

Immunization in Pregnancy

This clinical practice guideline has been reviewed by the Infectious Diseases Committee and reviewed and approved by the Executive and Council of the Society of Obstetricians and Gynaecologists of Canada.

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Disclosure statements have been received from all authors and members of the committee.

Values: The evidence obtained was reviewed and evaluated by the Infectious Diseases Committee of the Society of Obstetricians and Gynaecologists of Canada (SOGC) under the leadership of the principal authors, and recommendations were made according to guidelines developed by the Canadian Task Force on Preventive Health Care.

Benefits, Harms, and Costs: Implementation of the recommendations in this guideline should result in more appropriate immunization of pregnant and breastfeeding women, decreased risk of contraindicated immunization, and better disease prevention.

Recommendations

The quality of evidence reported in this document has been assessed using the evaluation of evidence criteria in the Report of the Canadian Task Force on Preventive Health Care (Table 1).

1. All women of childbearing age should be evaluated for the possibility of pregnancy before immunization. (III-A)
2. Health care providers should obtain a relevant immunization history from all women accessing prenatal care. (III-A)
3. In general, live and/or live-attenuated virus vaccines should not be administered during pregnancy, as there is a, largely theoretical, risk to the fetus. (II-3B)
4. Women who have inadvertently received immunization with live or live-attenuated vaccines during pregnancy should not be counselled to terminate the pregnancy because of a teratogenic risk. (II-2A)
5. Non-pregnant women immunized with a live or live-attenuated vaccine should be counselled to delay pregnancy for at least four weeks. (III-B)
6. Inactivated viral vaccines, bacterial vaccines, and toxoids can be used safely in pregnancy. (II-1A)
7. Women who are breastfeeding can still be immunized (passive-active immunization, live or killed vaccines). (II-1A)
8. Pregnant women should be offered the influenza vaccine (including H1N1 vaccine, when it is available) when they are pregnant during the influenza season. (II-1A)
9. Pregnant women with suspected or documented H1N1 infection should be treated with oseltamivir (Tamiflu, 75 mg twice daily for 5 days) within 48 hours of onset of symptoms. (III-B)

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INTRODUCTION

Immunization programs are among the most cost-beneficial health interventions. As women who are considering pregnancy or who are already pregnant present for health care consistently, obstetrical care providers are well

Abstract

Objective: To review the evidence and provide recommendations on immunization in pregnancy.

Outcomes: Outcomes evaluated include effectiveness of immunization, risks and benefits for mother and fetus.

Evidence: The Medline and Cochrane databases were searched for articles published up to June 2008 on the topic of immunization in pregnancy.

Key Words: Pregnancy, immunization, live vaccine, live-attenuated vaccine, inactivated viral vaccine, bacterial vaccine, contraindications

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Table 1. Key to evidence statements and grading of recommendations, using the ranking of the Canadian Task Force on Preventive Health Care

Quality of Evidence Assessment*	Classification of Recommendations†
I: Evidence obtained from at least one properly randomized controlled trial	A. There is good evidence to recommend the clinical preventive action
II-1: Evidence from well-designed controlled trials without randomization	B. There is fair evidence to recommend the clinical preventive action
II-2: Evidence from well-designed cohort (prospective or retrospective) or case-control studies, preferably from more than one centre or research group	C. The existing evidence is conflicting and does not allow to make a recommendation for or against use of the clinical preventive action; however, other factors may influence decision-making
II-3: Evidence obtained from comparisons between times or places with or without the intervention. Dramatic results in uncontrolled experiments (such as the results of treatment with penicillin in the 1940s) could also be included in this category	D. There is fair evidence to recommend against the clinical preventive action
III: Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees	E. There is good evidence to recommend against the clinical preventive action
	L. There is insufficient evidence (in quantity or quality) to make a recommendation; however, other factors may influence decision-making

*The quality of evidence reported in these guidelines has been adapted from The Evaluation of Evidence criteria described in the Canadian Task Force on Preventive Health Care.²⁷

†Recommendations included in these guidelines have been adapted from the Classification of Recommendations criteria described in the The Canadian Task Force on Preventive Health Care.²⁷

placed to review their immunization status and recommend vaccination strategies. This can significantly reduce the occurrence of preventable diseases, benefiting not only the patient and her infant but also the rest of the population.

