

Clear Answers and Smart Advice About Your Baby's Shots

By Ari Brown, MD, FAAP



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In response to the recent media attention given to vaccines, autism, and other controversies concerning vaccines, the Immunize.org offers this **special excerpt from *Baby 411*** that answers these questions and more. Immunize.org thanks Dr. Brown for this clearly written information, but mostly we are grateful for her continued advocacy for safe and effective vaccines.

Since there is so much misinformation and disinformation out there on vaccines, you need to be armed with detailed, accurate information. The information we provide is based on scientific evidence and solid peer-reviewed research. Remember our mantra: show us the science! Your child is too precious to make such important decisions on anything less. This chapter is not based on personal anecdotes, conspiracy theories, "research" study participants recruited at a children's birthday party (we are not kidding), or provocative podcasters.

However, before we get to our take on this debate, let's go back in time a bit. Well, more than a bit. How did the human race survive when other early humans didn't? Yes, making tools and efficiently finding food played a big role.

But here's another key element: we built civilizations. And we developed a sense of responsibility...to ourselves and to our society.

The pandemic should remind us how we are not just individuals living in our own little worlds. It's part of our civic duty to lend a hand and take care of our neighbors. It is our responsibility to work together as a community to prevent the spread of infections, and that means getting vaccinated.

Consider a bit of history: in the 1890's, people would have seven or eight children in their families and only half of them would survive childhood. Just go to an old graveyard some time and look at the ages listed on the headstones. Many of the diseases that killed those children are now prevented by vaccination. It's a fact: vaccinations have increased the life expectancy of our nation's children. That's why our grandparents and parents embraced vaccines.

Outbreak: History Repeats Itself

Full disclosure: The first nine editions of *Baby 411* included this content box, previously titled "Outbreak: It Could Happen Today." It's not very funny or even ironic, just predictable.

Fast forward to the present day. Well, hello COVID-19. Here's a new virus that in a matter of weeks spread around the world and killed over six million people worldwide (thus far). Thanks to today's modern air travel system, a bug can go from a regional problem to a worldwide epidemic in a blink of an eye. COVID-19, like many of the diseases we vaccinate for, is a VIRUS. Besides a vaccine, there is little we can do to stop the spread of infection—despite our scientifically advanced world.

I think we all respect infectious diseases a whole lot more these days. Enduring a complete overhaul of life as we knew it due to a tiny little virus should have made all of us vaccine superfans. Yet we know some folks still have concerns about vaccines and we hear you.

We would like to point out in the next paragraph below that was originally written in 2002 and unedited for the 10th edition of *Baby 411*, because it is still absolutely true.

Here's a crucial point: the key to a vaccine's success is that everyone in the community gets vaccinated. Vaccines won't work if a large number of folks just choose to opt out of the system and their responsibility. Germs are rather simple creatures...they just look for a new person to infect. They don't play politics.

Please keep this in mind as you read about vaccinations. Your decision (and every other parent's decision) affects your child. And society as a whole.

REALITY CHECK

The concept of "public health" has been around since antiquity. Obviously, rulers had a vested interest in keeping their subjects healthy so they had a society to rule. Through the years, governments have been responsible for managing numerous programs. The most important advances in public health have been vaccination programs, water purification, and waste disposal/sanitation systems. The only way for public health to work, though, is for all members of the community to follow the same rules.

Who came up with the idea of vaccinations in the first place?

It took centuries of observation as well as trial and error. (And sometimes, error meant death.) The first real step was describing the disease, in this case, smallpox. Smallpox was a deadly disease that, historically, wiped out entire civilizations. The earliest descriptions can be found as far back as the ninth and tenth centuries among Turks. In fact, "inoculation," or the infecting of a person with the disease in hopes of introducing a mild form and then creating immunity, was practiced first in Asia. In the 1700s an English aristocrat, Lady Mary Wortley Montagu, was living in Constantinople and learned of the practice of inoculation (known then as variolation). She had her son inoculated and subsequently, brought the practice back to England.

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At about the same time, an English country doctor, Edward Jenner, made an interesting connection: milkmaids who had been exposed to cowpox (a common disease in cattle at the time) never seemed to get smallpox infections during epidemics. He began to study the idea that vaccinating humans with cowpox virus would make them immune to smallpox. In 1798 he published a paper on his idea and called it "Vaccination." Not to say, by the way, that Dr. Jenner's idea was accepted with completely open arms. In the nineteenth century there did emerge a group opposed to vaccination led by Mary C. Hume. See, even the anti-vaccination lobby has been around a long time! Of course, in those days, you could be prosecuted for refusing to vaccinate.¹

People were inoculated with a small amount of cowpox virus on their arm. It caused a localized infection at that site (hence, the scar that we forty-somethings and above bear). And true to Dr. Jenner's hypothesis, it provided protection against smallpox disease. In 1972, the United States stopped vaccinating against smallpox because it was no longer a threat to the population. In 1977, the last case of smallpox occurred in Somalia. In 1980, the World Health Organization declared the world free of smallpox, thanks to a global effort to immunize all children.

