

Avoiding allergic reactions to childhood vaccines (and what to do when they occur)

Routine childhood immunizations represent one of the greatest advances in public health of the 20th century. Previously lethal childhood infections—measles, paralytic poliomyelitis, congenital rubella—are no longer commonly seen. Invasive *Haemophilus influenzae* type b (Hib) disease has been virtually eradicated. In recent years, the incidence of varicella has appreciably declined. However, as the number of routine immunizations has increased—the average child born in 2002 will receive 23 immunizations for 11 different diseases by the time he is 6 years old—so have public concerns about vaccine safety.

In lay circles, blame for a variety of conditions has been laid at the feet of childhood vaccines; addressing those concerns is beyond the scope of this article. This review focuses instead on clinical adverse reactions—allergic and nonallergic—to required childhood vaccinations. Of the 1.9 billion doses of vaccines administered in the United States between 1991 and 2001, only 2,281 cases of allergic reactions were reported.¹ (By way of comparison, the estimated incidence, in the pediatric population, of allergic reactions to food of any kind is 6% to 8%; the incidence of allergy to an antibiotic in the same population is reported to be 7.3%.²) Although allergic reactions to vaccines are rare, the general pediatrician must nonetheless be able to recognize and treat such reactions, as well as the far more common nonallergic reactions. What's more, in light of the multiple dose regimens of many pediatric vaccines, the general practitioner must be able to identify those children in whom revaccination is contraindicated to avoid a potentially life-threatening event.

Nonallergic reactions

An adverse vaccine reaction is defined as any clinically abnormal response to vaccination. These reactions are most often nonimmunologically mediated (nonallergic).

In 1990, the Vaccine Adverse Event Reporting System (VAERS) was created as a nationwide passive surveillance system for monitoring adverse reactions to vaccines. Parents or physicians may submit reports of adverse events that occur as late as 30 days after vaccination, which are then entered into a database. Serious events are reviewed by medical personnel at the US Food and Drug Administration and receive follow-up at 60 days and one year. Approximately 11,000 reports of possible vaccine-related adverse events are received by the FDA yearly.³

The most common type of adverse vaccine reaction is a local reaction, typically mild and self-limited. Local reactions manifest as pain, erythema, induration, or swelling at the site of the injection, usually within a few hours after vaccination. A local reaction may occur in as many as 50% of vaccine recipients. Such reactions are more likely after administration of a vaccine that contains an adjuvant (a substance that increases the vaccine's immunogenicity), such as the vaccine for diphtheria, tetanus, and pertussis that contains tetanus toxoids and acellular components of *Bordetella pertussis* (DTaP). (See "[What's in a vaccine?](#)".) In general, local reactions to a vaccine are *not* a contraindication to future immunization. Sterile abscesses may also occur at the injection site, usually following administration of an inactivated vaccine.⁴

A large local reaction consists of redness or swelling greater than 10 centimeters in diameter. This type of reaction occurs less often than smaller local reactions and may follow DTaP or diphtheria and tetanus toxoid vaccination (DT or dT). Cases of entire limb swelling have been associated with the fourth or fifth dose of DTaP. Such a reaction has been attributed to the high diphtheria toxoid content of the vaccine.⁵

Systemic reactions to vaccines may include generalized symptoms such as fever, rash, arthralgia, arthritis, myalgia, headache, anorexia, and malaise. Although whole cell diphtheria, pertussis, and tetanus (DPT) vaccine frequently caused such symptoms, these reactions occur infrequently with current acellular DTaP preparations. Live attenuated vaccines such as measles-mumps-rubella (MMR) may produce a mild form of the natural disease, causing systemic symptoms one to three weeks after the vaccine is administered.

Many late reactions (days after the vaccine) attributed to vaccines may be due to coincident infection or allergic responses to other antigens. The point to be made is that a temporal association between a vaccination and a clinical condition does not prove causality.

