


COMMENTARY

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Maternal vaccine knowledge in low- and middle-income countries—and why it matters

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ABSTRACT

Maternal vaccines have the potential to reduce the global burden of neonatal morbidity and mortality by accessing the infant immune system before a vaccine administered in childhood would be effective. Maternal vaccines for influenza, tetanus, and pertussis have been shown to reduce neonatal disease and mortality, and other candidate vaccines for group B streptococcus and respiratory syncytial virus are being developed to continue this trend. However, safe and effective maternal vaccines will only successfully reduce neonatal illness if mothers decide to receive them. Maternal knowledge, attitudes, and beliefs around vaccines are key determinants to vaccine acceptance or vaccine hesitancy, and yet this issue is often understudied in low and middle-income country settings. A deeper understanding of these factors and how they influence maternal decision-making will allow public health practitioners and global and national policymakers to design more effective interventions. Addressing barriers to immunization at the policy and programmatic levels such as mothers' knowledge, attitudes, and beliefs of maternal vaccines is essential to increasing vaccination rates at a global scale and reducing global vaccine-preventable neonatal deaths.

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Maternal vaccines act as a guiding force in public health by serving to prevent dangerous and pervasive infectious diseases clustered in the neonatal period through transplacental transfer of IgG antibodies. Specifically, immunization in pregnancy is shown to reduce neonatal mortality and illnesses such as influenza, pertussis, and tetanus.^{1–3} As the scientific community continues to weigh maternal vaccines as a key strategy to reduce infant mortality and severe illness, barriers and facilitators to vaccine acceptance must be evaluated to support the vaccine ecosystem and improve vaccine policy and program implementation. Mothers' knowledge, attitudes and beliefs towards maternal vaccines play an important role in determining vaccine acceptance, and should be considered when evaluating the underlying mechanisms to vaccine uptake.

The scope of the problem

It is estimated that 46% of all deaths in children under five occur during the neonatal period with a large proportion of those deaths due to sepsis, prematurity, pneumonia and tetanus.⁴ While this is most likely an underestimate due to knowledge gaps in the global burden of disease, specifically in low and middle-income countries (LMICs), this data reveals the need for new and/or improved interventions to protect children during this critical period. A call to action within the scientific community to address these statistics, laid forth by the UN Sustainable Development Goals, has led to the development of new vaccines, particularly maternal vaccines.

Vaccination of pregnant women is widely recommended against a host of pathogens for mother and infant by preventing the disease in mothers and preventing transmission of the disease to infants through protective maternal antibodies.⁵ Currently, the World Health Organization (WHO) recommends three maternal immunization strategies: (1) influenza vaccine, which GAVI estimates could prevent 45 deaths per 100,000 people vaccinated, (2) maternal tetanus vaccine, which has reduced neonatal tetanus by an estimated 94% (95% CI: 80–98), and (3) the Tdap vaccine, which is recommended on a limited basis and is thought to be the most cost-effective strategy for reducing neonatal and infant pertussis.^{2,3,6–8} Specifically, the Strategic Advisory Group of Experts on Immunization (SAGE) recommends vaccination against tetanus during pregnancy and identifies pregnant women as a priority group for influenza vaccination in countries that administer or plan to introduce the vaccine. There are also candidate maternal vaccines being developed for respiratory syncytial virus (RSV) and group B streptococcus, that are estimated to be major causes of neonatal morbidity and mortality worldwide, and may also share the same association between maternal antibody and infant protection as influenza, pertussis, and tetanus.^{9,10}

Currently, the main driver behind a new vaccine introduction or inclusion in a country's National Immunization Program (NIP) is disease burden. While global burden of disease models produce best-estimates, the paucity of local data in LMICs expressing the burden of disease prevents

Ministries of Health from analyzing context-specific implications for the introduction of new vaccines. Maternal vaccines hold great promise to reduce infant deaths, but a lack of burden of disease estimates across global contexts limits our ability to understand the potential impact a vaccine program might have on reducing infant mortality.¹¹

Equally important to vaccine introduction is exploring potential challenges to implementation from both a policy and programmatic perspective, particularly when considering the financial investment in pipeline vaccines and the potential they hold to reduce neonatal mortality. As the scientific community continues to deepen its understanding of the true potential impact of maternal vaccines, vaccine hesitancy is increasingly posing a challenge to vaccine uptake.¹² Vaccine hesitancy, or the decision to delay or refuse vaccination, impacts both immunization rates and the ability of a vaccine to reach its full potential, which is why it must be considered a significant challenge to reducing global vaccine-preventable neonatal morbidity and mortality.

