

Parent's Guide to Childhood Immunizations



U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

In 1796, Edward Jenner inoculated an 8-year-old boy against smallpox and coined the term “vaccination” to describe what he had done.

Today, thanks to vaccination, there is no more small pox, and routine vaccination against childhood diseases is an important part of our children’s health care.

As parents, we want to do everything we can to keep our children from getting sick. In this booklet you will learn more about the role vaccines play in keeping them healthy. You will learn about:

- Diseases that are prevented by vaccines, and the vaccines that prevent them.
- How to prepare for a doctor’s visit that includes vaccinations, and what to expect during and after the visit.
- How vaccines help your child’s immune system do its job.
- How well vaccines work, and how safe they are.
- Where to find more information.

Table of Contents

Part 1:

Vaccine-Preventable Diseases and Childhood Vaccines.....7

Diseases.....7

Diphtheria.....7

Hepatitis A8

Hepatitis B.....8

Haemophilus influenzae type b (Hib).....9

Influenza (Flu).....9

Measles.....10

Mumps11

Pertussis (Whooping Cough).....	12
Pneumococcal Disease.....	12
Polio.....	13
Rotavirus.....	14
Rubella (German Measles).....	14
Tetanus (Lockjaw).....	15
Varicella (Chickenpox).....	15
Vaccines.....	17
The Vaccine Schedule.....	19
Other Vaccines	21

Part 2:

The Immunization Office Visit.....	23
Before the Immunization Visit.....	23
During the Immunization Visit.....	25
After the Immunization Visit.....	26

Part 3:

More About Vaccines.....	29
How do vaccine work?.....	29
Immunity.....	29
Vaccines.....	30
How Safe Are Vaccines?.....	31

Part 4:

Frequently Asked Questions.....	39
--	-----------

Part 5:

Summary of Childhood Vaccine Preventable Diseases.....	49
---	-----------

Glossary.....	55
----------------------	-----------

Learn More.....	59
------------------------	-----------

Your child’s vaccinations might be given by a doctor. They might also be given by a nurse, a nurse practitioner, a medical assistant, a physician’s assistant, or a pharmacist. The terms ‘health care provider’ or ‘provider’ also appear in this booklet. They can apply to anyone who gives a vaccination.

Part 1: Vaccine-Preventable Diseases and Childhood Vaccines

Most medicines are given to cure an illness or to relieve its symptoms. Vaccines are different. They are given to prevent illness.

Vaccine-Preventable Diseases

Fourteen diseases can be prevented by routine childhood vaccines:

Diphtheria

- Caused by bacteria.
- Causes sore throat, fever, and chills.
- If not properly diagnosed and treated, it can produce a toxin that can cause heart failure or paralysis.
- About 1 person in 10 infected with diphtheria dies.
- Through the 1920s, about 150,000 people got diphtheria each year, and about 15,000 died.

Hepatitis A

- Caused by hepatitis A virus.
- Found mostly in bowel movements and spread by personal contact or through contaminated food or water.
- Causes liver disease – muscle and stomach pain, diarrhea or vomiting, loss of appetite, fatigue, yellow skin or eyes (jaundice).
- Children younger than about 6 years old might not have any symptoms.
- About 100 people die each year from liver failure caused by hepatitis A.

Hepatitis B

- Caused by hepatitis B virus.
- Spread through contact with blood or other body fluids.
- Causes liver disease – muscle and stomach pain, diarrhea or vomiting, loss of appetite, fatigue, yellow skin or eyes (jaundice).
- Some people recover and others become “chronically infected,” which can lead to cirrhosis of the liver or liver cancer.

- Chronically infected people can infect others through, for example, unprotected sex or sharing needles.
- Babies of chronically infected mothers are usually infected at birth.
- About 3,000 to 5,000 people die each year.

Haemophilus influenzae type b (Hib)

- Caused by bacteria.
- If Hib bacteria enter the bloodstream they can cause meningitis, pneumonia, arthritis, and other problems.
- Before vaccine, Hib was the leading cause of bacterial meningitis in children younger than 5 (about 1 out of every 200 children in that age group).
- One child in 4 suffered permanent brain damage, and 1 in 20 died.

Influenza (flu)

- Caused by influenza virus.
- Occurs mostly during the winter.
- Causes fever, sore throat, cough, headache, chills, muscle aches.

- Can lead to sinus infections, pneumonia, and inflammation of the heart.
- Hospitalization rates are high among children, especially babies under 1 year old.
- Flu causes more deaths each year than any other vaccine-preventable disease – mostly among the elderly, but it can also kill children.

Measles

- Caused by measles virus.
- Extremely contagious.
- Causes a rash all over the body, runny nose, fever, and cough.
- About 1 child in 10 also gets an ear infection, up to 1 in 20 gets pneumonia, 1 in 1,000 gets encephalitis.
- Before vaccine, almost all children got measles – about 48,000 were hospitalized each year, 7,000 had seizures, about 1,000 suffered permanent brain damage, and about 450 died.
- Measles still kills about a half million people a year around the world.
- About 1 person in 1,000 who gets measles will die.

