines) Required in place of Vaccine Information Statement (VIS) for vaccines

MORE VACCINES

Anthrax	HPV	Pertussis	Rubella
COVID-19	Influenza	PCV	Smallpox
Diphtheria	Measles	PPSV	Tetanus
Hepatitis A	MenACWY	Polio	Varicella
Hepatitis B	MenB	Rabies	Zoster
Hib	Mumps	Rotavirus	

CDC COVID-19 Vaccination MAIN WEB PAGE

SUBSCRIBE IAC Express provides COVID-19 and immunization news

VACCINES SAVE LIVES Immunize.org

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