Known drivers to vaccine uptake

From the policy perspective, both global and national governing bodies must approve the implementation of a vaccine before it is introduced into the country's NIP. First, SAGE completes an analysis of the vaccine and determines whether there should be a global recommendation. A global recommendation is then considered by the national Ministry of Health, where the National Immunization Technical Advisory Group (NITAG) completes a country-specific analysis similar to that of SAGE, followed by the regulatory approvals and procurement phase. Ultimately, the determining factor in the development of vaccine policy is approval from the national Ministry of Health.

Once the policy has been established, successful implementation of a new vaccine can be influenced by several factors. The most frequently studied factors that facilitate or inhibit vaccine utilization globally are structural barriers such as cost, availability, and accessibility of vaccines. These barriers are to a large extent already known and are considered by vaccine policy and program implementers. In addition to these factors, the vaccine community must also consider vaccine hesitancy. An increasingly common phenomenon, vaccine hesitancy poses a threat to infectious disease reduction worldwide.¹² Vaccine hesitancy has been a research focus at WHO with contribution from various stakeholders including both governments and the private sector: they have developed tools to assess vaccine confidence and utilization among pregnant women, which can aid in the development of interventions to target vaccine hesitancy across global contexts.^{11,13}

Maternal knowledge of vaccines, coupled with attitudes and beliefs, contribute to or allay vaccine hesitancy.¹⁴ In fact, several studies looking at barriers and facilitators to the maternal influenza vaccine demonstrate that knowledge was a key determining factor in vaccine uptake.^{15–17} Other research has shown that there is a relationship between maternal vaccine hesitancy, intention to vaccinate, and maternal and child vaccine rates.¹⁸ Maternal knowledge, attitudes, and beliefs therefore should be considered not only by policy

implementers and researchers alike, but prioritized as a key potential barrier when considering current and future maternal immunizations.

Considering maternal vaccine knowledge, attitudes, and beliefs

The existence of safe and effective maternal vaccines will only prove useful if mothers decide to use them. Maternal knowledge, attitudes, and beliefs around vaccines are an integral part of the underlying mechanisms of vaccine hesitancy. Understanding these factors will allow public health practitioners to design more effective interventions.

While research on vaccine hesitancy and the factors that determine uptake is burgeoning in developing countries where the phenomenon is known to be most studied and increasingly prevalent, very little is known about maternal knowledge, attitudes, and beliefs toward maternal vaccines in resource-limited settings.^{19,20} A recent study in Zambia revealed that mothers had a limited knowledge of vaccines, but expressed positive views about vaccinating themselves and their children. Mitigating beliefs and norms such as paternal involvement and community rumors influenced women's attitudes toward vaccination.²¹ Further research in Zambia explored vaccine attitudes and hesitancy and found that lack of knowledge, along with other factors such as traditional religious practices, created misgivings toward western medicine amongst some participants.²² In other studies conducted in low-resource settings, researchers found that acceptability of maternal tetanus toxoid (Ivory Coast) and maternal Tdap vaccine (Pakistan) was good, but similarly noted that the mother's partner's opinions strongly affected women's attitudes and actions toward vaccinations; the study also noted that immunization campaigns should be directed toward men, as well as mothers.^{23,24} Additionally, research conducted in Saudi Arabia revealed that about a quarter of women surveyed were unwilling to get the maternal influenza vaccine, and that women with limited knowledge of vaccinations were significantly less likely to get vaccinated than those with greater knowledge of vaccinations.²⁵ Similarly, research in Mexico demonstrated that knowledge of pertussis vaccination was independently associated with the intention to receive maternal Tdap amongst pregnant women.²⁶ As demonstrated, studies of maternal vaccine knowledge, attitudes and beliefs have been sporadically conducted in LMICs, and as such the data is not sufficient to glean insights on whether these factors contribute to vaccine hesitancy at the global level.

Research exploring maternal attitudes toward childhood vaccines has also shown to be associated with uptake. The majority of research on this topic found that mothers' knowledge of immunizations was a factor associated with the decision to vaccinate their children.^{27–29} Attitudes also played a significant factor; in one three-country study of maternal vaccine acceptance, maternal attitudes toward the government and trust in the healthcare system was shown to influence vaccine uptake.³⁰ The parallels between a mother choosing to vaccinate her child versus choosing to vaccinate her child in

utero highlight the importance of understanding this as a factor for uptake.