Measles Trivia:

The word "measles" probably comes from a Latin word meaning "miserable."

In 1970, astronaut Ken Mattingly could not participate in the Apollo XIII moon mission because he had been exposed to measles.



Mumps

- Caused by mumps virus.
- Used to be a very common childhood disease.
- Usually a relatively mild disease – causes fever, headache, and inflammation of salivary glands.
- Mumps can lead to meningitis (about 1 child in 10), encephalitis or deafness (about 1 in 20,000) or death (about 1 in 10,000).

Pertussis (whooping cough)

- Caused by bacteria.
- Can look like a common cold at first.
- After one or two weeks, it can cause violent coughing spells that can interfere with eating, drinking, or even breathing.
- Can lead to pneumonia, seizures, encephalopathy (brain infection), and death.

Pneumococcal Disease

- Caused by bacteria.
- Most common in winter and early spring.
- After Hib disease began to decline, pneumococcal disease became the most common cause of bacterial meningitis in children under 5.
- Can lead to ear infections, blood infections, and death.
- African Americans, some Native American tribes, children with sickle cell disease or with HIV infection and children without a working spleen are at higher risk.

Polio

- Caused by polio virus.
- Can cause paralysis, leaving a person unable to walk or even breathe.
- About 1,200 polio victims in the United States were forced to live in 700-pound “iron lungs,” which enabled them to breathe. Several of these people, first confined to an iron lung in the 1950s, still live in them today.
- Polio caused panic in the 1950s before vaccine – about 20,000 people were paralyzed each year.

Polio Trivia:

In 1948, a retired schoolteacher was a patient in a San Diego polio ward, surrounded by young children also suffering from polio. To help cheer them up she created a simple board game for them to play together. A year later, the toy manufacturer Milton Bradley bought the game from her. Today polio has been nearly eliminated, but Candy Land is still being played in millions of homes around the world.

Rotavirus

- Caused by a virus.
- Causes diarrhea and vomiting in young children – sometimes so severe it can lead to dehydration.
- Before vaccine, rotavirus caused more than 400,000 doctor visits, 200,000 emergency room visits, up to 70,000 hospitalizations, and 20 to 60 deaths each year.

Rubella (German measles)

- Caused by a virus.
- Usually a mild disease, causing swollen glands in the neck, fever, rash on the face and neck, and sometimes arthritis-like symptoms.
- The greatest danger from rubella is to unborn babies. If a pregnant woman gets rubella, her unborn baby has about an 80% chance of “congenital rubella syndrome” (CRS), which can lead to deafness, blindness, mental impairment, or heart or brain damage. Miscarriages are also common.

- In 1964-65, before vaccine, a major rubella epidemic in the United States infected 12.5 million people and led to 20,000 cases of CRS.

Tetanus (lockjaw)

- Caused by bacteria.
- Enters the body through cuts, burns, or other breaks in the skin – not spread from person to person.
- About 3 weeks after exposure, a child could become cranky, get a headache, or have spasms in the jaw muscles.
- Tetanus can then produce a toxin that causes painful muscle cramps in the neck, arms, legs, and stomach – strong enough to break a child's bones.
- A child might have to spend several weeks in intensive care. One or two out of every 10 die.

Varicella (chickenpox)

- Caused by varicella virus.
- Causes an itchy rash all over the body, fever, and drowsiness.

- Usually mild, but can cause skin infections and encephalitis. For every 100,000 infants younger than 1 year old who get chickenpox, about 4 die.
- If a pregnant woman gets chickenpox around the time of delivery, the baby can be infected, and 1 out of 3 will die if not treated quickly.
- Before vaccine, almost every child (about 4 million each year) got chickenpox.

Many of these diseases are spread from person to person through the air by coughing, sneezing, or just breathing. Exceptions are polio, hepatitis A, and rotavirus, which enter the body through the mouth; hepatitis B, which is transmitted through blood or body fluids; and tetanus, which enters the body through breaks in the skin.

All of these diseases were much more common before vaccines.

However, after declining for years, some of them – notably measles and pertussis – are again causing outbreaks in the United States, partly because some parents are not getting their children vaccinated.

Disease	Annual Reported Cases 20th Century (Pre-Vaccine)	Reported Cases 2013
Diphtheria	21,053	0
Measles	530,217	187
Tetanus	580	26
Mumps	162,344	584
Rubella	47,745	9

Childhood Vaccines

Ten vaccines, which children receive between birth and 6 years of age can prevent these 14 diseases.

- 1** Hepatitis A (HepA) vaccine
- 2** Hepatitis B (HepB) vaccine

- 3** Hib (Haemophilus influenzae type b) vaccine
- 4** Influenza (flu) vaccine
- 5** PCV13 (pneumococcal disease) vaccine
- 6** Polio vaccine
- 7** Rotavirus (RV) vaccine
- 8** Varicella (chickenpox) vaccine
- 9** DTaP (Diphtheria, Tetanus, and Pertussis) vaccine
- 10** MMR (Measles, Mumps, and Rubella) vaccine

These vaccines are given by injection (shot), except for rotavirus, which is a liquid that is swallowed, and one type of flu vaccine, which is sprayed into the nose.