Allergic reactions

An allergic reaction to a vaccine is defined as an immunologically mediated reaction to a vaccine antigen or other vaccine component. The reaction may be IgE-mediated or may involve another immunologic mechanism, such as cell-mediated immunity.⁶ Although allergic vaccine reactions occur rarely, any practitioner administering vaccines should be equipped to identify and treat severe allergic reactions. Allergic reactions may be local or systemic, and generally occur within minutes or hours of injection.

A local allergic reaction to a vaccine may consist of a wheal and flare or localized urticaria at the injection site. Systemic allergic reactions may be classified as non-life-threatening or life-threatening. Non-life-threatening systemic reactions such as generalized urticaria may follow DTaP, DT, and dT administration. Transient petechiae or urticaria following DPT vaccination usually occurs within minutes and may be caused by preformed circulating antibodies to diphtheria and tetanus. Transient generalized urticaria following a vaccine is *not* a contraindication to further vaccination.⁷

An Arthus reaction is a severe local reaction with warmth, erythema, edema, petechiae, or ulceration usually occurring two to eight hours after vaccination. This reaction occurs secondary to the presence of a high level of preformed antibody in a previously vaccinated patient, and most commonly follows diphtheria and tetanus toxoid injection. For this reason, these booster vaccines should not be given more often than every 10 years,⁸ although, in cases of tetanus exposure, a booster injection for tetanus may be given if more than five years have passed since the last dose.

Anaphylactic reactions are life-threatening systemic allergic reactions that may manifest as hypotension, bronchospasm, generalized urticaria, angioedema, and laryngeal edema. An estimated two cases of anaphylaxis occur for every 100,000 DPT injections administered; the rate of anaphylaxis after DTaP vaccination is unknown. Anaphylaxis to hepatitis B vaccine has been estimated to occur in one of every 600,000 recipients, most of whom are adults.⁴ Eleven reports of anaphylaxis secondary to MMR vaccination (after 70 million MMR doses administered) have been received by VAERS.⁹ The frequency of anaphylaxis to tetanus toxoid is 1.6 for every million doses given.¹⁰ *For all vaccines, a true anaphylactic reaction is an absolute contraindication to further immunization with that vaccine.*

It is important to differentiate other, more common, nonallergic clinical syndromes from anaphylactic vaccine reactions. Vasovagal reactions with pallor, bradycardia, weakness, dizziness, and brief syncope may occur five to 15 minutes after vaccination. These reactions occur more often in adolescents and adults than in children. Over 2,000 reports of vaccine-associated syncope were received by VAERS from 1990–2001.³ A hypotonic–hyporesponsive episode (HHE) is a shock-like syndrome, occurring 10 to 48 hours after vaccination, marked by sudden loss of muscle tone, pallor, fever, and unresponsiveness. HHE has been described following whole cell pertussis vaccine and is considered a relative contraindication (the physician should weigh the benefit against the risk in determining whether to administer the vaccine) to pertussis revaccination.⁹

Allergic reactions to pneumococcal, Hib, hepatitis B, hepatitis A, and poliovirus vaccines occur very rarely. Allergic reactions to any vaccine may occur secondary to the vaccine antigen itself or to other vaccine components. IgE antibodies to tetanus or diphtheria toxoids have been detected in the sera of patients experiencing generalized urticaria or anaphylaxis to vaccines containing these toxoids.¹¹

Because the live attenuated viruses used in MMR vaccine are grown in cultured chick embryo fibroblasts, minute amounts of the egg protein ovalbumin (<1 nanogram) are contained in the final vaccine preparation. Before 1997, the American Academy of Pediatrics (AAP) recommended that patients with a history of egg anaphylaxis undergo skin testing with the MMR vaccine.¹² Positive skin tests would necessitate vaccine desensitization via a graded dose protocol. These recommendations were revised in 1997 after numerous reports of safe administration of MMR vaccine to children allergic to eggs.¹³⁻¹⁷ Skin testing is no longer required for egg-allergic individuals. Instead, MMR may be routinely administered to egg-allergic children with the precaution that vaccine recipients be observed for 90 minutes post-vaccination in a facility equipped to treat vaccine anaphylaxis.¹⁸ Allergic reactions to MMR vaccine have occurred in children who are not allergic to eggs and may also be caused by sensitivity to neomycin or gelatin, both of which are contained in the vaccine. Khakoo has suggested that children with egg allergy and asthma may be at increased risk of adverse MMR reactions.¹⁹

