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## **The role of nursing staff in the prevention of vaccine adverse reactions and complications**

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### **Abstract**

Infectious diseases, resulting from infection by various microorganisms, are still a current problem of humanity. For decades, they had led to the death of one million people, which was put an end to by the development of vaccinology, leading to a diametrical change in the global epidemiological situation. An epochal event in this process was the invention of vaccinations that significantly reduced the incidence of infectious diseases and even contributed to the almost total eradication of some of them.

Vaccine adverse reactions (VARs), despite the continuous development of vaccinology, still constitute a problem. As indicated in a number of studies, their etiology is mainly related to the action mechanism of the vaccine, mistakes in their vaccination technique, as well as systemic pathologies, coexistence of infectious diseases or systemic defects associated with the site of vaccine application. The role of the therapeutic team, consisting of a doctor and nurse employed at the vaccination point, is early detection of contraindications to the technique of vaccination, prevention, as well as initial diagnosis and treatment of VARs.

The article presents the basic issues related to the subject of vaccination, with the emphasis on the role of nursing staff in their realization and prevention of vaccine adverse

reactions. This should be the basis for intensifying dissemination of knowledge on vaccination, leading to reduction in the incidence of adverse vaccine reactions in patients.

**Key words:** vaccinations, adverse vaccine reactions, vaccination complications, nurse

## **Introduction**

Immunization is one of the most effective forms of preventing life-threatening infectious diseases. Owing to them it was feasible to stop epidemics of many dangerous diseases in the world. In a large number of developed countries, vaccinations have contributed to the reduction of incidence, and even led to almost complete elimination of certain diseases such as: poliomyelitis, smallpox, diphtheria, tetanus and measles. Thanks to this, the invention of vaccination is treated as an epochal event, which has significant importance in reducing mortality and increasing health of people all around the world [1].

Vaccinology is a relatively young branch of medical sciences, which deals with issues related to vaccination and their impact on the body [2]. Over the years, this science has been undergoing permanent evolution. Newer and newer technologies have been being implemented. Preparations of live vaccines have been being replaced by attenuated or inactivated ones. Components such as thiomersal or gelatin have been eliminated from the composition of vaccines in order to improve their safety and the obligation to counteract the incidence of vaccine adverse reactions [3]. A number of new procedures and schemes, fluency in the principles of vaccination technique, knowledge of individual vaccines, their properties, routes of administration and typical VARs are the basis of the nurse's work, in which they aim to minimize the occurrence of vaccine adverse reactions and complications [4, 5].

## **Basic information about vaccines.**

In their composition vaccines contain various antigens, modified to be safe in use, to stimulate appropriate immune response and to be available to the people for whom they were intended [2, 6]. The ideal vaccine is the preparation of a vaccine antigen that, after administration, induces permanent and specific immunity in the vaccinated person, without severe adverse reactions. The most common division of vaccines is the division into the form of the vaccine antigen, the form of the vaccine and its specificity (Table 1).

## **Principles of immunization**

The process of qualification and realization of immunization program is one of the main tasks for a doctor and a family nurse. The basic mistakes made by medical personnel at the vaccination point include improper decisions on the patient's qualification for vaccination, violation of the fundamental principles of vaccination and lack of knowledge of individual vaccines, their properties, administration patterns as well as potential VARs, which may have serious consequences for the patient. Therefore, elementary knowledge on vaccination and the

principles of vaccination techniques should be disseminated among nurses, doctors of all specialties, midwives and other medical professions [5].