The Vaccine Schedule

All of these childhood vaccines are given in a series of 2 or more doses, at specific ages.

Age	Vaccine
at birth	HepB
2 months	HepB (1-2 mos) + DTaP + PCV13 + Hib + Polio + RV
4 months	DTaP + PCV13 + Hib + Polio + RV
6 months	HepB (6-18 mos) + DTaP + PCV13 + Hib + Polio (6-18 mos) + RV
12 months	MMR (12-15 mos) + PCV13 (12-15 mos) + Hib (12-15 mos) + Varicella (12-15 mos) + HepA (12-23 mos)
15 months	DTaP (15-18 mos)

For more detailed versions of this schedule, visit CDC's website at <http://www.cdc.gov/vaccines/schedules/index.html>.

For some of these vaccines, a booster dose is also recommended at 4-6 years of age.

A dose of flu vaccine is recommended every winter for children 6 months old or older.

Vaccine Trivia:

The world's first vaccine, Dr. Edward Jenner's smallpox vaccine, was actually made from cowpox virus. Jenner called the process "vaccination" from vacca, a Latin word for cow.



Several “combination” vaccines are available for children. These are vaccines that contain more than one vaccine in a single shot, which means fewer shots at one visit:

Vaccine Name	Contains
Pediarix®	DTaP, Polio, and HepB
Pentacel®	DTaP, Polio, and Hib
Kinrix®	DTaP and Polio
Quadracel®	DTaP and Polio
ProQuad®	MMR and Varicella

Other Vaccines

There are other vaccines that might be recommended for older children or adolescents, or for young children in certain circumstances.

Rabies vaccine might be recommended for a child who was bitten by an animal, or is traveling to a country where rabies is common.

Children traveling abroad may need other vaccines, too. These could include **Japanese encephalitis, typhoid, meningococcal, or yellow fever vaccines.**

Meningococcal vaccine is also recommended for adolescents between 11 and 18 years of age, and for younger children with certain medical conditions, to protect them from infections that could cause bacterial meningitis. **Tdap** is a tetanus, diphtheria, pertussis vaccine that is similar to DTaP, but is formulated for adolescents and adults. It is recommended at the 11-12 year doctor's visit. **Human papillomavirus (HPV)** vaccine is also recommended at the 11-12 year visit. HPV is a virus that causes cervical cancer and other types of cancer.

Your healthcare provider can tell you more about these vaccines.

Part 2: The Vaccination Office Visit

Before the Vaccination Visit

If you have a vaccination record card for your child, take it along so the provider can enter the shots given today. If she is getting her first vaccination(s), ask for a card. This record could come in handy later to show that your child has had the vaccinations necessary to get into school, or if you move or switch doctors. The provider should enter the vaccinations into an electronic medical record or vaccine registry.

The doctor or nurse will ask you some questions about your child. Be prepared to tell them:

- **If your child ever had a severe reaction to a dose of any vaccine.**

Babies often get a sore leg or a mild fever after vaccinations. But let your provider know if your baby has ever had a more serious reaction. There are a few uncommon reactions that could be a reason to not get another dose of certain vaccines.

- **If your child has any severe allergies.**

A severe allergy is one that could be life-threatening. A baby who has a severe allergy to a substance that is in a vaccine shouldn't get that vaccine. Milder allergies aren't a problem.

You can't be expected to know whether or not your baby is allergic to every substance in every vaccine, but report any allergies you do know about, including eggs, gelatin, any antibiotics, yeast, or latex. Your doctor or nurse will be able to check them against lists of vaccine ingredients.

Don't be too worried that your child might have allergies you don't know about. Severe allergic reactions to vaccines are rare (around 1 in a million), and your provider is prepared to deal with them if they do occur.

- **If your child has an immune system problem.**

A child with a damaged or suppressed immune system should not get vaccines containing live virus, such as MMR, varicella, or rotavirus. Immune system problems can be caused by diseases such as AIDS, leukemia, sickle cell disease, or cancer, or by medical treatments such as steroids, chemotherapy, or radiation.

Your doctor, nurse, or other provider will be able to help you answer any questions.

During the Vaccination Visit

Your provider should give you a Vaccine Information Statement (VIS) for each vaccine your child receives. The VIS contains useful information about the vaccine, including its risks and benefits. If you would like to review these statements before the office visit, you can find them online at <http://www.cdc.gov/vaccines/hcp/vis/>.

Your provider will ask questions to help them determine if there are reasons your baby should not get certain vaccines.

Always ask your provider if you have any questions or would like more information.

Your provider might ask you to hold your baby in a certain way to steady the arm or leg where the shot will be given. These techniques are designed to

keep children still without actually holding them down or frightening them.

