What's New in Immunizations (non-Covid) for the Practicing Clinician: Navigating the Maze

Edward T. Ryan, MD

I have no COI

If off-label, I will point out

Historical Comparisons of Morbidity and Mortality for Vaccine-Preventable Diseases in the United States

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Context National vaccine recommendations in the United States target an increasing number of vaccine-preventable diseases for reduction, elimination, or eradication.

Objective To compare morbidity and mortality before and after widespread implementation of national vaccine recommendations for 13 vaccine-preventable diseases for which recommendations were in place prior to 2005.

Design, Setting, and Participants For the United States, prevaccine baselines were assessed based on representative historical data from primary sources and were compared to the most recent morbidity (2006) and mortality (2004) data for diphtheria, pertussis, tetanus, poliomyelitis, measles, mumps, rubella (including congenital rubella syndrome), invasive *Haemophilus influenzae* type b (Hib), acute hepatitis B, hepatitis A, varicella, *Streptococcus pneumoniae*, and smallpox.

Main Outcome Measures Number of cases, deaths, and hospitalizations for 13 vaccine-preventable diseases. Estimates of the percent reductions from baseline to recent were made without adjustment for factors that could affect vaccine-preventable disease morbidity, mortality, or reporting.

Results A greater than 92% decline in cases and a 99% or greater decline in deaths due to diseases prevented by vaccines recommended before 1980 were shown for diphtheria, mumps, pertussis, and tetanus. Endemic transmission of poliovirus and measles and rubella viruses has been eliminated in the United States; smallpox has been eradicated worldwide. Declines were 80% or greater for cases and deaths of most vaccine-preventable diseases targeted since 1980 including hepatitis A, acute hepatitis B, Hib, and varicella. Declines in cases and deaths of invasive *S pneumoniae* were 34% and 25%, respectively.

Conclusions The number of cases of most vaccine-preventable diseases is at an all-time low; hospitalizations and deaths have also shown striking decreases.

JAMA. 2007;298(18):2155-2163 www.jama.com

VACCINES ARE AMONG THE greatest achievements of biomedical science and public health,[1,2] stimulating protective immune responses against acute and chronic infectious diseases, as well as some infectious diseases that result in cancer.[3-5] In the United States, vaccination programs have made a major contribution to the elimination of many vaccine-preventable diseases and significantly reduced the incidence of others. Vaccine-preventable diseases have societal and economic costs in addition to the morbidity and premature deaths resulting from these diseases—the costs include missed time from school and work, physician office visits, and hospitalizations.[6-14] National recommendations provide guidance for use of vaccines to prevent or eliminate 17 vaccine-preventable diseases, namely diphtheria, pertussis, tetanus, poliomyelitis, measles, mumps, rubella (including congenital rubella syndrome), influenza, invasive *Haemophilus influenzae* type b (Hib), acute hepatitis B, hepatitis A, varicella, *S pneumoniae*), in addition to smallpox, for which vaccination has not been routinely recommended since tion policy, vaccine distribution and coverage assessment, vaccine safety monitoring, and surveillance.

Table 1. Historical Comparison of Morbidity and Mortality for Vaccine-Preventable Diseases With Vaccines Licensed or Recommended Before 1980: Diphtheria, Measles, Mumps, Pertussis, Poliomyelitis, Rubella, Smallpox, Tetanus[a]

Vaccine-Preventable Disease	Prevaccine No. (y)				Vaccine Date(s), y[f]	Most Recent Postvaccine Reported No.		Prevaccine Estimated Annual No. vs Most Recent Reported No. (% Reduction)	
	Estimated Annual Average		Peak						
	Cases[b]	Deaths[c]	Cases[d]	Deaths[e]		Cases, 2006[g]	Deaths, 2004[h]	Cases	Deaths
Diphtheria	21 053 (1936-1945)	1822 (1936-1945)	30 508 (1938)	3065 (1936)	1928-1943	0	0	21 053 (100)	1822 (100)
Measles	530 217 (1953-1962)	440 (1953-1962)	763 094 (1958)	552 (1958)	1963, 1967, 1968	55	0	530 162 (99.9)	440 (100)
Mumps	162 344 (1963-1968)	39 (1963-1968)	212 932 (1964)	50 (1964)	1940s, 1967	6584	0	155 760 (95.9)	39 (100)
Pertussis	200 752 (1934-1943)	4034 (1934-1943)	265 269 (1934)	7518 (1934)	1914-1941	15 632	27	185 120 (92.2)	4007 (99.3)
Poliomyelitis, acute	19 794 (1941-1950)	1393 (1941-1950)	42 033 (1949)	2720 (1949)	1955, 1961-1963, 1987	0	0	19 794 (100)	1393 (100)
Poliomyelitis, paralytic	16 316 (1951-1954)	1879 (1951-1954)	21 269 (1952)	3145 (1952)	1955, 1961-1963, 1987	0	0	16 316 (100)	1879 (100)
Rubella	47 745 (1966-1968)	17 (1966-1968)	488 796 (1964)	24 (1968)	1969	11	0	47 734 (99.9)	17 (100)
Congenital rubella syndrome	152 (1966-1969)	Not available	20 000 (1964-1965)	2160 (1964-1965)	1969	1	0	151 (99.3)	Not available
Smallpox	29 005 (1900-1949)	337 (1900-1949)	110 672 (1920)	2510 (1902)	1798	0	0	29 005 (100)	337 (100)
Tetanus	580 (1947-1949)	472 (1947-1949)	601 (1948)	511 (1947)	1933-1949	41	4	539 (92.9)	468 (99.2)

[a] Footnote letters correspond to Box 1.

2022

Table 1 Recommended Adult Immunization Schedule by Age Group, United States, 2022

Vaccine	19–26 years	27–49 years	50–64 years	≥65 years
Influenza inactivated (IIV4) or **Influenza recombinant** (RIV4)	1 dose annually			
or				
Influenza live, attenuated (LAIV4)	1 dose annually			
Tetanus, diphtheria, pertussis (Tdap or Td)	1 dose Tdap each pregnancy; 1 dose Td/Tdap for wound management (see notes)			
	1 dose Tdap, then Td or Tdap booster every 10 years			
Measles, mumps, rubella (MMR)	1 or 2 doses depending on indication (if born in 1957 or later)			
Varicella (VAR)	2 doses (if born in 1980 or later)		2 doses	
Zoster recombinant (RZV)	2 doses for immunocompromising conditions (see notes)		2 doses	
Human papillomavirus (HPV)	2 or 3 doses depending on age at initial vaccination or condition	27 through 45 years		
Pneumococcal (PCV15, PCV20, PPSV23)	1 dose PCV15 followed by PPSV23 OR 1 dose PCV20 (see notes)			1 dose PCV15 followed by PPSV23 OR 1 dose PCV20
Hepatitis A (HepA)	2 or 3 doses depending on vaccine			
Hepatitis B (HepB)	2, 3, or 4 doses depending on vaccine or condition			
Meningococcal A, C, W, Y (MenACWY)	1 or 2 doses depending on indication, see notes for booster recommendations			
Meningococcal B (MenB)	2 or 3 doses depending on vaccine and indication, see notes for booster recommendations			
	19 through 23 years			
***Haemophilus influenzae* type b** (Hib)	1 or 3 doses depending on indication			

Recommended vaccination for adults who meet age requirement, lack documentation of vaccination, or lack evidence of past infection

Recommended vaccination for adults with an additional risk factor or another indication

Recommended vaccination based on shared clinical decision-making

No recommendation/ Not applicable

2022

Table 2 Recommended Adult Immunization Schedule by Medical Condition or Other Indication, United States, 2022

