UNIT NO. 3

VACCINATION FOR SPECIAL GROUPS

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ABSTRACT

Vaccination is an important method of prevention which is superior to therapy for patients with impaired host defense. Vaccination needs to be tailored based on patient's underlying host defects and epidemiological exposures. This paper visits the key points to take note of when advising patients that fall into the following categories: pregnant/breast-feeding, high risk groups due to medical conditions, transplant patients, and severely immunocompromised patients.

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INTRODUCTION

Individuals may have altered immunocompetence as the result of pregnancy, disease, treatment or HIV infection. Impaired host defense makes them more susceptible to a wider range of microorganisms than is encountered in individuals with normal immunocompetence, more rapid progression of an infectious disease, increased disease severity, impaired clinical symptoms and signs of infection resulting in delayed diagnosis, and poorer response to therapy. For these reasons prevention is superior to therapy. Vaccination is an important method of prevention and should be tailored to the needs of each patient based on his or her underlying host defects and epidemiological exposures (Table 1). The benefits and risks for vaccination differ from those with normal immunocompetence and care must therefore be taken to advise and manage them appropriately[1].

For discussion, these patients can be grouped into the following:

- Pregnant and breast feeding mothers,
- High risk groups due to medical conditions: (a) diabetes mellitus, cardiac, respiratory, and liver disease, including alcoholism (b) renal failure, end-stage disease, and (c) asplenia, including elective splenectomy,
- Transplant patients, and
- Severely immunocompromised patients – (a) those who have congenital immunodeficiency or are on chemotherapy, and (b) those who are HIV/AIDS related.

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PREGNANT AND BREAST FEEDING MOTHERS

(a) Pregnant mothers

Although pregnancy is a normal state of health, pregnant women have increased morbidity from infections. Furthermore, infection in the pregnant mother may affect the fetus adversely. Thus, women of childbearing age should be immunized against measles, mumps, rubella, varicella, tetanus, diphtheria, and hepatitis B virus as adolescents before becoming pregnant[2,3].

All pregnant women should be screened for immunity by a careful history of immunizations and childhood diseases. Rubella or hepatitis B infection however can be subclinical. Hence, for these two, rubella antibody and hepatitis B virus surface antigen (HBsAg) respectively needs to be ordered to confirm susceptibility for those with a negative history of immunization or infection. Also, women found to be HBsAg-positive should be followed carefully to ensure that the infant receives hepatitis B virus immunoglobulin, begins the hepatitis B virus vaccine series up to 12 hours after birth, and completes the recommended series[5].

Vaccinations during pregnancy

The following are the key points to note:

- Live vaccines are contraindicated, although no reports of adverse reactions reported except in smallpox (vaccinia) vaccination.
- Tetanus and influenza should be kept current.
- No contraindication to give indicated inactivated vaccinations in high risk situations.

Live vaccines that are contraindicated

MMR and Varicella Vaccine

Because of theoretical risks to the fetus, mumps, measles, and varicella vaccines should not be administered to pregnant women or to women who are likely to become pregnant within 1 month. Routine testing for pregnancy before administration of vaccines are not required. After rubella vaccination, a women should wait 28 days before becoming pregnant. Congenital disease from maternal immunization has not been reported for any current routine vaccine, including rubella and varicella vaccines[2,5].

Pregnant women who are susceptible to hepatitis B or rubella will need to be vaccinated after the completion of the pregnancy and before discharge, three doses, and one dose respectively. For varicella, give one dose of varicella vaccine upon completion or termination of pregnancy and the second dose four to 8 weeks after dose[1,2,4,5].

Table 1. Recommended Adult Immunisation Schedule by Vaccine and Special Indications

Special group & indications / Vaccine	Normal health status but increased susceptibility to infections	High Risk groups			Transplant patients Severely immunocompromised patients	HIV related	Potential risk if not immunised
	Pregnancy	Diabetes mellitus, heart disease; chronic pulmonary disease; chronic liver disease; chronic alcoholism	Kidney failure; end-stage renal disease; recipients of renal dialysis or clotting factor concentrates	Asplenia (including elective splenectomy and terminal complement component deficiencies)	Congenital immunodeficiency; leukemia, lymphoma; generalized malignancy; therapy with alkylating agents; antimetabolites; radiations; or high dose long-term corticosteroids	Human immunodeficiency virus infection	Health care professionals
MMR 1-2 doses							
Varicella 2 doses (0, 4-8 wks)							
Tetanus, diphtheria 1 dose booster every 10 yrs							
Influenza 1 dose annually							
Pneumococcal (polysaccharide) 1-2 doses							
Hepatitis A 2 doses (0, 6-12 mths, or 0, 6-18 mths)							
Hepatitis B 3 doses (0, 1-2, 4-6 mths)							
Meningococcal 1 dose							

