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Immunization in Special Situations

Immunization in Preterm/low Birth Weight Infants

In principle, all vaccines may be administered as per schedule according to the chronological age irrespective of birth weight or period of gestation. BCG and birth dose of OPV can be safely and effectively given to low birth weight/preterm babies after stabilization and preferably at the time of discharge. Studies have shown that the take of BCG is similar in pre term/low birth weight babies whether given at discharge or later. The birth dose of hepatitis B vaccine can be administered at any time after birth in babies weighing ≥ 2 kg. In babies less than 2 kg, the birth dose of hepatitis B vaccine should be delayed for 1 month after birth as immunogenicity is lower if given earlier. In babies less than 2 kg born to a hepatitis B positive mother, hepatitis B vaccine should be given along with HBIG within 12 hours of birth and 3 more doses at 1, 2 and 6 months are recommended. All other childhood vaccines may be given as per chronologic age and have acceptable safety, immunogenicity and efficacy. Since preterm, low birth weight babies have increased susceptibility to infections, Category 3 and 4 vaccines such as pneumococcal conjugate vaccines, rotavirus and influenza should be offered if resources permit.

Immunization in the Immunocompromised

The immunocompromised are in greater need for vaccines as they are more susceptible to infections. But at the same time the immunogenicity/efficacy is lower and risk of adverse

effects with live vaccines are higher. General principles for vaccination of the immunocompromised are:

- In severe immunodeficiency all live vaccines are contraindicated. In mild/moderate immunodeficiency live vaccines may be given if benefits outweigh the risks. Patients administered live vaccines inadvertently prior to diagnosis of immunodeficiency should be watched for vaccine related adverse effects.
- Household contacts of immunocompromised should not receive transmissible vaccines such as OPV but can safely receive other non transmissible live vaccines such as MMR and varicella. All household contacts should be fully immunized including varicella and influenza to reduce risk of transmission to the immunocompromised.
- All inactivated vaccines can be given but immunogenicity and efficacy may be lower.
- Higher doses, greater number of doses should be given if indicated (hepatitis B), antibody titers should be checked post immunization/regular basis and regular boosters administered if needed. For major/contaminated wounds tetanus immunoglobulin is required in addition to TT even if 3 or more doses of TT have been received in the past.
- Some category 3 and 4 vaccines including pneumococcal, varicella (depending on degree of immunocompromise and in 2 doses 4-8 weeks apart), hepatitis A, inactivated influenza vaccines should be given if resources permit. There is at present insufficient data on the safety and efficacy of the rotavirus vaccine in the immunocompromised.

Additional information on immunization in various types of immunodeficiency is discussed further

*Children Receiving Corticosteroids/other
Immunosuppressive Therapy/Chemotherapy/
Radiotherapy*

Children receiving oral corticosteroids in high doses (prednisolone > 2 mg/kg/day or for those weighing more than 10 kg

20 mg/day or its equivalent) for ≥ 2 weeks should not receive live virus vaccines until the steroids have been discontinued for at least one month. Killed vaccines are safe but may be less efficacious. Children on lesser dose of steroids or those on inhaled or topical therapy may be safely and effectively given their age appropriate vaccines. Children on immunosuppressive therapy other than corticosteroids should avoid live vaccines during therapy unless benefits outweigh risks. Children on chemotherapy and radiotherapy for malignancy should avoid all live vaccines during therapy and for at least 3 months after stopping treatment.

Children with Asplenia/Hyposplenia

Children with asplenia/hyposplenia are at high risk of serious infections with encapsulated organisms. Vaccination with pneumococcal, Hib and meningococcal vaccines is indicated in addition to all routine live and inactivated vaccines. In patients with planned splenectomy, vaccination should be initiated at least 2 weeks prior to splenectomy.

Children with HIV Infection

Children infected by HIV are vulnerable to severe, recurrent, or unusual infections by vaccine preventable pathogens. The efficacy and safety of vaccines depends on the degree of immunodeficiency. In general, in early life most vaccines are safe and efficacious as the immune system is relatively well preserved. The duration of protection may be compromised as there is impairment of memory response with immune attrition. Efficacy and safety are significantly lower in advanced disease. Consideration should be given for readministering childhood immunizations to such children when their immune status has improved following anti-retroviral therapy. Vaccination of a baby born to an HIV positive mother but with an indeterminate HIV status should be as per the normal schedule. Table 5.1 summarizes IAP recommendations for vaccination of HIV infected children.

