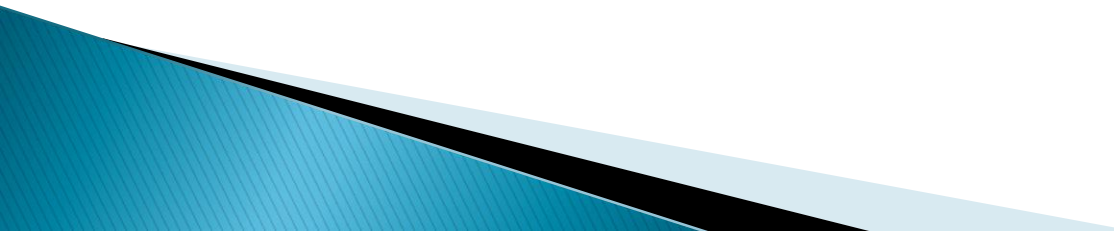


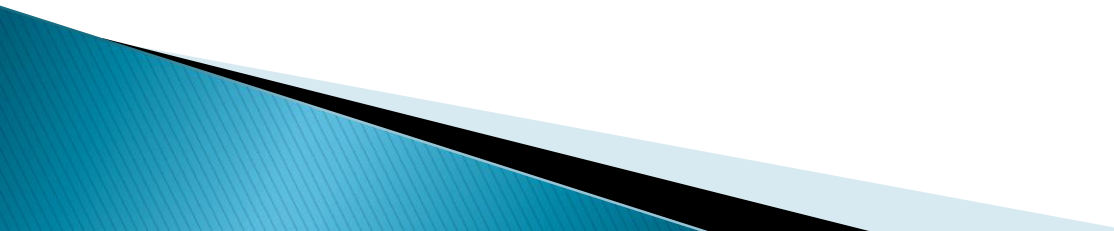
Immunizations for the Pediatric Nephrology Patient

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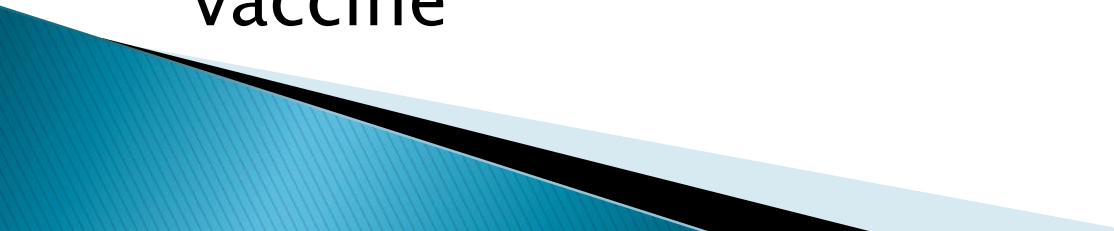
Objectives

- ▶ Understand the differences in immune function in patients with kidney disease
 - ▶ Understand the differences in immunization practices for the general nephrology patient population
- 

History

- ▶ Variolation – began in China during the 10th century
 - ▶ Dry scabs from pox were made into a powder and blown into the nostril
 - ▶ 1661 Kangxi Emperor gives royal support for inoculation
 - ▶ 1694 Queen Mary II dies of Smallpox
- 

History

- ▶ Inoculation introduced into the west in 1720s when Lady Mary Montagu has son variolated in Constantinople by Dr. Charles Maitland, followed by 2 year old daughter in 1721 in England
 - ▶ 1760 Edward Jenner learns about smallpox protection from a milkmaid
 - ▶ 1796 Edward Jenner introduces smallpox vaccine
- 

1970 Recommended Vaccines



Polio
DTP
MMR

Figure 1. Recommended immunization schedule for persons aged 0 through 18 years – 2013.**(FOR THOSE WHO FALL BEHIND OR START LATE, SEE THE CATCH-UP SCHEDULE (FIGURE 2)).**

These recommendations must be read with the footnotes that follow. For those who fall behind or start late, provide catch-up vaccination at the earliest opportunity as indicated by the green bars in Figure 1. To determine minimum intervals between doses, see the catch-up schedule (Figure 2). School entry and adolescent vaccine age groups are in bold.

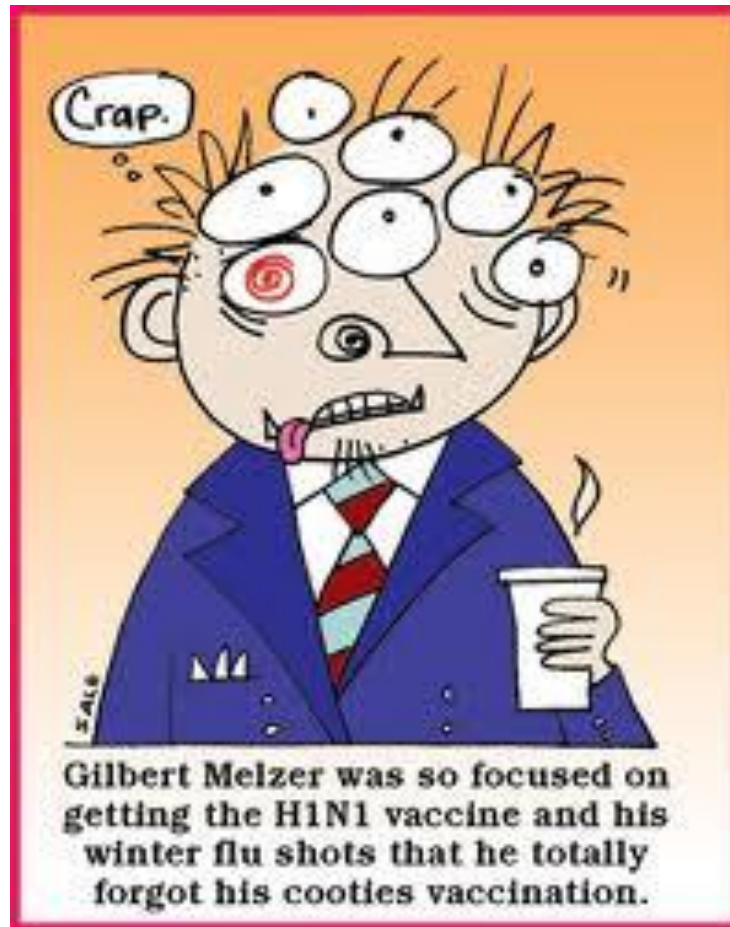
Vaccine	Birth	1 mo	2 mos	4 mos	6 mos	9 mos	12 mos	15 mos	18 mos	19–23 mos	2–3 yrs	4–6 yrs	7–10 yrs	11–12 yrs	13–15 yrs	16–18 yrs
Hepatitis B ¹ (HepB)	← 1 st dose →	← 2 nd dose →			← 3 rd dose →											
Rotavirus ² (RV) RV-1 (2-dose series); RV-5 (3-dose series)		← 1 st dose →	← 2 nd dose →	See footnote 2												
Diphtheria, tetanus, & acellular pertussis ³ (DTaP; <7 yrs)		← 1 st dose →	← 2 nd dose →	← 3 rd dose →				← 4 th dose →				← 5 th dose →				
Tetanus, diphtheria, & acellular pertussis ⁴ (Tdap; ≥7 yrs)														(Tdap)		
<i>Haemophilus influenzae</i> type b ⁵ (Hib)		← 1 st dose →	← 2 nd dose →	See footnote 5			← 3 rd or 4 th dose, see footnote 5 →									
Pneumococcal conjugate ^{6a,c} (PCV13)		← 1 st dose →	← 2 nd dose →	← 3 rd dose →			← 4 th dose →									
Pneumococcal polysaccharide ^{6b,c} (PPSV23)																
Inactivated Poliovirus ⁷ (IPV) (<18 years)		← 1 st dose →	← 2 nd dose →	← 3 rd dose →								← 4 th dose →				
Influenza ⁸ (IIV; LAIV) 2 doses for some: see footnote 8					Annual vaccination (IIV only)						Annual vaccination (IIV or LAIV)					
Measles, mumps, rubella ⁹ (MMR)							← 1 st dose →					← 2 nd dose →				
Varicella ¹⁰ (VAR)							← 1 st dose →					← 2 nd dose →				
Hepatitis A ¹¹ (HepA)							← 2-dose series, see footnote 11 →									
Human papillomavirus ¹² (HPV2: females only; HPV4: males and females)														(3-dose series)		
Meningococcal ¹³ (HibMenCY ≥ 6 weeks; MCV4-D ≥ 9 mos; MCV4-CRM ≥ 2 yrs.)			see footnote 13											← 1 st dose →		booster

 Range of recommended ages for all children	 Range of recommended ages for catch-up immunization	 Range of recommended ages for certain high-risk groups	 Range of recommended ages during which catch-up is encouraged and for certain high-risk groups	 Not routinely recommended
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This schedule includes recommendations in effect as of January 1, 2013. Any dose not administered at the recommended age should be administered at a subsequent visit, when indicated and feasible. The use of a combination vaccine generally is preferred over separate injections of its equivalent component vaccines. Vaccination providers should consult the relevant Advisory Committee on Immunization Practices (ACIP) statement for detailed recommendations, available online at <http://www.cdc.gov/vaccines/pubs/acip-list.htm>. Clinically significant adverse events that follow vaccination should be reported to the Vaccine Adverse Event Reporting System (VAERS) online (<http://www.vaers.hhs.gov>) or by telephone (800-822-7967). Suspected cases of vaccine-preventable diseases should be reported to the state or local health department. Additional information, including precautions and contraindications for vaccination, is available from CDC online (<http://www.cdc.gov/vaccines>) or by telephone (800-CDC-INFO [800-232-4636]).