Routinely required if not given or infected before or no documentation of such events

Recommended because of high risk medical condition

Contraindicated

Source: CDC, 2005 (adapted)

Vaccinations to be kept current

Tetanus & diphtheria Toxoid (Td)

Susceptible pregnant women should receive the combined Td vaccine. Pregnant women who are unimmunized or only are immunized partially against tetanus should complete the primary series. (A primary series in the adult is three doses; administer the first two doses at least 4 weeks apart and the third dose six to 12 months after the second). Previously immunized pregnant women who have not received a Td immunization in the past 10 years should receive a single booster dose[2,4,5].

Influenza Vaccine

The influenza vaccine is a killed virus preparation with an annually adjusted antigenic makeup. Women who are more than 14 weeks' gestation (second and third trimesters) during the influenza season are recommended to receive influenza immunization. The hospitalization rate of women in the third trimester of pregnancy is 250/100,000, which is comparable with non-pregnant women who have high-risk medical conditions. The increased risk of medical complications of influenza infection in pregnancy is related to the increases in heart rate, stroke volume, and oxygen consumption and decreases in lung capacity and changes in immunological function which is the greatest in the third trimester[2,5].

High risk situations

High risk situations may be encountered where the benefits of vaccination outweigh the risks of infection.

Pneumococcal vaccine

The current vaccine includes purified capsular polysaccharide from the 23 most common types of *S. pneumoniae*. The Advisory Committee on Immunization Practices (ACIP) currently recommends that women at high risk, namely, those with diabetes, cardiovascular disease, asplenia, immunodeficiency, and asthma, be given this vaccination before, but not during, pregnancy. The safety of the pneumococcal vaccine during pregnancy has not been evaluated, although no adverse consequences have been reported among newborns whose mothers were inadvertently vaccinated[2,3,5].

Hepatitis A

Hepatitis A vaccines are derived from viruses grown in diploid cell cultures and are formalin inactivated. Safety of hepatitis A vaccination during pregnancy has not been determined. However, because hepatitis A vaccine is produced from inactivated virus, the risk to the developing fetus is expected to be low. Hence, theoretical risks of vaccination should be weighed against the risk for hepatitis A infection in pregnant women who may be at risk for exposure. Examples calling for immunization include travel to endemic areas or intravenous drug use during pregnancy[2,5].

Japanese Encephalitis (JE)

JE vaccination is recommended only for travelers with a significant risk of exposure. In general, those spending at least a month in endemic areas during the transmission season (late summer in temperate areas and year-round in tropical areas) and those planning to participate in outdoor activities exposing them to unavoidable mosquito bites should be vaccinated. Vaccination should be considered before conception in a woman who will be traveling to high-risk areas while pregnant, in conjunction with optimized mosquito-bite precautions[2].

Meningococcal meningitis

Meningococcal vaccine contains the purified polysaccharide of four serogroups of *Neisseria meningitidis.* Routine vaccination is recommended for high-risk groups, including patients with terminal complement component deficiencies, and persons with anatomic or functional asplenia. Vaccination also may benefit travelers to areas in which *N. meningitidis* is endemic or epidemic, such as sub-Saharan Africa. Studies have shown that the meningococcal vaccine is safe and efficacious when given to pregnant women[2,3].

Rabies

Indications for pre-exposure rabies immunization depend on the likelihood of exposure. It may be considered in animal workers and travelers to enzootic areas who anticipate animal exposure[2].

Anthrax

The potential use of anthrax in acts of bioterrorism may remotely necessitate its use. The anthrax vaccine is prepared from a bacteria-free culture containing the three major toxin components produced by the bacteria: the protective antigen, the lethal factor, and the edema factor. The recommended immunization schedule consists of three injections given at two-week intervals, followed by another three doses at six-month intervals[2].

No studies to date have addressed the safety of the anthrax vaccine during pregnancy. As with other non-live-virus vaccines, anthrax vaccine adsorbed does not carry theoretic risks of fetal infection. As such, vaccination should be considered on a case-by-case basis and administered only when the potential benefits outweigh the potential risks to the mother and fetus[2].