Vaccine	Pregnancy	Immuno-compromised (excluding HIV infection)	HIV infection CD4 percentage and count		Asplenia, complement deficiencies	End-stage renal disease, or on hemodialysis	Heart or lung disease; alcoholism[1]	Chronic liver disease	Diabetes	Health care personnel[2]	Men who have sex with men
			<15% or <200 mm³	≥15% and ≥200 mm³							
IIV4 or RIV4	1 dose annually										
or										or	
LAIV4	Contraindicated						Precaution			1 dose annually	
Tdap or Td	1 dose Tdap each pregnancy	1 dose Tdap, then Td or Tdap booster every 10 years									
MMR	Contraindicated*	Contraindicated	1 or 2 doses depending on indication								
VAR	Contraindicated*	Contraindicated			2 doses						
RZV		2 doses at age ≥19 years			2 doses at age ≥50 years						
HPV	Not Recommended*	3 doses through age 26 years			2 or 3 doses through age 26 years depending on age at initial vaccination or condition						
Pneumococcal (PCV15, PCV20, PPSV23)		1 dose PCV15 followed by PPSV23 OR 1 dose PCV20 (see notes)									
HepA					2 or 3 doses depending on vaccine						
HepB	3 doses (see notes)	2, 3, or 4 doses depending on vaccine or condition									
MenACWY	1 or 2 doses depending on indication, see notes for booster recommendations										
MenB	Precaution	2 or 3 doses depending on vaccine and indication, see notes for booster recommendations									
Hib		3 doses HSCT[3] recipients only			1 dose						

- Recommended vaccination for adults who meet age requirement, lack documentation of vaccination, or lack evidence of past infection
- Recommended vaccination for adults with an additional risk factor or another indication
- Recommended vaccination based on shared clinical decision-making
- Precaution—vaccination might be indicated if benefit of protection outweighs risk of adverse reaction
- Contraindicated or not recommended—vaccine should not be administered.
  *Vaccinate after pregnancy.
- No recommendation/ Not applicable

1. Precaution for LAIV4 does not apply to alcoholism. **2.** See notes for influenza; hepatitis B; measles, mumps, and rubella; and varicella vaccinations. **3.** Hematopoietic stem cell transplant.

Influenza

Globally,

- **$3\text{-}5 \times 10^6$ severe cases/year**
- **250,000-500,000 deaths/year**

In US, 10,000-60,000 deaths/yr

>90% deaths in industrialized world in individuals >65 years of age

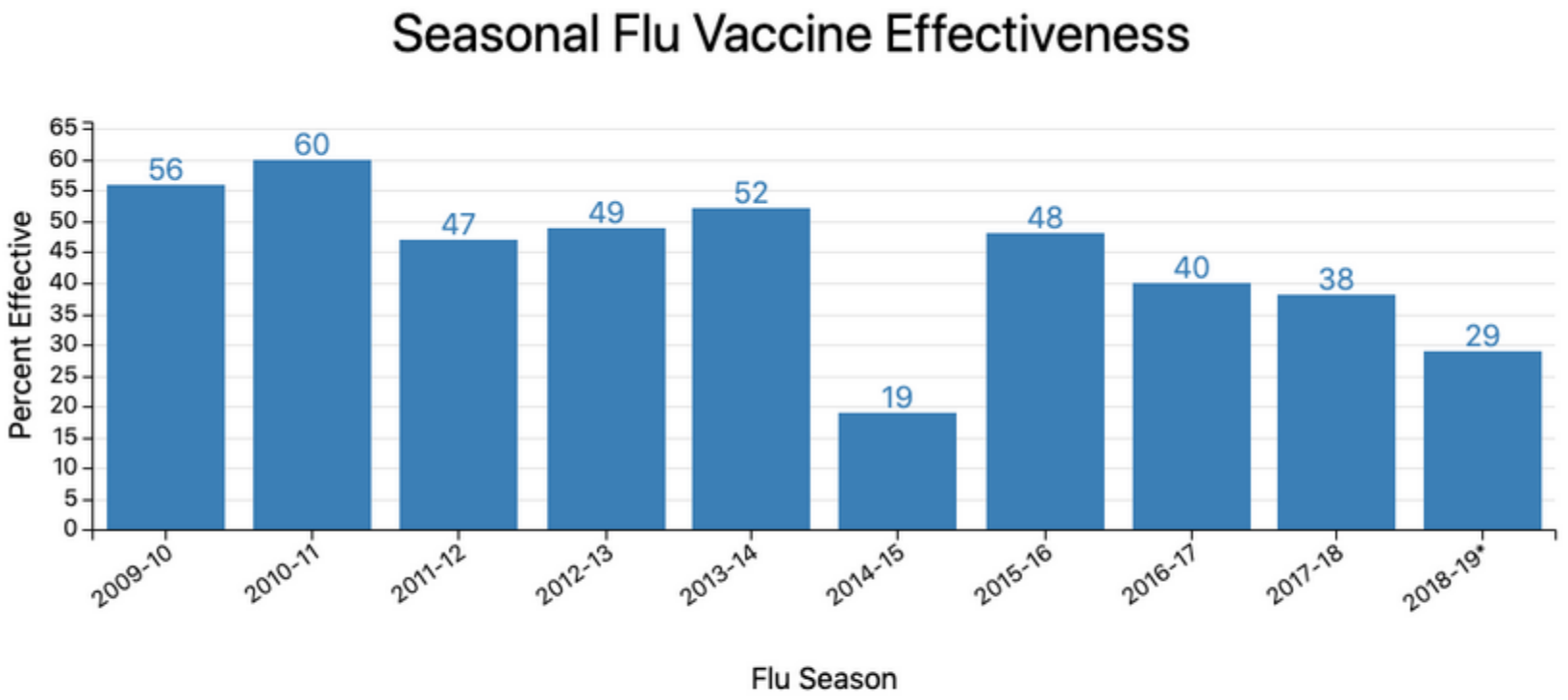
Vaccine provides:

- **30-40% reduction in illness**
- **50-60% reduction in hospitalization**
- **80% reduction in ICU**

In US, only 60-70% individuals >65 yoa immunized, and 20-45% of high risk younger individuals;

40% overall

Northern hemisphere, Southern hemisphere, equator



Data Table

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Adj. Overall VE (%)	56	60	47	49	52	19	48	40	38

2018-19: all ages, all flu 29%; 44% VE H1N1

https://www.cdc.gov/flu/professionals/vaccination/effectiveness-studies.htm

Many options

Quadrivalents: 2 As 2 Bs

2021–22 season are quadrivalent, containing hemagglutinin (HA) derived from one influenza A(H1N1)pdm09 virus, one influenza A(H3N2) virus, one influenza B/Victoria lineage virus, and one influenza B/Yamagata lineage virus

IIV4, RIV4, LAIV4

High dose, standard dose

Adjuvanted, unadjuvanted

Avoid LAIV in immunocompromised

Quadrivalent flu vaccines include:

- **Quadrivalent flu shots approved for use in different age groups, including children as young as 6 months.**
- **An intradermal quadrivalent flu shot, which is injected into the skin instead of the muscle and uses a much smaller needle than the regular flu shot. It is approved for people 18 through 64 years of age.**
- **A quadrivalent flu shot containing virus grown in cell culture, which is approved for people 4 years of age and older.**
- **A recombinant quadrivalent flu shot approved for people 18 years of age and older, including pregnant women (new this season).**
- **LAIV4: live attenuated influenza quadrivalent vaccine (nasal)**

Vaccinate

Immunize all >6 months of age annually

There were two new vaccines licensed for use during the 2020-2021 flu season.

The first is a quadrivalent high-dose vaccine licensed for use in adults 65 years and older. This vaccine replaces the previously licensed trivalent high-dose vaccine.

The second new vaccine is a quadrivalent adjuvanted vaccine licensed for use in adults 65 years and older.

This vaccine is similar to the previously licensed trivalent vaccine containing MF59 adjuvant, but it has one additional influenza B component.