This schedule is approved by the Advisory Committee on Immunization Practices (<http://www.cdc.gov/vaccines/acip/index.html>), the American Academy of Pediatrics (<http://www.aap.org>), the American Academy of Family Physicians (<http://www.aafp.org>), and the American College of Obstetricians and Gynecologists (<http://www.acog.org>).

NOTE: The above recommendations must be read along with the footnotes of this schedule.

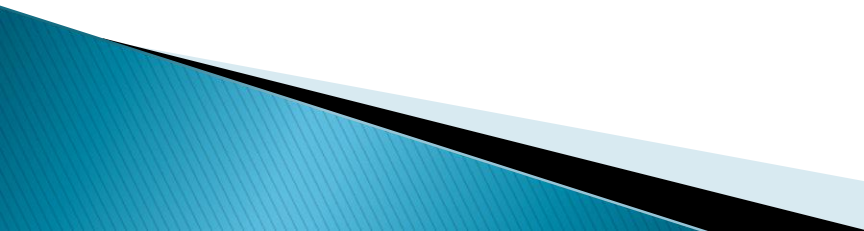


Gilbert Melzer was so focused on getting the H1N1 vaccine and his winter flu shots that he totally forgot his cooties vaccination.

Definitions– Types Of Vaccines

- Killed or Inactive:
 - Killed previously virulent micro-organisms destroyed with heat, chemical, radioactivity or antibiotic
 - Influenza, cholera, polio, HAV
- Attenuated /Live Attenuated:
 - Viruses cultivated under conditions that disable virulent properties or use closely related but less dangerous organisms to produce broad immune response.
 - Typically provoke more durable immunological response; preferred in healthy adults
 - MMR, Varicella;

Both forms contains whole agent



Definitions– Types Of Vaccines

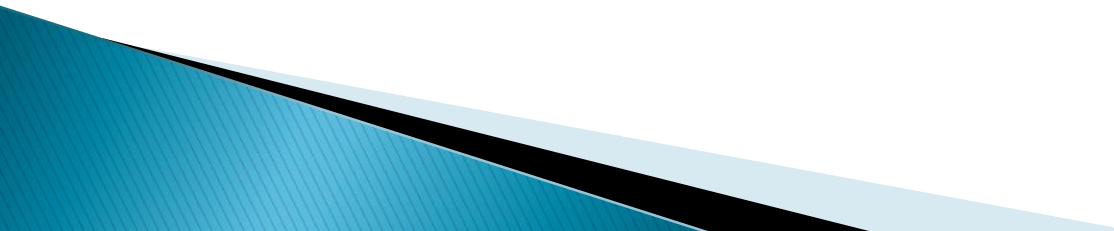
- Toxoid – inactivated toxic compounds that cause illness, (not the microorganisms)
 - Tetanus, diphtheria
- Subunit or Component
 - Protein subunit – Subunit composed of surface proteins of the virus (HBV)
 - VLP – Virus–Like Particle composed of viral major capsid protein (HPV)
 - Hemagglutinin and neuraminidase subunit (Influenza)

Definitions: Effectiveness

Adjuvant– typically used to boost immune response

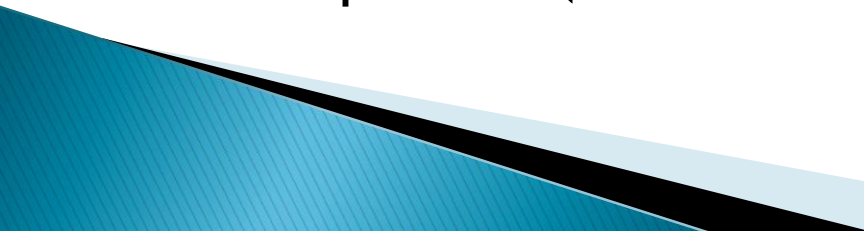
- Most often aluminium adjuvants
- Others being tested include squalene and phosphate adjuvants

Effectiveness influenced by

- Adherence to the vaccination schedule
 - Presence of non-responders
 - Ethnicity, age (older) or genetic predisposition
- 

Definitions – Valence

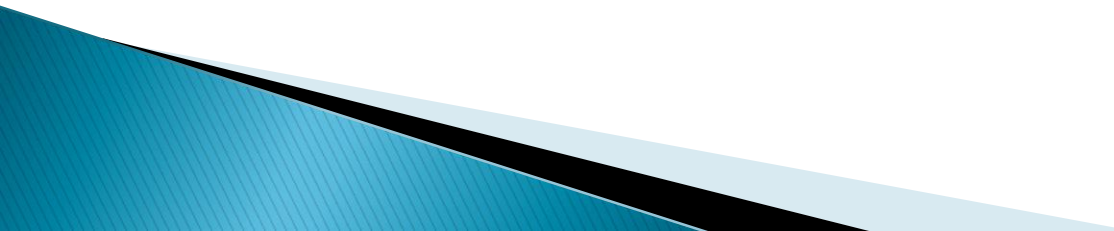
Valence

- Monovalent (Univalent) – designed to immunize against a single antigen or single microorganism
 - Multivalent (Polyvalent) designed to immunize against 2 or more strains of same microorganism or against 2 or more microorganisms
 - In some cases a monovalent vaccine may be preferable for rapidly developing a strong immune response (Initial HBV in neonate)
- 

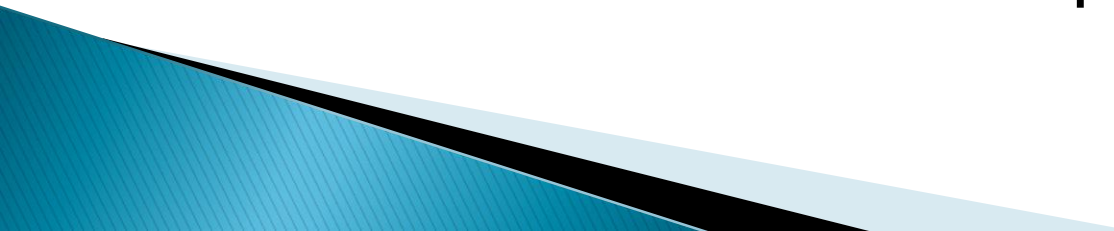
Immune Dysfunction in CKD

- ▶ Infection, including vaccine-preventable infections, represent the leading cause of morbidity and mortality in kids on dialysis and after transplant.
- ▶ US Renal Data System –
 - 0–19 yr ESRD : 32% or less received seasonal flu vaccine between 2005 – 2008;
 - 13% or fewer received the Strep pneumoniae vaccine

Immunizations in CKD

- ▶ In general, immunizations for CKD patients follow primary vaccine schedules
 - ▶ Immunization recommendations updated yearly by CDC, ACIP (Advisory Committee on Immunization Practices) and Committee of Infectious Disease of AAP (American Academy of Pediatrics)
- 

Immune Dysfunction in CKD

- ▶ CKD associated with chronically activated immune system with inflammatory components while simultaneously having a poor response to vaccination and infection
 - ▶ High failure rates for vaccinations against HBV, Influenza, tetanus, Diphtheria thought to be caused by alterations of T cell functions
 - ▶ Uremia decreases T-Cell proliferation
- 