As pregnancy is considered to be an immunologically competent status, a full and unaltered response to immunization is expected.^{1,2} However, given the theoretical risks to the fetus following administration of vaccines, it is essential that the obstetrical care provider counsel the pregnant woman with respect to the risks and benefits of vaccines, as well as potential exposure to the diseases the vaccines are expected to prevent. Appropriate information and counselling must also be provided in cases of inadvertent vaccination in pregnancy. This document reviews active and passive immunization, indications for and contraindications to such interventions in pregnancy, and suggested precautions. Finally, specific vaccines are discussed and recommendations made for their use in pregnancy (Table 2).

General Comments

Prenatal care providers should obtain a thorough immunization history. In many cases, women present for prenatal care having not had their immunization status reviewed since they completed the school-age vaccination schedule.

Ideally, women should have their vaccination status optimized pre-pregnancy, so there would be no concern about coverage in pregnancy. However, if this is not possible, planning for vaccination in pregnancy with killed or recombinant vaccines or planning for vaccination postpartum with live-attenuated vaccines is appropriate. Prenatal care providers should also be aware of the risks, if any, of inadvertent vaccination during pregnancy.

The overall objective of immunization in pregnancy is to induce a state of immunity such that the woman and the fetus are protected following exposure to the organism for which the immunization is given. In addition, this offers an opportunity for protection of the neonate for the first 6 to 12 months of life. Vaccines may be prepared from various sources, including the inactivated agent, live attenuated agent, and modified and single antigen recombinant forms of the organism.

Immunizations can be either active or passive, depending on the characteristics of the agent used. Passive immunization is a process whereby the antibody has been obtained from serum of either a person or an animal already adequately immunized or previously infected. From this process, antibodies can be obtained either as whole serum or as concentrated IgG and may be administered to the host to confer immediate protection. Active immunization relies on the administration of antigens and results in a prompt but transient IgM response in the host. This is followed by a rise in IgG antibody production that will be more or less sustained. In cases where the response is not sustained, booster doses may be required for long-term immune

ABBREVIATIONS

CRS	congenital rubella syndrome
HPV	human papilloma virus
Tdap	diphtheria and tetanus toxoids and acellular pertussis

memory. Of note, oral vaccines will stimulate IgA initially as opposed to IgM (parenteral).

Given the theoretical fetal risks associated with maternal immunization, an evaluation of potential risks of exposure to the infectious agent, as well as benefits of vaccination should be performed before this intervention is considered. The type of vaccine required must be taken into consideration as some may be contraindicated.

Recommendations

The quality of evidence reported in this document has been assessed using the evaluation of evidence criteria in the Report of the Canadian Task Force on Preventive Health Care (Table 1).

1. All women of childbearing age should be evaluated for the possibility of pregnancy before immunization. (III-A)
2. Health care providers should obtain a relevant immunization history from all women accessing prenatal care. (III-A)

REVIEW OF SPECIFIC VACCINE CATEGORIES

Live and Live-attenuated Vaccines

In general, live and/or live-attenuated virus vaccines are contraindicated during pregnancy, as there is a primarily theoretical risk of infection to the fetus. However, it is important to mention that, to date, there is no evidence to demonstrate a teratogenic risk from any currently available live vaccines (e.g., mumps, measles, rubella varicella).^{3,4}

Rubella vaccine

The rubella virus is moderately infectious and clinically manifests as fever, malaise, lymphadenopathy, and upper respiratory symptoms followed by the appearance of a typical rash. Complications are more common in the adult and include arthralgia, arthritis, encephalitis, neuritis, and thrombocytopenic purpura. Congenital rubella syndrome is particularly severe and more common if it occurs early in pregnancy, with up to 85% of infants affected if infected in the first trimester. CRS may result in deafness, cataracts, cardiac defects, microcephaly, mental retardation, hepatosplenomegaly, bone damage, and thrombocytopenia. Furthermore, the effects may be delayed by several years, and children may present with diabetes or a progressive encephalopathy. The best way to eradicate CRS is to immunize all susceptible women and women without adequate proof of immunization. The obstetrical care provider is in a good position to identify susceptible women and to provide immunization postpartum. The rubella vaccine alone and in combination (MMRII) is a live vaccine and therefore contraindicated during pregnancy. It is therefore suggested that women should delay pregnancy by one month following such immunization.