The success of the smallpox vaccine and other scientific discoveries led to the evolution of many vaccines, that have made diseases like polio and diphtheria unheard of by most parents today.

Dr. B's Opinion: Today's Paradox—Are vaccines Too Successful?

Vaccinations are one of the greatest achievements in medical history. Long before COVID-19 (and the vaccine) ever showed up, vaccines significantly decreased infant and childhood mortality. Yet, amazingly, doctors have to convince some parents that immunizing their child is extremely important, not "optional."

Most parents have not spent a night in a pediatric intensive care unit with a child who has HIB meningitis, watched a child gasping for breath with whooping cough, or seen a child die from medical complications of chickenpox. I have. Sadly, every pediatrician has had one of these experiences and has known that the child's illness or death could have been prevented by vaccination. I don't want your child to be that child. And I refuse to let a child become a statistic because of online myths or fear mongering.

That's the bitter irony of today's vaccine "debate." As a vaccinated society, we've made diseases like measles so rare that parents have no idea today how devastating it was and still can be. I hope we have all gained more respect for infectious diseases and vaccines after living through COVID-19.

Why do you care whether I vaccinate my child or not?

For starters, I want your baby to be protected. But I also want you to realize that the decision to vaccinate your child impacts the health of other children in the community. Choosing NOT to vaccinate your child is choosing to put your child AND your community's children at risk.

As a parent, you want to make the right choices for your child to protect them. I want you to ask questions. I want you to be informed. And I want you to get your child vaccinated. YOUR decision impacts ALL children. Why?

There are two critical points for vaccination to work:

1. You need to be vaccinated.
2. Your neighbor needs to be vaccinated.

If you followed pandemic news at all, you probably have a decent idea of what herd immunity means. Here is an analogy. Think of germs as rain. Vaccination is a raincoat. Even with a raincoat on, you can still get wet. You need an umbrella, too. The umbrella is "herd immunity." Those who don't vaccinate expect someone to share their umbrella when it rains. But society can only buy umbrellas TOGETHER. And raincoats aren't made for newborns—they need umbrellas!

Seven Biggest Misconceptions About Vaccines

Pop online to any of the anti-vaccine web sites out there today and you'll find a plethora of misconceptions, untruths and worse about vaccines. Here are the top seven we hear most often:

1. Diseases disappeared before vaccines were introduced. **No!**
2. Vaccines cause illness and death. **Reactions are very rare!**
3. Vaccine-preventable diseases are rare. **No!**
4. Too many vaccines, given too soon overload the immune system. **No!**
5. Vaccines cause infertility. **No!**
6. Vaccines cause autism. **No!**
7. There is a government and Big Pharma conspiracy to inject microchips into the population to control them. **Dr. Strangelove, check your messages!**

Source: CDC and Dr. Brown's patients.

Or, as comedian Jon Stewart once put it, herd immunity is like a zombie movie. You are in an isolated farmhouse and the occupants rely on each other to board up their windows to keep the zombies (germs) out. The zombies get in when some lady from Marin County decides not to board up her windows because she read an article on a wellness blog about the potential health risks of boarding up windows. You can guess what happens next!

Some decisions you make as a parent have little or no impact on the community at large. Deciding whether or not your child eats organic baby food, goes to preschool, or sleeps in a family bed is entirely up to you—your decision only affects your child.

However, your decision whether or not to vaccinate your child affects all our kids. If you are a parent who is considering delaying or skipping vaccinations altogether, please realize the impact of your decision.

If more than 10% of American parents choose to "opt out" of vaccines, these horrible diseases of bygone days will return. Fortunately, very few parents decide to do this.

What is most concerning today is that there are pockets of under-vaccinated children. Birds of a feather flock together. Like-minded parents who don't vaccinate their kids tend to live in the same community and send their kids to the same schools. With lower immunization rates, there is no herd immunity. We have these "Ground Zero" areas to thank for recent measles and whooping cough outbreaks.²

■ REALITY CHECK

The Good News – While parents are asking more questions, they are still choosing to vaccinate their kids. The most recent Centers for Disease Control and Prevention (CDC) survey (2021) showed 99.9% of U.S. children aged 19 to 35 months are being vaccinated. Yes, 99.9%. Despite all the media stories on vaccine "controversy," only a tiny fraction of parents—about 1%—are choosing to forgo vaccinations.

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The Top Vaccine Questions

What are vaccines?

