Prevention of Disease: Vaccinations

MAVEN Project
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Disclaimers

I am an internal medicine doctor not a pediatrician

Vaccine information can change over time-look to reliable evidence-based sources for information

Will not discuss special populations or travel vaccines

Will not cover all vaccines for children and adults for this talk

Will not discuss diagnosis or treatment

Please read about contraindications for vaccines in resources listed

Objectives

Discuss brief history of vaccine preventable diseases

Be able to identify what vaccines are recommended to prevent severe diseases

- For adults
- For pediatrics

Be able to communicate with patients about vaccination

50 Years of Vaccine Efficacy: Expanded Programme on Immunizations

Shattuck AJ etal. The Lancet 2024, 403:2307-16

- 154 million deaths averted overall
- 146 million deaths averted in children < 5 yo (101 million in <1 yo)
- For every 1 death averted, gained 66 years of full health
- Translates to 10.2 billion years of full health gained
- Vaccines account for 40% of the observed decline in global infant mortality
- Take home point: “EPI vaccination program has provided the single greatest contribution to improved infant survival in past 50 years”

https://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(24)00850-X.pdf

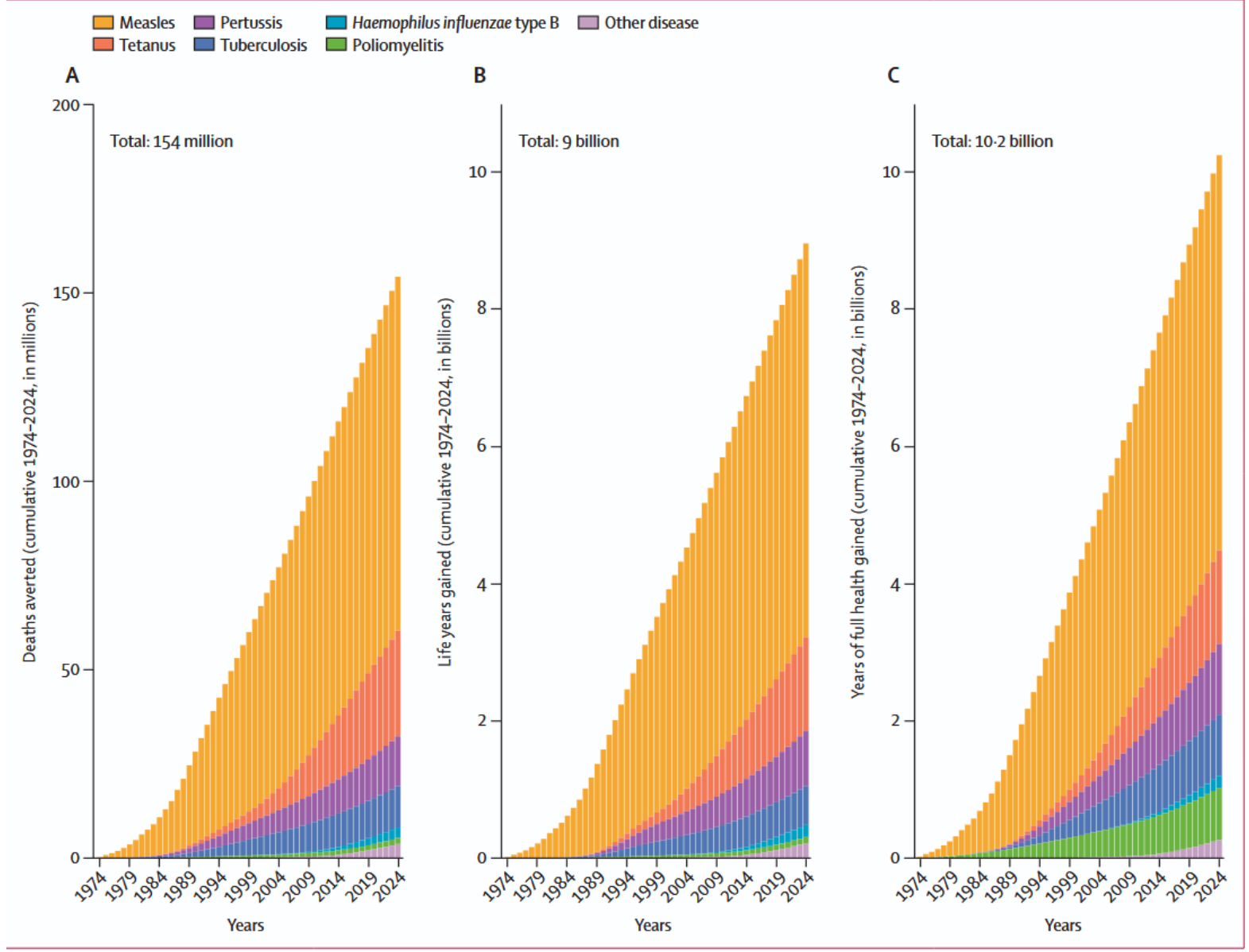


Figure 1: **Deaths averted, years of life saved, and years of full health gained due to vaccination**

Data are cumulative 1974–2024. Measles: deaths averted: 93·7 million; years of life saved: 5·7 billion; years of full health gained: 5·8 billion. Tetanus: deaths averted: 27·9 million; years of life saved: 1·4 billion; years of full health gained: 1·4 billion. Pertussis: deaths averted: 13·2 million; years of life saved: 0·8 billion; years of full health gained: 1 billion. Tuberculosis: deaths averted: 10·9 million; years of life saved: 0·6 billion; years of full health gained: 0·9 billion. Haemophilus influenzae type B: deaths averted: 2·8 million; years of life saved: 0·2 billion; years of full health gained: 0·2 billion. Poliomyelitis: deaths averted: 1·6 million; years of life saved: 0·1 billion; years of full health gained: 0·8 billion. Other diseases: deaths averted: 3·8 million; years of life saved: 0·2 billion; years of full health gained: 0·3 billion.