**Table 1. Division of vaccines according to accepted general qualifications.**

Qualification criterion	Group inner division	Characteristics	Vaccine example
The form of the vaccine antigen	Vaccines containing live microorganisms	<ul style="list-style-type: none"> <li>- contain live microorganisms of attenuated strains, whose characteristic feature is depriving the strains of infectious properties or reducing their pathogenic features,</li> <li>- antigens considered to be vaccines with good immunization properties</li> </ul>	<ul style="list-style-type: none"> <li>- live BCG bacterial vaccine,</li> <li>- live virus OPV vaccines,</li> <li>- vaccine against measles, mumps, rubella, chickenpox or yellow fever, poliomyelitis according to Sabin</li> </ul>
	Vaccines containing dead microorganism (inactivated)	<ul style="list-style-type: none"> <li>- they contain whole deactivated microorganisms,</li> <li>- appropriately selected in terms of immunogenicity microbial strains are used for their production,</li> <li>- killed microorganisms are subjected to densification and purification. A preservative, for example thiomersal, is then added</li> </ul>	<ul style="list-style-type: none"> <li>- pertussis, typhoid fever and cholera vaccine,</li> <li>- viral rabies and poliomyelitis vaccines according to Salk</li> </ul>
	Vaccines including products of bacterial cell metabolism (toxoids) in their composition	<ul style="list-style-type: none"> <li>- highly toxinogenic bacterial strains are used to produce this type of vaccine,</li> <li>- inactivated toxins and toxoids are the most effective vaccines</li> </ul>	<ul style="list-style-type: none"> <li>- anatoxin against diphtheria, tetanus and botulinum (against botulism)</li> </ul>
	Subunit vaccines	<ul style="list-style-type: none"> <li>- contain broken microorganisms or fragments thereof prepared from an isolated fraction that contains a defense antigen</li> </ul>	<ul style="list-style-type: none"> <li>- Haemophilus influenzae type b vaccine,</li> <li>- meningococcal or pneumococcal vaccines</li> </ul>
	Recombinant vaccines	<ul style="list-style-type: none"> <li>- obtained by genetic engineering,</li> <li>- the correct pathogen genome sequence is incorporated into the mammalian or yeast cells at the final stage of production,</li> <li>- the production of a new protein begins with recombinant cells, which after purification and isolation become a vaccine antigen</li> </ul>	<ul style="list-style-type: none"> <li>- hepatitis B and influenza vaccine,</li> </ul>
	Polysaccharide vaccines	<ul style="list-style-type: none"> <li>- contain polysaccharide capsules of a particular microorganism,</li> <li>- they are most often immunogenic in children over 2 years of age and in adults, although they do not stimulate immunological memory,</li> </ul>	<ul style="list-style-type: none"> <li>- Haemophilus influenzae type b and pneumococcal vaccines,</li> </ul>
The form of the vaccine	Liquid vaccines	<ul style="list-style-type: none"> <li>- produced in a form ready for administration,</li> <li>- in their composition they contain stabilizers and preservatives</li> </ul>	<ul style="list-style-type: none"> <li>- most vaccines available on the Polish market</li> </ul>
	Dry powder vaccines	<ul style="list-style-type: none"> <li>- they are in the form of a powder which must be mixed with the solvent attached by the manufacturer before use,</li> <li>- these are usually more resistant to external factors and have a longer shelf life than liquid vaccines</li> </ul>	<ul style="list-style-type: none"> <li>- attenuated rotavirus vaccine,</li> <li>- attenuated cholera vaccine</li> </ul>

<b>The specificity of the vaccine</b>	<b>Monovalent vaccines</b>	<ul style="list-style-type: none"> <li>- called single cells contain in their composition strains of one pathogenic microorganism or antigens derived from one microorganism,</li> <li>- this type of vaccine immunizes the body against one disease</li> </ul>	<ul style="list-style-type: none"> <li>- hepatitis B and hepatitis A vaccine,</li> <li>- tetanus vaccine</li> </ul>
	<b>Polyvalent vaccines</b>	<ul style="list-style-type: none"> <li>- combination vaccines that contain all or several types of the same microorganism,</li> <li>- they simultaneously immunize against several infectious diseases, contain in their composition strains of several appropriately changed microorganisms or antigens obtained from several types of microorganisms</li> </ul>	<ul style="list-style-type: none"> <li>- three – component influenza vaccine,</li> <li>- human papilloma vaccine – HPV,</li> <li>- a trivalent polio vaccine,</li> <li>- polysaccharide 23 – valent pneumococcal vaccine</li> </ul>
	<b>Combined vaccines</b>	<ul style="list-style-type: none"> <li>- they simultaneously immunize against several infectious diseases,</li> <li>- mixtures of different vaccines, both monovalent and polyvalent ones</li> </ul>	<ul style="list-style-type: none"> <li>- vaccine against tetanus, diphtheria and pertussis DTP</li> </ul>

