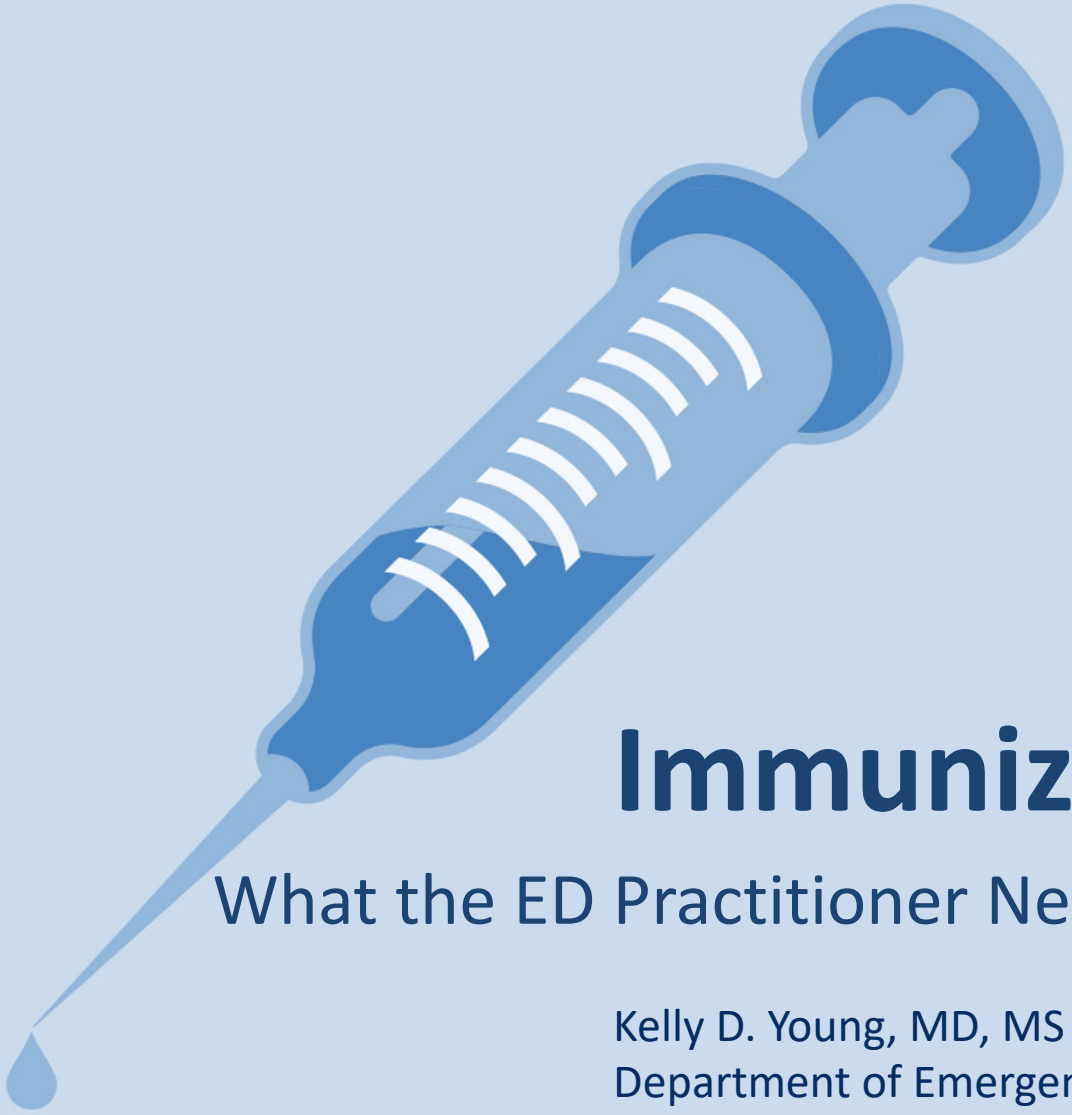

Immunizations

What the ED Practitioner Needs to Know

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The Schedule – Too Complicated!