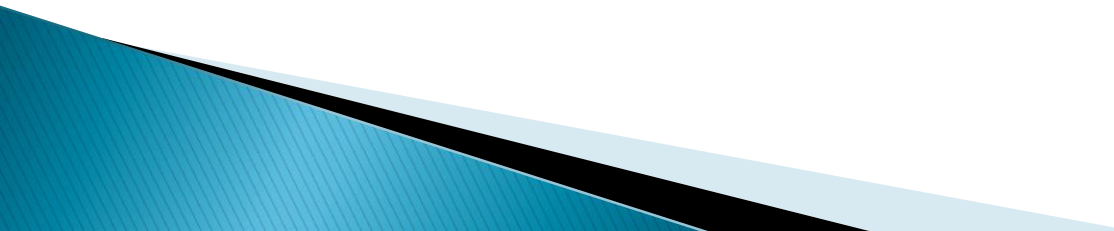
Vitamin D Deficiency

- ▶ Vitamin D Deficiency very common finding in CKD stages 3–5
- ▶ Many different types of cells express Vitamin D receptors
- ▶ Monocytes, macrophages and dendritic cells can convert 25(OH)D to calcitriol via their own 1α -hydroxylase
- ▶ Calcitriol produces strong T helper cell–1 response and production of interferon- γ and TNF- α

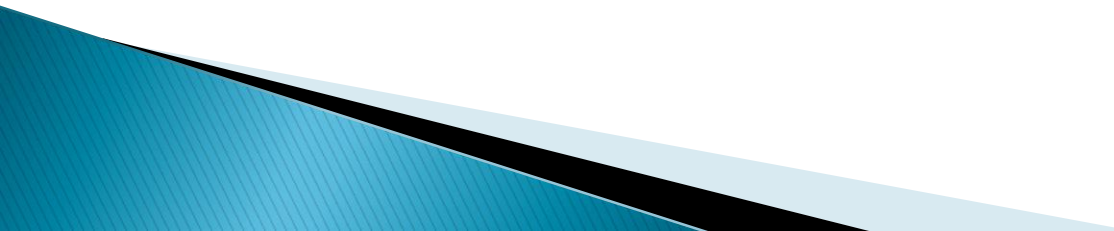
Vitamin D Deficiency

- ▶ Stimulation of the Vitamin D receptor on monocytes and macrophages also results in the synthesis of cathelicidin
- ▶ Cathelicidin –peptide capable of destroying bacterial agents

Zitt, Sprenger–Hahr, et al 2011

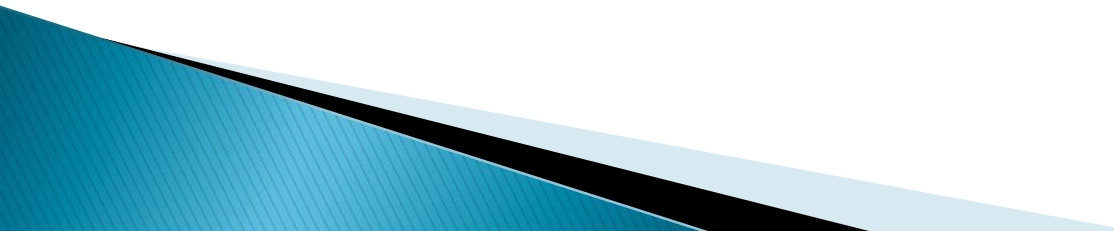
- ▶ Retrospective analysis of adult patients with CKD 3–5; on and not on dialysis
 - ▶ Given 40ug HBV for 3 doses
 - ▶ Non–response defined as absent antibody titre <10 IU/L
 - ▶ Seroconversion defined as antibody titer ≥ 10 IU/L which is considered protective
 - ▶ Vitamin D deficiency (level <10 mg/ml) was a predictor of non–response
- 

Nephrotic Syndrome

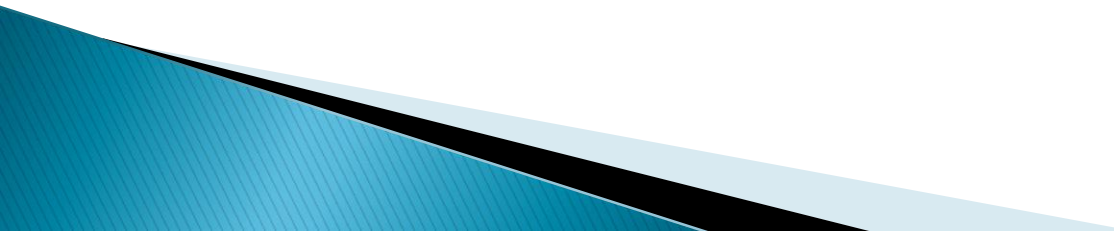
- ▶ Rate of peritonitis is 2–6% with a mortality rate of 1–5%
 - ▶ Impaired complement–opsonization delays clearance of micro–organisms especially *Streptococcus pneumoniae*
 - ▶ Also predisposed to gram–negative bacterial infections
 - ▶ Many are non–immune to varicella due to age of onset of NS in relation to completion of Varicella vaccination
- 

Nephrotic Syndrome

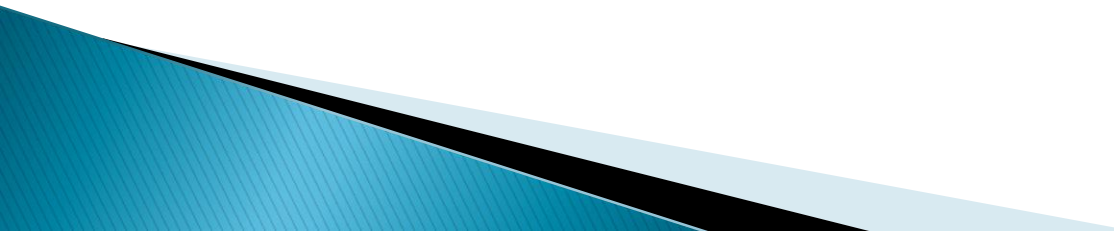
Defer immunization with live vaccines:

- ▶ Until prednisone dose is 2 mg/kg per day or less
 - ▶ For 3 months from completion of therapy with cytotoxic agents
 - ▶ For 1 month from completion of other daily immunosuppression
- 

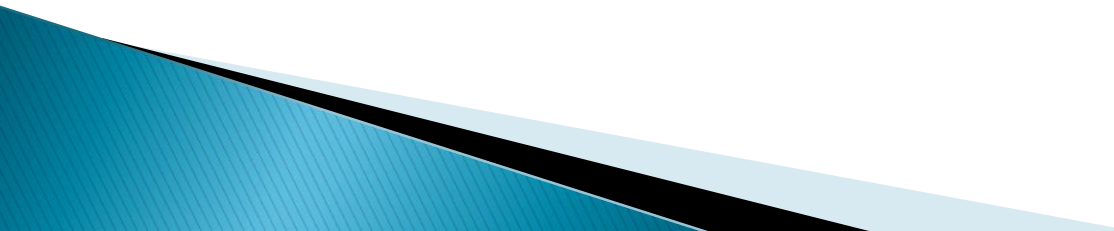
Transplant

- ▶ Two possible risk when given after transplant- rejection and live vaccine-induced infections
 - ▶ Killed or component vaccinations shown not to have deleterious effect
 - ▶ Live virus vaccines documented as safe in children on conservative treatment or on dialysis
 - ▶ Most guidelines do not recommend live virus after transplant
- 

Diphtheria, Tetanus, Pertussis Vaccine

- ▶ DTaP – Diphtheria & Tetanus toxoids with acellular pertussis
 - ▶ 5 doses (2,4,6, and 15–18 months; 5th at 4–6 yrs)
 - ▶ Before 1992 whole-cell DTP associated with high rate adverse reactions
 - ▶ ACIP recommends acellular pertussis antigens (DTaP) since 1997
- 

Diphtheria, Tetanus, Pertussis Vaccine

- ▶ 2006 Routine Tdap recommended for adolescents 11–12 years and for adults
 - ▶ Patients aged ≤ 14 are likely to have received the acellular vaccines
 - ▶ Several studies suggest CKD and dialysis patients have sub-optimal seroconversion rates after DTP
 - ▶ Data lacking on response to acellular pertussis vaccine in CKD
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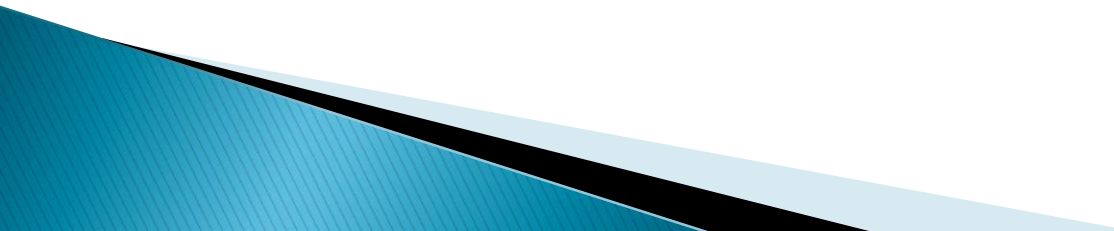
Pertussis Outbreak in Washington 2012