Vaccination Truths

One of the most effective, safest public health measures to prevent several diseases

Vaccines are safer than getting the disease

Vaccines save lives

Vaccines can reduce severity of illness (ie Covid, Influenza)

Vaccines save billions of dollars in healthcare and other costs (ie. Work absence)

Vaccines help protect populations (and individuals)

Vaccines do **NOT** cause autism

Side effect from vaccines are rare and usually self limited

mRNA vaccines do NOT affect your DNA-they do not enter the nucleus where DNA resides

Partial Vaccine History

1796-Smallpox (eradicated from world by 1977)

1800's-Rabies, Typhoid

1890-Tetanus and diptheria antitoxin/ pertussis 1914

1945-Influenza

1950's-60's –Polio (eradicated from Americas in 1994 but still exists in several countries)

1969-MMR

1978-Pneumococcal vaccine

1986-Hepatitis B*

1991-DTaP/ 2005: Tdap

1996: Hepatitis A

2006: HPV*

2021: Covid 19

Other vaccines: Hib, Rotavirus, RSV, Yellow Fever, Shingles, Dengue

*also anticancer vaccine

Smallpox

Variola virus (Poxviridae)

Humans only known source

Spread by droplet

Clinical: high fever, classic rash, septicemia

Case fatality- 20-30%

1 infected could cause 60% of household contact illness

300-500 million deaths in 20th century

Prevention- vaccinia vaccine (initially cowpox vaccine)

Smallpox vaccine development

Variolation had been used for centuries- practice of inoculating a small dose of smallpox onto the skin

1776-Edward Jenner observed that those infected with cowpox did not get the more severe smallpox

First inoculation of cowpox to James Phipps

Jenner publishes his data in 1778 about discussing vaccination for this disease


QUENING
MIXTURE
VACCINE
POCK
COW

Eradication efforts

1958- World Health Assembly –USSR calls for collaboration in global eradication

1966-WHO calls for Intensification of eradication

1977- last case identified in Somalia

At time: 10-15 million cases in 31 countries

Cost: $23 million annually from 1967-1979 (approx $300million total)

Savings: approx 1 billion dollars annually (direct and indirect costs)

Utilized 200,000 people in 40 countries

Collaboration of governments, NGO, health care workers, public health .....

Case One

Maria brings her 12 month old Sarah for an annual visit. There is no documented vaccinations for Sarah.

Her mother was concerned about the news and asks what would be recommended?

What about safety concerns?

Case One

American Academy of Pediatrics: Childhood Vaccine Recommentations

Aap.org/ImmunizationSchedule

Please refer to the immunization schedule for what Sarah is due for

Discussion points:

What may be most important for prevention of serious diseases?

MMR, IPV Polio, DTaP, Covid, Influenza

Other vaccines to consider: Hep B series, Hep A, Hib

Given age she is not eligible for Rotavirus and need to review RSV recommendations

Measles

Highly contagious virus causing an acute febrile rash illness

>90% secondary attack rate

Spreads by direct contact with infectious droplets and airborne (sneezing, coughing)-can remain infectious at least 2 hours on surface and in air.