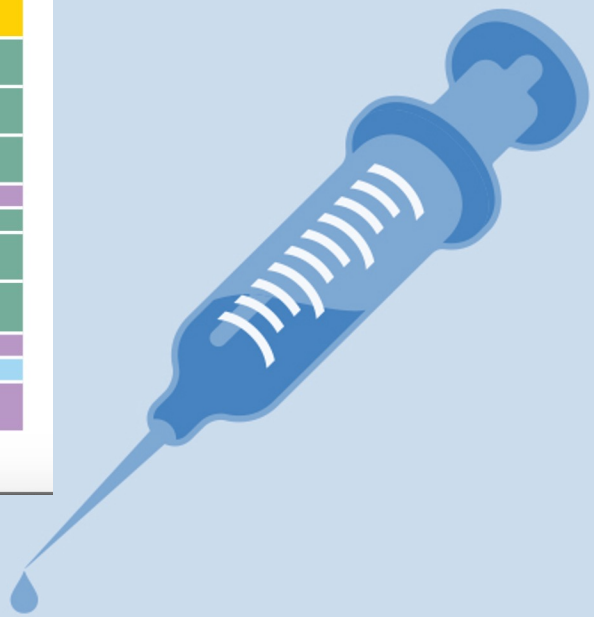
Table 1 Recommended Child and Adolescent Immunization Schedule for ages 18 years or younger, United States, 2021

These recommendations must be read with the notes that follow. For those who fall behind or start late, provide catch-up vaccination at the earliest opportunity as indicated by the green bars. To determine minimum intervals between doses, see the catch-up schedule (Table 2). School entry and adolescent vaccine age groups are shaded in gray.

Vaccine	Birth	1 mo	2 mos	4 mos	6 mos	9 mos	12 mos	15 mos	18 mos	19–23 mos	2–3 yrs	4–6 yrs	7–10 yrs	11–12 yrs	13–15 yrs	16 yrs	17–18 yrs
Hepatitis B (HepB)	1st dose	◄---- 2nd dose ----►			◄---------- 3rd dose ----------►												
Rotavirus (RV): RV1 (2-dose series), RV5 (3-dose series)			1st dose	2nd dose	See Notes												
Diphtheria, tetanus, acellular pertussis (DTaP <7 yrs)			1st dose	2nd dose	3rd dose			◄---- 4th dose ----►				5th dose					
Haemophilus influenzae type b (Hib)			1st dose	2nd dose	See Notes		◄ 3rd or 4th dose See Notes ►										
Pneumococcal conjugate (PCV13)			1st dose	2nd dose	3rd dose		◄---- 4th dose ----►										
Inactivated poliovirus (IPV <18 yrs)			1st dose	2nd dose	◄---------- 3rd dose ----------►							4th dose					
Influenza (IIV)					Annual vaccination 1 or 2 doses								Annual vaccination 1 dose only				
or													or				
Influenza (LAIV4)											Annual vaccination 1 or 2 doses		Annual vaccination 1 dose only				
Measles, mumps, rubella (MMR)					See Notes		◄---- 1st dose ----►					2nd dose					
Varicella (VAR)							◄---- 1st dose ----►					2nd dose					
Hepatitis A (HepA)					See Notes		2-dose series, See Notes										
Tetanus, diphtheria, acellular pertussis (Tdap ≥7 yrs)														Tdap			
Human papillomavirus (HPV)													*	See Notes			
Meningococcal (MenACWY-D ≥9 mos, MenACWY-CRM ≥2 mos, MenACWY-TT ≥2years)			See Notes											1st dose		2nd dose	
Meningococcal B													See Notes				
Pneumococcal polysaccharide (PPSV23)											See Notes						

Range of recommended ages for all children | Range of recommended ages for catch-up immunization | Range of recommended ages for certain high-risk groups | Recommended based on shared clinical decision-making or *can be used in this age group | No recommendation/ not applicable

What does "Imms up to date" really mean??