Inadvertent vaccination in pregnancy was reportable to the Centers for Disease Control and Prevention between 1971 and 1989. Analysis of the accumulated data revealed that subclinical infection was detected in 1% to 2% of fetuses but that there was no evidence of CRS in any of the 321 women inadvertently vaccinated who elected to continue their pregnancies.⁵ Therefore, in such situations, women should be reassured that ending the pregnancy is not necessary on the basis of fetal risks following maternal immunization. However, given the small theoretical fetal risk, immunization with the rubella vaccine is best delayed until after delivery. Neither breastfeeding nor anti-Rho(D) administration is a contraindication to immunization.

Varicella vaccine

Although varicella is relatively uncommon in the pregnant population (0.7 per 1000), it can result in very significant maternal and fetal morbidity and mortality. Despite improvements in clinical care, varicella may be complicated by pneumonia in up to 28% of pregnant women, and this remains associated with a risk of mortality. In a recent report of 198 cases of varicella in pregnancy, 16 deaths were reported, all in the group complicated by pneumonia.⁶ Furthermore, varicella in early pregnancy is associated with a 1% risk of congenital infection, which carries serious sequelae such as cerebral cortical atrophy, mental retardation, and dermatomal specific limb abnormalities.⁷ Maternal varicella occurring five days before to two days after delivery is associated with severe neonatal varicella in 17% to 30% of infants and a case fatality rate as high as 31%.⁸

These facts highlight the importance of adequate immunization in women of childbearing age and the influence obstetrical care practitioners can exert on the prevention of varicella in mother and fetus.

Immunity to varicella should be reviewed in the context of maternal health care, and vaccination should be recommended as soon as appropriate. Since the varicella vaccine is a live, attenuated virus vaccine (two preparations are available in Canada and both are live), it should not be given in pregnancy. A program of administration to susceptible postpartum women should be developed. A second dose is recommended as for all non-immune adults and should be administered approximately four weeks after the first.⁹

Breastfeeding is not a contraindication to vaccination with varicella vaccine, nor is household contact with a newborn. A study of 362 women inadvertently exposed to varicella vaccine in pregnancy between 1995 and 2000 identified no cases of congenital varicella.¹⁰ Therefore, inadvertent vaccination with varicella vaccine during pregnancy does not constitute a reason to recommend pregnancy termination. Instances of inadvertent varicella immunization during

Table 2. Indications for vaccine use in pregnancy

Vaccine	Indication for use in pregnancy	Comment
Live		
Measles	Contraindicated	No known fetal effects, but live vaccine-theoretical risk with increased risk of preterm labour, small for gestational age, and low birthweight
Mumps	Contraindicated	As above—see text
Poliomyelitis (oral polio vaccine: Sabin)	Contraindicated; not available in Canada	Use inactivated polio vaccine (see “Poliomyelitis: Salk” below)
Rubella	Contraindicated	As above—see text
Typhoid (oral)	No data on safety Preferable to use non-live preparation	See non-live preparation
Vaccinia	Contraindicated; not available in Canada	Has been reported to cause fetal infection
Varicella	Contraindicated	Fetal effects, if any, unknown. Not reason for termination Varicella zoster immunoglobulin to be considered if pregnant woman exposed to virus. Antiviral if diseased should immunize susceptible women postpartum
Yellow fever	Generally contraindicated unless high-risk situation	No data on fetal safety, although fetuses exposed have not demonstrated complications Not a reason for pregnancy termination If travel to high-risk endemic area unavoidable, suggest vaccination
Non-Live		
Cholera	No data on safety	To be used if high-risk situation only (e.g., outbreak)
Diphtheria/tetanus	No evidence of teratogenicity	Susceptible women to be vaccinated as per general guidelines for non-pregnant women
Hepatitis A	No apparent fetal risk	Appropriate in the presence of medical indication
Hepatitis B	No apparent fetal risk	Vaccine recommended for pregnant women at risk
Influenza	Indicated in pregnancy	No adverse effects in over 2000 fetuses exposed Influenza may be associated with greater morbidity in pregnancy
Japanese encephalitis (inactivated Japanese encephalitis vaccine)	No data on safety in pregnancy	Not to be given routinely in pregnancy, as theoretical risk exists Consider only if travel where risk exposure is high (benefit > risk)
Meningococcus	Safe and efficacious in pregnancy	Vaccine to be administered using same guidelines as for non-pregnant patients
Plague	No data on safety in pregnancy	Vaccination to be considered only if benefits outweigh risk
Pneumococcus	Indicated in high-risk patients	No safety data available, but no adverse effects reported
Poliomyelitis (inactivated polio vaccine: Salk)	To be considered in high-risk situations	Consider if pregnant woman needs immediate protection (high-risk situation/travel) No known fetal effects
Rabies	No indication of fetal effects	Risks from inadequate treatment significant Pregnancy not contraindication to post-exposure prophylaxis
Tdap (diphtheria and tetanus toxoids and acellular pertussis vaccine)	Case-by-case evaluation needed	Td considered safe in pregnancy Tdap not well studied Risks—benefit to be closely evaluated, depending on risk of pertussis in particular
Typhoid (injectable)	No data on safety in pregnancy	To be considered only in high-risk cases (e.g., travel to endemic areas).