Pneumococcal

PPV23: (pneumococcal polysaccharide vaccine 23)

Adult vaccine

60-80% protective against invasive disease;

no effect on mortality?

Only ~65% individuals >65 yoa immunized, and <20% of high risk younger individuals

PCV13: (pneumococcal conjugate vaccine 13) (Childhood and FDA approved for use in adults in 2011; ACIP recommendation for adults 2012; broadened to all ≥65 in 2014); (partially curtailed 2019)

PCV15 and PCV20: for adults ACIP Oct 2021.

New recs

Age 65 years or older or 19-64 with certain underlying conditions who have not previously received a pneumococcal conjugate vaccine or whose previous vaccination history is unknown:

- 1 dose PCV20 or
- 1 dose PCV15 followed by a dose of PPSV23 given at least 1 year after the PCV15 dose. A minimum interval of 8 weeks between PCV15 and PPSV23 can be considered for adults with an immunocompromising condition,* cochlear implant, or cerebrospinal fluid leak to minimize the risk of invasive pneumococcal disease caused by serotypes unique to PPSV23 in these vulnerable groups.

If already received

- Adults with previous PPSV23 only. Adults who have only received PPSV23 may receive a PCV (either PCV20 or PCV15) ≥1 year after their last PPSV23 dose. When PCV15 is used in those with history of PPSV23 receipt, it need not be followed by another dose of PPSV23.
- Adults with previous PCV13. The incremental public health benefits of providing PCV15 or PCV20 to adults who have received PCV13 only or both PCV13 and PPSV23 have not been evaluated. These adults should complete the previously recommended PPSV23 series (or PCV20 if PSV23 not available)
- Coadministration with other vaccines. PCV15, PCV20, or PPSV23 can be coadministered with QIV in an adult immunization program, Currently, no data are available on coadministration with other vaccines (e.g., tetanus, diphtheria, acellular pertussis vaccine, hepatitis B, or zoster vaccine) among adults. Evaluation of coadministration of PCV15, PCV20, or PPSV23 with COVID-19 vaccines is ongoing (34,35).

TABLE 1. Recommendations for use of 15-valent pneumococcal conjugate vaccine in series with 23-valent pneumococcal polysaccharide vaccine or 20-valent pneumococcal conjugate vaccine in pneumococcal conjugate vaccine-naïve adults aged ≥19 years — United States, 2022

Medical indication group	Specific underlying medical condition	Age group, yrs	
		19–64	≥65
None	None	None	1 dose of PCV20 or 1 dose of PCV15 followed by a dose of PPSV23 ≥1 years later*
Underlying medical conditions or other risk factors	Alcoholism Chronic heart disease† Chronic liver disease Chronic lung disease¶ Cigarette smoking Diabetes mellitus Cochlear implant CSF leak Congenital or acquired asplenia Sickle cell disease or other hemoglobinopathies Chronic renal failure** Congenital or acquired immunodeficiencies**,†† Generalized malignancy** HIV infection** Hodgkin disease** Iatrogenic immunosuppression**,§§ Leukemia** Lymphoma** Multiple myeloma** Nephrotic syndrome** Solid organ transplant**	1 dose of PCV20 or 1 dose of PCV15 followed by a dose of PPSV23 ≥1 years later§	1 dose of PCV20 or 1 dose of PCV15 followed by a dose of PPSV23 ≥1 years later*

Abbreviations: CSF = cerebrospinal fluid; PCV15 = 15-valent pneumococcal conjugate vaccine; PCV20 = 20-valent pneumococcal conjugate vaccine; PPSV23 = 23-valent pneumococcal polysaccharide vaccine.

* Adults with immunocompromising conditions, cochlear implant, or CSF leak might benefit from shorter intervals such as ≥8 weeks. These vaccine doses do not need to be repeated if given before age 65 years.
† Includes congestive heart failure and cardiomyopathies.
§ Adults with immunocompromising conditions, cochlear implant, or CSF leak might benefit from shorter intervals such as ≥8 weeks.
¶ Includes chronic obstructive pulmonary disease, emphysema, and asthma.
** Indicates immunocompromising conditions.
†† Includes B- (humoral) or T-lymphocyte deficiency, complement deficiencies (particularly C1, C2, C3, and C4 deficiencies), and phagocytic disorders (excluding chronic granulomatous disease).
§§ Diseases requiring treatment with immunosuppressive drugs, including long-term systemic corticosteroids and radiation therapy.

Routine Immunizations

Influenza

Pneumococcal

MMR

Tdap-T/d

Hepatitis B

Varicella and Shingles

Polio

HPV

MMR: Measles-mumps-rubella

Global and local

Measles update

< 1957 immune (unless born overseas, healthcare)

> 1957, 2 MMR: Measles

1963-67 (unknown type)

Students post secondary

Health care workers

Travel

Outbreaks

Mumps

- **≥ 1957: 2 MMR: Mumps**
  - **Students (K-12)**
  - **Health care**
  - **Travel**
  - **Outbreaks, 2 doses 85-90% protective**

Rubella

- **1 MMR**
- **Check rubella status childbearing age**

Tdap (tetanus-diphtheria-pertussis); Td

- **At least one Tdap at or after age 11 yoa, then Tdap or Td every 10 years.**
- **Give to all pregnant women during EACH pregnancy. Optimal timing is between 27 and 36 weeks gestation to maximize the maternal antibody response and passive antibody transfer to the infant.**
- **Tdap can be administered regardless of interval since the most recent tetanus or diphtheria-containing vaccine (can be same day).**