Many providers like to keep a child in the office for observation for about 15 or 20 minutes after getting vaccines, in the unlikely event of an allergic reaction or in case the child becomes dizzy or faints.

If your child has a moderate or severe cold or other illness, you might be asked to postpone vaccinations until he gets better.

Be sure that all vaccinations that are given get recorded in your baby's shot record.

After the Vaccination Visit

Sometimes a child will have a fever or a sore leg or arm where a shot was given. You can give your child a non-aspirin pain reliever to reduce any pain or fever that might follow vaccinations. Giving the child plenty of fluids to drink can also help reduce a fever. A cool, wet washcloth over the sore area can help relieve pain.

If your baby cries for 3 or more hours without stopping, if he seems limp or unresponsive, if he starts having seizures (convulsions), or if you are worried at all about how your baby looks or feels, call your provider right away. Serious reactions are not common, but your provider will know how to deal with them if they occur.

Again, severe allergic reactions after a vaccination are very rare, but if one were to happen, be ready to respond to it:

- If an allergic reaction occurs, it will usually happen within a few minutes to a few hours after the vaccination.
- Signs of a severe allergic reaction can include difficulty breathing, dizziness, swelling of the throat, hives, fast heartbeat, hoarseness or wheezing.
- If your child shows these signs, call 9-1-1 or get him to the nearest hospital right away.
- Be ready to tell the doctor when the reaction occurred, what vaccinations were given, and when.

In the unlikely event that your child does have any serious reaction to a vaccination, there are two programs you should know about afterward:

- **VAERS. The Vaccine Adverse Event Reporting System** is a system for reporting possible vaccine side effects. If your child has an unusual medical condition after getting a vaccine, even if you don't know whether it was caused by the vaccine, you should report it to VAERS. One of the jobs of VAERS is to collect these reports and use the data to help determine whether specific medical problems might be caused by vaccines.

Your provider will usually file a VAERS report for you. However, you can also file it yourself. For more information, visit the VAERS website at www.vaers.hhs.gov.

- **Vaccine Injury Compensation Program.** If you believe your child was seriously injured by a vaccine, there is a no-fault federal program that can help compensate you for his care. To learn more about the Vaccine Injury Compensation Program, visit their website at www.hrsa.gov/vaccinecompensation.

Most parents will never need these programs, but they are there if you do.

Part 3: More About Vaccines

How Vaccines Work

Immunity from Disease

When disease germs enter your body, your immune system goes to work.

It does three important things:

- 1** It recognizes the disease germs as not belonging in your body – as being “foreign invaders.”
- 2** It responds by producing proteins called antibodies, which help destroy these germs. **Unfortunately, these antibodies can’t act quickly enough to stop you from getting sick.** But by eliminating the germs, they help you get well.
- 3** It remembers the germs that made you sick, and if they ever try to infect you again – even after many years – your immune system will come to your defense again. But now they are able to stop the invading germs before they can make you sick. This is immunity. It is what keeps you from

getting sick from diseases like measles or chickenpox a second time, no matter how often you are exposed to them.

In other words, the first time you are exposed to a disease, your immune system won't stop you from getting sick, but it will help you recover and make you immune to that disease if you are ever exposed to it again.

Immunity from Vaccines

With vaccination, killed or weakened disease germs are intentionally introduced into the body, usually by injection. Then your immune system goes to work, just as if you were exposed to a disease:

- 1** It recognizes the vaccine germs as not belonging in your body – as being “foreign invaders.”
- 2** It responds by producing antibodies, the same as if you had been exposed to the disease. **But there is a difference. The germs in the vaccine are weakened or killed, so they won't make you sick.**

- 3** However, you will still develop immunity, just as if you had gotten sick from the actual disease. So if germs from that disease ever do try to infect you, your immune system will come to your defense and stop them from making you sick.

In other words, getting a disease or getting a vaccine can both give you future protection from that disease. The difference is that with the disease you have to get sick to get that protection. With the vaccine you don't.

How Safe Are Vaccines?

This is a question that naturally worries any new parent. No matter how good vaccines are at preventing disease, no matter how much they have reduced diseases over the years, no matter how many lives they have saved, what if they can actually harm your baby?

Vaccine safety is a complex issue, and some specific questions will be addressed in Part 4 (Frequently Asked Questions) of this booklet. In the meantime, here are some basics:

Can vaccines harm my child? Any medicine can cause a reaction, even aspirin. Vaccines are no exception.

Will vaccines harm my child? Probably not. Many children never have a reaction to a vaccine. For those who do, most reactions will be minor... a sore leg, a slight rash, or a mild fever that goes away in a day or two.

Some children have more serious reactions like a high fever, chills, fussiness, or muscle aches. One of the scariest of these reactions is called a febrile seizure. This is a seizure, or convulsion, caused by a high fever. During a febrile seizure a child might shake uncontrollably, become unresponsive, or even lose consciousness. About one child in 25 will have at least one febrile seizure, usually between 6 months and 3 years of age. Any high fever, regardless of the cause, can trigger a febrile seizure, including a fever associated with a vaccination. Febrile seizures look serious, but fortunately they almost never are. Children recover with no lasting effects. You can learn more about febrile seizures at www.ninds.nih.gov/disorders/febrile_seizures/detail_febrile_seizures.htm.