Typhoid

Primary prevention consists of hand washing, drinking only safe water, peeling all fruits and vegetables, and eating well-cooked foods. The two types of typhoid vaccination in use today are a live attenuated oral vaccine and a parenteral polysaccharide vaccine.

Neither form of typhoid vaccine is officially recommended during pregnancy. The oral form is contraindicated in pregnancy because it is a live vaccine, presenting theoretical risks of transmission to the fetus. This contraindication does not exist with the parenteral form; however, studies demonstrating the latter's efficacy and safety during pregnancy have not been performed. Potential benefits and risks of immunization should be considered on an individual basis[2].

Yellow fever

Yellow fever vaccination is an exception for the administration of a live vaccine during pregnancy if it is a situation when avoidance of exposure to mosquitoes is not possible and travel to the endemic area cannot be avoided. Yellow fever vaccine contains live attenuated virus but is not known to be teratogenic[2,5].

Poliovirus Vaccine

Poliovirus is an enterovirus with three different strains that cause disease. Exposure may result in asymptomatic infection as well as nonparalytic and paralytic disease. Asymptomatic patients can transmit the disease to susceptible persons. The disease continues to be a problem worldwide, but all recent domestic polio cases have been caused by the strains of virus found in the oral polio vaccine (OPV). This situation has resulted in a change in the ACIP's recommendation for use of inactivated polio vaccine (IPV), instead of OPV or a combination of OPV-IPV for all routine vaccinations[2].

IPV is inactivated by formaldehyde, and its use has eliminated vaccine-associated polio infection[1]. Although no adverse effects have been documented with OPV or IPV in pregnant women or their fetuses, both vaccines should be avoided during pregnancy on a theoretical basis. However, the CDC states that IPV may be administered in accordance with the recommended schedules for adults if a pregnant woman is at increased risk for infection and requires immediate protection against polio, such as possible occupational exposure or travel to areas of endemic poliomyelitis[3].

Smallpox (Vaccinia)
Recent world events have brought to light the threat of terrorists who may deliberately release smallpox. Vaccinia vaccine should not be administered to susceptible pregnant women for routine non-emergency indications[2].

Vaccination of household members

The presence of a pregnant woman in the household is not a reason for avoiding immunizations of household members for routine vaccines, including varicella. However, vaccinia (smallpox) vaccine should not be administered to pregnant women or to persons with close contact (i.e., household contact) with a pregnant woman as immunization with vaccinia during pregnancy may lead to congenital abnormalities in the fetus (about 50 cases have been described)[1].

(b) Breastfeeding mothers

Women of childbearing age are often concerned about whether breastfeeding is safe during immunization. The patient should be reassured that breast-feeding does not adversely affect the response to any of the recommended vaccines for adults. No current recommended vaccine is contraindicated in breast feeding mothers[2,3,5].

HIGH RISK MEDICAL CONDITIONS

Patients with high risk medical conditions are generally not considered immunosuppressed for the purposes of vaccination. They can therefore receive routine vaccinations with both live and inactivated vaccines according to the usual schedules. Due to the underlying medical conditions, there are specific immune deficits that require attention[6]. Those with high risk medical conditions can be divided into three subgroups.

(a) Diabetes, heart disease, chronic pulmonary disease, chronic liver disease, including alcoholism

The fatality rate from influenza begins to rise in mid-life and is highest in persons who have chronic medical conditions, such as chronic obstructive lung disease, and cardiovascular disease, particularly if they are elderly. The elderly, due in part to a high rate of chronic medical conditions, are the population with the highest age-specific case-fatality rate from influenza and account for 90% or more of deaths. However, middle-aged persons with multiple chronic medical conditions have a higher case-fatality rate than healthy persons 65 years of age.

Influenza vaccine
Annual influenza vaccine is strongly recommended for these patients. Influenza vaccination is also recommended for health care workers, especially staff of nursing homes and chronic care facilities and the aim is to reduce the possibility of transmission of influenza from healthcare worker to patients. For the same reason, household contacts of persons at high risk for influenza complications should be vaccinated.

Pneumococcal vaccine
A one-time pneumococcal vaccination is recommended.