The influenza virus vaccine contains greater amounts of ovalbumin than does the MMR vaccine, because the virus utilized in the vaccine is derived from the allantoic fluids of infected chick embryos. Generally, influenza virus vaccine is contraindicated in any child with a history of egg anaphylaxis. A recent study, however, included a protocol for relatively safe administration of influenza virus vaccine to egg-allergic individuals.²⁰

Egg protein is also contained within the monovalent measles, monovalent mumps, yellow fever, and rabies vaccines, but not within monovalent rubella vaccine (Table 1).

TABLE 1 Examples of vaccines that contain egg protein		
Brand (manufacturer)	name	Vaccine

FluShield (Wyeth) Fluzone (Aventis Pasteur) Fluvirin (Evans)	Influenza
Attenuvax (Merck)	Measles
M-M-R II (Merck)	Measles, mumps, rubella
M-R-Vax II (Merck)	Measles, rubella
Mumpsvax (Merck)	Mumps
Biavax II (Merck)	Rubella, mumps
RabAvert (Chiron)	Rabies
YF-VAX (Aventis Pasteur)	Yellow fever

Preservatives are often included in vaccine preparations to prevent microbial contamination. Thimerosal is a mercury-containing preservative contained in a number of childhood vaccines (Table 2). Concern over possible neurodevelopmental effects of heavy metal exposure in children prompted the AAP and the United States Public Health Service to call for removal of thimerosal from vaccines in 1999.²¹ Immediate-type allergic reactions to vaccines containing thimerosal have not been described. However, delayed local hypersensitivity reactions to such vaccines have been reported.²²

TABLE 2 Examples of vaccines that contain thimerosal		
Brand name (manufacturer)	Vaccine	Amount of mercury/dose*
Tripedia (Aventis Pasteur)	Diphtheria and tetanus toxoids and acellular pertussis vaccines adsorbed (DTaP)	Tripedia: Single-dose vials contain trace amount; multi-dose vials contain 25 µg
Td (Aventis Pasteur)	Tetanus and diphtheria toxoids	25 µg

	adsorbed, for adult use	
DT (Aventis Pasteur)	Diphtheria and tetanus toxoids adsorbed, for pediatric use	25 µg
TT (Aventis Pasteur)	Tetanus toxoid adsorbed	25 µg
TriHIBit (Aventis Pasteur)	<i>Haemophilus influenzae</i> type b (<i>Haemophilus</i> b conjugate) reconstituted with Tripedia (single-dose vials)	Trace amount
Engerix-B (GlaxoSmithKline)	Hepatitis B (recombinant)	Trace amount (adult dose contains <1 µg)
FluShield (Wyeth) Fluzone (Aventis Pasteur) Fluvirin (Evans)	Influenza	FluShield: 25 µg (dose for children 6–35 mo contains 12.5 µg) Fluzone: 25 µg; a preparation with a trace amount is available, for use in children 6–35 mo, and another with <1 µg, for children >3 yr Fluvirin: 25 µg; a preparation with <1 µg is available, but Fluvirin is not approved for use in children <4 yr
JE-VAX (Aventis Pasteur)	Japanese encephalitis	35 µg (dose for children 1–3 yr contains 17.5 µg)
Menomune (Aventis Pasteur)	Meningococcal polysaccharide	25 µg (multi-dose vials)

Pnu-Imune (Wyeth)	23	Pneumococcal polysaccharide	25 µg
*Trace amount = <0.5 µg mercury/dose			

Antibiotics have also been used to decrease bacterial growth within vaccine preparations. Trace amounts of neomycin, streptomycin, and polymyxin B, for example, may be contained in various vaccines (Table 3). Vaccine administration may be contra-indicated in patients reporting antibiotic allergy. Neomycin most commonly causes a contact dermatitis 48 to 96 hours after topical application. A delayed-type hypersensitivity reaction consisting of an erythematous pruritic papule that develops 48 to 96 hours after vaccination has been attributed to neomycin. A history of contact dermatitis or a papule after vaccination does not preclude future vaccination. A history of neomycin anaphylaxis is an absolute contraindication to a vaccine that contains neomycin.²³ Penicillin is not contained in any current vaccine preparations, so penicillin allergy is not a contraindication for any vaccine.