Rarely, a child will have a truly serious reaction, like encephalopathy (brain

infection) or a severe allergic reaction. These are the scary possibilities that make some parents think that it might actually be better not to vaccinate their children.

Would it?

First, serious reactions are extremely rare. One of the most serious – a life-threatening allergic reaction to a substance in a vaccine – occurs only about once in every million vaccine doses.

There are about a million words in the 7-volume series of Harry Potter books. If we let each of those words represent a dose of vaccine, then one word, somewhere within the 7 books' 4,224 pages, would represent the risk of a severe allergic reaction.

Second, sometimes it is hard to tell if a reaction was even caused by a vaccine. Any serious reaction that could be caused by a vaccine could also be caused by something else. There is no such thing as a serious health problem that is caused only by vaccines. For something that affects only one child in a hundred thousand or a million, it can be very hard to isolate the cause.

Example: Sudden Infant Death Syndrome (SIDS) is the unexplained, sudden death of an infant, usually while sleeping. The causes of SIDS have always been uncertain, and for a time, some people blamed DTP* vaccine. As evidence, they pointed to the fact that SIDS deaths often seemed to occur within several days after a child received a dose of DTP vaccine.

But SIDS, by definition, occurs at the same ages when millions of babies were getting multiple doses of DTP – so it would have been remarkable if SIDS didn't occasionally strike right after the shot. Studies were conducted to test this theory, and it was found that babies who had been vaccinated with DTP were no more likely to get SIDS than babies who weren't vaccinated –in other words, there was no association. Since then, we have learned that precautions such as putting babies to sleep on their backs and not smoking around them can dramatically reduce the risk of SIDS. (For more information about SIDS, see the American SIDS Institute webpage at [http://sids.org/.](http://sids.org/))

*DTP is an older version of DTaP.

Third, it isn't just risks – it's also benefits. True, there is a risk that a dose of vaccine could cause discomfort and other side effects, and a very small risk

that it could cause a serious problem.

What do you get for taking that small risk?

Most importantly, your baby will be protected from more than a dozen potentially serious diseases. (At this point you might be asking how likely your child is to actually be exposed to one of these diseases if she isn't vaccinated? For a discussion of this question, see Part 4 [Frequently Asked Questions].)

However, the benefits of vaccinating your child also extend to other children. As mentioned earlier, a small percentage of children fail to develop immunity from vaccines. There are also children who can't get certain vaccines for medical or other reasons, and babies who are too young to be vaccinated. These children rely on the immunity of people around them to protect them from infectious diseases. The more children in a community who are vaccinated, the harder it is for a disease to spread.

And finally, getting vaccinated today will help protect future generations of children.

Meet Riley

In most ways, Riley is a typical 8-year-old girl. She takes piano and gymnastics lessons, plays soccer, likes to swim, and gets into fights with her brothers.

But Riley has something most 8-year olds don't – another child's heart. She was born with a serious heart defect and had to get a transplant within days of her birth.

Because Riley's new heart doesn't really belong to her, her body would reject it if she didn't take special drugs. These drugs suppress her immune system, and because of this she can't get live-virus vaccines like measles, mumps, rubella, or chickenpox.

Consequently, Riley is not immune to these diseases. She has to depend on the immunity of people around her for protection. If one of her schoolmates or playmates were to come down with a case of measles or chickenpox, Riley could easily catch it from them. And because her immune system can't fight off the infection, it could become very serious if not treated promptly.



Riley enjoys a normal life today, partly thanks to her friends who are protecting her from infections by getting all their shots.

Smallpox was one of the deadliest diseases the world has ever known, killing 300 million people in the 20th century alone. But as millions of children and adults got vaccinated over the years, the disease began to disappear until finally, in October 1977, only one person on Earth had smallpox. When he recovered, smallpox was gone, and it will never kill another baby.

In the United States where disease rates are very low, your child's risk of getting one of these diseases may also be very low. Does that mean vaccination isn't important? What would happen if everyone stopped getting vaccinated? We know what would happen because it has happened in other countries.

Even a few cases of a contagious disease in a vulnerable population could touch off a major outbreak. This is why we still vaccinate against polio, even though we haven't seen it in this country for more than 10 years. One infected traveler from another country could set us back 50 years if our own population wasn't protected.

Example: In the mid-1970s, about 80% of Japanese children were vaccinated against pertussis. In 1974, there were only 393 cases of whooping cough in the entire country, and no one died from it. But then, because of fear about the vaccine's safety, the immunization rate dropped to only about 10%. Within 5 years, the country was in the grip of a whooping cough epidemic that infected more than 13,000 people and left 41 dead in 1979 alone. When routine vaccination was resumed, the disease numbers dropped again.