The undeniable basis for the prevention of VARs is the knowledge of contraindications for vaccination. A contraindication is the condition in which it is necessary to waive the vaccination in case of the high risk of VARs. Each administration of the vaccine is preceded by an interview and physical examination, which should reveal possible contraindications to vaccination [1,5]. The permanent contraindication that applies to all vaccines is the occurrence of a severe allergic event to the previous dose of the vaccine or any of its components [5]. Repeated administration of the vaccine, in such a person, may induce an even stronger response of the organism, which may be life-threatening. However, milder allergic vaccination reactions, such as rashes and exanthema, do not constitute a contraindication to vaccination [7]. Deep immunodeficiency is also a permanent obstacle to using vaccines containing live microorganisms (i.e. against tuberculosis, measles, mumps, rubella, varicella and rotavirus). In the case of asymptomatic HIV infection, administration of some live vaccines should be carefully considered [5,7].

Apart from permanent contraindications, there are also a number of temporary contraindications, such as: acute febrile illness, labile neurological condition in the case of diseases of the nervous system (cerebral palsy, Down’s syndrome, effectively treated epilepsy), exacerbation of chronic disease, immunosuppressive treatment as well as blood and its preparations. Crucial information on all contraindications can be found in the fliers attached to each vaccine by manufacturers [5,7].

In everyday practice of following a vaccination calendar by medical personnel, it is very important to know the recommended intervals between individual vaccinations, which are presented in Table 2 [5].

**Table 1. Minimal intervals between vaccinations - recommendations ACIP (MMWR 2006, 55, RR-15 and Red Book, 2009).**

Type of administered vaccines: first – second	Recommended interval
Inactivated – inactivated	can be administered simultaneously or on an arbitrary interval;
Inactivated – attenuated Attenuated – inactivated	can be administered simultaneously or an arbitrary interval;
Attenuated – inactivated	can be administered simultaneously or an arbitrary interval;

inactivated vaccine - killed vaccine, live attenuated vaccine some live oral vaccines (poliomyelitis, against rotaviruses) can be administered at any intervals in relation to other vaccines
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Many years of research and observations have shown that prolongation, beyond the recommended period, of the administration of consecutive doses of vaccines does not significantly affect the overall result of the specific response [1]. Due to the fact that vaccinations are often postponed in infants and children, prolonging the intervals between them is of great practical importance. If the vaccine has not been administered in due time, it should be received at the earliest convenient time, and in that case the vaccination schedule will not start from the beginning [1,5]. It is not without significance that unfounded delay of the administration of subsequent doses of the vaccine has an unbeneficial effect on the patient resulting in the delayed generation of antimicrobial resistance [5]. Shortening the intervals between different doses of the same vaccine can have negative effects. The interval between two doses of a given vaccine should not be shorter than 4 weeks. Shortening this time may result in a lowering of the immune response, although this does not mean that vaccination will be completely ineffective - the immune system response may become insufficient and the dose will need to be repeated. According to the Advisory Committee for the Immunization Practices, the admissible acceleration of the next vaccine dose with respect to the manufacturer's recommended date is 4 days. The exception is the rabies vaccine, due to the faster schedule of administration and observance of the recommended intervals between successive doses. If the next dose is given 5 or more days before the due date, it should not be counted as the required number of doses. It is recommended to repeat this dose after the interval recommended by the manufacturer [1,2,5].

### Vaccine adverse reactions and complications

The term for a vaccine adverse event is defined as any health disorders and response of the organism that occur within 4 weeks after the administration of the vaccine [8,9]. Usually, an adverse event is the presumed response characteristic of a given vaccine [10]. They may be the result of: a mistake in the technique of vaccination, improper storage of vaccine preparations and defects of the preparation that appeared during production or transport. The VAR causes include an inaccurately collected interview and failure to consider contraindications to vaccination [11]. The prevailing majority of VARs have a mild course and subside within a few days. In such cases, the doctor's intervention and the use of special treatment are unnecessary.