Symptoms start 7-14 days after exposure

high fever, cough, runny nose, conjunctivitis

2-3 days later Koplik spots in oropharynx

3-5 days later flat red rash spreads down face to trunk and extremities

Serious illness: 1 in 20 children develop pneumonia

1 in 1000 children can have brain swelling and sequelae

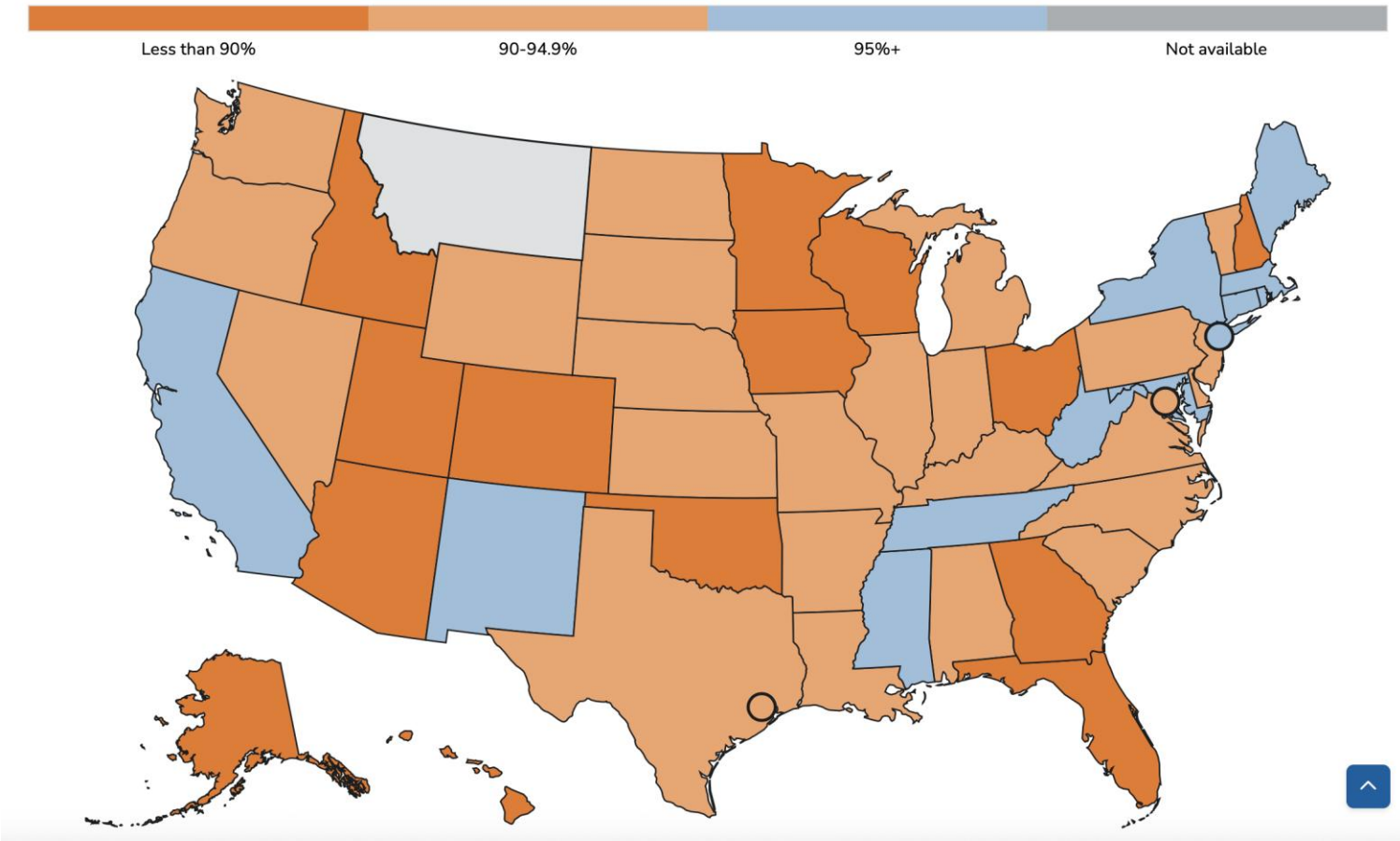
1-3 in 1000 children can die

7-10 per 100,000 can develop SSPE (subacute sclerosis panencephalitis

1 in 5 children hospitalized

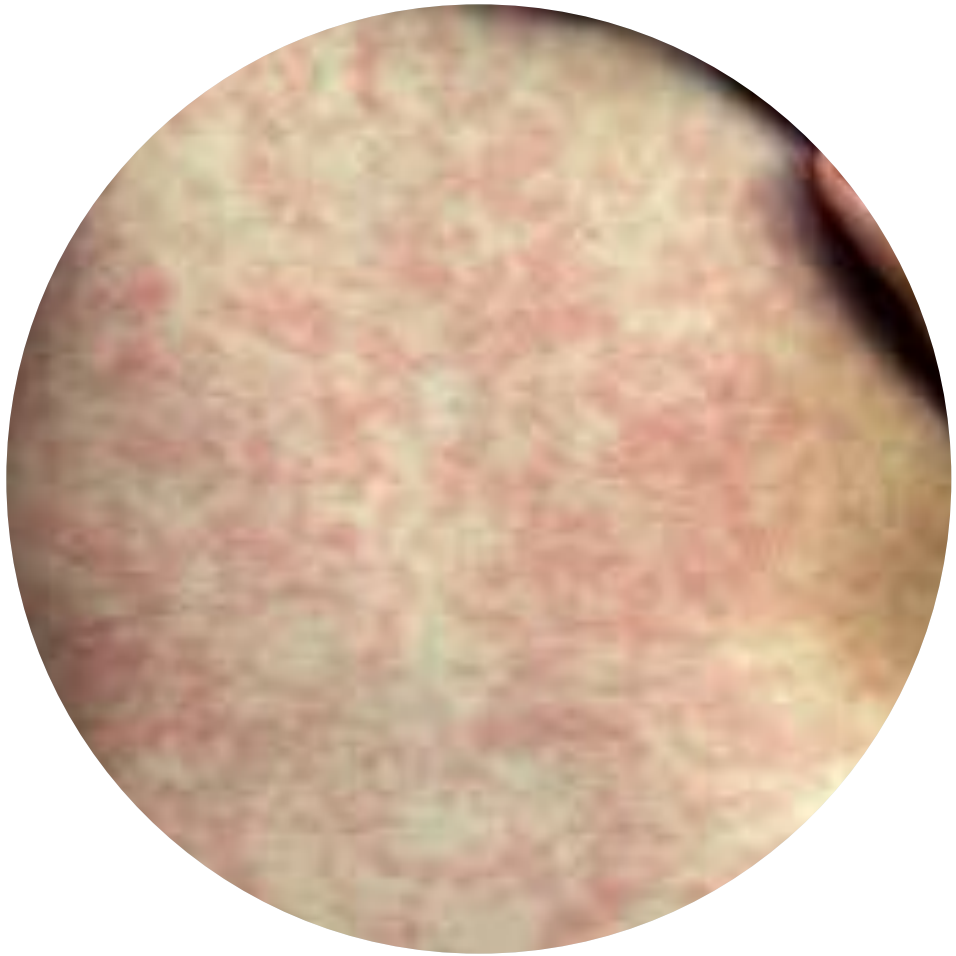
Koplik Spots

Measles Vaccination rates



Measles Rash in Adult

Source: NHS Internet photos



Measles

Prevention-with vaccination =>95% herd immunity is present in a community.