When you get your child vaccinated, you are not just protecting her. You are also protecting her friends and schoolmates and their families, and her children, grandchildren, and future generations.

Part 4: Frequently Asked Questions

How do we know vaccines aren't causing long-term health problems?

Observing vaccinated children for many years to look for long-term health conditions would not be practical, and withholding an effective vaccine from children while long-term studies are being done wouldn't be ethical. A more practical approach is to look at health conditions themselves and at the factors that cause them. Scientists are already working to identify risk factors that can lead to conditions like cancer, stroke, heart disease, and autoimmune diseases such as lupus or rheumatoid arthritis. Thousands of studies have already been done looking at hundreds of potential risk factors. If immunizations were identified as a risk factor in any of these studies, we would know about it. So far, they have not.

We learn about a vaccine's safety during clinical trials before it is licensed, and monitor it continually as millions of doses are administered after it is licensed.

We also know there is not a plausible biologic reason to believe vaccines would cause any serious long-term effects. Based on more than 50 years of experience with vaccines, we can say that the likelihood that a vaccine will cause unanticipated long-term problems is extremely low.

Why do children need so many doses of certain vaccines?

The reason depends on whether the vaccine is inactivated (killed) or live. With an inactivated vaccine, each dose contains a fixed amount of disease antigen (virus or bacteria). Immunity is built in phases, with each dose boosting immunity to a protective level. Live vaccines are different in that they contain a small amount of antigen which reproduces and spreads throughout the body. One dose produces satisfactory immunity in most children. But a second dose is recommended, because not all children respond to the first one.

Aren't some of the ingredients in vaccines toxic?

Some vaccine ingredients could be toxic, but at much higher doses. Any substance – even water – can be toxic given a large enough dose. But at a very low dose, even a highly toxic substance can be safe. For example, many adults have one of the most toxic substances known to humanity, Botox, injected into their face to reduce wrinkles.

We aren't always aware of it, but we are exposed to small amounts of these same "toxic" substances every day:

Mercury: Babies are exposed to mercury in milk, including breast milk. Seafood also contains mercury.

Formaldehyde: Formaldehyde is in automobile exhaust; in household products and furnishings such as carpets, upholstery, cosmetics, paint and felt-tip markers; and in health products such as antihistamines, cough drops, and mouthwash.

Aluminum: The average person takes in an estimated 30 to 50 mg of aluminum every day, mainly from foods, drinking water, and medicines. Not all vaccines

contain aluminum, but those that do typically contain about .125 mg to .625 mg per dose, or roughly 1% of that daily average.

Components of vaccines are all there for a reason. Some (like aluminum) help the vaccine work better. Others (like formaldehyde) were used during manufacturing and have been removed except for a tiny trace.

One final word – you can't believe everything you read about harmful ingredients in vaccines. For example, no vaccine contains, or has ever contained, even a molecule of antifreeze, although you would never know that after reading any of a dozen websites claiming that they do.

Can a child get a disease even after being vaccinated?

It isn't very common, but it can happen. Depending on the vaccine, about 1% to 5% of children who are vaccinated fail to develop immunity. If these children are exposed to that disease, they could get sick. Sometimes giving an additional vaccine dose will stimulate an immune response in a child who didn't respond to

1 dose. For example, a single dose of measles vaccine protects about 95% of children, but after 2 doses, almost 100% are immune.

Sometimes a child is exposed to a disease just prior to being vaccinated, and gets sick before the vaccine has had time to work. Sometimes a child gets sick with something that is similar to a disease they have been vaccinated against. This often happens with flu. Many viruses cause symptoms that look like flu, and people even call some of them flu, even though they are really something else. Flu vaccine doesn't create immunity to these viruses.

Can a child actually get the disease from a vaccine?

Almost never. With an inactivated (killed) vaccine, it isn't possible. Dead viruses or bacteria can't cause disease. With live vaccines, some children get what appears to be a mild case of disease (for example, what looks like a measles or chickenpox rash, but with only a few spots). This isn't harmful, and can actually show that the vaccine is working. A vaccine causing full-blown disease would be extremely unlikely. One exception was the live oral polio vaccine, which could

very rarely mutate and actually cause a case of polio. This was a rare, but tragic, side effect of this otherwise effective vaccine. Oral polio vaccine is no longer used in the U.S.

Considering that rates of vaccine-preventable diseases are very low, my child is unlikely to get one of these diseases. Therefore, isn't the benefit of vaccination also very low?

That's a reasonable question. Statistically, the chances of any particular child getting measles, pertussis, or another vaccine-preventable disease might be low.

But you don't wear a seatbelt because you expect to be in a serious accident; you wear it because you want to be protected in the unlikely event that you are. If you're never in an accident, the benefit of wearing a seat belt might be zero. But if you are, the consequences of not wearing it can be very high.

It's the same with vaccines. Your child might never need the protection they

offer, but you don't want him to be lacking that protection if he ever does need it.

Why does the government require children to be vaccinated to attend school?