TABLE 3 Examples of vaccines that contain antibiotics		
Antibiotic	Brand name (manufacturer)	Vaccine
Amphotericin B	RabAvert (Chiron)	Rabies
Chlortetracycline	RabAvert (Chiron)	Rabies
Neomycin	M-R-Vax II (Merck)	Measles, rubella
	M-M-R II (Merck)	Measles, mumps, rubella
	Attenuvax (Merck)	Measles
	Mumpsvax (Merck)	Mumps
	Ipol (Aventis Pasteur)	Poliovirus
	RabAvert (Chiron)	Rabies

	Imovax (Aventis Pasteur)	
	Biavax II (Merck)	Rubella, mumps
	Meruvax II (Merck)	Rubella
	Varivax (Merck)	Varicella
Polymyxin B	Ipol (Aventis Pasteur)	Poliovirus
Streptomycin	Ipol (Aventis Pasteur)	Poliovirus

Stabilizers are added to vaccines to stabilize the vaccine antigen. Porcine gelatin is the stabilizer contained within MMR and its component vaccines and in varicella, viral influenza, yellow fever, Japanese encephalitis, and DTaP vaccines (Table 4). Patients reporting clinical gelatin allergy have usually reacted to the bovine gelatin contained in foods. These patients may be at risk of allergic reactions following administration of gelatin-containing vaccines.²⁴ It is possible that many reactions previously attributed to egg allergy in MMR recipients were due to gelatin allergy. IgE antibodies to gelatin were detected in 93% of patients reporting anaphylaxis to the monovalent measles, mumps, and rubella vaccines in Japan.²⁵

TABLE 4 Examples of vaccines that contain gelatin		
Brand (manufacturer)	name	Vaccine
Tripedia (Aventis Pasteur)	(Aventis Pasteur)	Diphtheria and tetanus toxoids and acellular pertussis vaccines adsorbed (DTaP)
ActHIB (Aventis Pasteur)	as TriHIBit (Aventis Pasteur)	Haemophilus influenzae type b
Fluzone (Aventis Pasteur)	(Aventis Pasteur)	Influenza
JE-VAX (Aventis Pasteur)	(Aventis Pasteur)	Japanese encephalitis
M-M-R II	(Merck)	Measles, mumps, rubella

M-R-Vax II (Merck)	Measles, rubella
Attenuvax (Merck)	Measles
Mumpsvax (Merck)	Mumps
RabAvert (Chiron)	Rabies
Biavax II (Merck)	Rubella, mumps
Meruvax II (Merck)	Rubella
Vivotif Berna (Berna)	Typhoid, oral
Varivax (Merck)	Varicella
YF-VAX (Aventis Pasteur)	Yellow fever

Adjuvants are generally utilized in vaccines that contain killed microbes or toxoids. The aluminum-adsorbed vaccines DTaP, DT, Td, hepatitis A, and hepatitis B are adjuvant-containing vaccines. Administration of such vaccines may cause subcutaneous nodules that persist for weeks or months.⁴ Pain and tenderness at the injection site have also been attributed to aluminum contained in various vaccine preparations.

Current hepatitis B vaccines are prepared from yeast cultures. Yeast hypersensitivity is an absolute contraindication for hepatitis B vaccine administration.²⁶

Allergy to chicken, duck, or feathers is *not* a contraindication to any routine pediatric vaccine.