Routine Immunizations

Influenza

Pneumococcal

MMR

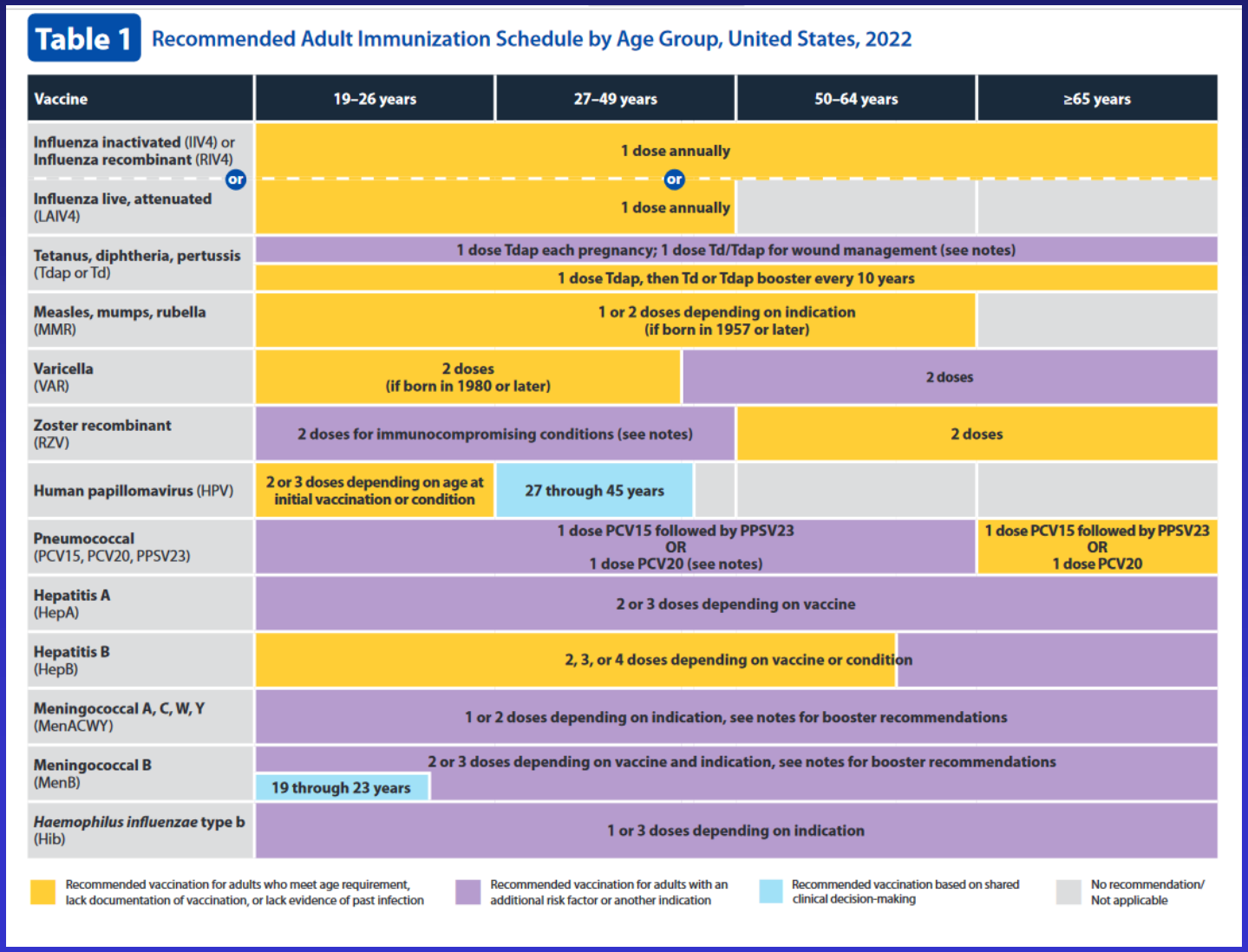
Tdap-T/d

Hepatitis B

HPV (Human papilloma virus)

Varicella and Shingles

2022: Hepatitis B now universal <60



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	1 dose Tdap, then Td or Tdap booster every 10 years			
Measles, mumps, rubella (MMR)	1 or 2 doses depending on indication (if born in 1957 or later)			
Varicella (VAR)	2 doses (if born in 1980 or later)		2 doses	
Zoster recombinant (RZV)	2 doses for immunocompromising conditions (see notes)		2 doses	
Human papillomavirus (HPV)	2 or 3 doses depending on age at initial vaccination or condition	27 through 45 years		
Pneumococcal (PCV15, PCV20, PPSV23)	1 dose PCV15 followed by PPSV23 OR 1 dose PCV20 (see notes)			1 dose PCV15 followed by PPSV23 OR 1 dose PCV20
Hepatitis A (HepA)	2 or 3 doses depending on vaccine			
Hepatitis B (HepB)	2, 3, or 4 doses depending on vaccine or condition			
Meningococcal A, C, W, Y (MenACWY)	1 or 2 doses depending on indication, see notes for booster recommendations			
Meningococcal B (MenB)	2 or 3 doses depending on vaccine and indication, see notes for booster recommendations			
	19 through 23 years			
***Haemophilus influenzae* type b** (Hib)	1 or 3 doses depending on indication			

Recommended vaccination for adults who meet age requirement, lack documentation of vaccination, or lack evidence of past infection

Recommended vaccination for adults with an additional risk factor or another indication

Recommended vaccination based on shared clinical decision-making

No recommendation/ Not applicable

Hepatitis B vaccination

Routine vaccination

- **Age 19 through 59 years:** complete a 2- or 3-, or 4-dose series
  - 2-dose series only applies when 2 doses of Heplisav-B* are used at least 4 weeks apart
  - 3-dose series Engerix-B or Recombivax HB at 0, 1, 6 months [minimum intervals: dose 1 to dose 2: 4 weeks / dose 2 to dose 3: 8 weeks / dose 1 to dose 3: 16 weeks])
  - 3-dose series HepA-HepB (Twinrix at 0, 1, 6 months [minimum intervals: dose 1 to dose 2: 4 weeks / dose 2 to dose 3: 5 months])
  - 4-dose series HepA-HepB (Twinrix) accelerated schedule of 3 doses at 0, 7, and 21–30 days, followed by a booster dose at 12 months
  - 4-dose series Engerix-B at 0, 1, 2, and 6 months for persons on adult hemodialysis (note: each dosage is double that of normal adult dose, i.e., 2 mL instead of 1 mL)

***Note**: Heplisav-B not recommended in pregnancy due to lack of safety data in pregnant women

- **Age 60 years or older* and at risk for hepatitis B virus infection:** 2-dose (Heplisav-B) or 3-dose (Engerix-B, Recombivax HB) series or 3-dose series HepA-HepB (Twinrix) as above
    - **Chronic liver disease** (e.g., persons with hepatitis C, cirrhosis, fatty liver disease, alcoholic liver disease, autoimmune hepatitis, alanine aminotransferase [ALT] or aspartate aminotransferase [AST] level greater than twice upper limit of normal)
    - **HIV infection**
    - **Sexual exposure risk** (e.g., sex partners of hepatitis B surface antigen [HBsAg]-positive persons; sexually active persons not in mutually monogamous relationships; persons seeking evaluation or treatment for a sexually transmitted infection; men who have sex with men)
    - **Current or recent injection drug use**
    - **Percutaneous or mucosal risk for exposure to blood** (e.g., household contacts of HBsAg-positive persons; residents and staff of facilities for developmentally disabled persons; health care and public safety personnel with reasonably anticipated risk for exposure to blood or blood-contaminated body fluids; hemodialysis, peritoneal dialysis, home dialysis, and predialysis patients; patients with diabetes)
    - **Incarcerated persons**
    - **Travel in countries with high or intermediate endemic hepatitis B**

***Note**: Anyone age 60 years or older who does not meet risk-based recommendations may still receive Hepatitis B vaccination.

HepB-CpG (Heplisav-B)

- Yeast derived HepBsAg
- CpG TLR9 adjuvant
- Seroprotective anti-HBs levels were achieved in 90%–100% of subjects receiving HepB-CpG, compared with 71%–90% of subjects receiving Engerix-B (MMWR)
- Two dose: 0 and 1 month

PreHevBrio

- HepB: 0, 1, 6
- 3 dose vaccine, Adjuvanted
- 3 antigens (S, pre-S2, and pre-S1 HBV surface antigens)
- ≥18 yoa
- 2022

Updates: HPV9

- **11/2018: now all females and males 9-45 years of age; 2 or 3 dose series depending on age**
- **9-26yoa recommended**

- **0, 1-2 months, 6 months**
- **If received 2 doses at least five months apart initiated before age 15 can get 2 dose regimen**

- **ACIP recommends vaccination based on "shared clinical decision making" for individuals aged 27 through 45 years who are not adequately vaccinated. HPV vaccines are not licensed for use in adults older than age 45 years**

Varicella:

Live viral vaccine

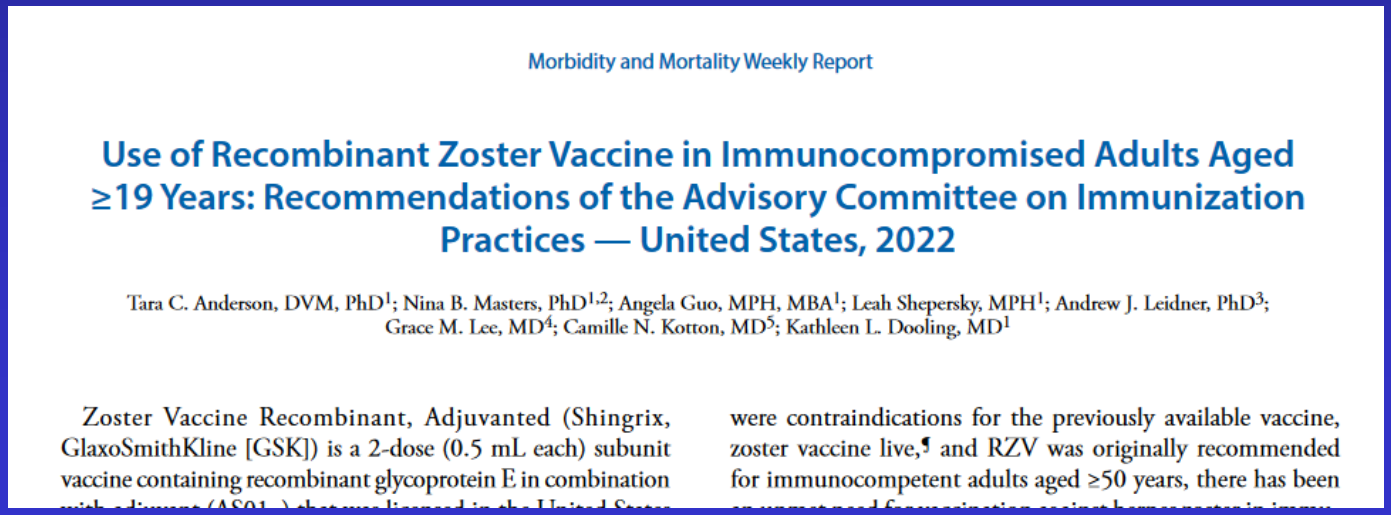
Two doses if not immune (0, 4-8 weeks later); 2 doses born 1980 or later

97% reduction in deaths due to varicella

Shingles (Zostavax [ZVL OFF MARKET 11/2020] and Shingrix [RZV])

Age 50 years or older: 2-dose series RZV (Shingrix) 2–6 months apart (minimum interval: 4 weeks; repeat dose if administered too soon), regardless of previous herpes zoster or history of zoster vaccine live (ZVL, Zostavax) vaccination (administer RZV at least 2 months after ZVL but all ZVL should be gone by now)

- **ACIP 2022**
- **<50 and "immunosuppressed or becoming** immunosuppressed"



Morbidity and Mortality Weekly Report

Use of Recombinant Zoster Vaccine in Immunocompromised Adults Aged ≥19 Years: Recommendations of the Advisory Committee on Immunization Practices — United States, 2022

Tara C. Anderson, DVM, PhD[1]; Nina B. Masters, PhD[1,2]; Angela Guo, MPH, MBA[1]; Leah Shepersky, MPH[1]; Andrew J. Leidner, PhD[3]; Grace M. Lee, MD[4]; Camille N. Kotton, MD[5]; Kathleen L. Dooling, MD[1]

Zoster Vaccine Recombinant, Adjuvanted (Shingrix, GlaxoSmithKline [GSK]) is a 2-dose (0.5 mL each) subunit vaccine containing recombinant glycoprotein E in combination

were contraindications for the previously available vaccine, zoster vaccine live,[¶] and RZV was originally recommended for immunocompetent adults aged ≥50 years, there has been

CDC ACIP

•Care should be taken not to confuse the two different zoster vaccine formulations. RZV (Shingrix) (two dose) is stored in the refrigerator and administered intramuscularly (IM). ZVL (Zostavax) one dose is stored in the freezer and administered subcutaneously (SC).

•Reconstitution. Shingrix consists of a lyophilized vaccine which needs to be reconstituted with the liquid adjuvant.

•Schedule. 2 doses should be administered IM at 0 and 2-6 months. The vaccine series need not be restarted if more than 6 months have elapsed since the first dose. The minimum interval between doses is 4 weeks and doses given at shorter intervals should be repeated.
Shingrix can be given regardless of: 1) prior receipt of varicella vaccine; 2) prior receipt of ZVL; and 3) prior history of herpes zoster. Do not screen for a history of varicella (verbally or via laboratory serology).

Meningococcal vaccine

- **Quadrivalent (A/C/Y/W-135)**
- **Polysaccharide (MSV4) replaced with conjugate (MCV4) 2017**
- **A 2-dose MCV4 series of meningococcal conjugate vaccine is recommended for adults with anatomic or functional asplenia, HIV, or persistent complement component deficiencies (including eculizumab, ravulizumab) (0 and 2 months).**
- **Single dose (MCV4) for unvaccinated college students, travelers to meningitis belt, Hajj, others at risk.**
- **Revaccinate every 5 years if risk ongoing.**
- **Meningococcal B vaccine FDA approved late 2014 (3 dose); and Jan 2015 (2 dose)**

Meningitis B

ACIP Recommends for patients:

- **Aged ≥10 years who are at increased risk for meningococcal disease should receive MenB vaccine. These patients include:**
  - **Patient with persistent complement component deficiencies (including: inherited or chronic deficiencies in C3, C5-9, properdin, factor D, factor H, or taking eculizumab or ravulizumab)**
  - **Patient with anatomic or functional asplenia**
  - **Microbiologists routinely exposed to isolates of *Neisseria meningitidis***
  - **Patient identified as at increased risk because of a serogroup B meningococcal disease outbreak**

  - **ACIP recommends MenB booster doses for previously vaccinated persons who become or remain at increased risk (Single dose at 1 yr after completion of primary vaccination and every 2–3 yrs thereafter)**

  - **ACIP recommends a MenB series for adolescents and young adults aged 16–23 years on the basis of shared clinical decision-making to provide short-term protection against disease caused by most strains of serogroup B *N. meningitidis*.**

Haemophilus influenzae type b (Hib) vaccination

- **One dose of Hib vaccine should be administered to persons who have functional or anatomic asplenia or sickle cell disease or are undergoing elective splenectomy if they have not previously received Hib vaccine. Hib vaccination 14 or more days before splenectomy is suggested.**
- **Hib vaccine is not recommended for adults with HIV infection since their risk for Hib infection is low.**

Travel or special immunizations

Hepatitis A

Yellow fever

Polio

Typhoid

Cholera

Rabies

Dengue

Japanese Encephalitis

Tick borne Encephalitis

Hepatitis A vaccine:

- Inactivated virus
- 2 doses: 0, 6-18 months
- No booster currently recommended
- 95% with immunity after 4 weeks
- Combination hepatitis A & B vaccines available

Hepatitis A

- Chronic liver disease
- HIV infection
- Men who have sex with men
- Injection or noninjection drug use
- Persons experiencing homelessness
- Work with hepatitis A virus
- Travel in countries with high or intermediate endemic hepatitis A
- Close, personal contact with international adoptee (e.g., household or regular babysitting) in first 60 days after arrival