School immunization laws are not imposed by the federal government, but by the individual states. But that doesn't answer the question, which is often asked by people who see this as a violation of their individual rights.

Public health programs, such as immunization, are designed to protect the health of the public – that is, everybody. Remember that vaccines protect not only the person being vaccinated, but also people around them. Immunization laws exist not only to protect individual children, but to protect all children.

If vaccines were not mandatory, fewer people would get their children vaccinated – they would forget; they would put it off; they would feel they couldn't afford it; they wouldn't have time. This would lead to levels of immunity dropping below what are needed for herd immunity (see Glossary),

which would, in turn, lead to outbreaks of disease.

So mandatory vaccination might not be a perfect solution, but it is a practical solution to a difficult problem. School immunization laws are like traffic laws. Laws forbidding us to drive as fast as we want on crowded streets or ignore traffic signals could also be seen as an infringement on individual rights. However, these laws are not so much to prevent drivers from harming themselves, which you could argue is their right, but to prevent them from harming other people, which is not.

Can children be exempted from school immunization laws?

Under certain circumstances, yes. All states allow medical exemptions, so children who cannot safely receive certain vaccines (like Riley – see page 36) are not required to get them. Most states also allow religious exemptions for children whose religion prohibits vaccination. Finally, some states allow philosophic exemptions for people who oppose vaccination on non-religious

grounds. To protect themselves and others, unvaccinated students may be prohibited from attending classes if there is an outbreak of a vaccine-preventable disease at their school or in their community.

Vaccines are expensive. Is there a way to reduce the cost?

You can go to a public clinic or health department rather than to a private physician. Vaccinations are generally cheaper there, and may be free except for an administration charge.

There is also a national program called Vaccines for Children (or VFC), which allows qualified families to get free vaccinations for their children at participating doctors' offices. You can learn more about the VFC program at <http://www.cdc.gov/vaccines/programs/vfc/index.html>

Can't so many vaccines overwhelm a child's immune system?

We may not know exactly how many germs a baby's immune system can handle at one time, but it is considerably more than they will ever get from vaccines. After all, this is the immune system's job. From the day a baby is born, her immune system has to deal with the thousands of germs she is exposed to as part of daily life. As one doctor put it, "Worrying about too many vaccines is like worrying about a thimble of water getting you wet when you are swimming in an ocean."

Isn't vaccination "unnatural?"

No. Your child's immune system produces immunity following vaccination the same as it would following "natural" infection with a disease. The difference is that the child doesn't have to get sick first. (See "How Vaccines Work" on page 29.)

Part 5: Summary of Childhood Vaccine-Preventable Diseases

Disease	Caused by	Spread by
Chickenpox	Varicella Zoster virus	Air, direct contact
Diphtheria	Corynebacterium diphtheriae bacteria	Air, direct contact
Hib Disease	Haemophilus influenzae type b bacteria	Air, direct contact
Hepatitis A	Hepatitis A virus	Personal contact. Contaminated food or water.
Hepatitis B	Hepatitis B virus	Contact with blood or body fluids

Disease	Caused by	Spread by
Influenza (Flu)	Influenza virus	Air, direct contact
Measles	Measles virus	Air, direct contact
Mumps	Mumps virus	Air, direct contact
Pertussis (whooping cough)	Bordetella pertussis bacteria	Air, direct contact
Polio	Poliomyelitis virus	Through the mouth
Pneumococcal Disease	Streptococcus pneumoniae bacteria	Air, direct contact
Rotavirus	Rotavirus virus	Through the mouth
Rubella (German measles)	Rubella virus	Air, direct contact

Disease	Caused by	Spread by
Tetanus (lockjaw)	Clostridium tetani bacteria	Exposure through cuts in skin

Disease	Signs & Symptoms	Complications
Chickenpox	Rash, fever	Bacterial infections, meningitis, encephalitis, pneumonia, death.
Diphtheria	Sore throat, mild fever, membrane in throat, swollen neck	Heart failure, paralysis, pneumonia, death.
Hib Disease	May be no symptoms unless bacteria enter blood.	Meningitis, epiglottitis, pneumonia, arthritis, death.

Disease	Signs & Symptoms	Complications
Hepatitis A	Fever, stomach pain, loss of appetite, fatigue, vomiting, jaundice, dark urine.	Liver failure, death.
Hepatitis B	Fever, headache, malaise, vomiting, arthritis.	Chronic infection, cirrhosis, liver failure, liver cancer, death.
Influenza (Flu)	Fever, muscle pain, sore throat, cough.	Pneumonia, Reye syndrome, myocarditis, death.
Measles	Rash, fever, cough, runny nose, pinkeye.	Pneumonia, ear infections, encephalitis, seizures, death.
Mumps	Swollen salivary glands, fever, headache, malaise, muscle pain.	Meningitis, encephalitis, inflammation of testicles or ovaries, deafness