Table 5.1: IAPCOI recommendations for immunization of HIV infected children

<i>Vaccine</i>	<i>Asymptomatic</i>	<i>Symptomatic</i>
BCG	Yes (at birth)	No
DTwP/DTaP/ TT/Td/Tdap	Yes (routine schedule)	
Polio vaccines	IPV at 6,10,14 weeks, 15-18 months and 5 years. If indicated IPV to household contacts. If IPV is not affordable, OPV should be given*	
Measles vaccines	Yes, 2 doses at 6 and 9 months	
MMR vaccine	Yes	Yes if CD4 count \geq 15%
Hepatitis B	Yes, normal dose and schedule	Yes, four doses, double dose, check for seroconversion, regular boosters
Hib	Yes as per routine schedule	
Pneumococcal vaccines (PCV and PPV 23)	Yes as per routine schedule	
Inactivated Influenza vaccine	Yes as per routine schedule	
Rotavirus vaccine	Insufficient data to recommend	
Hepatitis A vaccine	Yes	Yes, check for serocon- version, boosters if needed
Varicella vaccine	Yes, two doses at 4-12 weeks interval	Yes, if CD4 count \geq 15%, two doses at 4-12 weeks interval
Vi typhoid vaccine	Yes as per routine schedule	
HPV vaccine	Yes (females only) as per routine schedule	

*OPV has been found to be generally safe in HIV infected especially in early stages.

Children with Congenital Immunodeficiency

In patients with severe B-cell immunodeficiency (X linked agammaglobulinemia) live vaccines including OPV, BCG, oral typhoid, live attenuated influenza are contraindicated. Measles and varicella vaccines may be given but may be ineffective due to concomitant immunoglobulin therapy. Inactivated

vaccines may be given but are ineffective. In less severe B-cell deficiencies such as IgA and IgG subclass deficiency only OPV is contraindicated. In patients with severe T-cell immunodeficiencies (SCID) all live vaccines are contraindicated and all vaccines are ineffective. Patients who have received live vaccines especially BCG prior to diagnosis face an increased risk of complications including disseminated BCG disease. For patients with combined immunodeficiencies such as Di George syndrome, Wiskott Aldrich and ataxia telangiectasia, inactivated vaccines may be given but live vaccines are contraindicated. In complement deficiencies all vaccines may be safely given; pneumococcal, Hib and meningococcal vaccines are particularly indicated. In patients with phagocyte defects such as chronic granulomatous disease, only live bacterial vaccines are contraindicated, other vaccines may be safely and effectively given.

Transplant Recipients

Recipients of hematopoietic stem cell transplants (HSCT) are like the unimmunized as they have lost all memory responses during marrow ablation. It is recommended that 3 doses each of DTwP/DTaP/Td/Tdap (depending on age), IPV Hib, Hepatitis B be given at 12, 14 and 24 months post transplant. Two doses of PCV and 1 dose of PPV 23 with 8 weeks interval between doses beginning 12 months post transplant in children below the age of 5 years and 2 doses of PPV23 at 12 and 24 months post transplant in older children are recommended. Influenza vaccination should be given pre transplant, restarted 6 months post transplant and continue life long. MMR and varicella vaccines may be given 24 months post transplant if the recipient is adjudged immunocompetent. All susceptible contacts of HSCT recipients including household and health care worker contacts (HCW) should be immunized against varicella and influenza. Varicella vaccination of contacts should be completed 6 weeks before the transplant date.

Recipients of solid organ transplants should complete all immunizations prior to transplant in accelerated schedules if

needed. Vaccination with live vaccines should be completed at least 2 weeks prior to transplant. It is desirable that seroconversion be documented. In the post transplant period all live vaccines are contraindicated. In patients where immunization has not been completed prior to transplant, vaccination with inactivated vaccines can recommence 6 months post transplant when immunosuppression has been lowered. Boosters for inactivated vaccines should be given as per schedule/when antibody levels wane (Hepatitis A and B) starting 6 months post transplant. Annual influenza vaccination is recommended. All household and HCW contacts should be immunized against influenza and varicella.