The potential reactivity of latex-sensitive individuals to the latex contained in the rubber stoppers of vaccine vials is a concern. However, most vaccine vials contain synthetic rubber rather than the natural rubber latex associated with clinical reactivity. One case of anaphylaxis has been attributed to the rubber stopper of a hepatitis B vaccine vial.²⁷

Avoiding allergic reactions: Pre-vaccination screening

All patients should be screened before vaccine administration for any possible contraindications to vaccination (see the [Key Points](#) box). In addition to obtaining a detailed patient history for any food allergies (egg or gelatin) or drug allergies (such as to neomycin, polymyxin B, streptomycin), it is important to screen all vaccine recipients for a history of vaccine reactions. Revaccination is contraindicated in any patient reporting prior anaphylaxis to a vaccine or vaccine component.

Managing allergic reactions

Local reactions such as localized urticaria may be treated with an oral antihistamine such as diphenhydramine or hydroxyzine. Vaccine-associated generalized urticaria may also be treated with an oral antihistamine. A systemic corticosteroid may be helpful if the reaction is severe or if there is associated angioedema.

The treatment of vaccine-induced anaphylaxis is no different than that for anaphylaxis due to any other cause. Initial management should include evaluation of the patient's airway, breathing, and circulation. Intravenous access should be obtained promptly. Placement of a tourniquet proximal to the vaccine injection site may help occlude venous return. Epinephrine infiltration around the injection site may also slow absorption. Administration of subcutaneous epinephrine 1:1,000 (0.01 mL/kg to a maximum of 0.3 mL), diphenhydramine (1–2 mg/kg IM/IV/PO to a maximum of 50 mg), and methylprednisolone (1–2 mg/kg per dose) may be life-saving.

Supplemental oxygen and nebulized albuterol (0.05–0.15 mg/kg, to a maximum of 2.5 mg, in 3 mL normal saline) should be given if there is respiratory compromise. Patients with hypotension should be placed in the Trendelenberg position and given IV boluses of normal saline (20 mL/kg). IV epinephrine 1:10,000 (0.1 mL/kg) may be considered in cases of shock.²⁸

Emergency medical services should be contacted as soon as possible for immediate transport of the patient to the nearest hospital emergency department for further evaluation and treatment. Emergency equipment such as bag mask ventilators, intravenous catheters, intravenous fluid tubing, laryngoscopes, endotracheal tubes, oral airways, and oxygen should always be available in all facilities where vaccines are administered.²⁹

Any significant allergic vaccine reaction should be fully documented in the medical record and reported to VAERS via telephone (24-hour toll-free

information, 800-822-7967) or via its Web site (www.fda.gov/cber/vaers/vaers.htm or www.vaers.org).

Revaccination

If a patient has had a significant allergic reaction after a dose of a vaccine and further doses are required, serologic testing is indicated. If protective IgG antibody titers are demonstrated, no further immunization is necessary. If antibody titers are not protective, evaluation by an allergist may be useful in determining which vaccine component may have caused the reaction and whether additional evaluation is warranted. The risks of vaccine administration must be weighed against the benefits of immunization. In cases of MMR or varicella vaccine reactions, an allergist can perform a radioallergosorbent test (RAST) or a prick test with gelatin or egg protein to determine whether the patient has IgE-mediated sensitivity to these foods. Double-blind, placebo-controlled food challenges may be required to confirm a diagnosis of food allergy.

If further vaccine administration is required, an allergist may perform vaccine skin testing. Although such testing is not standardized, the 2000 *Red Book* recommends vaccine skin testing for patients reporting tetanus toxoid reactions, yellow fever vaccine reactions, and significant hypersensitivity reactions, not including anaphylaxis, to the measles vaccine.³⁰ Generally, vaccine skin testing consists of a prick test of a 1:10 dilution of the vaccine with appropriate positive control (histamine) and negative control (saline). If the vaccine prick skin test is negative at 15 to 20 minutes, an intradermal skin test (0.02 mL of a 1:100 dilution of the vaccine) is placed with concurrent positive and negative controls. If the intradermal skin test is negative, the vaccine may be given. The patient should be observed for 30 minutes after vaccination.