Updates HAV

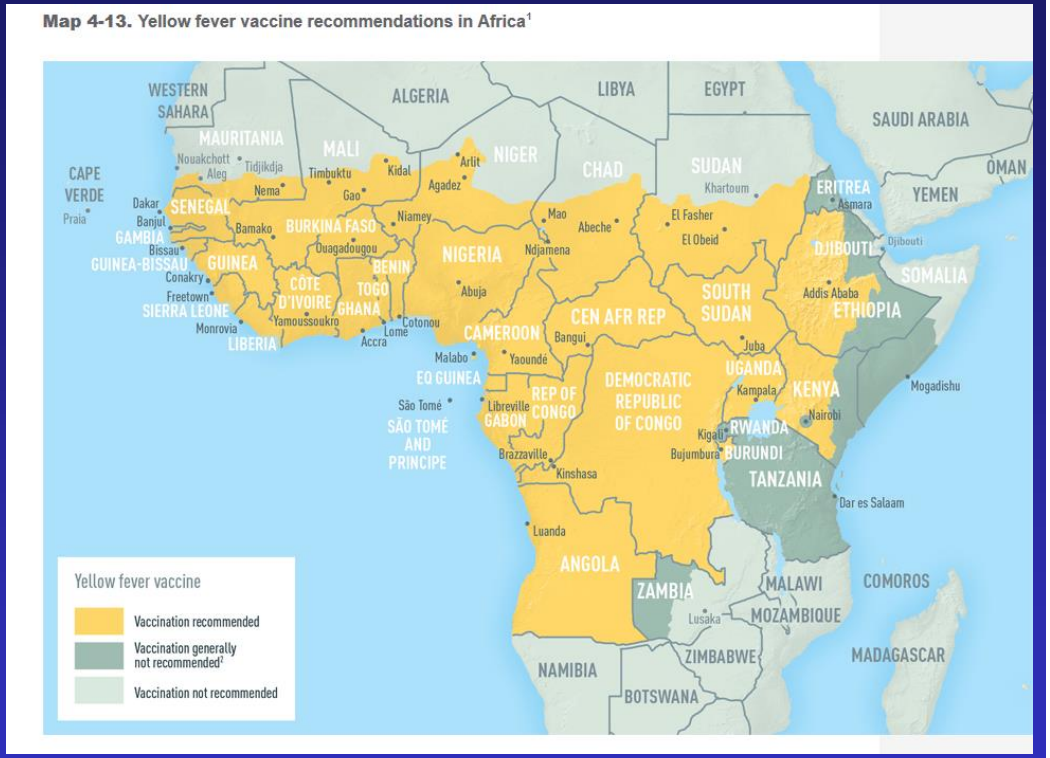
- **For PRE-exposure, can give vaccine now as young as vaccine can be given ≥6moa (but does not count toward 2 dose regimen)**
- **For POST exposure, the age 40y upper limit for using vaccine has been removed, and now can give hepA vaccine after exposure, with clinical discretion of also giving immunoglobulin (for instance if chronic liver disease or immunocompromised etc)**

- **Gamma globulin dose increased from 0.02 ml/kg for 1 month protection to 0.1 ml/kg for one month protection**
- **7 ml IM injection for 70 Kg adult!**

Yellow fever vaccine

- Live attenuated 17D viral-strain vaccine
- Administered through WHO
  - Yellow Fever Vaccinating Centres
- Waiver can be issued (pregnant, immunocompromised, egg anaphylaxis)
- 1 dose; booster after 10 years
- Controversies/new data
  - 1:15,000-50,000 risk death if >60yoa
- Viscerotropic and neurotropic adverse events

Yellow fever distribution, CDC 2020



SAGE-WHO: no 10 year boosters

CDC Yellow Book yellow fever vaccine requirement and recommendation, by country

Display only: [All] Go >

Afghanistan

Yellow Fever

Requirements: Required if traveling from a country with risk of YFV transmission.[a]
Recommendations: None

Malaria

Areas with malaria: April–December in all areas <2,000m (<6,561ft).
Estimated relative risk of malaria for US travelers: High[b]
Drug resistance[c]: Chloroquine
Malaria species: *P. vivax* 80%-90%, *P. falciparum* 10%-20%.
Recommended chemoprophylaxis: Atovaquone-proguanil, doxycycline, or mefloquine.

Albania

Yellow Fever

Requirements: Required if traveling from a country with risk of YFV transmission and ≥1 year of age.[a]
Recommendations: None

Malaria

No malaria transmission.

Algeria

Yellow Fever

Requirements: Required if traveling from a country with risk of YFV transmission and ≥1 year of age.[a]
Recommendations: None

Malaria

No malaria transmission.

Niger

Yellow Fever

Requirements: Required upon arrival from all countries if traveler is ≥1 year of age. The government of Niger recommends vaccine for travelers departing Niger.
Recommendations:
Recommended for all travelers ≥9 months of age traveling to areas south of the Sahara Desert (see Map 3-18).
Not recommended for travelers whose itineraries are limited to areas in the Sahara Desert (see Map 3-18).

Malaria

Areas with malaria: All
Estimated relative risk of malaria for US travelers: High
Drug resistance[c]: Chloroquine
Malaria species: *P. falciparum* 85%, *P. ovale* 5%–10%, *P. vivax* rare.
Recommended chemoprophylaxis: Atovaquone-proguanil, doxycycline, or mefloquine.

Nigeria

Yellow Fever

Requirements: Required if traveling from a country with risk of YFV transmission and ≥1 year of age.[a]
Recommendations: ***Recommended*** for all travelers ≥9 months of age.

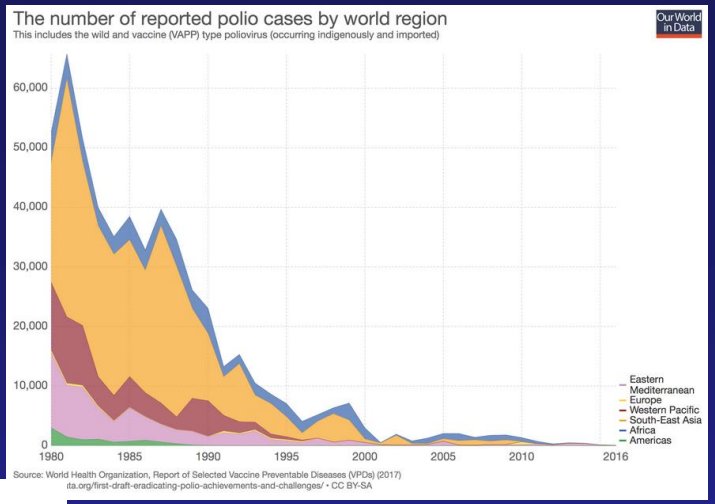
Malaria

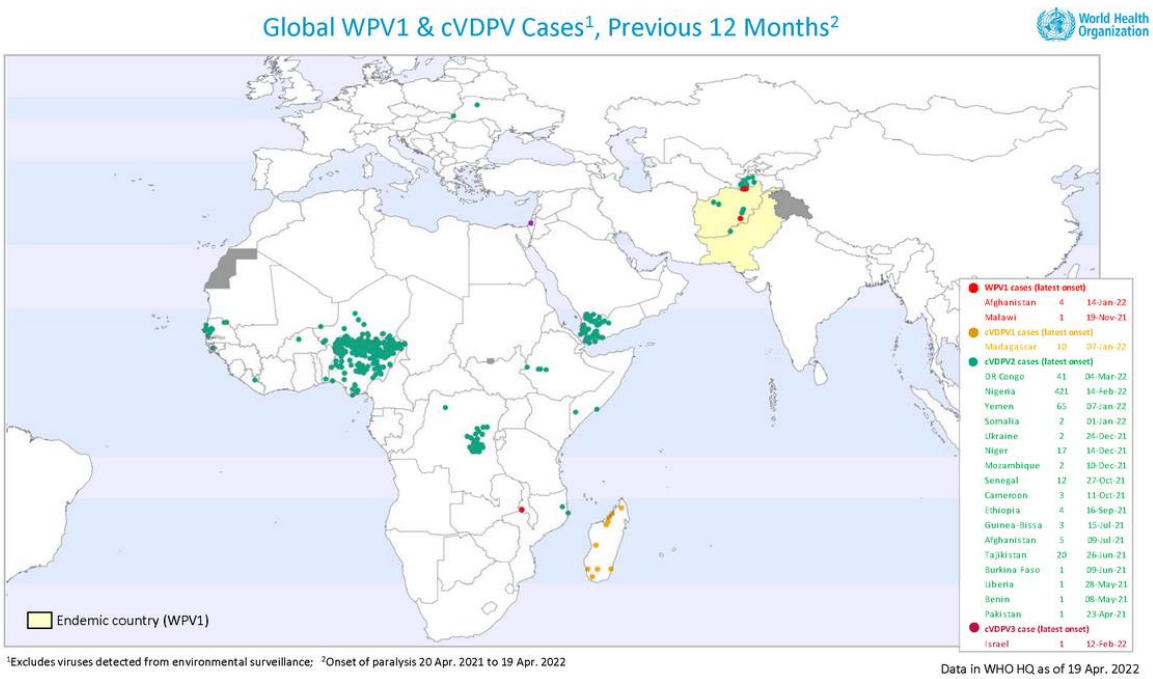
Areas with malaria: All
Estimated relative risk of malaria for US travelers: High
Drug resistance[c]: Chloroquine
Malaria species: *P. falciparum* 85%, *P. ovale* 5%–10%, *P. vivax* rare.
Recommended chemoprophylaxis: Atovaquone-proguanil, doxycycline, or mefloquine.