Vaccines are materials that are given to a person to protect them from disease (that is, provide immunity). The word vaccine is derived from "vaccinia" (cowpox virus), which was used to create the first vaccine in history (smallpox). Modern medicine has created many vaccines. Vaccines PREVENT viral and bacterial infections that used to cause serious illness and death.

Seven Truths About Vaccines

Let's contrast those misconceptions with these truths.

1. Vaccines save lives. They have single-handedly reduced infant mortality rates.
2. Lower immunization rates mean higher disease and mortality rates
3. Misinformation is everywhere—online, media, and playgroups.
4. The decision NOT to vaccinate is a decision to accept the consequences of the disease.
5. The decision NOT to vaccinate is a decision to put your community at risk for epidemics and pandemics.
6. Like any medication, vaccines are not 100% risk-free.
7. You know what a pandemic looks like now. Respect infectious diseases and the power of vaccines to protect us.

How do vaccines work?

Here is your microbiology lesson for today. Your immune system is your body's defense against foreign invaders (viruses, bacteria, parasites). Vaccines prepare your body to recognize foreigners without getting infected. A vaccine revs up your immune system to make antibodies (smart bombs with memory) for the signature of a particular germ. So, if your body sees the real germ, voila! You already know how to fight it off. There are three types of vaccinations: inactivated, live attenuated, and inactivated bacterial toxins.

- **Inactivated vaccines** do not contain any living germs. An immune response forms against either a dead germ, part of the germ (recombinant DNA, mRNA), or a protein or sugar marker that sits on the outer layer of the germ (its signature). Very cool. These vaccines are safe to give to immune-compromised people. The only down side is that several doses of the vaccine are needed to provide full, lifelong protection against disease. Some of these types of vaccines include: influenza, hepatitis A & B, *Haemophilus influenzae* type B (Hib), pertussis (whooping cough), inactivated polio, pneumococcal and for pregnant people and older adults, respiratory syncytial virus.
- **Live attenuated vaccines** are weak forms of the germs that cause infection. An immune response occurs just as if your body had the infection. So one or two doses of vaccine gives you lifelong protection. These vaccines are not given to immune-compromised people because they can make them sick. Examples include: measles, mumps, and rubella (MMR), oral polio, tuberculosis, varicella (chickenpox), rotavirus.
- **Toxoids** (inactivated bacterial toxins) are vaccines that create a defense against the toxin (poison) that a bacteria germ makes. Examples of toxoid vaccines include diphtheria and tetanus.

What are the diseases we are protected against with vaccination?

Good question. You are probably unfamiliar with most of these diseases since we don't see them much anymore in the U.S. After you hear about the many successes we've had in eradicating disease with vaccination, thank your parents for immunizing you. As you read through the vaccination schedule, note that some diseases are viruses. Antibiotics kill bacteria only. Doctors have no medications to cure the viral infections. Doubt the effectiveness of vaccines? Just take a look at the sharp decline of illness and death rates from these diseases over the past 100 years. Here is the link if you want to check it out at www.immunize.org/catg.d/p4037.pdf. Rather amazing, no? Diseases that used to kill thousands (if not hundreds of thousands) now only harm a handful of people – thanks to vaccines.

How are vaccines tested to make sure they're safe?

Vaccines are researched extensively for an average of 15 years before being approved for use. The reason why the FDA approved the COVID-19 vaccine so quickly was because the government eliminated many of the financial hurdles and expedited regulatory paperwork hurdles to make it happen. The scientific technology existed pre-pandemic era and the rigorous nature of the vaccine research and study format was the same as for other vaccines.

A pharmaceutical company conducts medical research trials in a series of stages. Once safety is proven, the vaccine is tested in several thousand volunteers to make sure the vaccine actually works. These volunteers are followed for at least one year to be sure that no serious side effects occur. The majority of adverse reactions to vaccines occur within 30–60 days of being vaccinated, not a year (or years) later.

Nothing in this world is 100% foolproof, including vaccine science. But the research trials that occur before licensing are very rigid. If you think there are a lot of vaccines on the market, imagine how many didn't make it through the research phase of development.

The Food and Drug Administration (FDA) governs this whole process. The FDA is the watchdog for any medication that is sold over-the-counter or by prescription. There are extremely high standards that must be met before any product is allowed for human use.

I know, I know, we have all now witnessed how sausage is made over at the FDA. But the transparency of the COVID-19 vaccine emergency use authorization and approval process should reassure you that these experts are extremely cautious, mindful, and data-driven. Making decisions in real-time during an evolving pandemic with more moving parts (scientific variables) is extremely challenging. After a vaccine is approved for use, long-term follow-up studies are done to assess for side effects, adverse reactions, and potency over a lifetime.

Why is my child getting more shots than I did?

Simple answer: we've been successful inventing vaccines to fight more diseases. It's one of the important advances in modern medicine—vaccines prevent disease, injury, and death. More vaccines are a good thing!