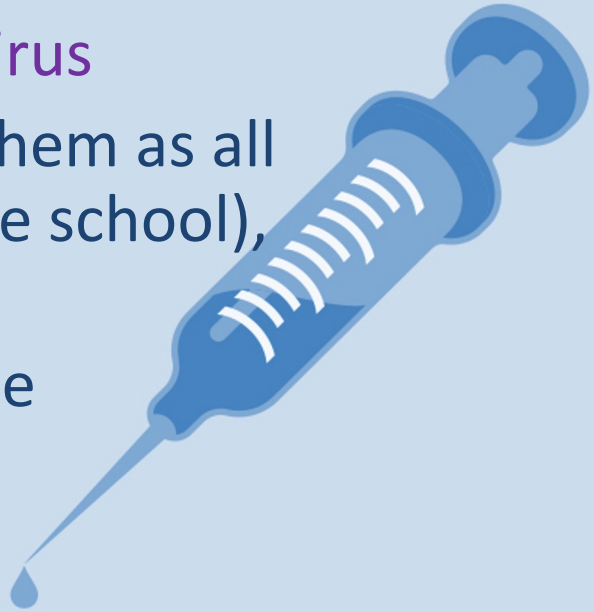


https://www.cdc.gov/vaccines/schedules/index.html

The Schedule - Simplified

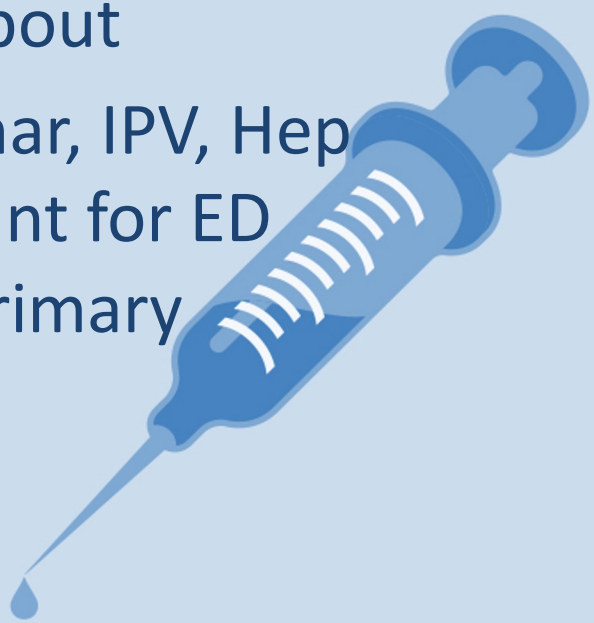
- Hepatitis B #1 often given at birth
  - Mostly meaningless in the ED evaluation
- First "real" set of immunizations at 6-8 weeks
  - Think 2, 4, 6 months
  - DTaP, polio (IPV), Hib, Prevnar, Rotavirus
  - After this "primary" series, think of them as all good in terms of tetanus (until middle school), H. flu, pneumococcus protection
  - Will also get Hep B #2 and #3 – let the pediatricians worry about when

A 4 week old that is "up to date on imms" means very little



The Schedule - Simplified

- 12-15 months
  - Mnemonic: 2 + 4 + 6 = 12
  - **There are no "9 month shots"** – don't let a parent tell you baby missed those
  - MMR, Varicella – what you care about
  - Also a booster for DTaP, Hib, Prevnar, IPV, Hep B, and start Hep A series – irrelevant for ED evaluation if the patient got the primary series



The Schedule – Simplified!

- Kindergarten entry
  - 2nd MMR and Varicella
  - DTaP booster, IPV
- Middle school (usually required for 7th grade)
  - Tdap booster
  - Meningococcal ACYW #1
- 16-18 years (before college)
  - Meningococcal ACYW #2, Meningococcal B
- Yearly influenza starting at age 6 months
- COVID Pfizer approved for 12yo and older

The Schedule Simplified

Age	Shots you care about	Other shots
Birth		Hep B #1
2, 4, 6 months	**DTaP, Hib, Prevnar**	Polio (IPV), Rotavirus
12 months	**MMR, Varicella**	DTaP, Hib, Prevnar, IPV, Hep A, Hep B
Kindergarten (5yo)	MMR, Varicella, DTaP	IPV
Middle school (7th grade)	**Tdap** Meningococcus ACYW #1	HPV
12yo and older	COVID	
Before college	Meningococcus ACYW #2 Meningococcus B	

Prevnar-13 Efficacy

Schedule: 2, 4, 6, 12-15mo

- Prevention of invasive pneumococcal disease 80% by vaccine serotypes, 58% by other serotypes
- Large declines in pneumococcal otitis media
  - Small declines in all-cause otitis media
- 97-100% after full series for vaccine serotypes
  - **Can you still have invasive pneumococcal disease if immunized? Yes**, there are many serotypes
- Implications for febrile infant work-up
  - **4 weeks after 1 dose, efficacy 80-90% for most vaccine serotypes**
  - Also herd immunity