Expanded Access Program (EAP): Yellow Fever Vaccine

- No YF-Vax (Sanofi) in U.S. till "mid-2019"
- IND EAP to use Stamaril (Sanofi) European vaccine x 3 years
- 250 Sites (from 4000); IRB approval, Informed Consents
- Now over, but between EAP and COVID many YF clinics now closed

Polio



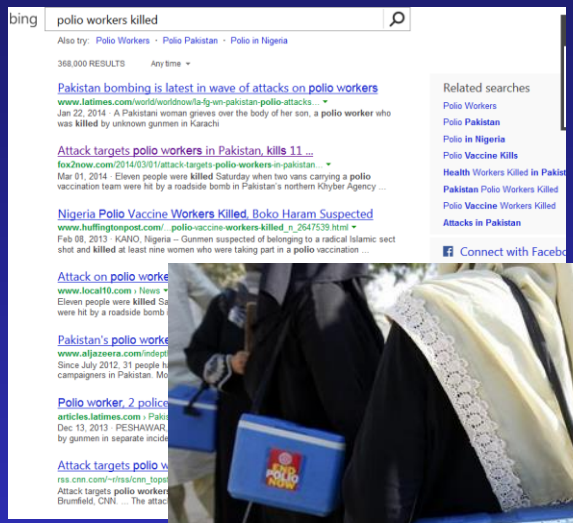


www.npr.org

WHO

WHO: birth dose bOPV (no 2), then 3 bOPV and one tIPV (6, 10, 14 wks)

Vaccine workers killed



2013: 24 killed
2014: 89 killed
(80 Pakistan; 9 Nigeria)
2015 >4
2016>23
2017>2
2018>5
2019>4
2020>1
2021>4

More people now dying giving polio vaccine, than from polio itself

Adult polio booster

What is the current situation?

The following destinations in Africa are currently considered high risk for polio (see map):

- Benin
- Burkina Faso
- Cameroon
- Central African Republic
- Chad
- Democratic Republic of the Congo
- Djibouti
- Egypt (healthcare facilities, refugee camps, and humanitarian aid settings only)
- Ethiopia
- Gambia
- Guinea
- Guinea-Bissau
- Liberia
- Madagascar
- Malawi
- Mauritania
- Mozambique
- Niger
- Nigeria
- Republic of the Congo
- Senegal
- Sierra Leone
- Somalia
- South Sudan
- Uganda

Map: Countries in Africa where a booster dose of polio vaccine is recommended before travel (see larger map)

booster dose of polio vaccine.

- Destinations in Asia and Eastern Europe currently considered high risk for polio are listed below.

What is the current situation?

The following destinations in Asia and Eastern Europe are currently considered high risk for polio (see map):

- Afghanistan
- Iran (healthcare facilities, refugee camps, and humanitarian aid settings only)
- Israel
- Occupied Palestinian Territories
- Pakistan
- Tajikistan
- Ukraine
- Yemen

Map: Countries in Asia and Eastern Europe where a booster dose of polio vaccine is recommended before travel (see larger map)

Typhoid

- Salmonella enterica serovar Typhi
- Risk: 3-30/100,000 month in developing nation
- Higher risk groups:
  - ≥ 3-4 weeks travel
  - Off usual tourist route
  - Staying with family/friends
  - South Asia
  - Backpackers

Typhoid

Also consider typhoid vaccine if immunocompromised/severe atherosclerotic disease/internal prosthesis/cholelithiasis

All typhoid vaccines are 50-80% effective:

Oral Ty21a, attenuated strain (off market)
Typhim Vi polysaccharide

(globally: typhoid conjugate vaccine; not in US)

Rabies vaccines:

1-2% risk of animal bite/year in developing countries

Optimal post-exposure prophylaxis often unavailable overseas (HRIG; tissue culture-derived vaccines)

Long-term travelers, unavoidable animal contact, unable to receive timely PEP, unable to report problem (young children)

Rabies vaccines: (cell cultured derived)

HDCV, human diploid-cell vaccine

RVA, rabies vaccine adsorbed

PCEC, purified chick embryo cell culture vaccine

All ages

Pre-exposure: 3 doses; 0, 7, 21 or 28 days
(ACIP 2021 voted to change to day 0 and 7 if immunocompetent and >=18 yoa; if protection wanted longer than 36 months can give #3 "booster" 21 days to 35 months after #2)

Post-exposure: 4-5 dose schedule; 0, 3, 7, 14, (28) (immunocompetent, HDCV, PCEC)

Japanese encephalitis:

Viral infection, day-biting mosquitoes

Rural Asia

Risk 0.1/100,000 clinical encephalitis

Target population:

- **Prolonged rural exposure, especially during peak transmission season**

JE Vaccines in US

- **IXIARO: Cell culture derived**
- **2 dose (d0, d28)**

(*Update 2018 (d0, d7) adults 18-65 yoa*)

1 year Booster (long term)

2 months-<3 years: 0.25 ml

>3 years of age: 0.5 ml

Cholera Vaccine

- CVD 103 HgR; VaxChora
- Currently off market
- Single dose live attenuated vaccine strain.
- ≥2 yoa, not immunocompromised
- HIGH risk of cholera (not typical traveler)
- ACIP Recommendations MMWR
- Protection for at least 3 months
- No info on boosters

Dengue Vaccine

- Quadrivalent; live attenuated (17D backbone)
- 0, 6, 12 months
- Efficacy: 50-80% depending on metric
- Increases risk of severe disease in children never previously exposed to dengue
- FDA approved USA April 2019
- 9-16 years of age (do not use off label; FDA rejected application for use 9-45 yoa)
- Only in areas with prevalent disease (Puerto Rico, USVI, American Samoa)
- Only if CONFIRMED previous case of dengue

Tick-borne encephalitis (TBE)

- **USDA 2021 approved Ticovac TM use >=1yoa (available x 20 years in Europe)**
- **ACIP 2/2022 approved**
- **The risk for TBE is very low for most travelers visiting countries where TBE is found. However, travelers are at increased risk if they plan to:**
- **Visit areas with TBE when ticks are most active (April through November)**
- **Take part in outdoor activities in or near forested areas such as hiking, camping, hunting, fishing, or birdwatching.**

General distribution of tick-borne encephalitis (TBE) virus: Country-specific risk information provided below the map

Country-specific risk information (*as of March 7, 2022*)

The information should be interpreted cautiously because TBE virus transmission can be highly variable within risk areas and from year to year. Additional information is available on websites or publications from national authorities in some TBE-endemic countries.

Country	Risk information
Austria	Focally endemic throughout country. Highly endemic regions include Burgenland, Carinthia, Styria, Tyrol, and Vorarlberg States.
Belarus	Almost all of the country considered endemic; no TBE virus detected in some small geographically dispersed areas

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Original Article

Original Article

Tick-borne encephalitis among US travellers, 2010–20

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Tick-borne encephalitis vaccination schedule

	PRIMARY VACCINATION SCHEDULE			
	DOSE 1	DOSE 2	DOSE 3	BOOSTER
ADULTS (≥ 16 YEARS)	Day 0	14 days–3 months	5–12 months	A fourth dose may be given at least 3 years after completion of the primary vaccination schedule if ongoing exposure or re-exposure to tick-borne encephalitis is expected
CHILDREN (1–15 YEARS)	Day 0	1–3 months	5–12 months	

2010-2020: 6 cases (5 recovered with varying lengths equelae)
25 M US travel to Europe each year
6/275M: 1 in 40-50M

2017 Combined ... | Influenza vaccin... | Progress Toward... | Polio Now – GPEI | death of polio w...

linghomehealthy.org 70% Search

Getting Started | eCommons | Web Slice Gallery | NYT > Home Page | New Bookmark

Massachusetts General Hospital Language: English

HEADING HOME HEALTHY

FOR THE TRAVELER | FOR THE CLINICIAN | OUR PARTNERS | TRAVEL HEALTH STORIES

Planning A Trip?