Professional societies (AAFP, AAP) recommend giving the combination MMR or MMRV

Give 1st dose age 12-15 month, Dose 2-age 4-6 yo

Case 2: 40 yo immigrant comes to clinic. Does not know immunization status for measles. What is the recommendation?

Most experts would recommend vaccinating with MMR vaccine (unless he has medical contraindications)

Titer is not needed (and could add cost and delay vaccination).

Measles Question adult

Case 2: 40 yo immigrant comes to clinic. Does not know immunization status for measles. What is the recommendation?

Most experts would recommend vaccinating with MMR vaccine (unless he has medical contraindications)

Titer is not needed (and could add cost and delay vaccination).

He is also likely needs Tdap, Influenza, Covid

Consider Hep A and Hep B (if not prior vaccinated and no prior disease)-Here you should check for Hep B status (HBsAg, HBsAb)

Consider HPV if not prior vaccinated and at risk

Poliomyelitis

Highly infectious virus spread by droplet and/or fecal-oral contact

Most affected children under 5 yo

Symptoms: fever, HA, meningitus, paralysis

Meningitis in 1-5 out of 100 people infected

Irreversible paralysis in 1in 200 infected (of these 5-10% can die)

There is no cure for disease

Polio vaccine most effective to prevent disease.

Wild polio has decreased by over 99% worldwide since 1988. Only 2 countries currently have endemic polio

Polio Vaccination

Vaccine introduced in 1955 Salk (IPV) and in 1961 Sabin (OPV)

Currently only IPV is used in US

Pediatric Dosing: 2mo, 4mo, 6-18 mo, 4-6 yrs

Adults: is prior unvaccinated-give 1st dose anytime, 2nd dose: 1-2 mo later, 3rd dose: 6-12 mo later

Eradication of polio could save $40-50 Billion, esp for lower income countries

In addition to eliminating death or paralysis from this disease

Mumps

Respiratory paromyxovirus

Incubation 12-25 days, usually 16-18 days

Most infectious before onset of parotitis, spread by respiratory droplets, direct contact and fomites

Usually self limited fever, myalgias, headache, fatigue, anorexia followed by parotitis

Complications:

- orchitis (15-30 % post pubertal male 5-10 days after parotitis),
- oophoritis, (5% post pubertal females, mastitis, premature menopause)
- meningitis, encephalitis, deafness
- less common transverse myelitis, Guillan Barre, poly radiculitis

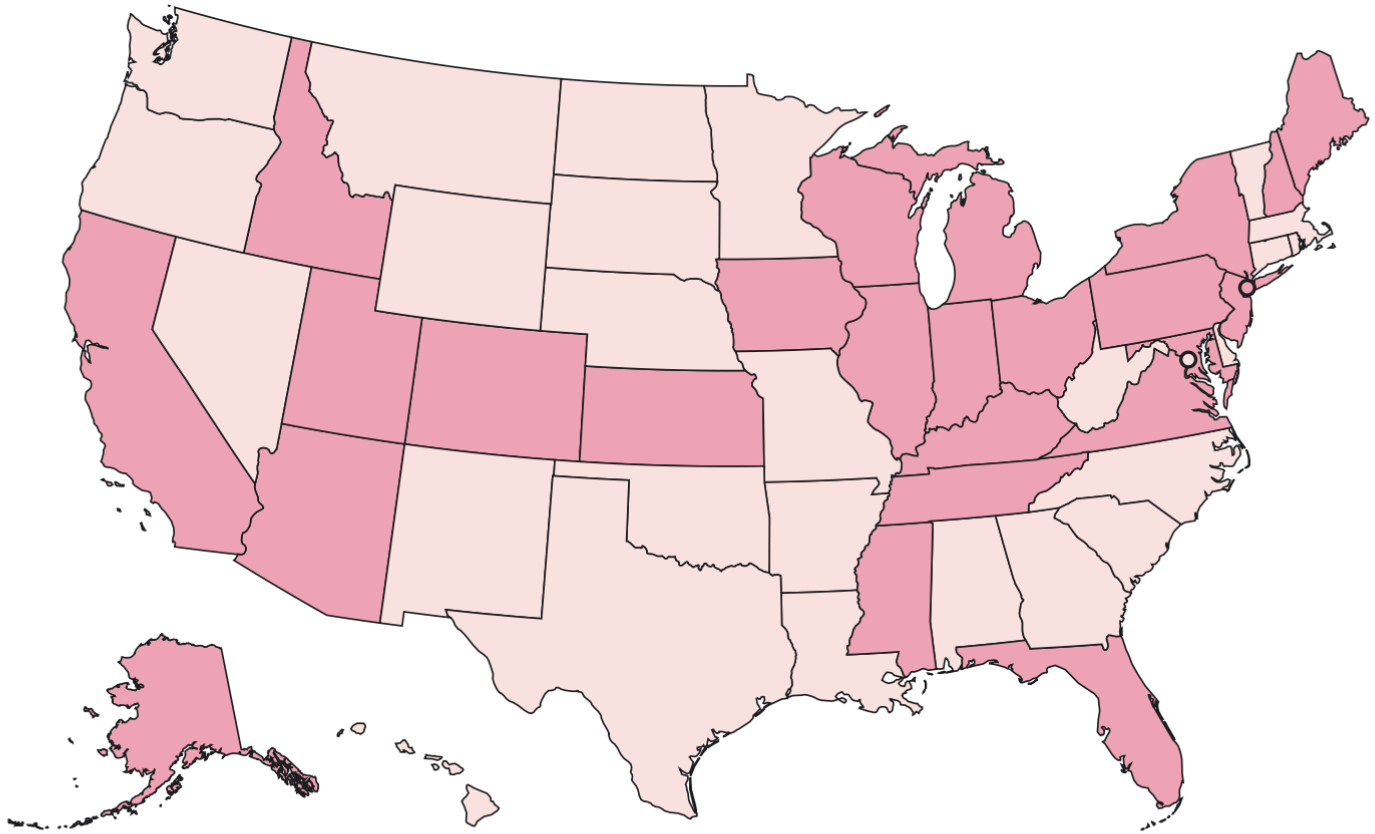
Uncommon complications myocarditis, pancreatitis, arthritis, thyroiditis