Hib Efficacy

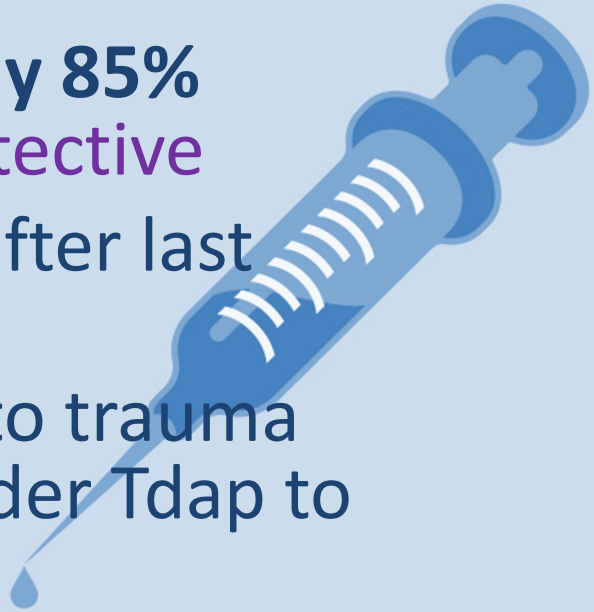
Schedule: 2, 4, sometimes 6 depending on formulation, 12-15mo

- Against invasive disease
  - After one dose 59%
  - After two doses 92%
  - After three doses 93%
- **Can you still have Hib if immunized? Yes**
- Implications for fever work-up
  - Not a lot of Hib around anymore
  - Herd immunity

Pertussis Efficacy

Schedule: 2, 4, 6, 15-18mo (min age 12mo), 4-6 years

- At ≥ 6 weeks of age, having had at least one pertussis vaccination resulted in odds ratios:
  - Death 0.28 (95% CI 0.11-0.74)
  - Hospitalization 0.69 (95% CI 0.63-0.77)
  - Pneumonia 0.80 (95% CI 0.68-0.95)
- **Can you still have pertussis if fully immunized? Yes, after 3 doses only 85% protective**, after 5 doses, 89% protective
- Also, immunity wanes with years after last booster
- When giving tetanus booster due to trauma in older adolescent or adult, consider Tdap to boost pertussis immunity too

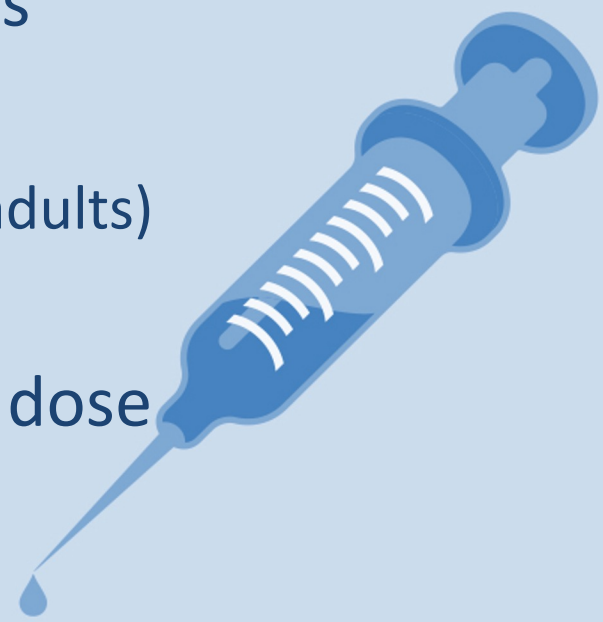


MMR Efficacy

Schedule: 12-15mo, 4-6 years

Component	Seroconversion after 1 dose	Efficacy after 1 dose	Efficacy after 2 doses
Measles	96%	93%	97%
Mumps	94%	78%	88%
Rubella	99%	97%	

- Long duration of protection 15+ years
- Can you still have if immunized?
  - Mumps definitely (outbreaks in young adults)
  - Measles milder version
- During outbreaks in e.g. colleges, 3rd dose may protect against mumps



Varicella Efficacy

Schedule: 12-15mo, 4-6 years

- One dose
  - 80% effective at preventing varicella
  - 95-98% effective at preventing moderate (50-500 lesions) or severe disease
  - ≥99% effective at preventing severe disease
- Two doses more effective
  - 92-93%

Breakthrough Varicella

- Can you still get if immunized?
- Yes, “breakthrough varicella” after exposed to wild type (non-vaccine) varicella
  - **1-3% per year after vaccination**
  - Much milder
    - Low or no fever
    - Rash may be maculopapular, not vesicular
    - 50 or fewer lesions