- ▶ Pertussis is endemic and cyclical in nature but there has been a gradual and sustained increase in the US after reaching historic lows in the 1970s
- ▶ In 2010, 27,550 pertussis cases were reported
- ▶ In 2012, cases surpassed those from the previous 5 years suggesting early waning of immunity from acellular vaccines
- ▶ High rates of disease were observed in adolescents 13–14 years despite high vaccination coverage and recent Tdap administration
- ▶ Unvaccinated children have at least 8x greater risk for pertussis than children vaccinated with DTaP
- ▶ Vaccinated children can develop pertussis but are less infectious, have milder symptoms and shorter illness duration and are at less risk for severe outcomes

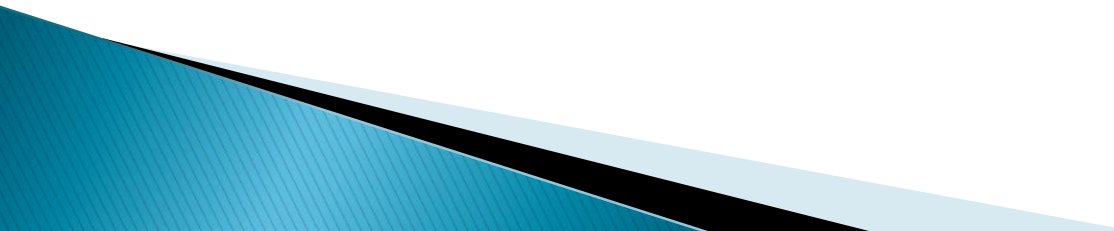
Hib – Hemophilus Influenzae type B conjugate

- ▶ Hemophilus influenzae was major cause of bacterial meningitis in children worldwide before vaccine introduced in late 1980s
- ▶ Since introduction of HiB – Cases of invasive HiB decreased >99%
- ▶ 4 dose series between 2 mo and 12 – 15 months
- ▶ Vaccine stimulates production of anti-Hib capsular polysaccharide antibodies
→ triggers complement-dependent killing and phagocytosis of bacteria

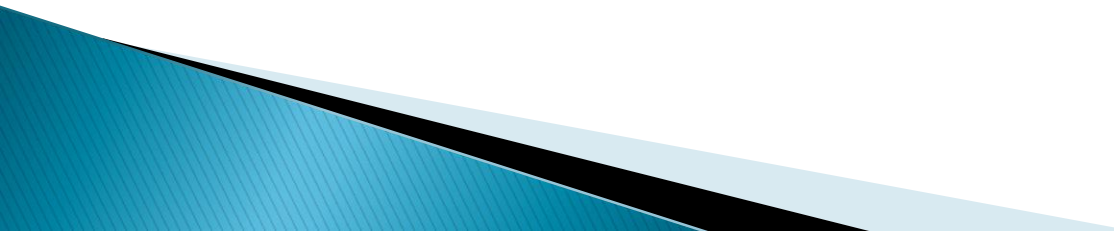
Hib

- ▶ Multi-center study on infants on dialysis found 9/10 (90%) had protective antibody levels which remained protective up to 22 months after vaccination (Neu, et. al 2012)
 - ▶ Another study found protective antibody levels 2 months after vaccine #3 in 100% of patients (Neu, et. al 2012)
- 

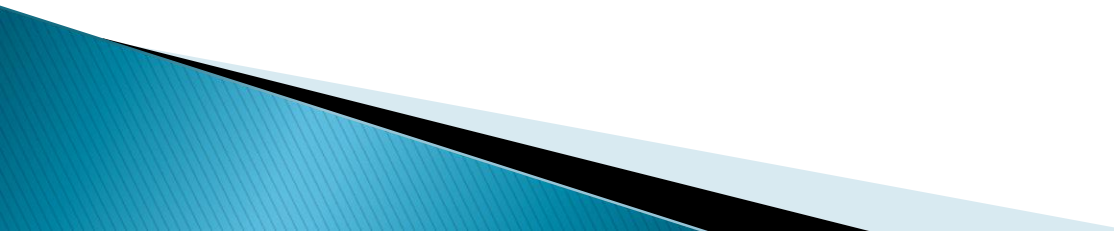
Hepatitis B Vaccine (HBV)

- ▶ Acquisition of Hepatitis B infection at younger age associated with stronger probability of chronic Hepatitis B infection, cirrhosis, or cancer
 - ▶ First dose must be monovalent to all newborn before discharge from hospital
 - ▶ Complete series with 2 monovalent or up to 3 doses of combination
 - ▶ First dose at birth, 2nd at 1–2 months, and 3rd at 6–18 months
 - ▶ Monovalent Recombivax HB and Engerix–B
 - ▶ Hep B combo: Comvax (HiB and HBV) and Pediarix (HBV, DTaP, IPV) –
- 

Hepatitis B Vaccine

- ▶ Dialysis, especially HD, increases risk for HBV
 - ▶ Suboptimal response to HBV and a more rapid decline in anti-hepatitis B antibody levels after immunization well documented in adults.
 - ▶ ACIP recommendations in adult patients on dialysis is to give 40 µg
 - ▶ Limited studies of infants with CKD
- 

Hepatitis B Vaccine

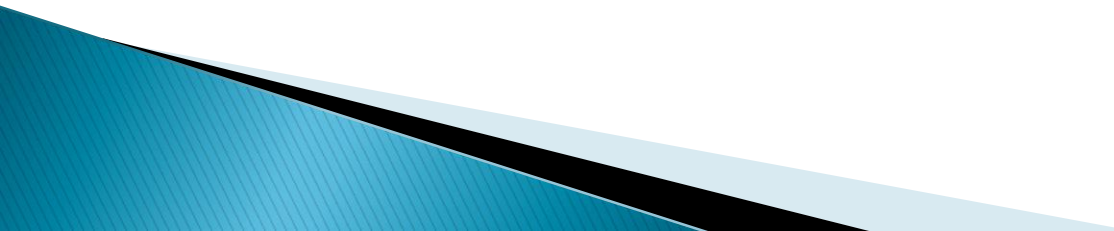
- ▶ ACIP recommends CKD and dialysis patient <2 years receive HBV on standard schedule but with higher doses (20–40 µg)
 - ▶ Post-vaccine testing recommended 1–2 months after primary series: if antibody level <10ml IU/ml repeat series x 1.
 - ▶ Measure antibody levels annually and provide boosters as needed
- 

Hepatitis B Vaccine

- ▶ Multi-center Study 78 CKD pre-dialysis, on dialysis, or s/p transplant given 3 doses of 20 µg
 - 91% had protective titers of 10 IU/ml
 - Low percentage of Post-transplant had protective antibody levels compared to those pre dialysis or on dialysis (66.7% vs 96.4%)
 - Post immunization titers also were lower in post transplant patients
 - Authors suggest at least 2 vaccines pre-transplant

(Neu 2012)

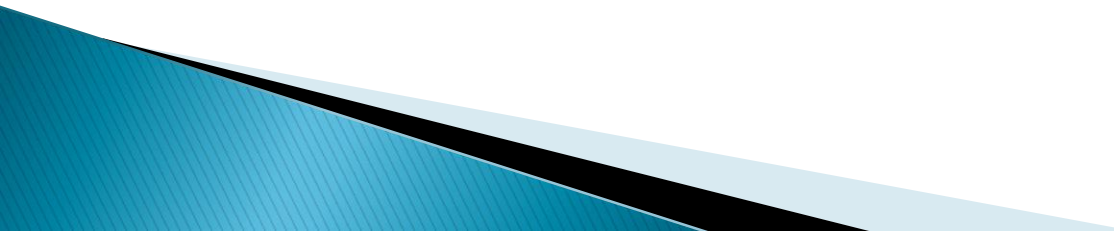
Hepatitis A Vaccine (HAV)

- ▶ Inactive vaccine recommended for children over 1 year
 - ▶ 2 dose series, separated by 6 months
 - ▶ No studies in CKD
 - ▶ Most common vaccine recommended for travel
- 