No treatment only prevention with MMR vaccine

2 doses of MMR is approx. 86% of preventing mumps

There is swelling of the parotid gland anterior and inferior to the auricle, obscuring the angle of the mandible.

Reported U.S. mumps cases by jurisdiction, 2025*



Legend

No reported cases

Reported mumps cases

Other Vaccine considerations

Hepatitis B-virus that is spread via contaminated blood or other body fluids and perinatally

Infants exposed to Hep B have high risk of developing chronic hepatitis B

Of those with chronic Hep B-25 % can die prematurally from cirrhosis or liver cancer

Best prevention is early vaccination

Pediatric: birth, 1-2 mo, 6-15 mo

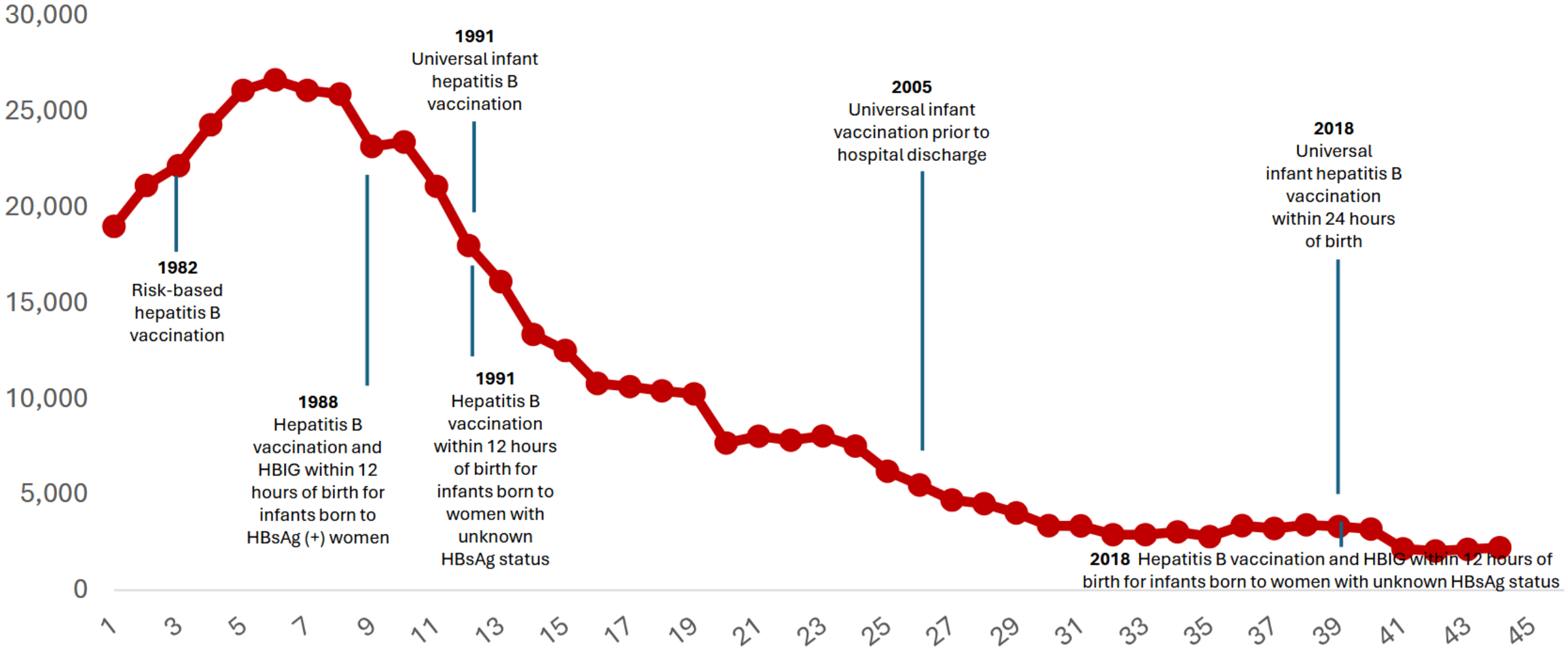
Adults: 2 dose regimens

Hep B vaccine is very safe and effective

Could be considered an anti-cancer vaccine (reducing risk of liver ca)

Hepatitis B vaccination has been the cornerstone of hepatitis B control for decades and has brought the U.S. within reach of elimination.