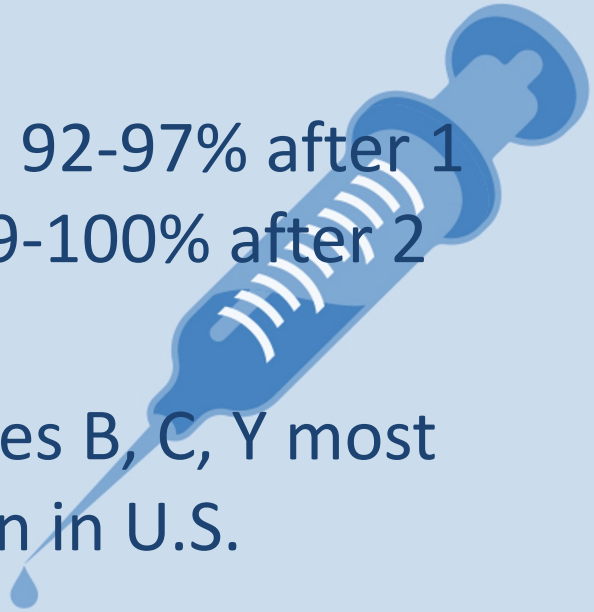
Meningococcal Vaccines

are confusing

ED docs don't really need to know this

Brand Names	Coverage	When Given
Menactra, Menveo, Nimenrix outside U.S.	Serogroups A, C, Y, W135	11-12 years, booster at 16 years (or just before college)
Trumenba (3 dose series), Bexsero (2 dose series)	Serogroup B	Approved for 10-25yo, preferred 16-18yo, Also used for outbreaks

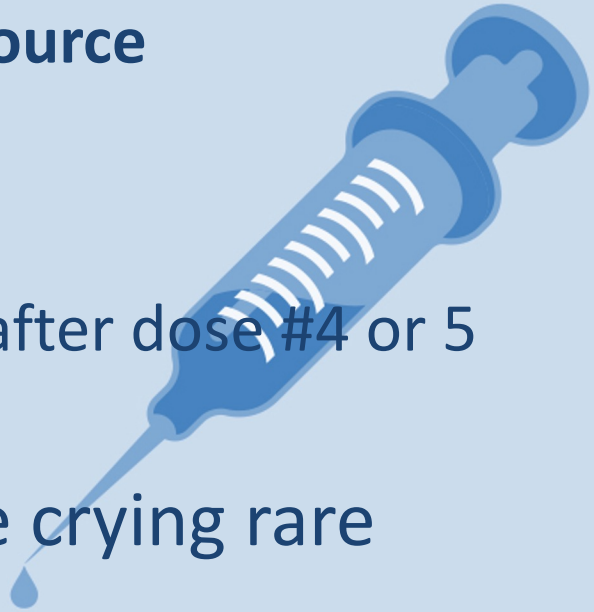
- Efficacy Men ACYW 85%
  - Waned to 69% within 6-8 years
- Trumenba 54-63% after one dose, 83-85% after 3 doses
- Bexsero 92-97% after 1 dose, 99-100% after 2 doses
- Serotypes B, C, Y most common in U.S.



Common Adverse Effects After DTaP

- **Give acetaminophen**
- **Tell parents the correct dose for weight**

- When? First 48 hours
- Fever
  - Low-grade 25% (40% per AAP recent fever guidelines)
  - 40.5 C or higher – only 0.1%
  - **The higher the fever, or started at > 48 hours, or lasting > 48 hrs, work up for other source**
- Local redness, tenderness, pain
  - Mild 25%
  - 2-3% entire limb swelling especially after dose #4 or 5
  - Not a contraindication for next dose
- Seizures, anaphylaxis, inconsolable crying rare