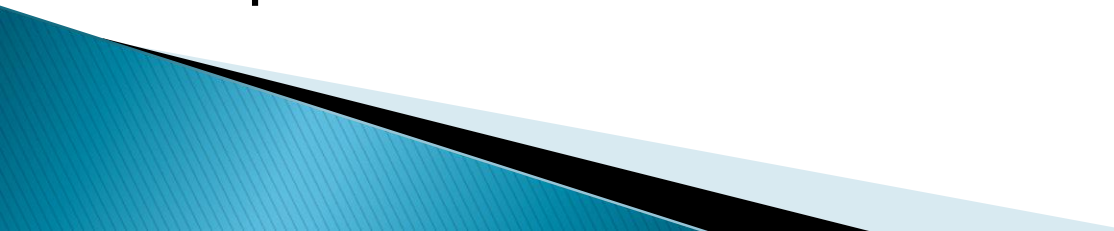
Inactivated Polio Vaccine (IPV)



Inactivated Polio Vaccine (IPV)

- ▶ 2,4,6–18 months and last dose 4–6 years
 - ▶ Last indigenously transmitted case in US was 1979; still cases in multiple countries
 - ▶ Changed to IPV from OPV in 2000 because of vaccine-associated paralytic poliomyelitis
 - ▶ OPV most commonly used form worldwide and is preferred vaccine suitable for eradication of the disease
- 

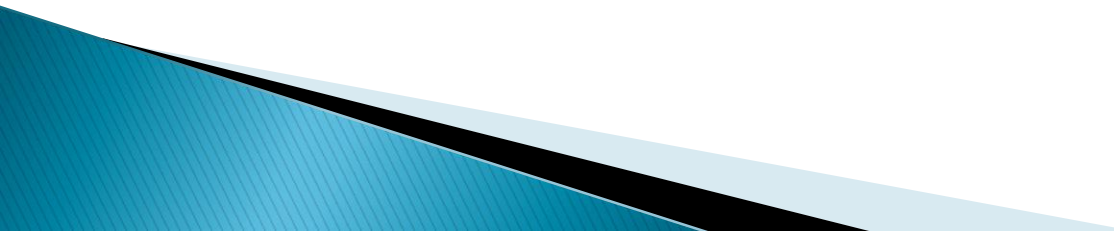
Pneumococcal Vaccine (PCV13, PPSV23)

- ▶ Streptococcus pneumonia
 - ▶ Risk of Invasive Pneumococcal Disease(IPD)
 - ▶ Increased with renal allografts, CKD, or NS
 - ▶ Preceded by colonization of the nasopharynx
 - ▶ Colonization occurs in a normally sterile body site:
 - Common presentations in patients with CKD or transplant are bacteremia with no focus or pneumonia
 - Patients with NS commonly seed their ascitic fluid while bacteremic and present with peritonitis
- 

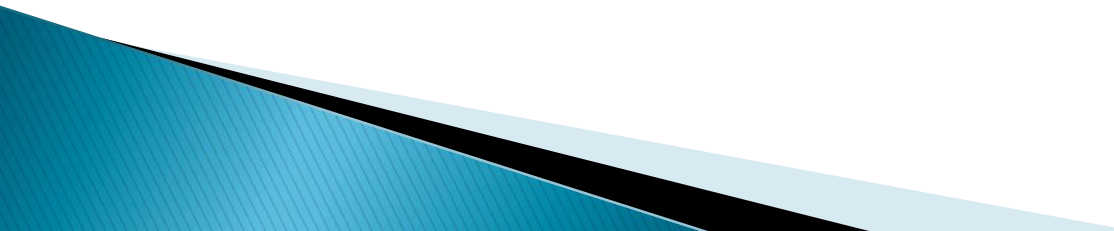
Pneumococcal Vaccine (PCV13, PPSV23)

- ▶ 2000 Conjugated pneumococcal vaccine introduced (PCV 7)
 - ▶ Highly immunogenic in infants
 - ▶ Given at 2,4,6, 12–15 months
 - ▶ Studies show adequate antibody response in children with CKD, on dialysis and s/p transplant
 - ▶ 2011 ACIP and AAP recommend PCV13 replace PCV7
 - ▶ CKD children ages 6–18 years should be given one dose of PCV13 regardless of their previous history of PCV7 or PPSV23
- 

Pneumococcal Vaccine (PCV13, PPSV23)

- ▶ PPSV 23 (23–valent polysaccharide pneumococcal vaccine) recommended in nephrotic syndrome since 1989 and CKD since 1997 (high risk group)
 - ▶ Poorly immunogenic in infants
 - ▶ Use in age > 24 months
 - ▶ Recommended that children with CKD and Nephrotic syndrome > 2 years receive PPSV23 – given at least 8 weeks after the final PCV13.
 - ▶ Revaccination after 5 years
- 

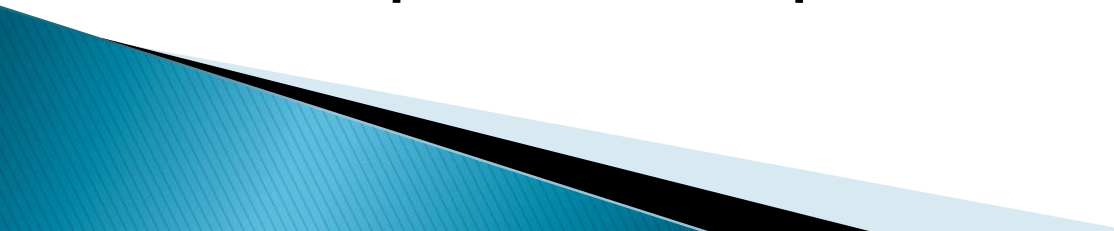
Pneumococcal Vaccine (PCV13, PPSV23)

- ▶ Vierira, et. al 2008
 - ▶ Evaluated response to PCV7 in kids with CKD on conservative treatment and on dialysis by analyzing pre- and post-vaccination antibody response
 - ▶ 100% of patients with conservative treatment and >95% on dialysis presented adequate response (> 0.35 ug/ml of IgG antibodies) to 5 or more serotypes in the PCV7
- 

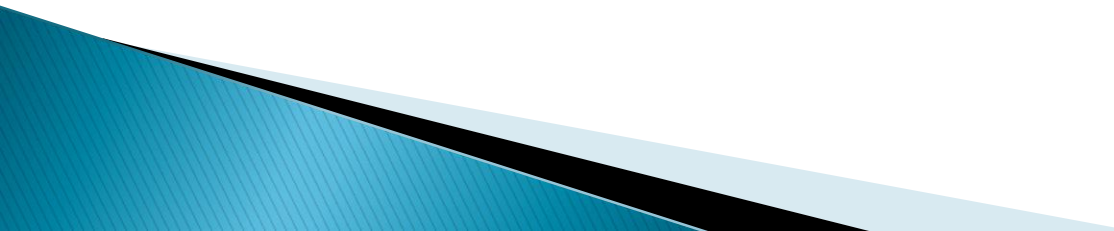
Measles, Mumps, Rubella



Measles, Mumps, Rubella

- ▶ License of MMR in 1963
 - ▶ Prior to vaccine >500,000 cases on average in US each year between 1951 – 1962
 - ▶ By 1993 – 312 cases reported
 - ▶ 2000 measles declared “not endemic to the US” – 20–30 cases/yr from importation
 - ▶ Rubella considered no longer endemic to US
 - ▶ Mumps cause sporadic outbreaks
- 

Measles, Mumps, Rubella

- ▶ Live attenuated viruses
 - ▶ 12–15 months, and 4–6 years
 - ▶ During outbreaks or if child traveling before the age of 1, can give as early as 6 months of age but should not be considered part of the primary series
 - ▶ No evidence to support link between MMR and autism
- 

Measles, Mumps, Rubella

Measles Outbreaks after Importation

- ▶ Utah March–June 2011
- ▶ Genotype D4 sequence differed by single nucleotide suggesting 2 separate importations
- ▶ Outbreak 1: Unvaccinated teen had traveled in Europe; 6 individuals infected through school
- ▶ Outbreak 2: initial case in 7 yo unvaccinated; no source identified; 5 unvaccinated family members infected
- ▶ For both outbreaks: Approximately 13,000 contacts were notified

(MMR March 2013)