Immunization of Children with Chronic Diseases

Children with chronic neurologic, endocrinologic (diabetes), liver, renal, hematologic, cardiac, pulmonary and gastrointestinal disease are at increased risk of infections and serious infections. Live vaccines may be given safely in these children. These children should be offered certain category 3 and 4 vaccines including pneumococcal, hepatitis A, varicella, influenza and rotavirus vaccines. The immunogenicity, efficacy and duration of protection of vaccines is lower than healthy children and hence if indicated higher antigen content/more doses (Hep B), assessment for antibody response and frequent boosters (Hep A and B) are recommended. It is important to stress the role of hepatitis A vaccine in patients with liver disease, pertussis boosting in those with stable neurologic disease and influenza in those with cardiac/pulmonary disease.

Immunization in Children with History of Allergy

First time immunization with any vaccine is contraindicated in children with history of serious hypersensitivity/anaphylaxis to any of vaccine components. The package label should always be checked for vaccine constituents which in addition to antigen include stabilizers/buffers, preservatives, antibiotics and residue from the manufacturing process. Children with history of serious

egg allergy should not receive influenza and yellow fever vaccines but can safely receive other vaccines including measles and MMR vaccines. Children with history of any hypersensitivity are at increased risk for allergic reactions with inactivated Japanese encephalitis vaccines and thus should be monitored carefully. Children who have had a serious hypersensitivity reaction/anaphylaxis to a particular vaccine must never receive it again. A mild reaction is not a contraindication to vaccination. In any case all children should be watched for at least 15 minutes after vaccination for allergy and resuscitation equipment should be kept standby.

Immunization in Relation to Antibody Containing Products (Whole Blood, Packed Red Cells, Plasma, Immunoglobulin)

Inactivated vaccines can be safely administered simultaneously though at different sites or at any time in relation to antibody containing products with no loss of immunogenicity and efficacy (exception administration of RIG 7 days after rabies vaccine). Live vaccines including MMR and varicella should be avoided for at least 3 months after antibody containing products and antibody containing products should be avoided for 2 weeks after receipt of these vaccines. If immunization outside this prescribed period has occurred serologic response should be checked and revaccination done if indicated. Oral typhoid vaccine, LAIV, OPV and yellow fever may be given at any time in relation to antibody containing products. Rotavirus vaccine should be avoided for 6 weeks after giving antibody containing products but if this deferral results in 1st dose of rotavirus being postponed beyond 12 weeks the vaccine may be given.

Immunization During Illness

All immunizations need to be postponed only during serious illness. Vaccination should be encouraged during minor illness such as upper respiratory tract infections and mild diarrhea so that immunization opportunities of contact with health care

provider are not missed. Immunization schedules of hospitalized patients should be completed at the time of discharge.

Lapsed Immunization/Preponed Immunization/ Unknown Immunization Status

There is no need to restart a vaccine series regardless of the time that has elapsed between individual doses due to immune memory. Immunizations should be given at the next visit as if the usual interval had elapsed and the immunization schedule should be completed at the next available opportunity. Doses should not be given 4 or less days from the minimum interval. If inadvertently given 5 or more days from the minimum interval the dose should not be counted. In case of unknown immunization status, the child should be considered unimmunized and vaccinated accordingly. Self reported doses should not be accepted in the absence of documentation with the exception of influenza and PPV vaccines. Serologic testing is also an option in patients with uncertain status but is usually not cost effective, may reduce compliance and may result in missed opportunities for vaccination.

Interchangeability of Brands

There is sufficient data that brands of Hib, Hep B and Hep A may be safely interchanged with no compromise on immunogenicity and efficacy. However robust data for immunogenicity of vaccination with different brands of DTaP is lacking. Hence vaccination with DTaP should be completed with the same brand. However if previous brand is not known or no longer available any brand may be used and vaccination should not be delayed/cancelled.