The responses technique that can occur in every vaccinated person are vaccination adverse reactions and complications. A vaccination adverse event is a temporary, proper clinical response to the vaccine given. The event does not require hospitalization in order to save life or any special treatment. In terms of etiology, we can distinguish topical and generalized vaccination adverse reactions. Their exact characteristics is illustrated in Table 3.

**Table 3. Division and characteristics of vaccination adverse reactions.**

A group of vaccination reactions	Characteristics and typical symptoms	Procedure
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<b>General vaccination reactions</b>	<ul style="list-style-type: none"> <li>- the most common general vaccination reactions are: fever, the feeling of 'mental confusion', muscle aches, joint pain, headache, drowsiness, anxiety, decreased appetite, fever convulsions, lymphadenopathy, allergic reactions (urticaria, rashes, eyelid edema),</li> <li>- the appearance of high fever may cause febrile seizures, especially in infants and younger children</li> </ul>	<ul style="list-style-type: none"> <li>- general symptoms related to vaccination usually disappear within 3 days,</li> <li>- the fever occurs within 72 hours after DTP vaccination and within 6-12 days after vaccination against measles, mumps and rubella,</li> <li>- generalized vaccination reactions usually subside spontaneously,</li> <li>- if the symptoms are intensified or intense, it is advisable to administer immediate antipyretic, analgesic or antihistamine drugs</li> </ul>
<b>Topical vaccination reactions</b>	<ul style="list-style-type: none"> <li>- the most common vaccination reactions,</li> <li>- appear at the injection site and on the skin around the injections site,</li> <li>- may occur after administration of any type of vaccine,</li> <li>- they are especially common after receiving live vaccines,</li> <li>- typical symptoms: swelling, redness, pain, pruritis,</li> <li>- the character of the change depends on the type of vaccine, the route of administration and the order of doses</li> </ul>	<ul style="list-style-type: none"> <li>- the topical reaction appears after a few hours after the injection and subsides spontaneously within 48-72 hours,</li> <li>- as a rule, they do not require treatment, at most symptomatic treatment,</li> <li>- paracetamol or ibuprofen can be used as analgesics, baking soda dressings topically,</li> <li>- to effectively prevent the occurrence of topical vaccination reactions, one should: follow the proper technique of administering the vaccine and make the correct selection of the optimal application site</li> </ul>

The complication is an excessive, pathological reaction with the characteristics of a vaccine disease, which depending on the severity and location of lesions, in extreme cases, may be life-threatening and require hospitalization. It can also lead to permanent health impairment or death [11, 12]. Table 4 illustrates the division of vaccination complications according to the adopted time criteria.

### Tasks of nursing staff in preventing vaccine adverse reactions and complications

Nursing staff working at vaccination points should be characterized by full professionalism, identified with a specific resource of knowledge, competence and skills for undertaking independent actions and decisions in the field of education, health promotion, prophylaxis of infectious diseases and prevention of vaccine adverse reactions and complications [13, 14].

**Table 4. The division of vaccination complications according to the adopted time criteria.**

Vaccination complications group	Example	Characteristics and symptoms
<b>Early vaccination complications</b>	<ul style="list-style-type: none"> <li>- systemic anaphylactic reaction</li> </ul>	<ul style="list-style-type: none"> <li>- the most common early vaccine complication,</li> <li>- appears within a few minutes up to 2 hours after vaccination procedure,</li> <li>- statistically this type of reaction occurs once in every 1,000,000 people vaccinated, most often after vaccination against tetanus, pertussis, typhoid, measles, mumps and rubella,</li> <li>- the symptoms of anaphylactic reactions may include topical changes such as rashes, urticaria, redness of the skin accompanied by pruritus of the whole body, swelling of the face and systemic disorders: dyspnea, tachycardia, palpitations, dizziness, disturbance of consciousness, feeling of anxiety, panic, fear, difficulties in swallowing and speaking</li> </ul>

