

Pregnancy vaccination guide

MONIKA ZASZTOWT-STERNICKA^{1, 2, B, D-F}, ANETA NITSCH-OSUCH^{1, A, D, E, G}

ORCID ID: 0000-0001-7335-8060

ORCID ID: 0000-0002-2622-7348

¹ Department of Social Medicine and Public Health, Medical University of Warsaw, Poland² Doctoral School, Medical University of Warsaw, Poland

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Summary Vaccinations are the most effective and economically beneficial form of preventing dangerous infectious diseases. Health-care professionals should strive for the highest possible immunisation rate in the population, especially among patients from risk groups, which include pregnant women. The vaccination coverage among pregnant Polish women is still unsatisfactory. A consensus on vaccination of pregnant women has recently been achieved by the greatest scientific authorities: global organisations and scientific societies recommend all pregnant women to be vaccinated against pertussis, influenza and COVID-19. Vaccination during pregnancy leads to the production of post-vaccination antibodies that migrate transplacentally to the foetus, providing protection to infants in their first months of life. The inactivated influenza vaccine is safe and effective when given at any stage of pregnancy. Vaccination against pertussis should take place between week 27 and 36 of pregnancy. The COVID-19 vaccine can be administered simultaneously with other vaccines or with a 14-day interval. The American Congress of Obstetricians and Gynecologists (ACOG) recommends vaccination of pregnant women with mRNA COVID-19 vaccines at any stage of pregnancy. As a general rule, pregnant women should not be vaccinated with live, attenuated viruses or bacterial vaccines. Vaccines contraindicated for pregnant individuals, such as the vaccine against measles, mumps, rubella and varicella, as well as HPV, can be administered after delivery and during the breastfeeding period. Vaccination of pregnant women against rabies or tetanus is necessary for post-exposure prophylaxis.

Key words: pregnancy, vaccines, immunization programmes, influenza vaccines, infant.

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Background

The period of pregnancy is undoubtedly a time of increased health surveillance, and the frequency of check-up visits and examinations performed among pregnant women in Poland proves that this group of patients is treated as a priority. Unfortunately, in spite of this, the vaccination coverage in pregnant Polish women is still unsatisfactory. Medical staff play a significant role in promoting pro-health behaviours, which include vaccinations. The Perinatal Care Standard announced by the Minister of Health (the most important document applicable to gynaecologists and obstetricians), updated in 2018, contains a provision on the education of pregnant women and women planning pregnancy in the field of infectious disease prevention, including preventive vaccinations during pregnancy [1]. In addition, physicians are bound by the Act of 5 December 2008 on preventing and combating infections and infectious diseases in humans to inform the patient about recommended vaccinations [2]. The purpose of introducing preventive vaccination programmes is to directly protect people from the risk of severe disease but also, indirectly, to reduce transmission among people who may respond sub-optimally to vaccination. Vaccinations are the most effective and economically beneficial form of preventing dangerous infectious diseases. Moreover, many scientific studies confirm the safety of vaccinations, even in the population of pregnant women. Cooperation in the field of education on vaccination among pregnant women by family physicians and obstetricians could contribute to an increase in the percentage of vaccination coverage in pregnant patients. The latest Guidelines of the Polish Society of Gynecologists and Obstetricians, the Polish Society for Vaccinology and the Polish

Society for Family Medicine on vaccinating women with reproductive plans and pregnant or breastfeeding women divides immunisations for pregnant women as follows: recommended, optional, required and contraindicated [3].

Vaccinations recommended for pregnant women

A consensus of the greatest scientific authorities regarding vaccination of pregnant women has been reached. Both global organisations and scientific societies recommend that all pregnant women should be vaccinated against pertussis (combination dTaP vaccine against diphtheria, tetanus and pertussis, with reduced amount of diphtheria toxoid, tetanus toxoid and acellular pertussis component), influenza (inactivated, quadrivalent influenza vaccine; split virion or subunit) and recently COVID-19 (mRNA-based vaccines only) [3]. Importantly, there is no scientific evidence of any risk to the foetus from vaccination of pregnant women with vaccines that contain non-live viruses or bacteria [4].