If vaccine skin testing is performed, it is preferable to use alternative preparations of the required vaccine. Use of the monovalent measles, mumps, or rubella vaccine may be indicated for skin testing and vaccine administration in patients who have had reactions to combination vaccines such as DPT or MMR. Similarly, use of diphtheria-tetanus combinations excluding pertussis may be desirable. The predictive value of vaccine skin testing is not known. In addition, vaccine skin tests may identify only those patients who have IgE-mediated sensitivity to a vaccine.

In cases in which vaccine skin testing is positive and vaccine administration is required, vaccine desensitization via a graded dosing protocol may be considered. This consists of the subcutaneous administration of gradually increasing amounts of diluted and full strength vaccine. Emergency

medications and resuscitation equipment should be available during skin testing and desensitization in case of allergic reaction.³¹ Desensitization protocols have been described for MMR vaccine, tetanus toxoid, yellow fever vaccine, and viral influenza vaccine.^{11,32} However, the value of vaccine desensitization is unproven.³³

Some authors have suggested in-hospital vaccination as an alternative to vaccine skin testing and vaccine desensitization. Intensive cardiorespiratory monitoring for at least two hours following immunization may be considered for patients with a history of significant egg allergy or previous vaccine reactions.¹⁹

In cases in which further vaccine administration is precluded, use of passive immunoprophylaxis or chemoprophylaxis may be useful in preventing certain infectious diseases in cases of known exposure. Administration of immune globulin (IG) or specific immune globulin preparations such as tetanus immunoglobulin, varicella zoster immune globulin (VZIG), hepatitis B immune globulin (HBIG), or diphtheria antitoxin within 72 hours of exposure to certain infectious agents may prevent infection. Chemoprophylaxis with acyclovir, rifampin, amantadine, or rimantadine may be indicated in cases of varicella, *Haemophilus influenzae*, or influenza A exposure, respectively.

Routinely screen, promptly treat

Although allergic reactions to vaccines are rare, prompt diagnosis, treatment, and follow-up of such reactions are important issues for the practicing pediatrician. Practitioners should screen all potential vaccine recipients for food allergy, medication sensitivities, and prior vaccine reactions. (You can distribute the [Guide for Parents](#) on to educate parents about vaccine reactions and what to look for post-vaccination.) Referral to an allergist should be made when a patient has had a significant reaction to a vaccine and further doses are required. Among the absolute contraindications for revaccination is prior anaphylactic reaction to a vaccine or vaccine component. Emergency medications and equipment should be available at all facilities where vaccines are administered. The [parent guide](#) on recognizing and avoiding serious vaccine reactions may be photocopied and distributed to families in your practice without permission of the publisher.

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What's in a vaccine?

Vaccine antigens may be classified as bacterial, viral, toxoid, conjugate, or recombinant. **Live attenuated vaccines** such as measles-mumps-rubella (MMR) or varicella vaccine contain weakened bacteria or virus, whereas **inactivated vaccines** such as diphtheria and tetanus toxoids and pertussis (whole cell DPT) or diphtheria and tetanus toxoids and acellular pertussis (DTaP) contain whole microbes or partially killed microbes. The biologic toxins within toxoid vaccines such as diphtheria and tetanus toxoids have been inactivated with formaldehyde.

Conjugate vaccines were designed to enhance antibody responses in young children who typically respond poorly to polysaccharide but adequately to protein antigens. In *Haemophilus influenzae* type b and pneumococcal conjugate vaccines, polysaccharides of encapsulated bacteria are linked to protein carriers, enhancing vaccine immunogenicity. **Recombinant vaccines** such as hepatitis B use yeast-containing systems to produce vaccine antigen, which is then purified.

In addition to the vaccine antigen, other inactive components, such as culture medium proteins, preservatives, stabilizers, adjuvants, and antibiotics, may be present in the vaccine. The package insert for each vaccine contains a list of the major constituents contained in that vaccine. Vaccine preparations may vary among manufacturers and from lot to lot.