<b>Late vaccination complications</b>	<ul style="list-style-type: none"> <li>- convulsions (especially if they appear without a fever),</li> <li>- hypotonic-hyporeactive syndrome,</li> <li>- vaccine encephalitis,</li> <li>- vaccine encephalopathy - it may result in mental retardation, autism, transverse myelitis, and flaccid paralysis</li> </ul>	<ul style="list-style-type: none"> <li>- they are associated with various immunological mechanisms,</li> <li>- the late vaccination complications occur most frequently after administration of live vaccine preparations and usually concern nervous system disorders,</li> <li>- the incidence of this type of complications depends on the general condition, especially neurological status, age, immune status and genetic determinants</li> </ul>
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One of the most important roles of the nurse at the vaccination point is education, which is the provision of comprehensive knowledge on effective and safe methods of health care regarding vaccinations. In the light of the knowledge and skills that a nurse is expected to have, it becomes the authority and the most reliable source of information concerning vaccination [1]. All vaccinated patients and parents of children need answers to bothering questions, they need knowledge on vaccines as well as vaccine adverse reactions and complications. During the interview, the nurse should use various forms of communication and active listening, which can effectively lower the level of anxiety and increase reliance [1]. Attitudes of vaccinated patients and parents, towards vaccination, can affect its realization to a large extent. Only reliable knowledge on vaccination, infectious diseases as well as vaccination adverse reactions and complications may affect these attitudes, and this ought to be provided by professionals, in doctors' offices and at vaccination points [15]. A nurse working in a vaccination office should fulfill her duties and educational tasks with regards to broadening knowledge and full awareness concerning the prevention of infectious diseases and the prevalence of VARs, with the use of recommended vaccinations and all the precautions [13]. Research confirms that people appearing at vaccination points value knowledge and information of nurses. As a professional source of knowledge, they can meet parents' needs, provide the necessary knowledge, dispel all doubts and point out the best solutions.

Prior to starting the vaccination procedure in the vaccination office, the nursing staff are obliged to perform all activities aimed at minimizing the risk of transmission of infection and the occurrence of the VARs [4]. Washing and disinfection of hands, use of disposable gloves, proper use of disposable equipment (syringes, needles), decontamination of the vaccination site, use of sterile swabs, securing the injection site with a sterile dressing are indispensable activities that significantly reduce the risk of adverse events [4, 16]. Knowledge of the principles of asepsis and obeying sanitary hygiene procedures by nurses are crucial. They help to reduce the spread of infections, and thus the occurrence of vaccine adverse reactions, such as: topical and overall ones, or late and delayed vaccination complications [17].

The principle of a minimum threefold control of the vaccine (during its preparation, after preparation and before administration) is valid for every nurse, regardless of the place of work. Many manufacturers pack the vaccines in similar types of packaging, which bear similar symbols and names ascribed to them, which further may be the reason for mistakes in nursing practice. The nursing staff employed at the vaccination point should know the name and designation of the vaccine preparations, their use, contraindications, as well as storage conditions. For a large number of vaccines, the proper temperature of storage ranges from 2 to

8°C. After freezing, they lose their properties. Therefore, when storing vaccines, they should be provided with the optimal temperature. For this purpose, the vaccination point should be equipped with functional refrigerators, thermometers and files, in which the nurse should constantly record temperature or damage to the equipment. In the case of vaccine preparations against HPV, measles, mumps, rubella, group C meningococcal infection, rotavirus infections and varicella, it is recommended to store them away from light [4].