Hepatitis A vaccine
Those with chronic liver disease should be vaccinated. A two-dose series is given, either at either zero and six months, or zero and six to 18 months. If it combined hepatitis A and hepatitis B vaccine is used, administer three doses at zero, one, and six months[3].

(b) Kidney failure, end-stage renal disease, recipients of hemodialysis or clotting factor concentrates.

Patients with chronic renal failure have an increased risk of infection with a variety of pathogens especially pneumococcus and hepatitis B. Sepsis related to vascular access, and urinary tract infections are other problems. There is also lower antibody response to vaccination, and the antibody levels of such patients may be lower; hence, they require an increased dose of vaccine or more frequent dosing. Since secondary antibody responses are less affected than primary antibody responses, immunization strategies should be formulated early in the course of progressive renal disease[1,6].

Hepatitis B vaccine
Dialysis-dependent patients should receive a higher-than-standard dose (i.e., 40 mg). After following the standard three-dose regimen, patients should be tested for adequacy of response (i.e., anti-HBsAg titers, $\geq$10 mIU/mL). Patients with an inadequate response should receive an additional three doses of vaccine and be retested for a vaccine response. Patients without an appropriate response should be considered nonresponders. Because patients have been demonstrated to have an improved response to vaccine during the predialysis phase of illness, every attempt should be made to immunize patients early in the course of illness in those with chronic renal failure who are likely to proceed to dialysis. Antibody titers should be assessed annually. Additional doses should be administered if anti-HBsAg levels decline to less than 10 mIU/mL[1].

Pneumococcal vaccine
The incidence of pneumonia in patients on dialysis has been reported as approximately 6 per 1000 patient-months; *S pneumoniae* is the causative agent in more than 50% of cases. All patients on dialysis should receive the 23-valent pneumococcal polysaccharide vaccine[1].

Influenza vaccine
Patients with chronic renal dysfunction, or on dialysis also should receive yearly influenza immunization[1,3,4].

(c) Asplenia including elective splenectomy and terminal component deficiencies

Patients with asplenia are at risk for fulminant bacteremia associated with a high mortality rate from Streptococcus pneumoniae, Haemophilus influenzae type b infections, and

also Neisseria meningitides infections[1,6]. When elective splenectomy is planned vaccination with pneumococcal, meningococcal, and Hib vaccines should precede surgery by at least 2 weeks if possible[6].

Pneumococcal vaccine

The patient should be revaccinated once after at least 5 years have elapsed since the initial vaccination. For patients who are undergoing elective splenectomy, vaccination should be done at least 2 weeks before surgery[1].

Meningococcal vaccine

This should also be routinely administered to asplenic patients. Meningococcal conjugate vaccine is preferred but meningococcal polysaccharide vaccine (MPSV4) is an acceptable alternative. Revaccination after 5 years is indicated for adults previously vaccinated with MPSV4 who remain at high risk for infection[4].

TRANSPLANT PATIENTS

Transplant patients may be divided into two categories: (a) the hematopoietic stem cell transplant patient (HSCT) and (b) the solid organ transplant patient. For both types of transplantation, infectious complications are frequent and represent a major cause of death. The proper use of vaccines in such patients continues to be an important preventative intervention to minimize their risk for infectious diseases.

Live vaccines

In both the categories of patients, oral polio vaccine, vaccinia (smallpox), BCG, live oral typhoid (Ty21a strain of S typhi), and live intranasal attenuated influenza vaccines are contraindicated. The Vi polysaccharide should be used instead of the oral live vaccine. The safety of MMR and varicella has not been established, so these vaccines are contraindicated in transplant recipients receiving immunosuppressive medications[1,7,9].

(a) The stem cell transplant patient (HSCT)

High-dose chemotherapy followed by hematopoietic stem cell transplantation (HSCT) is used to treat a variety of disorders, including multiple myeloma and lymphoma. Autologous and allogenic bone HSCT recipients lose immune memory of exposure to infectious agents and vaccines accumulated through a lifetime and therefore need to be revaccinated when their immune response recovers[1,7,8]. Current evidence suggests that immunization against vaccine-preventable diseases is not recommended before one year post-transplant because the response is poor[1,7,8].

For patients with HSCT, the greatest risk for infectious complications occurs during the period of immune reconstitution with donor cells after ablative radio-chemotherapy. As they transition from a state of profound humoral and cell-mediated immune deficiencies to a state capable of functional B- and T-cell responses, the recipients develop improved ability to respond to vaccines[1,7].