It is important to note that mothers' knowledge of maternal vaccines is dependent to a large extent on the expertise of healthcare providers advising upon and administering the vaccines. Healthcare providers are often parents' primary source of knowledge on vaccines, and have been shown to influence uptake.^{24,26} In one study, provider hesitancy to recommend a maternal vaccine negatively impacted women's decision to get vaccinated.²⁵ Healthcare provider hesitancy to recommend vaccines can have the unfortunate consequence of influencing mothers not to vaccinate their children, and should be considered a determinant of maternal vaccine attitudes.

Research in this field is far from complete in being able to provide answers to the question of how maternal knowledge, attitudes, and beliefs may impact vaccine uptake. Maternal knowledge, attitudes, and beliefs of immunization may vary across cultures and over time, as has shown to be true in developed settings. Most studies argue that these factors are important in predicting vaccine uptake, but it would be unwise to assume that the conclusions drawn from one context might be applied elsewhere. As vaccines, and in particular, maternal vaccines, become increasingly available in resource-limited settings, attitudes and beliefs may change culturally, which could drive behavior toward vaccine hesitancy.

Moving forward

Maternal vaccine knowledge, attitudes, and beliefs serve to facilitate or inhibit vaccine uptake, and the dearth of research in this field may prohibit maternal vaccines such as Tdap, RSV, and group B streptococcus from reaching their full potential. Failing to account for maternal knowledge, attitudes, and beliefs when developing vaccine policies and implementing maternal vaccine strategies could result in increased vaccine hesitancy and fail to reduce the burden of infectious disease morbidity and mortality amongst neonates worldwide.

In order to increase maternal vaccination rates at a global scale, vaccine uptake strategies should incorporate context-specific maternal vaccine attitudes, knowledge and beliefs about maternal vaccines to address any potential barriers to acceptance. This may be outlined in the following ways:

- (1) *Research:* Public health researchers should conduct more research about maternal vaccine knowledge, attitudes, and beliefs of maternal vaccines across different contexts, particularly in LMICs, to better understand the scope of the issue and its impact on global immunization coverage rates. The role of religion and partners in maternal decision-making processes should also be explored as potential facilitators and barriers to vaccine uptake. Research stratified across facility type or setting (rural vs. urban) should also take place to see if there is variation in acceptance and hesitancy across different settings.
- (2) *Policy development:* Firstly, vaccine policy development at the global and national levels should

include education of healthcare professionals so that they are adequately able to disseminate the benefits of maternal vaccinations. Many healthcare professionals still maintain skepticism about maternal vaccinations, which can be easily transferred to the patients.³¹ A consistent message across an entire healthcare workforce will fill in maternal knowledge gaps which will in turn reduce vaccine hesitancy. Secondly, SAGE, which already notes knowledge, attitudes, and beliefs as drivers of vaccine hesitancy, should prioritize acceptability in their review for a new vaccine introduction for maternal vaccines, as research outlined above has indicated its importance in maternal decision-making and ultimate vaccine uptake.¹⁴

- (3) *Program implementation:* In addition to considering structural barriers such as cost, availability, and accessibility of vaccines, programs designed to increase maternal immunization should specifically target maternal vaccine knowledge, attitudes and beliefs to amplify vaccine acceptance and ensure successful dissemination and uptake. Programs that focus on maternal knowledge of vaccines have been shown to improve the timing, completeness, and coverage of vaccination.²⁷ A strong communication strategy should also include culturally and contextually appropriate messaging that addresses the values, beliefs and norms of the groups and subgroups of populations, to address the attitudes and beliefs that could influence a mother's intention to vaccinate.³¹

Maternal vaccines contain great potential to reduce the global burden of infant morbidity and mortality, with their unique position to access the infant's immune system through maternal antibodies before a child vaccine could be effective. However, vaccine hesitancy, driven largely by maternal knowledge of vaccines, threatens to curtail the potential successes of such vaccines, thereby hindering public health goals to reduce the global burden of neonatal infectious disease and mortality. Across both policy and programmatic levels, addressing barriers to vaccine uptake, such as maternal knowledge, attitudes, and beliefs of maternal vaccines, is paramount to effective implementation and ultimate disease reduction.

Disclosure of potential conflicts of interest

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