The control of their shelf-life is also an important aspect when storing vaccines is. Their verification is carried out routinely according to the adopted procedures. In the case of exceeding the shelf-life, the vaccines should be disposed of in accordance with the procedure for the disposal of outdated medicinal products and medical devices, which is regulated by the relevant Ordinance of the Minister of Health of 27 February 2012. The consequences of administering the vaccine stored in inappropriate conditions or after the shelf-life can be serious for the patient, cause VARs or be a threat to life or health. Each vaccine has a specific administration site. Among the routes of administration of vaccines there can be distinguished: intramuscular, subcutaneous and intradermal injections. Incorrect depositing of the vaccine preparation may cause serious vaccine adverse reactions and complications [5,18]. Most vaccine preparations are administered intramuscularly or subcutaneously. The intradermal route of administration of the vaccine is used only in the case of BCG vaccination, which is administered in 1/3 of the upper part of the left arm [4,5]. The proper administration of the vaccine is most influenced by the injection technique adapted to the vaccine administration site. Subcutaneous injections typical of vaccination involve the introduction of 3/4 or 2/3 of the length of the needle to a depth of not less than 0.75 – 1.0 cm at an angle of 45 – 60 degrees after picking a fold of skin measuring 2 – 3 cm in thickness, and thus separating it from the underlying muscularis propria. In intramuscular injections, however, it is important to determine the injection site correctly [3,4]. Intramuscular injections are performed in a large, well-developed and blood-filled muscle, away from larger blood vessels and nerves. Vaccine preparations are usually administered to the quadriceps muscle of the thigh or deltoid muscle [5]. In order to perform an intramuscular injection properly: stretch the skin at the puncture site using the thumb and index finger, at the same time perpendicularly insert the needle at an angle of 90° to a depth of about 1 centimeter, that is 3/4 or 2/3 of the needle length.

The vaccine should be administered in the place where it will provide immunity. Preparations intended for intramuscular administration, applied to subcutaneous tissue, may cause unpleasant symptoms in the form of permanent subcutaneous nodules. Administering the vaccine to the adipose tissue can cause necrosis and the application to the blood vessel anaphylactic shock [4, 5, 18].

The selection of a suitable needle by a nurse for a specific injection site is no less important step in the vaccination process. The selection of the injection needle depends on the type and route of administration of the vaccine. The selection of needles for each injection depends on the age and size of the patient's muscles as well as their body weight. The use of long needles for intramuscular punctures reduces the risk of administering the vaccine preparation to the layers of tissues located above the muscle, thereby reducing the risk of adverse vaccination reactions. In contrast, too shallow administration of the vaccine antigen prevents normal penetration into the bloodstream, and thus the lack of immune response [5].



The use of appropriate needles for administering the vaccine by a nurse performing a vaccination procedure significantly influences the reduction of the risk of VARs and allows to obtain proper immunogenicity.

Every nurse practicing the vaccination procedure is required to document the vaccination carried out in accordance with the legal regulations in force in a given country. Vaccination documentation is a type of individual file for each vaccinated person, it is mainly used to record the course and correctness of performed vaccinations and any irregularities that may occur during or shortly after a vaccination procedure [19]. Keeping records of obligatory immunization, including storage of immunogenicity records and making entries confirming the vaccination performed are obligatory in Poland [1]. In accordance with the Regulation of the Minister of Health on obligatory preventive vaccinations of 18 August 2011, vaccination should be accompanied by information including: date of vaccination, vaccine name, its manufacturer, batch number, site and route of administration as well as a name of the person ordering the vaccination and the one performing the procedure. In Poland, it is not practicable to record information about the site of administration of the vaccine by nurses, which in the case of VARs prevents the identification of the vaccine that caused the event. This is particularly important in the implementation of the Polish Immunization Program for 2018 included in the Announcement of the General Sanitary Inspectorate of 18 October 2017, which assumes at least three punctures during one appointment at the vaccination point. Apart from individual patient's records, the vaccination point staff monitor the temperatures of refrigerators and damages to the equipment in vaccination offices [3], and moreover, are obliged to report any adverse vaccination reactions to the district sanitary inspector responsible for the area of vaccination, in accordance with the notification form template, which is an attachment to the Regulation of the Minister of Health of 21 December 2010 on adverse vaccination reactions and criteria for their recognition.

Lack of correctness in keeping records, deficit of conscientiousness, accuracy and self-discipline in nursing staff, may become a source of misunderstandings and even mistakes or violations in nursing practice. In connection with the above, an important aspect of the nurse's work in the vaccination office is the qualifications and appropriate training of nurses performing the vaccination procedure. Each nurse is obliged, according to the Regulation of the Minister of Health of 18 August 2011 on compulsory immunization §9, to keep an individual record of a vaccinated patient [1,4,5], in compliance with the provisions on the types and scope of medical record and the method of its processing.