They are at increased risk for vaccine-preventable diseases from the encapsulated bacteria, including *H influenzae* type b, *N meningitidis*, and especially *S pneumoniae*. These infections frequently occur in patients who underwent transplantation more than 6 months earlier. Although most cases occur in recipients of allogeneic HSCT, disease also has been reported in recipients of autologous HSCT[1].

Table 2 shows the revaccination programme for HSCT patients, provided they are not on immunosuppressive therapy and do not have graft-versus-host disease (GVHD)[1]. Meningococcal vaccination is only indicated in HSCT recipients who live in endemic areas or areas experiencing outbreaks[1].

Table 2. Recommended vaccinations for hematopoietic stem cell transplantation recipients, including allogeneic and autologous recipients

Time After HSCT			
Vaccine	**12 months**	**14 months**	**24 months**
Inactivated or toxoid			
Tetanus diphtheria	Td	Td	Td
Hib congugate[d]	Hib conjugate	Hib conjugate	Hib conjugate
Hepatitis B virus	Hep B	Hep B	Hep B
PPV23	PPV23	—	PPV23
Hepatitis A virus	Routine administration not indicated		
Influenza	Lifelong, seasonal administration, beginning before HSCT and resuming at > 6 months after HSCT		
Meningococcal	Routine administration not indicated		
IPV	IPV	IPV	IPV
Rabies	Routine administration not indicated		
Live attenuated			
Measles	—	—	MMR
Varicella	Contraindicated for HSCT recipients		

Source: Weber & Rutala, 2003

(b) The solid organ transplant patient

Unlike HSCT recipients, solid organ transplant recipients usually receive lifelong immunosuppression. Because many vaccines are more immunogenic in the time period before transplantation than after transplantation, the vaccine should be administered before transplantation. Similarly, many vaccines are more effective when administered early in the course of illness (e.g., liver and renal failure) rather than when the patient has end-stage organ failure[1].

Inactivated vaccines. Vaccines recommended for adults (if the immunizations are not up-to-date) include those for hepatitis B virus, hepatitis A virus (liver transplant recipients), yearly influenza (especially for patients with cardiac or pulmonary disease), inactivated poliovirus, Td, *H influenzae* type b conjugate, 23-valent pneumococcal polysaccharide (especially for patients with cardiac or pulmonary disease), and meningococcus[1,9].

SEVERELY IMMUNOCOMPROMISED PATIENTS

Severely immunocompromised patients can be divided into two groups, (a) those without HIV infection, and (b) those with HIV infection.

(a) Those without HIV infection

Within this group are those with congenital immunodeficiency, leukemia, lymphoma, generalized malignancy or those given therapy with alkylating agents, antimetabolites, radiation, or large amounts of corticosteroids[1,6].

Live vaccines

In general, these patients should not receive live virus vaccines because viral replication can be enhanced after administration of live, attenuated-virus vaccines. Additionally, oral poliovirus vaccine should not be administered to any household contact of a severely immunocompromised person. MMR and varicella vaccines are however not contraindicated for the close contacts of immunocompromised persons[1,6].

Persons with leukemia in remission who have not received chemotherapy for at least 3 months are not considered to be severely immunocompromised for the purposes of receiving live virus vaccines[1,6].

When cancer chemotherapy or immunosuppressive therapy is considered, vaccination ideally should precede the initiation of chemotherapy or immunosuppression by at least 2 weeks. Vaccination during chemotherapy or radiotherapy should be avoided, because antibody responses are suboptimal[1,6].

Patients who are vaccinated while on immunosuppressive therapy or in the 2 weeks before starting therapy should be considered unimmunized and should be revaccinated at least 3 months after discontinuing therapy. As with persons with HIV infection, severely immunocompromised persons respond less well to immunization than non-immunocompromised persons[1,6].

Passive immunoprophylaxis with immune globulins may be indicated for immunocompromised persons instead of or in addition to vaccination. When exposed to a vaccine-preventable disease such as measles, severely immunocompromised persons should be considered susceptible regardless of their history of immunization[1,6].