Use TRhIP to ensure a safe trip for you and your loved ones. It's a fast and free way to get personalized travel health advice based on the latest CDC recommendations.

Get Advice

En Français | En Español | Em Português do Brasil

An Kreyòl Ayisyen | বাংলায় | अभिव्यक्ति | 中文 | اللغة العربي

HEADING HOME HEALTHY

FOR THE TRAVELER

Health advice for safe travel based on the recommendations of the U.S. Centers for Disease Control and Prevention

FOR THE CLINICIAN

An interactive tool that guides you through preparing a U.S. traveler for a safe and healthy international trip.

Global TravEpiNet
A National Consortium of Travel Health Providers

Pre-Travel Providers' Rapid Evaluation Portal (Pre-Travel PREP)

Welcome to Pre-travel PREP! Pre-Travel PREP is a free clinical tool that guides you through preparing a US traveler for a safe and healthy international trip. It was developed to act as an interactive Yellow Book (Health Information for International Travel), and its output is based on the recommendations of the US Centers for Disease Control and Prevention. PREP is continuously updated as new recommendations arise. Its development is supported by the Massachusetts General Hospital and the CDC.

1 Provider information

Please provide information about yourself:

* Indicates a required question

Which of the following best describes you? *

Which of the following best describes your type of practice? *

Please provide your US ZIP code (use "99999" if not in US): *

If you do not practice in the U.S., please select your country:

Use a cookie to store the previous answers

2 Traveler information

Please provide information about the traveler:

How old is the traveler? *

years (for children < 1 year, please enter age in months: months)

- 36 yo pregnant VFR female traveling to Nigeria

https://gten.travel/prep/prep

MASSACHUSETTS GENERAL HOSPITAL

MASS GENERAL HOME

Global TravEpiNet
A National Consortium of Travel Health Providers

Pre-Travel Providers' Rapid Evaluation Portal (Pre-Travel PREP)

Customized clinical guidance for this traveler

Based on the following information about the traveler, Pre-Travel PREP makes the recommendations outlined below.

The traveler is a 36-year-old female who is traveling to Nigeria.

The traveler reported being pregnant. *Travelers with a complicated medical history or itinerary may benefit from consulting a travel medicine specialist. The CDC maintains a list of travel medicine providers.*

CDC COVID-19 related travel recommendations.

Vaccinations

☑ **ROUTINE VACCINATIONS**

Warning: The traveler is pregnant. Live-virus vaccines, such as MMR, are contraindicated during pregnancy. See Guidelines for Vaccination in Pregnancy.

The U.S. is presently experiencing a high number of measles cases. All travelers should be up-to-date on MMR vaccinations before international travel.

All travelers should be up-to-date for routine vaccines such as tetanus-diphtheria-pertussis (Tdap),… more

☑ **YELLOW FEVER**

Warning: The traveler is pregnant. Yellow fever vaccine is usually contraindicated during pregnancy. Consultation with a travel medicine specialist may be useful. See Pregnancy and the Yellow Fever Vaccine.

Yellow fever vaccine is recommended for people who are traveling to **Nigeria**. Yellow fever… more

☑ **HEPATITIS A VACCINE**

Zika
- CDC current Zika information page
- Geographic distribution of Zika
- Zika Travel Information
- Zika information map

☑ **MALARIA**

Malaria chemoprophylaxis is recommended for travelers to **Nigeria**.

Pre-Travel PREP recommends the following choices of anti-malarial medications. If more than four weeks' worth of medication is required, prescriptions should note that the traveler will be overseas and unable to obtain refills so that the pharmacy will dispense sufficient medication for the entire trip.

Mefloquine

Mefloquine prophylaxis (250 mg salt weekly for adults) should begin ≥ 2 weeks before travel to… more

Caution: the FDA has added a boxed warning to the drug label for mefloquine regarding possible neurologic side effects.

- Malaria
- Malaria Information by Country
- Drugs Used in the Prophylaxis of Malaria
- Map of Malaria in the Western Hemisphere
- Map of Malaria in the Eastern Hemisphere

Preventing food-borne illness

Travelers should wash their hands often with soap and water, especially before eating. If soap and water are not available, they should use an alcohol-based hand gel (with at least 60% alcohol). Travelers should only drink beverages that have been bottled and sealed, and they should eat food that is fully cooked and served hot. Self-treatment with an antibiotic directed at bacterial causes of diarrhea can shorten the duration of illness and is useful for some travelers.

HEADING HOME HEALTHY

Liste de contrôle pour voyager en bonne santé

Voici quelques conseils importants pour vous aider à rester en bonne santé pendant votre voyage !

Pour en savoir plus sur les voyages à l'étranger, consultez le site : *wwwnc.cdc.gov/travel* OU *www.headinghomehealthy.org*

HEADING HOME HEALTHY

Pendant votre voyage

① Prenez vos médicaments

- ✓ Prenez tous les médicaments que vous avez l'habitude de prendre chez vous.
- ✓ Prenez votre médicament contre le paludisme (si votre médecin l'a prescrit). Vous devez prendre tous les médicaments contre le paludisme **avant** votre départ et **après** votre retour :

☐ Aucun
☐ Atovaquone-proguanil
☐ Chloroquine
☐ Doxycycline
☐ Méfloquine
☐ Autre : _____

② Protégez-vous contre les piqûres d'insectes et les morsures d'animaux

- ✓ Évitez les piqûres d'insectes ; utilisez un insectifuge contenant au moins 20 % de DEET.
- ✓ Dans la mesure du possible, portez un haut à manches longues, un pantalon long, des chaussures fermées et un chapeau.
- ✓ Ne touchez pas les animaux que vous ne connaissez pas, même s'ils semblent inoffensifs.
- ✓ Consultez immédiatement un médecin si vous avez été mordu ou griffé par un animal.

③ Faites attention à ce que vous mangez

- ✓ Buvez des boissons embouteillées et scellées, et évitez les glaçons.
- ✓ Mangez des aliments bien cuits et servis chauds.
- ✓ Lavez-vous les mains souvent ou utilisez fréquemment un désinfectant pour les mains.
- ✓ Si vous avez de la diarrhée avec du sang ou de la fièvre, prenez votre antibiotique anti-diarrhéique et consultez un médecin :

☐ Aucun
☐ Ciprofloxacine
☐ Azithromycine
☐ Autre : _____

④ Sécurité routière et automobile

- ✓ Bouclez toujours votre ceinture de sécurité.
- ✓ Portez un casque lorsque vous vous déplacez à vélo ou à moto.
- ✓ Regardez les véhicules roulant dans le sens inverse et dans les deux sens.
- ✓ Évitez les voitures et les bus bondés.
- ✓ Évitez de conduire sur des routes inconnues la nuit.

APRÈS VOTRE VOYAGE

- ✓ Consultez un médecin si vous avez de la fièvre pendant votre voyage ou après votre retour.
- ✓ Effectuez un suivi auprès d'un prestataire de soins de santé si vous avez été gravement blessé(e) ou si vous êtes tombé(e) malade pendant votre voyage

OBSERVATIONS DU MÉDECIN :

_____

_____

_____

- **Thank you!!**