Measles, Mumps, Rubella

- ▶ Avoid if on immunosuppression – dose $>2\text{mg/kg}$ or 20mg/day or
- ▶ Once steroids stopped MMR should be delayed at least 1 month
- ▶ Contraindicated in s/p transplant
- ▶ Studies:
 - 10 dialysis patients vaccinated b/w 15–33 months: 70% developed protective titers to measles, 50% to mumps, 80% to rubella; and 30 % to all 3. (Neu 2012)
 - 9 infants immunized at mean age of 11.6 months (6 on dialysis) ---89% had protective titers to measles, 88% to mumps, and 100% to rubella, 88% to all 3 (Neu 2012)
 - Study of 62 dialysis patients 2 months after MMR with 100% positive antibody titers (Neu 2012)
 - Response to MMR in children on dialysis -n=10; 80% seroconversion rate for measles and rubella 50% to mumps 30% to all 3 (Schulman et. al 1990)

Varicella



Varicella

- ▶ Available since 1995, second dose recommended starting 2006
- ▶ First dose of 12–15 months; 2nd dose at 4–6 years
- ▶ If no vaccine and no infection by 13 years then should receive 2 doses 4–8 weeks apart
- ▶ Contraindicated if on immunosuppressive meds, s/p transplant
- ▶ Studies in children with CKD show seroconversion rates of 85–88% compared to 99% in healthy children
 - 2 Multi-center prospective studies on kids with CKD and 2 doses showed that 98–100% had seroconversion (Neu 2012)

MMR – Varicella

- ▶ Review of six studies looking at vaccinating solid organ recipients with live vaccines post transplant (included liver, small bowel, renal)
- ▶ Total n=97 (all studies) age 9–218 months; vaccinated with MMR and varicella 1.5–173 months after transplant
- ▶ Serologies checked 1–6 mo post-vaccination showed seroconversion rates from 41–100% for MMR and 64.5–87 for varicella
- ▶ Adverse events reported in 10 kids – rash and fever
- ▶ 3 patients given acyclovir empirically after rash developed; in all cases rash and fever resolved

(Abuali,2011)

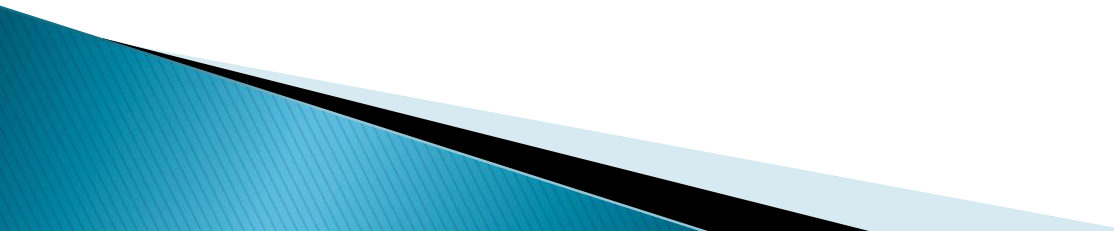
Rotavirus

- ▶ Single most important viral cause of severe gastroenteritis in children world wide
 - ▶ In developing countries is a major cause of childhood death
 - ▶ Nearly every child in US is infected by age 5
 - ▶ Before rotavirus vaccines
 - one in seven children in U.S. required medical assistance
 - One in 70 was hospitalized
 - One in 200,000 died
- 

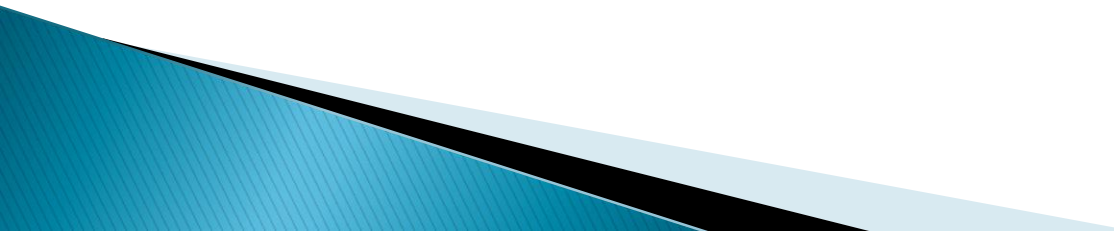
Rotavirus

- ▶ Two oral vaccines released in 2006 with extensive preclinical trials and no increase in intussusception in recipients vs placebo
 - RotaTeq pentavalent (RV, Merck) 3 doses
 - Rotarix monovalent (RV1, GlaxoSmithKline) 2 doses
- ▶ Similar efficacy
- ▶ Both must be started before 15 weeks of age and last dose must be given before 32 weeks of age.

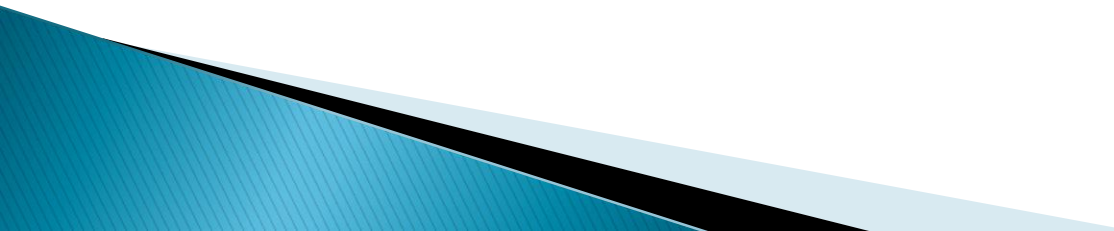
Risk of Intussusception

- ▶ 1999 RotaShield (RV4) – withdrawn after statistical association with idiopathic intussusception
 - ▶ Usually occurs within a week of first or 2nd dose
 - ▶ Clinical trials of RV1 and RV5 indicated no increase in occurrence compared to general population
 - ▶ One in 20,000 to 1 in 100,00 developed intussusception in infants who received RV1 or RV5 according to surveillance data from FDA and CDC
 - ▶ Contraindicated in infants with history of intussusception
 - ▶ ACIP continues to recommend rotavirus to all infants except severe immunodeficiency and those with GI abnormalities predisposing to intussusception
- 

Rotavirus

- ▶ No studies in immunocompromised infants
 - ▶ Rotavirus: because of viral shedding, transmission of vaccine strains has been documented – rare occurrence and vaccine can be given to household contacts of immunocompromised
 - ▶ Virus is more commonly shed and for longer after vaccination with Rotarix compared to Rotateq
 - ▶ Shedding of vaccine virus occurs for the first weeks post-vaccination
 - ▶ No clear guidelines on how long immunocompromised should avoid contact with stool of immunized kids, but strict hand hygiene essential
- 

Human Papilloma Virus Vaccine (HPV)

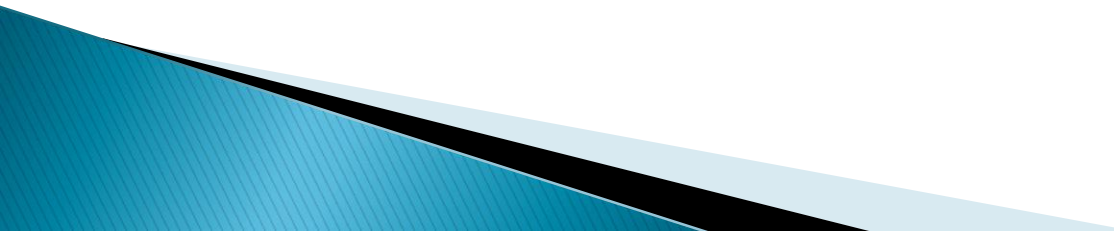
- ▶ Virtually all cases of cervical cancer and most cases of anal cancer caused by HPV strains
 - ▶ HPV types 16 and 18 which cause about 70% of cervical cancer, and about 50% of precancerous lesions
 - ▶ HPV types 6 & 11 cause 90% of genital warts
 - ▶ Gardasil (quadrivalent) Types 16,18, 6,11
 - ▶ Cervarix (bivalent) Types 16 and 18
 - ▶ Can be started as early as 9
 - ▶ Safe in immunocompromised
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I'm not having her
get the HPV vaccination
because I hope she'll
be a virgin when she
gets married...oh but
wait...will her
husband be?