KEY POINTS

When to refrain from giving a vaccine— and when to give it

- Revaccination is contraindicated in any patient reporting prior anaphylaxis to a vaccine or a vaccine component.
- MMR vaccine may be routinely administered to an egg-allergic child, provided the child is observed for 90 minutes after injection in a facility equipped to treat anaphylaxis. Influenza virus vaccine is generally contraindicated in any child with a history of egg anaphylaxis.
- Vaccine administration may be contraindicated in a patient reporting antibiotic allergy. For example, a history of neomycin anaphylaxis is an absolute contraindication to administration of a neomycin-containing vaccine.
- Hepatitis B vaccination is contraindicated in a patient with yeast hypersensitivity.

- A prior hypotonic-hyporesponsive episode after vaccination with pertussis is a relative contraindication to pertussis revaccination (the physician must weight the benefit against the risk in determining whether to administer the vaccine).
- Transient generalized urticaria after vaccination is *not* a contraindication to further vaccination.
- Allergy to chicken, duck, or feathers, is *not* a contraindication to any routine pediatric vaccine.
- A local reaction after vaccination is generally *not* a contraindication to future vaccination.

GUIDE FOR PARENTS

Recognizing and avoiding serious reactions to childhood vaccines

Vaccinations (also called immunizations) prevent a number of childhood infections that can cause serious illness and death, and are an essential part of your child's health care. Although vaccines are tested extensively before they are approved for use, it is possible your child will have an adverse reaction to a vaccine ("adverse" meaning that the reaction was not meant to happen)—just as a person could have a reaction to any medication. Mild local reactions, such as redness at the site of the injection, are common after routine vaccinations and are not a cause for worry. More serious reactions, which are usually an allergic response to an ingredient in the vaccine, are rare. For example, after 70 million shots of the measles-mumps-rubella vaccine (often called the MMR vaccine), only 11 cases of life-threatening allergic reactions have been reported.

Reducing the risk

Because of the possibility of a serious reaction, even if it is rare, certain precautions are taken at the time of immunization:

1. Prevacination screening is done to identify any child who should not be vaccinated with a particular vaccine. This is the child who has had:

- a previous allergic reaction or other significant adverse reaction to that vaccine

Or, depending on the particular vaccine, the child with:

- a food allergy, specifically an allergy to egg protein or gelatin, or
- an allergy to certain antibiotics—specifically an allergy to neomycin, streptomycin, or polymyxin B

2. The federal government's Centers for Disease Control and Prevention requires that the pediatrician give a vaccine information sheet to parents before a vaccine is administered to their child.

3. A child should be observed for 15 to 20 minutes after vaccination, if possible; most serious reactions occur minutes to hours after vaccination.

4. Health care personnel and emergency equipment should be available when a child is vaccinated in case of an allergic vaccine reaction.

Monitoring your child after vaccination

Check the site of the vaccination a few hours after the vaccine is given. Local pain, redness, and swelling are the most common reactions. Usually, no treatment is required and the symptoms disappear in a day or two.

Reactions involving the whole body—called systemic reactions—may occur after certain routine immunizations. Your child may complain of fever, joint pain, muscle aches, or malaise (a run-down feeling all over) within days or weeks of vaccine administration. If your child says he or she feels any of these symptoms (or, if he is too young to speak or gesture to you, you think he is experiencing any of these symptoms), consult your pediatrician.

True allergic reactions to vaccines are rare. Such reactions are usually mild—just one or a few hives at the site of the injection (known as a local allergic reaction). Severe allergic reactions (known as anaphylaxis) to vaccines are rare and usually occur minutes or hours after immunization. Signs may include:

- a flushed face
- swelling of the face, mouth, or throat
- hives, itching
- wheezing or other difficulty with breathing
- shock (confusion, lack of movement or response, or even unconsciousness)

If your child develops any of these signs after a vaccination, lay him down on his back and elevate his legs. Contact emergency medical services immediately so your child can be taken to the closest hospital emergency room for evaluation and treatment.

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