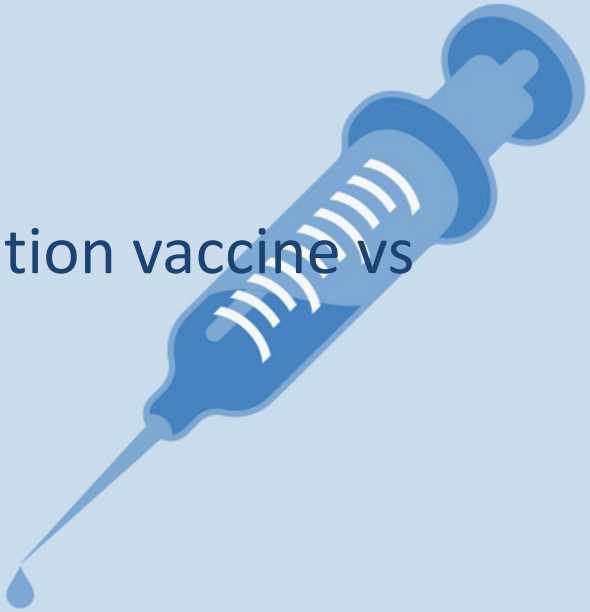


Other 2, 4, 6 mo vaccines

- Hib: first 24 hours, mild / uncommon
- Prevnar-13: first 1-2 days, mild, fever, headache, myalgias, fatigue
- Polio (IPV): very rare; contains streptomycin, neomycin, polymyxin B = potential for allergy
- Rotavirus: small ↑ risk intussusception
  - 1 excess case per 20,000 to 100,000
  - Applicator has latex = potential for allergy

Common Adverse Effects After MMR

- **When? 1-2 weeks after vaccine**
  - For kids 12-18mo, ask if got MMR/Varicella vaccine in last 1-2 weeks
- Fever ≥ 39.4 F in 5-15%, 6-12 days after MMR
- Transient rash in 5%, usually ~ 10 days after
- Febrile seizures 1 in 3000-4000
  - 5-12 days after vaccine
  - Twice as frequent if MMR-V combination vaccine vs two vaccines given separately
- Rare transient thrombocytopenia



Common Adverse Effects After Varicella Vaccine

- **When? 1-2 weeks after vaccine**
  - For kids 12-18mo, ask if got MMR/Varicella vaccine in last 1-2 weeks
- 1-3% localized rash, 3-5% generalized rash
  - 5-26 days after vaccine
  - May be maculopapular, not vesicular
- Fever 15%, higher if MMR-V combination vaccine
  - Usually 5-12 days after vaccine
  - Increased risk febrile seizures as per MMR slide

Other Vaccines

Teens faint

- Hepatitis B: mild, local reaction, low-grade fever
- Hepatitis A: mild, local reaction
- HPV: mild, headache, fever, fatigue, malaise
  - Association with syncope; lay down x 15 min after
- Meningococcal: common, local reaction, headache, fatigue, irritability, fever
  - Syncope common; lay down x 15 min after
  - Guillain-Barre' after Menactra?
    - 0 to 1.5 per million doses

Tetanus

Immunization history & wound type	Tetanus immunization	Tetanus immune globulin
< 3 doses or unknown; clean, minor wound	< 7yo: DTaP 7-11yo: Tdap 11yo+: Tdap or dT	No
≥ 3 doses, clean minor wound	Only if ≥ 10 years since last booster	No
< 3 doses or unknown; contaminated or high risk wound	< 7yo: DTaP 7-11yo: Tdap 11yo+: Tdap or dT	250 u IM (regardless of age or weight), different site from vaccine
≥ 3 doses, contaminated or high risk wound	Only if ≥ 5 years since last booster	No

For infants < 6mo old, use maternal immunization history to determine need for TIG

Influenza Immunization

- **Annually from age 6 months up**
- Intramuscular
  - **Age 6mo – 8yo *and* didn't get vaccine last year need 2 doses**, 4 weeks apart
    - Subsequent years # doses depend on age at first dose, vaccine history, current year's vaccine makeup
  - Age 9yo and up get one dose
- Intranasal alternative
  - 2yo and older
  - Live (as opposed to IM vaccine)
- Adverse effects
  - Fever within 24 hours in 10-35% young children
  - Mild influenza-like symptoms
  - Egg allergy is NOT a contraindication