An important point: many of the vaccine-preventable diseases are viruses. These viral infections cannot be treated with medicine once an infection occurs (for example, hepatitis B).

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Vaccines that protect against bacterial diseases are often serious ones, and resistant to many antibiotics (for example, pneumococcal vaccine).

And even though the number of shots has gone up, the total load on the immune system has gone down. Today's vaccines are smarter and better engineered than the shots from a few decades ago. In fact, the total number of immunologic agents in the entire childhood vaccination series today is less than what was in just two vaccines in 1980!

Our children are getting smarter, safer vaccines today and better protection than we ever got as kids.

Are we giving too many shots, too soon?

This is a false mantra of the anti-vaccine crowd: they say babies are receiving too many shots (compared to say, 1980) and too soon (infants can't handle all these shots, they say).

So, let's look at this scientifically. On any given day, your baby is exposed to literally thousands of germs (it doesn't matter how spotless your house is). Exposing your child to five to eight different germs in the form of vaccines is a spit in the bucket.

Young children have better immune responses to vaccines than adults and older children. So they will form adequate immune responses to various vaccines simultaneously. (This is studied extensively before a vaccine is licensed.) Even if your baby got 11 shots at the same time, they would only need to use about 0.1% of his immune system to respond to them.³

Giving several vaccines at once does not damage, weaken, or overload the immune system. Vaccines boost the immune system. Also, the diseases that the vaccines protect against are the most severe in infants and young children. Your doctor wants to get those vaccinations in as safely and effectively as possible. That's why the timing is so important (and why a staggered or delayed vaccination schedule is a bad idea—more on that in the controversies section of this handout).

Reasons Not to Vaccinate

There are very specific medical reasons to discontinue or hold off on certain vaccinations:

1. An immune-compromised patient or family member.
2. Had disease (for example, if you've had chicken pox, you don't need the vaccine).
3. Encephalitis or degenerative brain disorder.
4. Allergy to vaccine or an additive in vaccine.

If your baby has a food allergy to eggs or gelatin, or an allergy to antibiotics (such as Neomycin, Streptomycin, Polymyxin B), notify your doctor before any vaccinations are given. Several vaccines are grown in chick embryo cells and therefore contain a small amount of egg protein: flu vaccine (Flushield, Fluzone, Fluvirin), MMR, rabies (RabAvert), and yellow fever vaccine (YF-VAX). The good news: people with egg allergy can safely receive both the MMR and Flu vaccine. The MMR vaccine also includes gelatin.

Several vaccines may contain trace amounts of antibiotics from the manufacturing process to prevent contamination of the vaccine itself. The antibiotics are NOT in the penicillin, cephalosporin, or sulfa categories. The most commonly used antibiotic is Neomycin. You can see a complete list antibiotics in vaccines here: chop.edu/centers-programs/vaccine-education-center/vaccine-ingredients/antibiotics.

Can't you just give one big shot that has all the vaccines in it?

Medical science is working on it! There have been a few combination vaccines licensed for use. The largest combination vaccine is Vaxelis, approved to prevent diphtheria, tetanus, pertussis, polio, *Haemophilus influenzae* type b, and hepatitis B in infants and toddlers. The reason there isn't just one big shot is that some vaccines are ineffective when they are sitting together in a solution. Your baby may still need more than one shot, but if your doctor uses a combo vaccine, at least it will be fewer shots than if they are all administered separately.

More combination vaccines are on the horizon.

What groups make decisions about vaccinations for children?

There are four governing panels of experts in infectious diseases that make recommendations for vaccinations. These smart folks include: American Academy of Pediatrics (AAP), American Academy of Family Physicians (AAFP), Advisory Committee on Immunization Practices (ACIP), and the Centers for Disease Control and Prevention (CDC). Because there are several groups involved in this effort, there is some variability in vaccination schedule recommendations. If you are really geeky like me, you could have watched several hours of ACIP meetings on YouTube as the group deliberated on the COVID-19 vaccine. It was impressive to see how these experts painstakingly reviewed and reflected on the data. It wasn't exactly riveting, but it was reassuring!

Helpful Hints: Top Five Tips to Make Shots Less Painful

- **Distraction:** Blow in your child's face, or pull out a new toy.
- **A spoonful of sugar.** Put a little sugar water on a nipple or pacifier. It is a known pain reliever (analgesic)
- **Acetaminophen** (e.g., Tylenol). It's a great pain medicine. Be sure to check with your doctor for the correct dose for your baby's weight. Remember, for your baby's immune system to respond optimally to his shots, wait at least four hours after the shots to give a dose of acetaminophen.
- **Numb it.** There is an over-the-counter lidocaine anesthetic cream that can be applied one hour before shots are administered. The downsides: a) Pain is not just from the needle going through the skin but also from the fluid injected into muscle. b) You may not know where to place the cream.
- **Freeze it.** There is a cold "vapocoolant" spray that can be placed on the skin just before the injections. A few doctors use it. It works slightly better than the distraction technique.