pregnancy or of pregnancy occurring within three months after immunization should be reported to the pharmaceutical company.*

Non-pregnant women who are vaccinated with varicella vaccine should delay conception by one month.

Following exposure of a pregnant woman to varicella, a history of previous vaccination or of chickenpox itself should be sought, as it has been shown to correlate with immune status. In the absence of such a history, the mother's immunity should be determined by obtaining varicella IgM, IgG serology. Susceptible women should then be offered varicella zoster immune globulin within 96 hours of exposure in an attempt to prevent the disease or reduce the severity of the infection in the mother. The recommended dosage is 125 units/10 kg to a maximum of 625 units. Although there may also be some benefit to the fetus, this remains to be investigated in a clinical trial.

Benefits versus risks of live-attenuated vaccines during pregnancy

Given the possible risks, live-attenuated vaccines should not be given in pregnancy unless there are special circumstances and the benefits clearly outweigh the theoretical risks. For example, if a pregnant woman **must** travel to an endemic area for yellow fever, the vaccine many need to be administered, even though it is a live attenuated vaccine, when the risk of exposure is high and the travel cannot be postponed. A recent report of 304 pregnant women exposed to yellow fever immunization in early pregnancy demonstrated that such exposure was not associated with an increase in major fetal malformation.¹¹

Recommendations

3. In general, live and/or live-attenuated virus vaccines should not be administered during pregnancy, as there is a, largely theoretical, risk to the fetus. (II-3B)
4. Women who have inadvertently received immunization with live or live-attenuated vaccines during pregnancy should not be counselled to terminate the pregnancy because of a teratogenic risk. (II-2A)
5. Non-pregnant women immunized with a live or live-attenuated vaccine should be counselled to delay pregnancy for at least four weeks. (III-B)

Inactivated Viral Vaccines, Bacterial Vaccines, and Toxoids

These vaccines are considered safe in pregnancy. The possible benefit of immunizing pregnant women must always be balanced against the potential risks of the vaccine. As there is no evidence to suggest a risk to the fetus or to the pregnancy from maternal immunization with these agents, the benefit of their use generally far outweighs the theoretical risks.

Recommendations

6. Inactivated viral vaccines, bacterial vaccines, and toxoids can be used safely in pregnancy. (II-1A)
7. Women who are breastfeeding can still be immunized (passive-active immunization, live or killed vaccines). (II-1A)

Diphtheria and Tetanus Toxoids and Acellular Pertussis Vaccine

There has been a long experience with the safe administration of tetanus toxoid (and tetanus-diphtheria toxoids) during pregnancy; indeed, in the developing world, the use of these vaccines has led to the virtual eradication of neonatal tetanus. Recently, Td combined with an adult formulation of acellular pertussis vaccine (Tdap; Adacel [Sanofi Pasteur], Boostrix [GlaxoSmithKline]) have become available in Canada and are recommended for universal immunization of adolescents. A single dose of Tdap is recommended for all adults to replace their next 10 yearly dose of Td. Although the safety of Td is well-established in pregnancy, that of Tdap during pregnancy has not yet been studied. Therefore, the decision to use Tdap during pregnancy should be made on a case-by-case basis, depending on the risk of acquisition of pertussis during pregnancy. Women who are not at particularly high risk of pertussis who are due for their 10 yearly Td can be given Tdap postpartum. Studies are currently underway to determine the safety of Tdap during pregnancy and the benefits and risks of maternal immunization for the newborn who is at the highest risk of morbidity and mortality from pertussis.