Reported cases of acute hepatitis B and key ACIP vaccination recommendations among infants, United States, 1980-2023



HBIG = Hepatitis B immune globulin; CDC NNDSS Viral Hepatitis Surveillance (https://www.cdc.gov/hepatitis/php/statistics-surveillance/index.html);
†From 1991–2010 all case classifications included (i.e., confirmed, probable, suspect, unknown); from 2011–2023 only confirmed cases included
Bixler D, Roberts H, Panagiotakopoulos L, Nelson NP, Spradling PR, Teshale EH. Public Health Rep. 2023 Jun 9

Case 3

52 yo male comes to with question as to whether he should get that “whopping cough” vaccine. His daughter is pregnant with first grandchild and they want to visit after the birth.

He states he had childhood vaccines but cannot recall last tetanus shot. He has no underlying conditions.

What are your recommendations?

It is September, are there any other recommendations?

Answer: Yes give the Tdap, also consider Influenza and Covid vaccines. Want to reduce risk of respiratory infections.

Tetanus, Diptheria and Pertussis

Tdap-is vaccine given as booster to adults-given every 10 yrs after initial vaccination

DTaP is vaccine given to children for primary vaccination: given at 2, 4, 6 months then booster at 12-15 mo and 4-6 yrs

Combination vaccine has been available since 1948

Effectivess: nearly 100% for prevention of tetanus, and approx. 97% for prevention of diptheria, about 80-85% for pertussis in kids (but immunity wanes)

**Current guidelines suggest getting Tdap during pregnancy as well as vaccinating those who will visit a newborn (to reduce risk of pertussis to newborn)

Diphtheria

Cause: toxin producing strains of gram positive rod Corynebacterium diphtheriae

Respiratory-mild sore throat, cough, lymphadenopathy, fever; progress to pseudomembranes, malignant swelling of all pharyngeal structures ; 2-6 week duration

Skin-more common in tropical areas or among homeless alcoholics, shallow non healing gray ulcers

Complications:

myocarditis 10-25%,

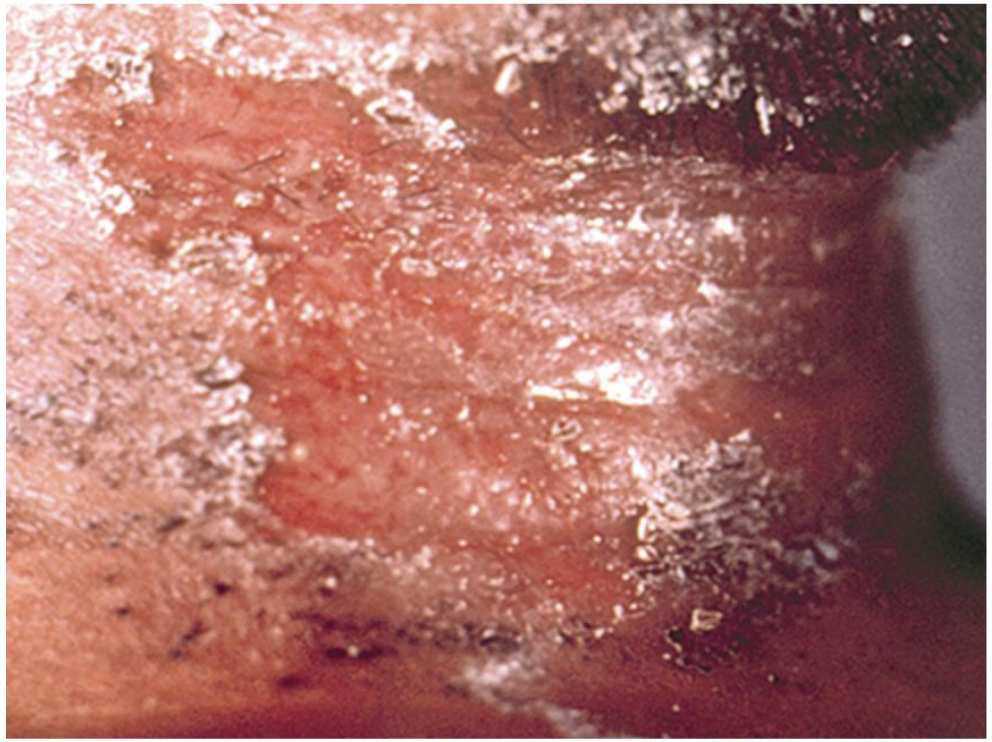
neurologic 5%(pharyngeal/palate neuropathy, peripheral neuropathy)

renal failure

Mortality 5-10% with treatment

Diphtheria Pseudomembrane

Skin Diphtheria



Pertussis (Whooping cough)