My baby has a cold. Should I hold off on vaccinations?

No! This is a common misconception of parents. Even if your baby has a minor illness, he can still get his shots. We cannot stress how important it is to get your child vaccinated in a timely manner. So don't let a sniffle or two make you reschedule an office visit for shots. Your child can also get his shots even if they are on antibiotics.

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Can I choose not to vaccinate my child?

Yes, but we wouldn't advise it. Choosing not to vaccinate is not a risk-free choice. It's choosing to expose your child to potentially serious infection. It's also choosing to expose other children in your community to serious, preventable diseases. And if you think your child will be safe because everyone else vaccinates their kids, you'd be wrong (and very selfish, we might add). You can also choose not to stop at a stop sign, but we wouldn't advise it!

■ REALITY CHECK

Vaccine requirements for school entry vary by state. There is no one consistent policy. All 50 states allow vaccine exemptions for medical reasons, 44 states allow exemptions for religious reasons, and 15 states allow exemptions for philosophical reasons. After a significant measles outbreak in 2015, California revoked its philosophical vaccine exemption law. Limiting the exemptions improves vaccination rates and thus, protects more children.

I've heard that getting a disease provides immunity forever and vaccinations might not provide lifelong protection. Wouldn't it be better to get the disease? Isn't that a more "natural" way of creating immunity?

No. The diseases we prevent by vaccination are not minor illnesses (this includes chickenpox). For instance, would you rather have your child get meningitis and die or get the vaccine? Getting chickenpox or any other disease the "natural way" is a much greater health risk without any significant benefit. And just think of the discomfort, pain and perhaps serious injury that come with getting any of these diseases.

It is true that some vaccinations require a booster dose to keep antibody levels high. That is why we need a tetanus booster every ten years. (And, we are learning about boosters as we go with the COVID-19 vaccine.)

What would happen if we stopped using vaccinations?

That's an easy one. The diseases would come back.

Vaccinations keep us from getting sick from these infections. But all of the infections we protect against are alive and well in our world. As of today, the only disease we have completely eliminated is smallpox. And when it was eliminated, we stopped vaccinating for it.

Anyway, it's a simple fact: when immunization rates drop, epidemics occur. Just look at states with lower immunization rates—their rates of pertussis (whooping cough) are twice the number seen in states with higher percentages of immunization rates. Children whose parents opt out of vaccines face a 23 times greater risk of getting whooping cough.⁴ In the 2019 measles outbreak (the largest and preventable outbreak in 25 years), 88% of the cases occurred in close knit, under-vaccinated communities.

What are the typical side effects of vaccination?

Fever, fussiness, redness, or lump at the site of the injection.

Inactivated vaccines cause an immediate immune response. The body mounts a response to the foreign invader as if it were being infected. The result, typically, is a fever within 24 hours of vaccination. Babies sometimes feel like they are coming down with a cold or flu (body aches, pains). Some babies prefer to sleep through the experience;

some choose to tell you how they feel (fussiness, crying). All of these symptoms resolve within 24 to 48 hours of vaccination.

Live attenuated vaccines (MMR, Varicella) cause a delayed immune response. This occurs one to four weeks after the vaccination is given. Long after the doctor's visit, your child may wake up one morning and have a fever. This may be accompanied by a rash that looks like measles (pimples) or chickenpox (clear, fluid-filled pimples). The rash can sometimes be dramatic. Both the fever and the rash tell you that your baby is forming an immune response to the vaccination. Babies are not contagious and aren't too bothered by the rash. You don't need to call your doctor. This reaction is expected.

Redness at the injection site is common. In particular, the fifth booster dose of the DTaP (at ages four or five years) can cause a pretty dramatic area of redness. No worries. We do get quite a few phone calls about it, though! A firm lump may develop at the injection site if some of the fat in the arm/leg gets nicked as the needle goes into the muscle. This is called fat necrosis. It usually goes away within six to eight weeks. It doesn't hurt.

Red flag! If your baby has a fever more than 72 hours after being vaccinated, it's not from the vaccination. You need to call your doctor. The only exceptions are the MMR and chickenpox vaccines, which typically cause a fever one to four weeks afterwards.

■ REALITY CHECK

To help reduce fever and discomfort from shots, it's okay to give your baby acetaminophen (e.g., Tylenol) as long as you wait at least four hours after vaccinations are given. The dose is not listed on the package. It says to "consult a doctor." That's because doctors don't want you giving this medicine to a baby three months or younger with a fever without checking in first. Other than with shots, you need to call your doctor about fevers in this age group.

What are the worst reactions to vaccination?