Catch up Immunization

Vaccination catch-up regimens should preferably be individualized. The basic principles are discussed. Any number of vaccines live/inactivated may be given on the same day either singly or as combination vaccines maintaining a gap of

5 cm between different vaccines (exception BCG and measles/MMR should not be given on the same day). Inactivated vaccines can be given at any time in relation to any other live/inactivated vaccines. If not given on the same day a gap of 4 weeks should be maintained between two live vaccines especially MMR and varicella but also yellow fever and live attenuated influenza vaccines. However OPV, rotavirus and oral typhoid vaccines may be given at any time in relation to any live/inactivated vaccine. For catch up immunization, doses should preferably be given at the minimum possible interval to entail early protection.

The Table 5.2 depicts the suggested catch up schedule for category 1 and 2 vaccines. Other vaccines may be given after one to one discussion with parents.

Table 5.2: *Suggested vaccination schedule for an unimmunized child*

<i>Visit</i>	<i>Suggested vaccines</i>
First	Measles (MMR if more than 12 months) DTwP1/DTaP1 (Tdap if 7 years or more) OPV1/IPV1 (only if less than 5 years) Hib 1 (Only if less than 5 years) Hep B1
Second visit (after 1 month of first visit)	BCG (only in less than 5 years) DTwP2/DTaP2 (Td if 7 years or more) OPV 2 (if OPV given earlier) Hep B 2 Hib 2 (if less than 15 months)
Third visit (after 1 month of second visit)	OPV3/IPV2 MMR (if more than 12 months) Typhoid (if more than 2 years)
Fourth visit (6 months after first visit)	DTwP3/DTaP3 (Td if 7 years or more) OPV4/IPVB1 HepB3

Immunization of Adolescents

Adolescences should be considered an appropriate age for “top-up” immunization as well as for administration of certain

vaccines which may not have been available earlier (Table 5.3). Preferred age for administration is at 10-12 years but catch up may be done till 18 years. Vaccines to be considered for adolescents if not received earlier are detailed in Table 5.3.

Table 5.3: Immunization schedule for adolescents

<i>Vaccine</i>	<i>Schedule</i>
Tdap/Td	Tdap preferred and then Td every 10 years
MMR	2 doses at 4-8 weeks interval
Hepatitis B	3 doses at 0,1 and 6 months
Typhoid	One dose every three years
HPV	3 doses at 0,1/2 and 6 months
Hepatitis A*	2 doses at 0, 6 months (prior check for Anti HAV IgG is likely to be cost effective)
Varicella*	2 doses at 4-8 weeks interval

*After one to one discussion with parents.

Immunization for Travelers

The risk of travelers contracting infectious disease depends on the region/country to be visited, duration of trip and nature and conditions of travel. Uniform recommendations are not possible because the epidemiology of disease differs in various geographical areas. The physician should update routine immunization and also provide destination specific immunizations. For instance, vaccines commonly recommended for Indian travelers include yellow fever vaccine for those intending to go to destinations in South America and Sub-Saharan Africa, polio and meningococcal vaccine for those intending to go on a Haj pilgrimage in Saudi Arabia and the quadrivalent meningococcal vaccine for those visiting the African meningitis belt. Similarly, visitors coming to India from abroad are usually advised vaccination against typhoid, hepatitis A, hepatitis B, rabies and Japanese encephalitis (if visiting rural JE endemic areas in JE season).

Immunization of Children with Bleeding Disorders or those Receiving Anticoagulants

Unless contraindicated, the subcutaneous route should be used.

For aluminium adjuvanted vaccines that can only be given intramuscularly, vaccination should be scheduled after factor replacement therapy, Needles > 23G should be used for injection and the parents should be asked to apply firm and sustained pressure, without rubbing, for at least 5 minutes.

Immunization in Pregnancy/Lactation

All live vaccines including MMR, varicella, LAIV and yellow fever vaccine should be avoided in pregnancy due to possible risk to the fetus. However if inadvertently vaccinated medical termination of pregnancy is not advised as surveillance data does not reveal an increased risk of congenital malformations in accidentally vaccinated women. Inactivated vaccines are safe in pregnancy but should be given only if indicated. All live vaccines with the exception of yellow fever vaccine may be safely given to lactating women.

Immunization of the Elderly

Annual influenza and a single dose of PPV23 vaccines are indicated in individuals aged 65 years or older.