Cause: highly infectious gram negative coccobacilli Bordetella pertussis

3044 cases in USA 2022

Transmission respiratory droplets from paroxysmal cough; infectiousness present until at least 5 days of antibiotic; asymptomatic infection in household contacts 5-56%

Adults and adolescents seem to be unrecognized and act as a reservoir for children

Incubation 1-3 weeks, usually 7-10 days

Immunity wanes

Risks-under 6 m, > 65 yo, obesity, asthma, COPD, female

Pertussis

- Clinical
  - Adults and adolescents-more likely to be asymptomatic, similar phases to infants/children; risk of preterm birth in pregnancy
  - Infants and children
    - Catarrhal-coryza, cough, minimal fever; 1-2 weeks
    - Paroxysmal –increase severe cough, gagging, cyanosis, whooping, sweating, post-tussive vomiting; 2-8 weeks
    - Convalescence-cough resolves over weeks to months
    - Atypical including apnea, renal failure
    - Complications-extreme leukocytosis, pulmonary hypertension, seizures, death

Tetanus

Cause: exotoxin of Clostridium tetani

Transmission: usually through skin (puncture wounds, IVDU, unhygienic surgical or delivery procedures)

Incubation: 3-21 days

No person to person transmission

Clinical: painful muscle contractions,rigidity, “Lockjaw”, “risus sardonicus”

Fatality: 10-80%

Prevention of disease: Tdap or Td

Give within 48 hrs of injury (if vaccine not up to date or > 5yrs from last)

Tetanus
Muscle rigidity
Risus sardonicus

Case 4

50 yo presents to clinic for an annual exam in October. Looking at the health maintenance you see they are due for some vaccinations. Not on any meds. BMI 40, BP 120/70

The patient seems concerned about vaccines given what they have read on line.

The patient has had all childhood vaccines (including MMR, DTaP and booster within 6 yrs, polio).

Works in the food industry.

What would you recommend for this patient?

Case 4 Recommended Vaccines

Would recommend Covid 19 vaccine booster

Recommend seasonal influenza vaccine

As a food service worker would recommend Hepatitis A vaccine (a 2 dose vaccine regimen)

Can give vaccines at same visit if patient prefers

Also eligible for Shingles vaccine (this is a 2 dose vaccine regimen)

Influenza

Respiratory virus spread by droplet (airborne)

Symptoms: fever, cough,myalgia, HA

Cannot distinguish on symptoms from other respiratory viruses (ie RSV, Covid etc)

Incubation period: 2 days

History: H1N1 Influenza of 2018 (Spanish Flu)-killed btwn 50-100 million

Vaccine must be given annually as the composition of what strains are circulating change yearly and immunity wanes after some months

Best time to give vaccine is prior to the “flu” season starting (ie Sept-Oct in US)

Covid 19

Caused by Coronavirus

Airborne transmission

Symptoms: cough, fever, myalgia, HA-severity can fluctuate

Older and <2 yo pts, obese, co-morbid conditions, Immune compromise are at higher risk for severe disease

Vaccination reduces risk of severe disease and hospitalization

- Studies showed that approx. 2.8 million deaths prevented btwn 2020-2024
- https://jamanetwork.com/journals/jama-health-forum/fullarticle/2836434

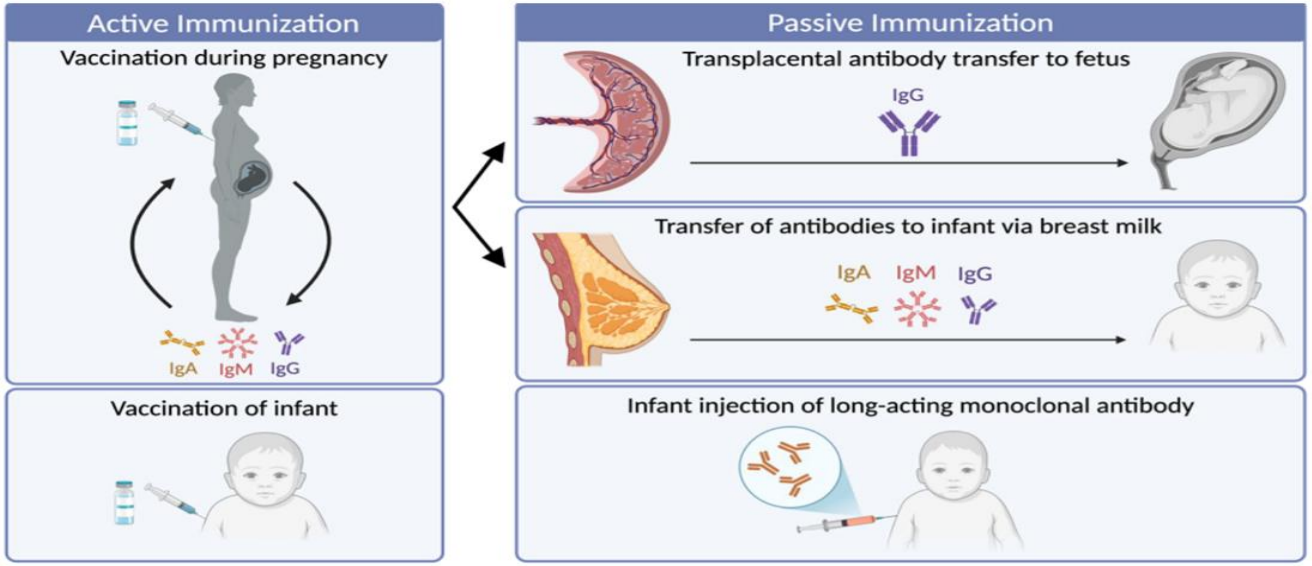
May also reduce risk of long covid.