These are called adverse reactions. This is the equivalent of an allergic reaction to a medication – and fortunately, they are all quite rare. With each generation of newer vaccinations, the risk of serious reactions is almost eliminated.

Adverse reactions include:

1. Death.
2. Anaphylactic reaction.
3. Encephalitis.
4. Fever-related seizure (convulsions).

Both the CDC and FDA keep close tabs on adverse reactions to vaccines via a Vaccine Adverse Event Reporting System (VAERS). Both doctors and patient families may submit a VAERS form if any adverse reaction occurs.

Keep in mind that medical illness reports do not prove an association of a particular illness with a specific vaccination. The job of both the CDC and FDA is to review each report that occurs and see if there is a pattern of subsequent illness after vaccination. VAERS data are publicly available at vaers.hhs.gov. To report a possible reaction, you can download a form at the same site. There is also a Clinical Immunization Safety Assessment Project comprised of six U.S. academic medical centers that evaluates adverse reactions to vaccines (www.cdc.gov/vaccinesafety/ensuringsafety/monitoring/cisa/index.html).

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While we would be remiss if we didn't tell you that vaccinations have some risks associated with them, we want you to remember that the risk of adverse reaction is *significantly* lower than leaving your baby unprotected.

In 1988, recognizing that there are rare, serious reactions that occur as a result of vaccinating children, the U.S. Department of Health and Human Services created the Vaccine Injury Compensation Program. This program attempts to determine whether adverse reactions from vaccines are responsible for injuries or death and then to provide the victim with compensation.

Over the past 30 years, there have been 8,767 claimants whose cases were reviewed and received compensation. Several billion vaccinations covered by VICP have been given during that same period of time. So the odds are literally about 1 in 1 million to have a vaccine injury. (Compare that statistic to one in 50 adults who have a food allergy!)

We agree that an adverse reaction only has to happen to one child for it to be heartbreaking. But if we look at the big picture, we can point to the millions of children who might have experienced illness, chronic disability, and death if diseases like smallpox or polio were not controlled by vaccinations.

Red flags!

Call the doctor if your baby does any of the following after a vaccination:

1. Inconsolable crying over three hours.
2. Fever over 105 degrees.
3. Seizure activity.
4. Extreme lethargy.

Who keeps a record of my child's vaccinations?

You and your doctor. Your doctor keeps a record of vaccinations in your child's records. All states have an immunization registry that also keeps records of vaccinations. The pandemic has brought more attention to this issue.

But ultimately, YOU need to have a copy of these in your personal medical record file. You will need proof of vaccinations for many things. Any childcare or school program requires this information. Summer camps and athletic programs want the records, too. And with the pandemic, proof of vaccination is required for some travel destinations as well.

► HELPFUL HINT

It's a good idea to have a medical file for your child. This summary should include an immunization record, growth chart, list of medical problems, list of surgeries, drug allergies, and name and dosage of any medications that are used regularly (such as asthma medicine).

How do I know when my child needs booster shots?

Your doctor will remind you at each well child visit. You can also book-mark the vaccination schedule on the page nearby or go to the Centers for Disease Control and Prevention at www.cdc.gov/vaccines/parents/schedules/index.html

What vaccines are required and which ones are optional?

The answer varies state to state. It also varies depending on the frequency of disease in particular counties within a state. Check out your state health department's website for details. A table of the most recent requirements in the U.S. can be found at www.immunize.org/official-guidance/state-policies/requirements/

Can I take my baby out before they get their first set of shots?

The short answer: yes. The pandemic, however, makes this answer a bit more complicated. You have to consider all infectious disease exposures when you are out in public.

Pediatricians usually recommend limiting human contact with babies under four weeks of life. Why? Because if your newborn gets any fever (of 100.4° or greater), that is an automatic ticket to an extensive emergency work-up. Even if your baby has the cold that the rest of the household has, we still need to rule out a serious infection. That said, you don't have to live in a complete bubble, but use discretion when planning your outings. In cold and flu season (October through April) or during a COVID-19 surge, avoid crowded places for the first three months of life.

With respect to an unvaccinated baby, the biggest threat these days is whooping cough. Whooping cough is spread by cough and sneeze droplets of an infected person. Babies get a series of four shots over the first two years of life to protect them from whooping cough. To keep everyone inside that long is crazy! But being cautious until she gets her first shot at two months isn't a bad idea.

As for measles, many babies from 0–6 months of age are protected by mom's antibodies passed on to them during pregnancy. The measles vaccine is usually not given to children until 12–15 months of age when they will mount a good immune response to it. So, the most vulnerable group is babies from 6–11 months of age.