Vaccination against influenza

Pregnant women are more exposed to a severe course of influenza and post-influenza complications than the rest of the population, which is most likely due to physiological changes that occur in the functioning of the immune, circulatory and respiratory systems [5]. The Centers for Disease Control and Prevention (CDC) recommend that all pregnant women receive the inactivated influenza vaccine by the end of October (although peak timings vary from season to season). A protective antibody



level at the beginning of the influenza season is intended to protect the pregnant woman against the influenza virus at a time of greatest risk. Studies on the safety of the influenza vaccine during pregnancy have found that the inactivated influenza vaccine is safe and effective when administered at any stage of pregnancy (regardless of the trimester). Vaccination of a pregnant woman against influenza leads to the production of post-vaccination antibodies, which migrate transplacentally to the foetus, providing protection to infants in the first months of life, i.e. until they can be vaccinated themselves (inactivated influenza vaccine is available after the infant reaches 6 months of age). It is worth emphasising that the inactivated influenza vaccine can be administered with other vaccinations at the same time, optimally at two different anatomical sites. A simultaneous vaccination against COVID-19 and influenza is not contraindicated, and the required interval between vaccinations is arbitrary. However, administration of the above vaccines 1 or 2 days apart may help to distinguish between potential side effects. Only in the case of vaccination with Nuvaxovid should the interval between vaccinations be a minimum of 7 days (due to indications that simultaneous influenza vaccination reduces the number of antibodies produced in response to the COVID-19 virus). Live attenuated influenza vaccine, registered in Poland for immunization of children, is contraindicated in pregnancy, although there is no scientific evidence that LAIV vaccination poses a risk during pregnancy. The reason for the lack of risk is that live viruses cannot replicate effectively anywhere in the body except for the nasal passage (requires lower temperature), and therefore, there is no theoretical reason to be concerned about infection of the foetus. However, considering other inactivated preparations on the market, LAIV is preferred by pregnant women. Importantly, there is no need to ask about pregnancy or test for pregnancy when offering LAIV to females or advise women who have recently been vaccinated to avoid pregnancy [6]. Recommendations on influenza vaccination with an inactivated vaccine for pregnant women and women planning pregnancy are written down in the Polish Protective Vaccination Programme (PSO) [7].

Vaccination against *Bordetella pertussis*

The risk of dying from whooping cough in infants is as high as 6–8%. This is due to the fact that pertussis is associated with many complications, such as pneumonia, pertussis encephalopathy, apnoea and seizures. Vaccination against pertussis in pregnant women is currently the most effective form of protection of infants against whooping cough. This is because the antibodies produced by the pregnant woman in response to the vaccination are transmitted transplacentally to the foetus. As a result, vaccination of pregnant women has a spectacular 90% effectiveness rate and reduces the risk of pertussis in infants up to 2 months of age by 78%. In addition, a systematic review on a group of 1 million 400 thousand pregnant women showed that the vaccine is completely safe for the foetus. Currently, it is recommended to provide pregnant women with a vaccine with an acellular pertussis component combined with tetanus and diphtheria toxoid (Tdap; Tetanus, diphtheria, acellular pertussis). Vaccination consists in administering a single dose of the vaccine in each pregnancy. The level of antibodies against whooping cough decreases in a pregnant woman with the duration of pregnancy. Therefore, the CDC recommend that women receive Tdap during each pregnancy, even if their pregnancies are only a year or two years apart. Thanks to this, each child will receive the optimal amount of post-vaccination antibodies and the best possible protection. This vaccine dose is a booster dose and should be recommended regardless of previous vaccination status, as most adults were vaccinated against whooping cough in infancy or naturally exposed to whooping cough in childhood.

The CDC, the American College of Obstetricians and Gynecologists (ACOG), the American College of Nurse-Midwives (ACNM), the American Academy of Pediatrics (AAP) and the

American Academy of Family Physicians (AAFP) unequivocally recommend the optimal timing of vaccination in pregnant women. Vaccination should take place between week 27 and 36 of pregnancy, and the best time for vaccination is the beginning of the third trimester. This is because protective levels of antibodies are at their highest around 2 weeks after the booster, but it takes time for the antibodies to pass on to the foetus. Vaccination can also be recommended to pregnant women after 36 weeks of gestation, but this is not the optimal time for immunisation, as antibody levels may peak too late to pass on protective levels to the baby. Vaccination after 38 weeks is unlikely to provide passive protection for the infant, but it will protect the mother from whooping cough infection and thus reduce the risk of exposure for her infant. Women who did not receive the vaccine during pregnancy should receive a pertussis-containing vaccine within two months after delivery, i.e. until their child receives the first dose of a pertussis-containing vaccine, as part of a cocooning strategy [4, 8, 9].