Disease	Signs & Symptoms	Complications
Pertussis (whooping cough)	Severe cough, runny nose, fever.	Pneumonia, seizures, brain disorders, ear infection, death.
Polio	May be no symptoms, sore throat, fever, nausea.	Paralysis, death.
Pneumococcal Disease	Pneumonia (fever, chills, cough, chest pain).	Bacteremia (blood infection), meningitis, death.
Rotavirus	Diarrhea, fever, vomiting	Severe diarrhea, dehydration, electrolyte imbalance, kidney and liver disease, death

Disease	Signs & Symptoms	Complications
<p>Rubella (German measles)</p>	<p>Rash, fever, lymphadenopathy, malaise.</p>	<p>Encephalitis, arthritis/ arthralgia, hemorrhage, orchitis.</p>
<p>Tetanus (lockjaw)</p>	<p>Stiffness in neck, difficulty swallowing, rigid abdominal muscles, muscle spasms, fever, sweating, elevated blood pressure.</p>	<p>Broken bones, breathing difficulty, death.</p>

GLOSSARY

Adverse Event — A medical problem that occurs after a vaccination, which may or may not have been caused by the vaccine.

Adverse Reaction — A medical problem that occurs after a vaccination when it is assumed that the vaccine is the cause.

Antibody — A protein produced by the immune system that helps identify and destroy foreign substances that enter the body.

Antigen — A substance that causes your immune system to produce antibodies against it. A disease germ, generally a bacterium or virus.

Bacteremia — Presence of bacteria in the blood.

Clinical Trials — Testing the safety and effectiveness of vaccines before they are licensed, during which they are given to increasingly larger groups of volunteer subjects.

Communicable Disease — A disease that can spread from one person to another.

Convulsion — See Seizure.

Encephalitis — Inflammation of the brain.

Encephalopathy — An illness affecting the brain.

Epidemic — A large outbreak of disease (see Outbreak). A worldwide epidemic is called a pandemic.

Exposure — Contact with germs that cause disease. A person must be both exposed and susceptible to a disease to get sick from it.

Febrile Seizure — A seizure caused by a high fever.

Herd Immunity — Protection from disease in a community, due to a large enough proportion of the population having immunity to prevent the disease

from spreading from person to person.

Immunity — Protection from disease. Having antibodies to a disease organism usually gives a person immunity.

Iron Lung — A cylindrical steel chamber that “breathes” for a person whose muscles that control breathing have been paralyzed. Some polio patients have been confined to an iron lung for life.

Local Reaction — A reaction that is confined to a small area of the body. With vaccines, a local reaction usually refers to redness, soreness, or swelling where an injection was given. (A reaction that affects the body as a whole, such as a fever or bacteremia, is called a “systemic” reaction.)

Meningitis — Inflammation of the covering of the brain or spinal cord.

Outbreak — An unusually large number of cases of a disease occurring at the same time and place, involving people who got the disease from the same source or from each other.

Paralysis — Inability to move the muscles. Paralysis usually occurs in the arms or legs, but any muscle can become paralyzed, including those that control breathing.

Schedule (or Vaccination Schedule) — The ages and/or intervals at which vaccines are recommended.

Seizure — A spell during which muscles may jerk uncontrollably, or a person stares at nothing. Usually a seizure lasts only a brief time and doesn't cause permanent harm. A seizure can have many causes, including epilepsy or other brain disorders, or a high fever (see Febrile Seizure). Also called convulsion or fit.

Susceptible — Vulnerable to disease. Someone who has never had a disease or has never been vaccinated against it is susceptible to that disease. Opposite of immune.

Toxin — Poison.

Vaccine-Preventable Disease — Any disease for which there is a vaccine.

LEARN MORE

CDC Websites:

- General vaccine information: www.cdc.gov/vaccines
- Information about hepatitis: www.cdc.gov/hepatitis
- Information about flu: www.cdc.gov/flu
- International travel information: wwwn.cdc.gov/travel
- Information about vaccine safety: www.cdc.gov/vaccinesafety

CDC-INFO. Live professionals are available 8:00 a.m. to 8:00 p.m., Monday through Friday to answer your questions. Call 800-232-4636 (800-CDC-INFO).

Your state health department's immunization program can answer many questions about immunization in your state. Find your state's immunization website at www.immunize.org/states.

There are many books and internet sites devoted to vaccination issues. Keep in mind that these reflect a wide range of interpretation of facts, not to mention personal opinions, making it hard for a parent to know what to believe. Here are a few questions to ask yourself when evaluating a vaccination-related book or website:

- What are the author's credentials? How well does he or she know the subject?
- Does the author cite his or her sources? Are the sources reputable?
- Does information from other sources appear to be edited or taken out of context? Are you directed to the original source?
- Is personal opinion presented as fact?
- What are the author's apparent motives?
- Is the author's tone reasonable? Does the language seem objective, or overly biased or manipulative?

**Department of Health and Human Services
Centers for Disease Control and Prevention
National Center for Immunization and Respiratory Disease**

**Live professionals are available to answer your questions about
vaccines and vaccine-preventable diseases.**

Call 800-232-4636 (800-CDC-INFO).