■ REALITY CHECK

Although newborns are too young to be vaccinated, a pregnant mom can pass their immunity to diseases like respiratory syncytial virus (RSV), pertussis, flu, and COVID-19 if they receive these vaccines during pregnancy. Nursing moms also pass some immunity to their babies via breast milk. These forms of passive immunity offer a layer of protection to a baby who is too young to be vaccinated against these infections.

I have a friend who does not vaccinate her child. Is it okay for our babies to play together?

Awkward, right? Unfortunately, the COVID-19 vaccine led to quite a difference of opinion in our society. And, unfortunately it has led to divisiveness among families and friends. But this uncomfy situation about childhood vaccines pre-dated the pandemic.

The most politically correct thing to do would be cancel a playdate when either child is ill. This is not a foolproof solution, however. As we know all too well, a person with COVID-19 may be symptom-free, very contagious, and may readily spread the infection to others. And a person with measles is contagious for three to four days before the rash erupts.

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If you want to make a statement (and potentially lose the friendship), be honest and explain to them that you feel uncomfortable with your kids being together—then it is their responsibility to consider their choices.

Vaccination Schedule

The schedule for babies, young children, and teens is constantly evolving as new vaccines are developed and as science leads to changes, such as fewer doses, different timing, etc. To see the most current recommended schedule of vaccinations, go to www.immunize.org/catg.d/p4050.pdf. If you want to know what shots your baby is due for, use the CDC's free Immunization Scheduler at www2a.cdc.gov/vaccines/childquiz/ and type in your baby's birth date!

Controversies

Let's face it, controversy drives TV ratings, web traffic, and Spotify subscriptions. No one is interested in hearing about things that work as they should—and vaccines are a good example. Vaccines have been a hot topic for the last two decades. Unfortunately, rare adverse events and theoretical concerns tend to make more headlines and clickbait than the remarkable success story of vaccinations. These problems are then seized on by vaccine opponents and spread online through the web like a, well, virus.

So, let's address this head on. We have compiled the following hit parade of controversies you might hear about with vaccines.

Dr. B's Opinion: Time to move on...

Vaccines have received intense scrutiny over the past twenty years in search for a cause of autism. The best scientific minds, worldwide, have looked for a link and none has been found. We want you to realize that a) science has devoted much brainpower, time and money to this concern and has concluded there is not link and b) many families with a child who has autism do not feel that vaccines have anything to do with their child's disorder.

Does COVID-19 vaccine cause infertility?

No. There is not a plausible way for this to occur.

The fear mongering began when a couple of research scientists in Europe speculated out loud that a protein on the surface of the placenta called syncytin-1 was similar to the COVID-19 spike protein. The hypothesis: if someone mounted an immune response to the spike protein, the immune system would also attack the placenta and lead to a miscarriage.

But there are several flaws with this hypothesis. First, the two proteins are not that similar! Next, the animal studies done on COVID-19 vaccine before the human trials began showed no impact on the reproductive system. And when women of childbearing age participated in the COVID-19 vaccine studies and accidentally became pregnant (oops), the miscarriage rate between vaccinated and unvaccinated participants was no different. Finally, natural infection with COVID-19 also creates an immune response to the spike protein. There has not been a decrease in the birth rates since the pandemic began.

Will the mRNA alter our genetic code?

No. The mRNA is basically a self-destructing recipe for our bodies to make what looks like the coronavirus spike protein. The mRNA is very unstable—meaning it disintegrates quickly, which is why it needs to be so darn cold and packaged in fat (lipid nanoparticle) to remain stable and enter your body. But once it has done the job, it is gone. To take you back to 7th grade science class, the mRNA enters the cytoplasm of our cells, not the nucleus where our DNA resides. It is not even remotely capable of entering our DNA and altering our genes.

I've heard that the MMR vaccine might cause autism. Is this true?

No. Spend a little time online and you'll find theories that vaccination cause autism...as well as multiple sclerosis, diabetes, asthma, and AIDS. None of these are caused by vaccination. The government operates a safety monitoring system (vaers.hhs.gov/index.html)—watching for any possible adverse effects from vaccines. *No one wants to increase autism rates.*

One small case report of only eight patients in 1998 led a research group to feel that the combination MMR vaccine might cause autism.⁵ But don't try to find the article online because the journal that published the article later retracted it when a former member of the research lab revealed that the data reported in the study was fabricated! Twelve years later, the lead author lost his license to practice medicine in England and was accused of fraud. The whole thing was a hoax.

Before this came to light, several reputable scientists tried to replicate the findings of this now discredited researcher. No one ever could—and now we know why!

Unfortunately, frightened parents chose to skip the MMR vaccine and measles epidemics occurred both in England and the U.S. as a result of these unfounded claims.

Bottom line: Talk to your child's doctor about any vaccine safety concerns.

If the MMR vaccine doesn't cause autism, why is the diagnosis made around the same time as the vaccination?