### **Minimizing pain in infants and children**

Vaccinations are the most commonly performed treatments in the youngest patients - infants and children. The vaccination schedule is updated almost annually with newer and newer vaccines, so if you want to have your offspring vaccinated, according to the current schedule, with mandatory and recommended vaccines, the infant should be pricked five times. Therefore, the nurse should know and apply various ways to minimize pain sensation while performing vaccinations in children [20,21].

The simplest method of fighting pain during the vaccination in infants is breastfeeding [21]. Giving the infant a breast for sucking significantly reduces their stress and anxiety associated with vaccination. This is particularly often observed in newborn infants. The

administration of glucose or sucrose solutions for drinking through the dummy is equally effective [5,7]. The sugar solutions should be as sweet as possible, i.e. their concentration should be around 50%. In order to do this, dissolve 50g of sugar in 70ml of hot boiled water, remembering to check the temperature of the liquid before serving the infant. If there is no possibility to make a sucrose solution, you will find ready – made glucose products in pharmacies [7].

The method of using an anesthetic cream containing a mixture of lidocaine and prilocaine (EMLA) is used among children who are one year old. The nurse determines the injection site and applies EMLA cream an hour before the planned vaccination procedure [4,5,7]. Due to the risk of allergy as well as to unknown individual response, it is not recommended to apply local analgesics routinely [21]. For anesthesia, the nurse can administer non-aspirin antipyretic and analgesic preparations. It is worth noting that EMLA cream with paracetamol should not be applied, because it may promote the formation of methemoglobinemia in infants. The nurse who performs the vaccination procedure should inform parents on important factors reducing the child's stress related to pain. Close contact with parents, interest in the child's favorite toy, chatting, stimulating laughter or performing a massage to the puncture site before the vaccination procedure significantly reduce the fear and pain that the procedure entails. To avoid additional problems, the child should wear clothes that are easy to take off and put on. Fear, panic, anxiety and stress of parents also significantly affect the child's sense of security. It intensifies the feeling of pain, which is manifested by crying or screaming [7,21].

The above methods of minimizing pain in vaccinated children do not require much sacrifice, but demand only good cooperation and a little commitment from parents and nursing staff. However, they improve the comfort of the vaccination process itself in children and the quality of the procedure [21].

## **Summary**

The whole therapeutic team takes part in the prevention of vaccine adverse reactions and complications. The general practitioner performing the basic physical examination of the patient qualifies them and excludes any contraindications. The nurse employed at the vaccination point is responsible for minimizing the risk of VARs, by complying with the standards included in national acts and regulations. Nursing staff are a group of people being the most frequently and directly in touch with the patient, which is associated with their educational, prognostic and preventive functions. Also, the responsibility for the mere fact of introducing the vaccine into the body rests with the nurse. Therefore, it is justified to disseminate knowledge on vaccination, contraindications to its use, as well as the basic VAR information in the nursing environment. A growing number of unvaccinated people, as well as the growth of the so-called “anti – vaccine” movements, is a disturbing signal for the entire healthcare sector, microbiologists, and sanitary-epidemiological services. The reason for the aforementioned facts may be the growing public awareness of vaccination issues and the related risks as well as the need to intensify activities aimed at proper, based on substantive knowledge, education of patients.

## **Conclusions**

1. Good knowledge of the principles of vaccination is an indispensable element in the prevention of adverse vaccination reactions.
2. Vaccination adverse reactions can be the result of a mistake in the technique of performing the vaccination itself or administration of the vaccine, the individual response of the vaccinated person's system or the defect of the vaccine preparation.
3. In order to prevent the occurrence of VARs effectively, the nurse should fulfill an educational function, follow aseptic and antiseptic rules, store vaccine preparations in accordance with the manufacturer's instructions, and the vaccination should be based on the choice of the proper site and route of administration of the vaccine. It is equally important to conscientiously keep records of the patient and equipment included in the vaccination office.

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