COVID

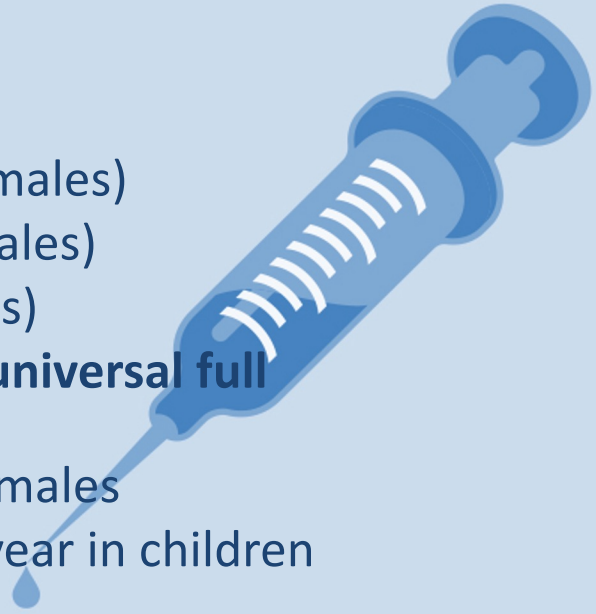
- At this time, only Pfizer BNT162b2 vaccine is approved for ages 5-17 years
  - 0.3mL IM, 2 doses given 21 days apart 12-17 yrs
  - 0.2mL IM, 2 doses given 21 days apart 5-11 yrs
    - **NOTE:** cannot use the adolescent / adult formulation, must use the formulation for 5-11 yr olds
  - Ongoing trials in children 6 months +
- OK to give concurrently with flu shot
- Booster 3rd dose recommended at 6-8 months after 2nd dose maybe

COVID Vaccine Adverse Effects

After (Pfizer, 16 and older)	Local reaction	Fatigue	Headache	Myalgias	Fevers, chills, joint pain
1st dose	65%	29%	25%	17%	
2nd dose	65%	48%	40%	37%	20% each

* Higher rate of these in younger patients

- Myocarditis & Pericarditis
  - Primarily young (teen / young adult) males
  - More often after 2nd dose
  - **62.8** cases per million in 12-17yo males (8-10 females)
  - 40.6 cases per million in 12-29yo males (4.2 females)
  - 2.4 cases per million in ≥ 30yo males (1.0 females)
  - **May have significant dysrhythmias, but nearly universal full recovery reported, no deaths in kids**
  - After COVID disease, **328** per million in 12-17yo males
  - General population 10-20 cases per million per year in children

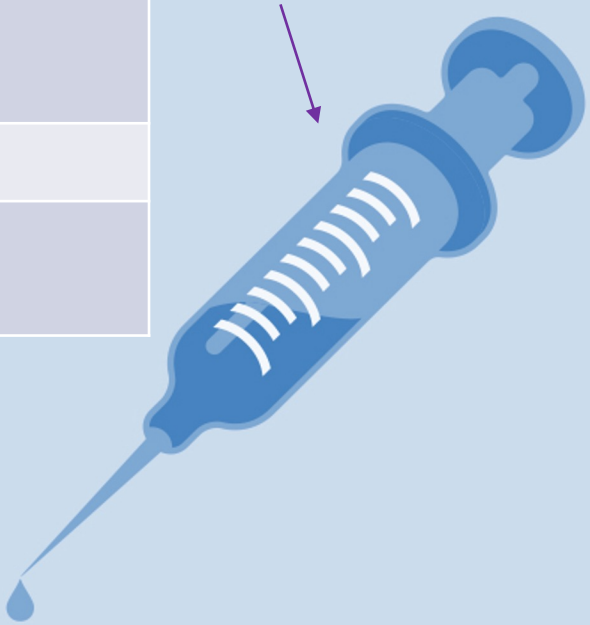


Summary

Age	Shots you care about	Other shots
Birth		Hep B #1
2, 4, 6 months	**DTaP, Hib, Prevnar**	Polio (IPV), Rotavirus
12 months	**MMR, Varicella**	DTaP, Hib, Prevnar, IPV, Hep A, Hep B
Kindergarten (5yo)	MMR, Varicella, DTaP	IPV
Middle school (7th grade)	**Tdap** Meningococcus ACYW #1	HPV
5yo and older	COVID	
Before college	Meningococcus ACYW #2 Meningococcus B	

Annual influenza after age 6mo

MMR, Varicella adverse effects 1-2 weeks later



Learn how to access the CAIR information in your EMR!

Resources

- CDC
- https://www.cdc.gov/vaccines/schedules/index.html
- Shots Immunization App
- https://apps.apple.com/us/app/shots-immunizations/id958783646
- https://play.google.com/store/apps/details?id=org.immunizationed.shotsG3&hl=en_US
- Vaccine preventable diseases from pemplaybook.org
- https://pemplaybook.org/podcast/vaccine-preventable-illnesses-part-1/
- https://pemplaybook.org/podcast/vaccine-preventable-illnesses-part-2/