Vaccination against COVID-19

Due to the dynamically developing epidemiological situation, vaccination against COVID-19 has recently been included in the recommended vaccinations for pregnant women. According to the CDC report, on the basis of data of 40,000 vaccinated pregnant women, it can be concluded that vaccination with the mRNA vaccine is safe for both pregnant women and their children: it does not increase, among other health problems, the risk of miscarriage, premature birth or low birth weight. On the contrary, it contributes to a decrease in the risk of contracting the disease and severe course of COVID-19 in pregnant women. Vaccination against COVID-19, similarly to vaccination against influenza and whooping cough, provides transplacental transport of antibodies from the mother to the foetus. 57% of children vaccinated in the study at 6 months of age showed antibodies to COVID-19 (compared to 8% of those unvaccinated). The ACOG recommends vaccination of pregnant women with mRNA vaccines at any stage of pregnancy. The COVID-19 vaccine can be administered simultaneously with other vaccines or with a 14-day interval (influenza and Tdap) [10, 11]. Experts from the Polish Society of Gynecologists and Obstetricians, based on the analysis of published global data, as well as their own research and observations, support the presented positions of the ACOG, CDC, as well as the Royal College of Obstetrician and Gynecologists (RCOG) and Society for Maternal Fetal Medicine (SMFM), stating that vaccines against COVID-19 should be offered to pregnant and breastfeeding women. They emphasise there is no increased risk of using vaccinations against COVID-19 in pregnant women compared to the remaining population of people of reproductive age, and there is no data on the harmful effects of the vaccine on the development of the foetus from the moment of conception. However, given the insufficient amount of data to assess these results according to the evidence-based medicine (EBM) criteria, each case of vaccination should be consulted with an obstetrician. Experts suggest that if there are no indications for urgent vaccination of a pregnant woman, the above procedure should be performed after the period of organogenesis. Due to the greater number of studies on the safety of vaccination of pregnant women with mRNA vaccines, they are preferred for use in pregnant women first [12].

Additional vaccinations

Tetanus

Pregnant women who have never been vaccinated or who have only been partially vaccinated against tetanus should receive a full course of vaccination. Women for whom the diphtheria (Td) vaccine is indicated and who have not completed the

recommended 3-dose schedule during pregnancy should complete the vaccination course after delivery. Importantly, vaccination is mandatory in post-exposure prophylaxis after an injury [3, 4].

Polio

The inactivated poliovirus vaccine (IPV) can be given to pregnant women who are at risk of exposure to wild-type poliovirus. Patients to be considered for vaccination include pregnant women traveling to areas or countries where polio is endemic, women from communities or specific population groups a with disease caused by wild polio viruses, laboratory workers handling samples that may contain polio viruses, medical personnel who may be in close contact with patients who shed wild-type polio viruses and unvaccinated pregnant women whose children have received the oral polio vaccine [3, 4].

Hepatitis A and B, pneumococcal and meningococcal disease

Vaccination should be considered in women at an increased risk of infection with *Hepatitis A and B*, *Streptococcus pneumoniae* and *Neisseria meningitidis* [3, 4].

Yellow fever

Pregnant women who are traveling to areas where there is a risk of developing yellow fever should receive the yellow fever vaccine, as the theoretical risk of vaccination is much lower than the risk of yellow fever infection [3, 4].

Vaccinations contraindicated during pregnancy

As a general rule, pregnant women should not be vaccinated with live, attenuated virus or bacterial vaccines, because they pose a theoretical risk to the foetus. In addition, patients immunised with a live vaccine should postpone pregnancy for 4 weeks after vaccination. However, the benefits of vaccinating pregnant women usually outweigh the potential risks when the likelihood of exposure to the disease is high, when infection would pose a risk to the mother or foetus and when the vaccine is unlikely to cause harm. Vaccinations against smallpox and against measles, mumps, rubella and varicella are therefore contraindicated. The smallpox vaccine is the only vaccine that has been shown to be harmful to the foetus when administered