Table 3. Immunisations awaiting solid organ transplantation

Vaccine[a]	Definition of Full Immunization	Visit 1	Visit 2 (1–2 mths after visit 1)	Visit 3 (6 mths after visit 2)	Routine schedule once fully immunized
Inactivated vaccines					
Td	3 doses, last within 10 years	Td-1	Td-2	Td-3	Td every 10 years
H influenzae type b conjugate	Not routinely recommended	—	—	—	—
Hepatitis B virus	3 doses	Hep B-1	Hep B-2	Hep B-3	Booster if titer <10 mIU/mL
Pneumococcal	2 doses of PPV23	PPV23-1	—	—	Complete 2 doses; second dose 5 years after first dose
Hepatitis A virus	2 doses (at-risk patients only)	Hep A-1	—	Hep A-2	Recommended for at-risk patients; complete 2 doses
Influenza	Annual administration (every fall)	—	—	—	Annual
Menigococcal	1–2 doses (at-risk patients only)	Mening-1	—	—	Recommended for at-risk patients; complete 1–2 doses, second dose 5 years after first
IPV virus	3 doses plus 1 booster) (at-risk patients only	IPV-1	IPV-2	IPV-3	Recommended for at-risk patients
Live vaccines					
MMR	Up to 2 doses	Transplant candidates, MMR-1	Transplant candidates, MMR-2	—	Vaccine not recommended after transplant
Varicella	2 doses (at - risk patients only)	Transplant candidates, varicella-1	Transplant candidates, varicella-1	—	Vaccine not recommended after transplant

Source: Weber & Rutala, 2003

Table 4. Recommended immunizations for adults and adolescents with HIV infection
It is assumed that primary immunization has been provided.

Vaccine	Definition of complete immunization	Recommendation
Td	Primary series plus booster within past 10 years	Booster every 10 years
Influenza (inactivated trivalent)	1 dose annually	All patients (annually, before influenza season)
H influenzae type B (conjugate)	—	Not routinely recommended
Hepatitis A virus	2 doses	All susceptible patients at increased risk for hepatitis A virus infection (e.g., illegal drug users) or patients with chronic liver disease (e.g., hepatitis C virus infection)
Hepatitis B virus	3 doses	All susceptible patients (i.e., antihepatitis B core antigen negative)
Meningococcal (quadrivalent)	—	Recommended only for patients at risk
Poliovirus (inactivated)	3 doses plus 1 booster	Recommended only for patients at risk
S pneumoniae (23-valent polysaccharide)	1 dose (single revaccination after 5 years)	On condition that $CD4^+$ count > 200/mL
Vaccinia	—	Contraindicated for pre-event prophylaxis; consider the event of smallpox release
Varicella	—	Contraindicated

Source: Weber and Rutala, 2003

(b) Those with HIV infection

In HIV patients, an emphasis on preventing opportunistic infections remains important because of the recognized limitations of HAART, including noncompliance, inability to tolerate HAART, and failure of HAART in some patients to restore immunity to a level that substantially reduces the risk for opportunistic infection[1,10].

The US Public Health Service and Infectious Disease Society of America recommendations emphasize the continued need to focus on the prevention of infection in persons with HIV infection, including appropriate immunizations[1,11].

Vaccine use in persons with HIV infection falls into four categories[1] (Table 4):

- Vaccines whose indications are unaltered by HIV infection status include the diphtheria-tetanus toxoid (Td), hepatitis A virus, rabies, and quadrivalent meningococcal vaccines.
- Vaccines that are specifically indicated for such persons. These include the 23-valent polysaccharide pneumococcal vaccine, influenza vaccine, and hepatitis B virus vaccine.
- Vaccines that are indicated only for persons with HIV infection that is early in the course of illness include vaccines for measles, mumps, and rubella and varicella as defined by the patient's immunologic status.
- Vaccines that are contraindicated include vaccines for oral typhoid, oral poliovirus, and smallpox (vaccinia).

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LEARNING POINTS

- **Women of childbearing age should be immunized against measles, mumps, rubella, varicella, tetanus, diphtheria, and hepatitis B virus as adolescents before becoming pregnant.**
- **Pregnant women who are susceptible to hepatitis B or rubella will need to be vaccinated after the completion of the pregnancy and before discharge.**
- **Breast-feeding does not adversely affect the response to any of the recommended vaccines for adults.**
- **Patients with high risk medical conditions can receive routine vaccinations with both live and inactivated vaccines according to the usual schedules.**
- **Transplant patients should be given pre-event intervention where feasible.**
- **Severely immunocompromised patients should not be given live vaccines.**
- **The choice of inactivated vaccines depend on the specific impaired host defense and consequent risk of infection.**