Covid strains have changed from year to year

Vaccine Integrity Project-talk by Dr Caitlin Dugdale- Harvard Med School

Background: Pregnancy-Specific Considerations

- Some infections (e.g., influenza) are more severe during pregnancy
- Infections in pregnancy may also increase the risk of preterm birth, stillbirth, and other adverse birth outcomes
- Immunizations during pregnancy can provide protection to the newborn during the first few months of life



Adapted from Cho 2024

Covid-19 Recommendations

Currently most controversial recommendations given new ACIP members

Professional Society Recommendations (from AAP, AAFP, ACOG)
AAP: All children 6-23 months
2-18 yo-risk assessment
AAFP: similar to AAP for pediatric.
Age 19 and older-recommend vaccination
ACOG:
Recommend vaccine during any trimester in pregnancy

ACP and IDSA will likely come out with recommendations as well

Case 5

35 yo comes to clinic for an annual exam. The patient lives in a multigenerational household (with small children as well as older adults with medical issues).

They are reluctant to get vaccines given what they have read online.

How would you address their concerns about vaccines?

What if they are a parent and are reluctant to have their children vaccinated?

Communicating about Vaccines

Can start by saying that they are due for XYZ vaccines today-would they like to get them?

If they say no or are hesitant..

Use patient centered communication

“I understand that you want to have good health. Vaccinations are one of the safest ways to prevent serious diseases. What concerns do you have?”

“ I know it is important to you to make an informed decision about your health. Vaccinations are one of the best ways to prevent disease. What questions can I answer?

Need to allow time for answers and listen to concerns

For parents: “ I can see that you want your children to be healthy and well. Vaccination for serious illness are one of the safest and best ways to prevent life-threatening diseases (such as measles, covid, influenza etc)? What concerns do you have?”

In answers: do not perpetuate myths: State Facts...

AAP and others have fact sheets that can be helpful for communicating truths

Vaccination Truths

One of the most effective, safest public health measures to prevent several diseases

Vaccines are safer than getting the disease

Vaccines save lives

Vaccines can reduce severity of illness (ie Covid, Influenza)

Vaccines save billions of dollars in healthcare and other costs (ie. Work absence)

Vaccines help protect populations (and individuals)

Vaccines do **NOT** cause autism

Side effect from vaccines are rare and usually self limited

mRNA vaccines do NOT affect your DNA-they do not enter the nucleus where DNA resides

Documenting conversation

Reduce stigmatizing language

- Do not say anti-vax
- Would not say refused vaccinations
- Would not say patient not-compliant with recommendation

If patient or parent declines vaccine:

- Patient chooses not to get vaccination at this time
- Following concerns were addressed:....
- Parent chooses not to have child get XYZ vaccine at this time

Key Points

Vaccines are one of the safest, best health interventions to prevent disease

Vaccines reduce both incidence of disease as well as serious adverse events from infections

Vaccination/Immunization reduces health care costs significantly

Important to utilize guidelines that are scientific-evidence based by experts in the field

Patient centered communication is important to identify barriers to vaccination

Vaccine Guidance References

American Academy of Pediatrics (AAP) COVID-19 Vaccine Guidance for people ages 6 months to 18 years old.

American College of Obstetricians and Gynecologists (ACOG) COVID-19 Vaccine Guidance for pregnant individuals.

https://www.acog.org/programs/immunization-infectious-disease-public-health/tools-and-resources/covid-19-vaccines-and-pregnancy-conversation-guide-for-clinicians

American Academy of Family Physicians (AAFP) COVID-19 Vaccine Guidance for people ages 19 years and older.

Pediatric Vaccine Recommendations from American Academy of Pediatrics: www.aap.org/VaccineSchedule

Adult Vaccine Recommendations from American Academy of Family Practice: https://www.aafp.org/family-physician/patient-care/prevention-wellness/immunizations-vaccines/immunization-schedules/adult-immunization-schedule.html

Danish study on aluminum in vaccines-showed no increased risk with vaccination

https://www.acpjournals.org/doi/10.7326/ANNALS-25-00997

Danish study looking at MMR vaccines and autism-found MMR did not cause autism

https://pmc.ncbi.nlm.nih.gov/articles/PMC1124634/

European study of Covid 19 vaccines and risk- no increased risk of 29 adverse events found

https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2836889

Articles addressing communication for vaccine hesitancy:

https://pmc.ncbi.nlm.nih.gov/articles/PMC7041657/

https://publications.aap.org/pediatrics/article/153/3/e2023065483/196695/Strategies-for-Improving-Vaccine-Communication-and

Other References

Books:

Deadly Choices by Dr Paul Offitt

Vaccines and Your Child-Dr. Paul Offitt

Vaccines and Your Family-Dr Paul Offitt

Tell Me When It’s Over-Dr Paul Offitt

Crisis Averted- Dr Caitlin Rivers

Articles

Expanded Program of Immunizations-50 year legacy

https://pmc.ncbi.nlm.nih.gov/articles/PMC12197319/

Thank you