Maternal Immunization to Benefit the Mother, Fetus, and Infant

Geeta K. Swamy, MD[a,*], Rebecca Garcia-Putnam, MD[b]

KEYWORDS

• Maternal immunization • Passive immunity • Influenza • Tetanus • Pertussis

KEY POINTS

- Prevention of vaccine-preventable diseases through immunization is one of the greatest public health achievements in the United States and worldwide.
- Pregnant women are at risk for the same infections as their nonpregnant peers and, in some cases, have increased morbidity and mortality.
- Maternal immunization provides maternal, fetal (preterm birth, fetal growth restriction, and fetal demise), and infant benefit (infection during early life).
- Future research should focus on maternal vaccine immunology, efficacy and safety of maternal immunization, and the development of new vaccines against important maternal-infant pathogens.
- Obstetric providers can aid in improving vaccine coverage and overcoming barriers to maternal immunization through direct vaccine recommendation, counseling, and education.

INTRODUCTION

It is well known that the implementation of routine immunizations has had a significant impact on the health and well-being of infants, children, and adults worldwide. From 1900 to 2000 the life expectancy of a United States–born resident increased from 47.3 years to 76.8 years.[1] The great reduction and, in some cases, eradication of vaccine-preventable diseases (VPDs), along with innumerable other public health

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Dr. Garcia-Putnam - none.
[a] Division of Maternal-Fetal Medicine, Department of Obstetrics & Gynecology, Duke University, Durham, NC 27705, USA; [b] Department of Obstetrics & Gynecology, Duke University, Durham, NC 27705, USA
* Corresponding author. Duke Maternal-Fetal Medicine, 2608 Erwin Road, Suite 210, Durham, NC 27705.
E-mail address: geeta.swamy@duke.edu

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and medical advancements, has contributed to this change, with vaccines deemed one of the greatest achievements of the decade by the Centers for Disease Control and Prevention (CDC) in 2011.[1] Polio and smallpox have been eradicated in the United States while cases of and deaths from rubella, diphtheria, tetanus, mumps, and pertussis have declined by more than 90% since the routine administration of the associated vaccines.[2] More recently the introduction of the pneumococcal vaccine has been credited with preventing more than 200,000 infections and 10,000 deaths over an 8-year period.[1]

Despite the progress made over the last century, there is still much work to be done to reduce VPDs in the United States, as routine adult vaccine coverage falls well below the Healthy People 2020 immunization goals.[3] As of 2009, there were still approximately 50,000 deaths annually from VPDs in the United States.[4] Pneumococcal disease continues to cause an estimated 30,000 cases of invasive disease, resulting in 175,000 hospitalizations for pneumonia per year.[5] Approximately 1 in 5 United States residents is infected with seasonal influenza and, depending on the circulating strain, the associated morbidity and mortality can be significant; an estimated 3000 to more than 40,000 Americans die as a result of influenza infection each year.[6]

There are now 17 VPDs covered by 14 routine, recommended vaccinations for adults.[7,8] Pregnant women are at risk for the same diseases as their nonpregnant peers and, in some cases, have increased morbidity and mortality associated with infection. For instance, pregnant women affected by seasonal and pandemic influenza viruses have higher rates of hospitalization, need for admission to the intensive care unit (ICU), pneumonia, and death.[9–15] However, pregnant women are not candidates for all vaccines, owing to the potential and theoretical risks of fetal harm. Vaccines are broadly classified into 2 categories: inactivated and live attenuated. Live attenuated vaccines contain altered pathogens that have very low virulence properties, which can replicate in the vaccinated individual and induce an immune response. Although technically possible for a live attenuated vaccine to cause a clinical infection, it is extremely uncommon and is mild in comparison with natural infection. However, given this theoretical risk of causing maternal infection and subsequent perinatal transmission, live attenuated vaccines are contraindicated in pregnancy. Inactivated vaccines contain heat-inactivated or chemically inactivated noninfectious pathogens, pathogen subunits, or toxoids, and are recommended during pregnancy based on weighing the risks and benefits of maternal-fetal exposure to the vaccine versus the exposure to infection and risks of morbidity and mortality. Because the immune response to inactivated vaccines is not cellular but rather almost entirely humoral, these vaccines tend to require multiple or booster doses to maintain adequate antibody levels over time. In addition to improving overall maternal health, there is mounting evidence that maternal immunization results in improved pregnancy outcomes and may be an effective strategy against particularly problematic VPDs during early infancy. This article describes the benefits of maternal immunization for the mother, fetus, and infant.

MATERNAL BENEFITS OF IMMUNIZATION

During pregnancy there are physiologic and immunologic changes that increase a woman's susceptibility to infection, making prevention and, thus, vaccination a highly important component of routine prenatal care. The immune response is modified to decrease inflammatory immune responses and diminish fetal rejection.[16] In addition, there is a shift from a T-helper 1 (Th1) response toward a more Th2-favored response, allowing for fetal antigen tolerance, but potentially increasing maternal vulnerability to infectious diseases.[17] This vulnerability is apparent in the increased morbidity and