someecards
user card

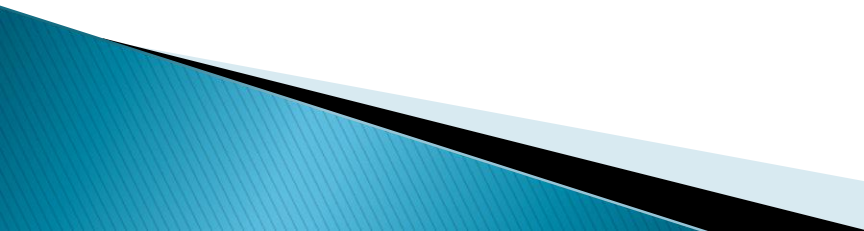
Meningitis

- ▶ Approximately 800–1200 cases/year
 - ▶ Infection progresses rapidly with fulminant disease occurring within 1–4 days after invasion
 - ▶ Overall case fatality rates 10–15%
 - ▶ 11–19% of survivors have long-term sequelae (neurologic disability, limb or digit loss, hearing loss)
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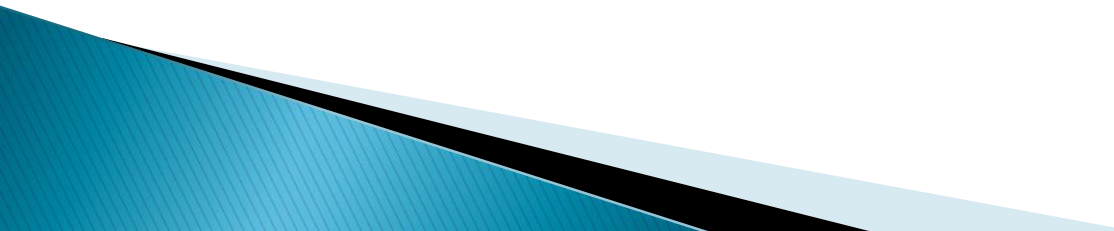
Meningitis

- ▶ *Neisseria meningitidis* presents as Meningitis (50.2%) Bacteremia (37.5%) or bacteremic pneumonia (9.2%)
- ▶ *N. meningitidis* colonizes mucosal surfaces of nasopharynx
- ▶ Transmitted through direct contact with large droplet respiratory secretions from infected or asymptomatic carriers.
- ▶ Nasopharyngeal carriage rates are highest in adolescents and young adults who are reservoirs

Meningitis

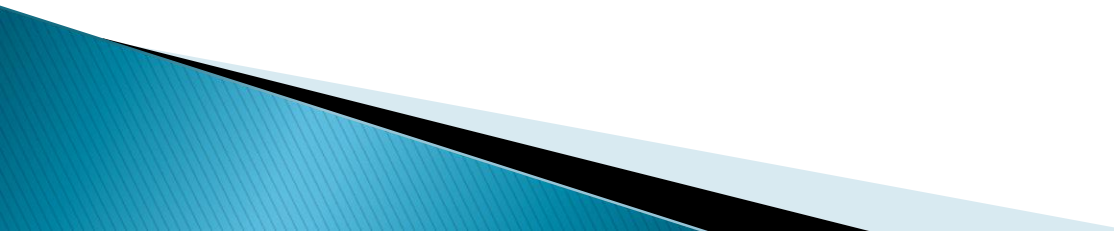
- ▶ Serogroups B, C, & Y are major causes
 - ▶ Each accounts for 1 / 3 of cases but proportion of cases caused by each serogroup varies by age group.
 - ▶ Serogroup B causes 60% of disease 0–59 months; no licensed vaccine for this group/strain
 - ▶ C, Y, & W cause 73% of cases in 11 years and older and are included in vaccines available in the US
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Meningitis –Conjugate Vaccines

- ▶ Conjugate vaccines: advantage is ability to elicit immunologic memory
 - ▶ Coupling the meningococcal capsular polysaccharide to a protein carrier that contains T-lymphocyte epitopes changes the nature of immune response
 - ▶ Conjugation results in improved primary response to the polysaccharide antigen and stronger immunologic response
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MenACWY-D

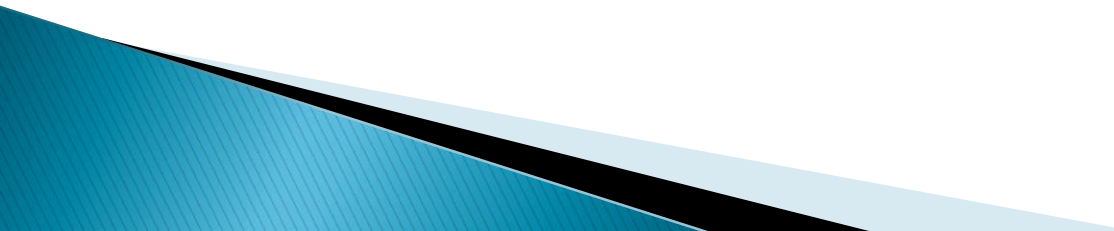
(Menactra – MCV4 / Sanofi)

- ▶ Single dose age 11–12 with booster at 16
 - ▶ Minimum age 9 months –18 yrs
 - ▶ Conjugated to the diphtheria toxoid
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MenACWY–CRM (Menveo, Novartis)

- ▶ Licensed 2010
- ▶ Minimum age 2 years
- ▶ Booster at 16
- ▶ Conjugated to CRM =
Corynebacterium diphtheriae –
naturally occurring, nontoxic form
of diphtheria toxin

Hib–MenCY–TT (MenHibrix)

- ▶ Against *Haemophilus influenzae* Type b (Hib) and meningococcal serogroups C & Y
 - ▶ Four Dose Series
 - ▶ **6 weeks – 18 months** that are at increased risk of invasive Hib and meningococcal
 - ▶ Licensed 2012
 - ▶ Conjugated to Hib and tetanus toxoid
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Adverse events

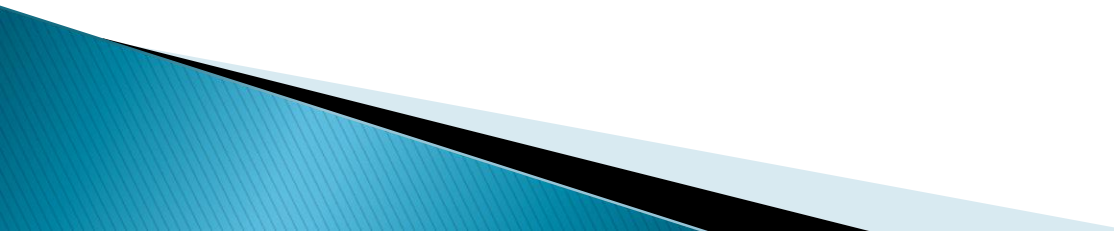
Menactra (MenACWY-D): mostly 11–19 yrs; males 40%

- fever, headache, erythema of injection site and dizziness, syncope;
- Serious events : Headache (37.5%) fever (32.5%) vomiting (23.6%) nausea (22.2%).
- Guillain-Barre Syndrome (15.3%)
- 24 deaths – 11 meningococcal infection; 5–cardiac; 2–neurologic; 2–infectious, 2–suicide, 1 2 rheumatologic and 1 unexplained; no pattern among reports identified

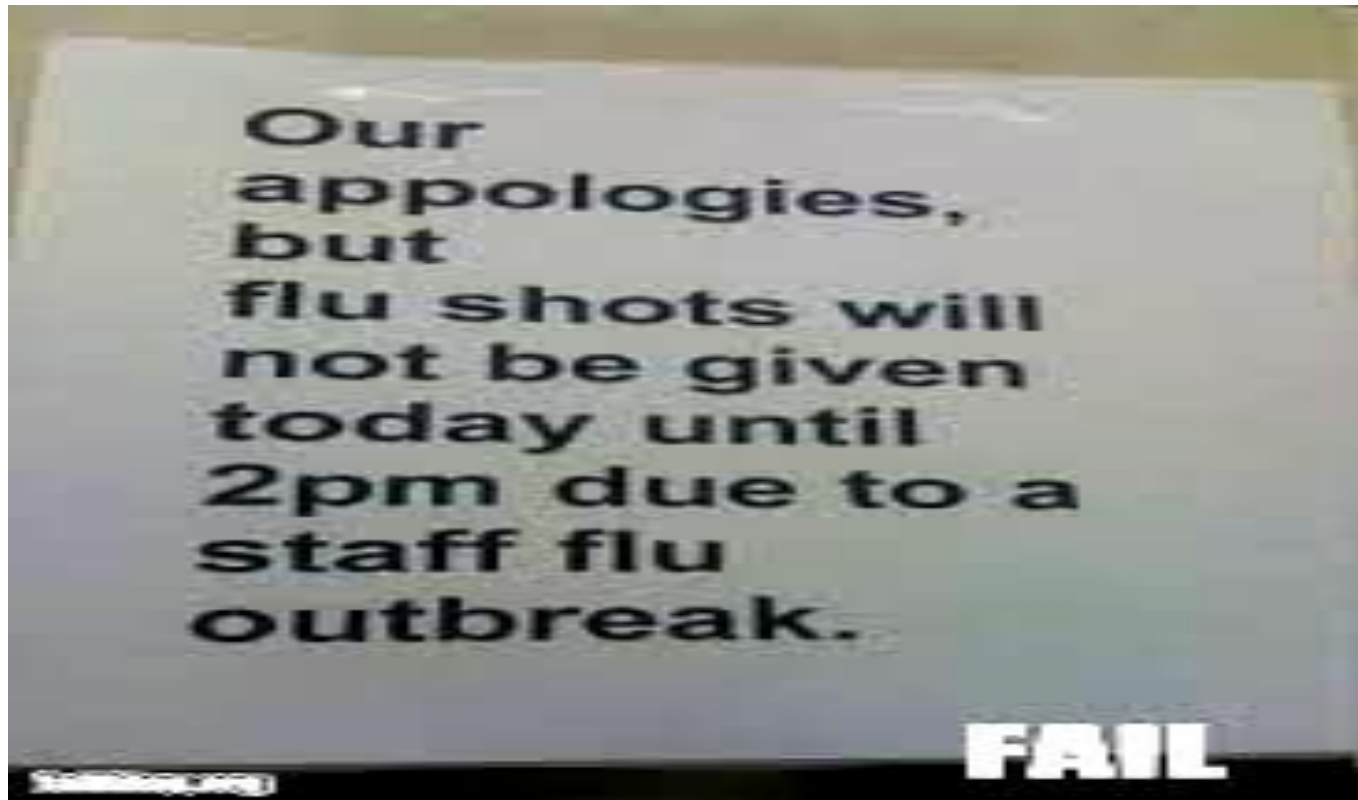
Menveo (Novartis/MenACWY-CRM)