to a pregnant woman. Pregnant women should not be in close contact with people who have recently (within the last 28 days) received the smallpox vaccine. Data from studies on children born to mothers who were inadvertently vaccinated with the rubella vaccine during pregnancy show the presence of rubella antibodies in unvaccinated infants. This may represent a passive transfer of maternal antibodies or a foetal antibody response to foetal infection with the vaccine virus. No cases of congenital rubella or varicella syndrome or other foetal abnormalities have been observed among infants born to women who inadvertently received the rubella or varicella vaccine during pregnancy. However, it is prudent practice in any vaccination programme to ask women of child-bearing age whether they may be pregnant prior to rubella and varicella vaccination and not to vaccinate women who declare they are pregnant or plan to become pregnant within the next 4 weeks [4]. The vaccine against *Human Papilloma Virus* (HPV) is contraindicated for pregnant women, as stated in the Summary of Product Characteristics. Vaccination against Dengue is recommended only for persons with a subsequent infection, when the previous infection was laboratory confirmed and for persons living in Dengue endemic areas [3, 4].

Conclusions

Vaccinations are an effective form of preventing infectious diseases. It is important to educate patients, both at pre-conceptional age and pregnant women, about the benefits of vaccinations. The information should include both assurances regarding the safety and advantages of vaccination for the patient and for the neonate. Routine immunisations in pregnancy include vaccinations against whooping cough, influenza and COVID-19. As a general rule, live vaccines are contraindicated during pregnancy. In special epidemiological situations, pregnant women may be administered vaccines against *hepatitis A and B*, pneumococcal and meningococcal disease, as well as against poliovirus. The medical community should place special emphasis on education in the field of vaccinology. Improving the vaccination rate of the Polish pregnant population should be based primarily on the cooperation of gynaecologists and obstetricians and family physicians.

Clinical inquiries

When do we recommend vaccination against COVID-19 for pregnant patients? The CDC and other scientific societies, including the American Congress of Obstetricians and Gynecolo-

Table 1. Summary of global recommendations for immunisation of pregnant women – vaccines specific to our geographical area [13]

Vaccine against	Recommended in each pregnancy	Possible to be administered in some pregnant people	Contraindicated in pregnancy	Can be given during the childbed and/or the breastfeeding period
Inactivated influenza	X			X
Tetanus toxoid, reduced diphtheria toxoid and acellular pertussis (Tdap)	X			X
Meningococcal conjugate (MenACWY) and Meningococcal serogroup B		X		X
<i>Hepatitis A</i>		X		X
<i>Hepatitis B</i>		X		X
<i>Human Papilloma Virus</i> (HPV)				X
Measles, mumps, and rubella			X	X
<i>Varicella</i>			X	X

gists and the Society for Maternal-Fetal Medicine, recommend vaccination against COVID-19 at any stage of pregnancy, with both primary and booster doses. Preferably, the procedure should be performed after the period of organogenesis.

Are side effects more common in pregnant women? Pregnant persons did not report different side effects than non-pregnant persons after vaccination with COVID-19 mRNA vaccines (Moderna and Pfizer-BioNTech vaccines) [11].

Is vaccination of children of pregnant women with live vaccines dangerous? People who have received the MMR vaccine do not transmit the vaccine viruses to their contacts. Transmission of the varicella vaccine virus to contacts is extremely rare. MMR and varicella vaccines should be given to children and other household members of pregnant women as indicated. Infants

living in households with pregnant women should be vaccinated with the rotavirus vaccine according to the same schedule as infants in households without pregnant women [4].

Should there be an interval between prophylactic administration of anti-D immunoglobulin (serological conflict prophylaxis) and vaccination of a pregnant individual? Antibody products interact less with non-live vaccines compared to live vaccines. Therefore, the administration of non-live vaccines concomitantly or at any time interval before or after receiving an antibody product should not substantially interfere with the development of a protective antibody response. The vaccine or toxoid and antibody preparation should be administered at different sites using the standard recommended dose [3, 4].

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Address for correspondence:

Monika Zasztowt-Sternicka, MD

Department of Social Medicine and Public Health

Medical University of Warsaw

Doctoral School, University of Warsaw

61 Żwirki i Wigury St

02-091 Warsaw

Poland

Tel.: +48 501638297

E-mail: mzasztowt@wum.edu.pl, monika.zasztowt@gmail.com