Influenza vaccine

Influenza is a highly contagious acute respiratory infection. It is manifested clinically as an abrupt onset of malaise, headache, and myalgia followed by a cough, fever, and sore throat.

There is literature demonstrating that pregnant women are at increased risk of hospitalization and serious complications including mortality from pandemic influenza.^{12,13} Pregnancy is associated with significant cardiovascular and respiratory demands, as evidenced by increases in stroke volume, heart rate, and oxygen consumption. More recent studies have shown an increase in influenza-related

*Immunization with Varivax III should be reported to Merck Frosst Canada, Medical Services (1-800-684-6686). Immunization with Varilrix should be reported to GlaxoSmithKline (1-800-387-7374).

hospitalization of healthy pregnant women, with seasonal influenza occurring at the rate of 1 per 1000 or 0.1%.^{15–20}

The risks were in fact calculated to be equivalent to those of non-pregnant women with high-risk conditions, for whom immunization has traditionally been recommended. Older data^{12,13} also suggest increased maternal risk, as previous reports of pandemics showed that morbidity and mortality was greater in pregnant women. Although the data are limited and more research is needed to clarify the maternal-fetal risks of influenza, current recommendations support immunization of pregnant women with the inactivated influenza vaccine. Neither influenza nor influenza vaccine are teratogenic. No adverse effects on perinatal outcome were observed in more than 10 000 women vaccinated during pregnancy.²⁰ Current Canadian recommendations advocate universal immunization of pregnant women, in any trimester, against influenza.²³

Another reason for immunization in pregnancy is the protection of the newborn after birth, which can be accomplished with passive immunity (transfer of maternal antibodies). Recently a randomized controlled prospective study showed that immunizing pregnant women benefited the women as well as their infants under 6 months of age.²² Such immunization also reduced febrile influenza-like illness by over 30% in both the mothers and their young infants while reducing proven influenza infections in the 0- to 6-month-old infants by 63%. The National Advisory Committee on Immunization in Canada recommends influenza vaccine for pregnant women as well as influenza immunization of the caregivers and family of the young infant.²¹

Further, the most common way for infants to acquire influenza is from household contacts, so immunization of the mother can prevent her from acquiring influenza and potentially passing it on to her child.

H1N1 in Pregnancy

H1N1 of swine origin has recently emerged as a pandemic strain and has resulted in increased morbidity and mortality for pregnant women.

Data from the US Centers for Disease Control and from a recent observational study have shown that pregnant women are at increased risk of hospitalization, morbidity, and mortality from H1N1.^{23,24} These increased risks of complications are believed to be related to the physiologic changes that occur during pregnancy, in particular, alterations in the cardiovascular, respiratory, and immune systems. Risks appear to be greater in the second and third trimesters. In this most recent study of all cases reported to the Centers for Disease Control from April to May 2009, authors reported 34 confirmed or probable cases of H1N1

in pregnant women.²⁴ The rate of hospitalization was 32%, and, importantly, between April and June of the same year, there were 6 maternal deaths from H1N1. In all cases, women suffered from pneumonias that deteriorated into acute respiratory distress syndrome. Authors suggested these data supported the prompt treatment of pregnant women with H1N1 influenza infection with anti-influenza drugs. Taken together, these data suggest that pregnant women appear to be at higher risk of serious complications from H1N1 than from seasonal influenza and that they should be treated aggressively.

Current recommendations regarding therapy include the use of oseltamivir (Tamiflu) and zanamivir (Relenza) for the treatment of H1N1 in the general population. This is supported by two recent meta-analyses that showed modest effectiveness of these drugs in alleviating symptoms of seasonal influenza in otherwise healthy adults and children.²⁵

The safety of these drugs in pregnancy and lactation has recently been reviewed by Tanaka et al.²⁵ Authors concluded that oseltamivir was the drug of choice for the treatment of pregnant women, since there are more data on its safety in pregnancy. In addition, it is also well absorbed systemically. Alternatively, zanamivir may also be used, although the safety data are much more limited. In addition, both drugs can be used safely during breastfeeding.