- 11–19 yrs; males 40%
- Injection-site erythema and/or swelling; syncope
- No GBS

Guillame Barre Syndrome

- ▶ Shortly after licensure of MenACWY-D 2005, cases of GBS reported
 - ▶ Symptom onset approx 14 days after vaccination
 - ▶ No deaths, most with full recover
 - ▶ Risk of meningococcal disease greater than risk of GBS
 - ▶ In June 2010, ACIP removed the precaution for persons with a history of GBS because the benefits outweigh the risk of Meningococcal disease
 - ▶ Large retrospective study 2005–2008 of 1.4 million vaccinated estimates of the attributable risk for GBS ranged from zero to 1.5 additional cases of GBS per 1 million vaccines within the 6 week period after vaccination.
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Influenza



Influenza

- ▶ < 9yrs never having received flu vaccine should receive 2 one month apart
- ▶ Live Attenuated Vaccine (LAIV) should not be given to those on dialysis and transplant
- ▶ Studies:
 - Several studies showing transplant patients have lower seroconversion rate than healthy siblings;
 - Studies evaluating response in dialysis patients showed equivalent seroconversion rates
 - Since there is a significant risk for morbidity and mortality in CKD patients, household contacts should also receive vaccination
- ▶ Severely immunocompromised should avoid contact for 7 days of people who receive LAIV

Resources

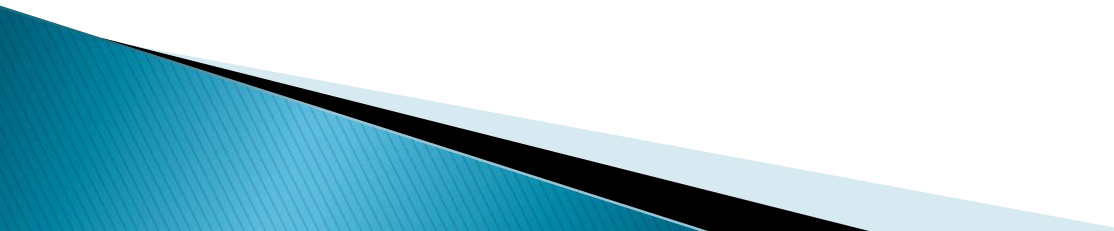
- ▶ Red Book Online – <http://aapredbook.aappublications.org/>
 - ▶ Healthy People – <http://www.healthypeople.gov/2020/topicsobjectives2020/overview>
 - ▶ CDC – <http://www.cdc.gov/mmwr/>
 - ▶ AAP Immunization schedule – <http://www2.aap.org/immunization/izschedule.html>
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FIGURE 2. Catch-up immunization schedule for persons aged 4 months through 18 years who start late or who are more than 1 month behind — United States • 2013

The figure below provides catch-up schedules and minimum intervals between doses for children whose vaccinations have been delayed. A vaccine series does not need to be restarted, regardless of the time that has elapsed between doses. Use the section appropriate for the child's age. Always use this table in conjunction with Figure 1 and the footnotes that follow.

Persons aged 4 months through 6 years					
Vaccine	Minimum Age for Dose 1	Minimum Interval Between Doses			
		Dose 1 to dose 2	Dose 2 to dose 3	Dose 3 to dose 4	Dose 4 to dose 5
Hepatitis B ¹	Birth	4 weeks	8 weeks and at least 16 weeks after first dose; minimum age for the final dose is 24 weeks		
Rotavirus ²	6 weeks	4 weeks	4 weeks ²		
Diphtheria, tetanus, pertussis ³	6 weeks	4 weeks	4 weeks	6 months	6 months ³
<i>Haemophilus influenzae</i> type b ⁴	6 weeks	4 weeks if first dose administered at younger than age 12 months 8 weeks (as final dose) if first dose administered at age 12–14 months No further doses needed if first dose administered at age 15 months or older	4 weeks ⁵ if current age is younger than 12 months 8 weeks (as final dose) ⁵ if current age is 12 months or older and first dose administered at younger than age 12 months and second dose administered at younger than 15 months No further doses needed if previous dose administered at age 15 months or older	8 weeks (as final dose) This dose only necessary for children aged 12 through 59 months who received 3 doses before age 12 months	
Pneumococcal ⁶	6 weeks	4 weeks if first dose administered at younger than age 12 months 8 weeks (as final dose for healthy children) if first dose administered at age 12 months or older or current age 24 through 59 months No further doses needed for healthy children if first dose administered at age 24 months or older	4 weeks if current age is younger than 12 months 8 weeks (as final dose for healthy children) if current age is 12 months or older No further doses needed for healthy children if previous dose administered at age 24 months or older	8 weeks (as final dose) This dose only necessary for children aged 12 through 59 months who received 3 doses before age 12 months or for children at high risk who received 3 doses at any age	
Inactivated poliovirus ⁷	6 weeks	4 weeks	4 weeks	6 months ⁷ minimum age 4 years for final dose	
Meningococcal ¹³	6 weeks	8 weeks ¹³	see footnote 13	see footnote 13	
Measles, mumps, rubella ⁹	12 months	4 weeks			
Varicella ¹⁰	12 months	3 months			
Hepatitis A ¹¹	12 months	6 months			
Persons aged 7 through 18 years					
Tetanus, diphtheria; tetanus, diphtheria, pertussis ⁴	7 years ⁴	4 weeks	4 weeks if first dose administered at younger than age 12 months 6 months if first dose administered at 12 months or older	6 months if first dose administered at younger than age 12 months	
Human papillomavirus ¹²	9 years	Routine dosing intervals are recommended ¹²			
Hepatitis A ¹¹	12 months	6 months			
Hepatitis B ¹	Birth	4 weeks	8 weeks (and at least 16 weeks after first dose)		
Inactivated poliovirus ⁷	6 weeks	4 weeks	4 weeks ⁷	6 months ⁷	
Meningococcal ¹³	6 weeks	8 weeks ¹³			
Measles, mumps, rubella ⁹	12 months	4 weeks			
Varicella ¹⁰	12 months	3 months if person is younger than age 13 years 4 weeks if person is aged 13 years or older			

Summary

- ▶ Children with Kidney Disease follow the same vaccination schedule as well children
 - ▶ Exceptions:
 - PPSV23 is given as early as 24 months if high risk and 8 weeks after last PCV 13
 - HBV – repeat series once if non-responders and boost when titers < 10IU/ml
 - Hib–MenCY–TT 4 dose series for those high risk for invasive disease 6 weeks to 18 months
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Summary

- ▶ MMR and Varicella
 - Minimum interval between 1st and 2nd doses of MMR or Varicella is 4 weeks
 - If giving MMRV then minimum interval between 1st and 2nd doses is 3 months
 - If MMR and Varicella are not given simultaneously then must separate vaccines by 4 weeks

QUESTIONS ANSWERED

SIMPLE	50¢
GUESSES	\$1.00
INTELLIGENT	\$2.00
HONEST	\$5.00

**DUMB LOOKS
ARE STILL FREE**