Therefore, it is recommended that pregnant women suspected or confirmed to suffer from H1N1 be treated with oseltamivir for 5 days (75 mg twice daily). This treatment should be initiated within 48 hours of the onset of symptoms, which include fever, cough, sore throat, sore joints/muscles, and fatigue. It is also recommended to institute treatment immediately and not delay until confirmation of infection.

Pregnant women, for all the above reasons, represent a high-risk group and an immunization priority. The current seasonal influenza vaccine does not protect against H1N1, but since it also carries significant protective benefits against other types of influenza, it should continue to be administered as recommended by National Advisory Committee on Immunization.

Recommendations

8. Pregnant women should be offered the influenza vaccine (including H1N1 vaccine, when it is available) when they are pregnant during the influenza season. (II-1A)
9. Pregnant women with suspected or documented H1N1 infection should be treated with oseltamivir (Tamiflu, 75 mg twice daily for 5 days) within 48 hours of onset of symptoms. (III-B)

Other Vaccines

Human papilloma virus

In Canada, the quadrivalent HPV vaccine was approved in July 2006 for the prevention of infection by HPV strains that are responsible for 70% of cervical cancers and 90% of genital warts. In February, 2007, after serious consideration, the National Advisory Committee on Immunization issued recommendations for the use of Gardasil for females aged 9 to 26 years.

Gardasil vaccine is manufactured using recombinant technology and uses a specific subunit of the virus L1, which then assembles into non-infectious virus-like particles. It specifically targets HPV 6, 11, 16, and 18, which are known to be associated with cervical, vulvar, and vaginal cancers and genital warts.

Although the vaccine is not recommended for use during pregnancy, there is no evidence that it is teratogenic.²⁶ If a woman becomes pregnant part way through the vaccine series, the rest of the series should be deferred until after pregnancy. The vaccine can be administered to women who are breastfeeding.²⁶

SIDE-EFFECTS OF VACCINES AND CONTRAINDICATIONS

Vaccines may cause various side effects, which should not all be interpreted as contraindications. Side effects can be divided in five categories: (1) immediate/early, (2) local, (3) systemic, (4) allergic, and (5) long-term.

1. Immediate/early effects include fainting and vasovagal reactions. These are differentiated from anaphylactic shock (see below). Patients who have received the vaccine should be kept in the waiting room for observation for 15 to 30 minutes.
2. Local effects are mild and are the most common. They include soreness, erythema, and swelling.
3. Systemic effects are less common and include malaise and fever.
4. Mild allergic reactions can also occur. In general, these will be in reaction to exposure to avian proteins (eggs, such as in yellow fever vaccine and influenza vaccine) or to traces of neomycin/streptomycin (MMR). Anaphylactic reactions are exceedingly rare. They should be recognized immediately and treated following local protocols with injection of sc epinephrine (1:1000).
5. Guillan-Barré syndrome can occur but usually at rates lower than that seen for spontaneous disease (there being a temporal association but not always a causal association).

Unfortunately, too often, vaccines are withheld on the basis of what is thought to be a contraindication.

The items on this list DO NOT represent contraindications to immunization

- Mild acute illness with or without low-grade fever
- Autoimmune disorder, multiple sclerosis
- Family history of convulsions, epilepsy
- Recent exposure to an infectious disease
- Current antimicrobial therapy or convalescence from recent illness
- Household contact with pregnant woman
- Breastfeeding
- Prior reaction to immunization with mild/moderate tenderness, redness, swelling, or fever of less than 40°C
- Personal history of allergies, excluding anaphylaxis, to neomycin/streptomycin or egg protein
- Family history of adverse reaction or allergies to vaccines
- Positive TB skin test

Two of these circumstances deserve additional discussion: household contact vaccination and breastfeeding. Although individuals immunized with some live virus vaccines can shed the virus, they usually do not transmit it; therefore, household contacts of pregnant women can be safely vaccinated without risks to the mother and her fetus. Breastfeeding is also considered safe following immunization of the mother, and it has not been shown to adversely influence the maternal immune response. Therefore, breastfeeding does not represent a contraindication to any immunization: passive-active immunization, live vaccines, or killed vaccines.

CONCLUSION

The development of new vaccines and the accumulating information about vaccine safety ensure that health care providers can provide immunizations and/or advice about immunization for their pregnant patients. This is most important in disease prevention, and obstetrician-gynaecologists must play an active role in vaccine administration. Furthermore, it is imperative that more research efforts be focused in the area of immunization in pregnancy.

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