One of the criteria used to make a diagnosis of autism is a language delay. Because children do not have significant expressive language under a year of age, doctors have to wait until 15 to 18 months to confirm a language delay and make the diagnosis. That's about the same time as the MMR vaccination, which leads some parents to wonder about autism and vaccination.

I've heard about a vaccine that was taken off the market. What was the problem with it? It makes me nervous about other new vaccines.

The original rotavirus vaccine was approved in August 1998 after a study was done on 10,000 individuals. It looked like a safe vaccine. That vaccine was then given to 1.5 million children over a period of nine months. During this time, there were 15 reports of bowel obstruction (intussusception) that occurred within a week of being vaccinated. There were no deaths. The CDC's advisory committee

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withdrew its recommendation for vaccination with Rotashield and initiated an investigation.

Although this was certainly a setback for new vaccinations, it proves that the adverse events reporting system (VAERS) works. Modifications have been made to the license process as a result of the rotavirus vaccine. This was the first vaccine recall in over 20 years.

As we mentioned earlier in the chapter, a newer rotavirus vaccine debuted in 2006—it was studied in 70,000 infants in Latin America and Europe before getting the nod by the FDA. After several years of use, this vaccine has clearly proven to be very safe. But given the history of the previous rotavirus vaccine, the FDA still closely monitors for any cases of bowel obstruction.

I've heard there is mercury preservative in the vaccines. Is this true?

Not anymore. It was removed from all required childhood vaccines more than 20 years ago. This deserves repeating: **YOUR baby will not be getting required vaccines that contain mercury (thimerosal) as a preservative.**

Despite the fact that vaccines have been mercury preservative-free for more than 20 years, speculation persists about vaccines *previously* containing mercury and links to autism. This speculation continues even after the Institute of Medicine (IOM), now known as the National Academy of Medicine, published a conclusive report in 2004 negating any association between vaccines and autism.⁶ (The IOM spent four years studying both the mercury question and the MMR combo vaccine question and published a series of eight reports on the subject.)

Should I should still ask my doctor if the vaccines for my baby are thimerosal-free?

We think you should ask as many questions as you need to feel comfortable. Remember that the entire childhood vaccine series went thimerosal (mercury) preservative-free more than 20 years ago. If your doctor has a 2001 vintage vaccine vial sitting on the shelf (which would be long expired by now), I'd have bigger concerns about your doc than their vaccine supply.

Here are the specific rules regarding thimerosal use in vaccines: the FDA requires manufacturers of *routine* childhood immunizations to no longer use thimerosal as a *preservative*. This rule does NOT apply to flu vaccine because (technically) this vaccination is optional (except in a few states) and not "routine."

Why does flu vaccine need thimerosal or any other preservative? First, understand the flu vaccine is reformulated every year to reflect the anticipated flu strains. Since millions of doses of flu vaccine are needed every year, the most efficient way to produce the shot is in multi-dose vials, which require a preservative.

Hence, *some* flu shots (not the flu nasal spray) contain the preservative thimerosal. However, there are single-dose preparations of flu vaccine that are mercury preservative-free. These can be given to young children and pregnant women. Ask your doctor for a thimerosal-free flu vaccine if you are concerned.

Are there other additives in the vaccines?

Yes. And you should know about them.

As we have already discussed, vaccines contain the active ingredients that provide immunity. But there are inactive ingredients that improve potency and prevent contamination. Below is a list of additives and why they are there. These products are present in trace amounts and none have been proven harmful in animals or humans.⁷

- **Preservatives:** Prevent vaccine contamination with germs (bacteria, fungus). Example: 2-phenoxyethanol, phenol, (thimerosal, prior to 2001).
- **Adjuvants:** Improve potency/immune response. Example: aluminum salts.
- **Additives:** Prevent vaccine deterioration and sticking to the side of the vial. Examples: gelatin, albumin, sucrose, lactose, MSG, glycine.
- **Residuals:** Remains of vaccine production process. Examples: formaldehyde, antibiotics (neomycin), egg protein, yeast protein.

Aluminum 411

Now that the mercury (thimerosal) saga is coming to an end, anti-vaccine crusaders have come up with a new bad guy: aluminum. Yes, trace amounts of aluminum salts are used in some childhood vaccines. Here's all you need to know (and more) about aluminum. Bottom line: we are not worried about it. Here's the 411:

Aluminum is everywhere. It's one of the most common metals in our earth's crust. So it is naturally present in our water, soil, and even in the air. Fruits, vegetables, nuts, flour, cereal, dairy products, and yes, even baby formula and breast milk... all contain some aluminum. Do you wear antiperspirant? It's in there, too. To avoid aluminum exposure, you'd have to quit wearing antiperspirant...and basically leave the planet.

Why is aluminum used in vaccines? Aluminum enhances the immune system's response to the vaccine. It's been used safely for several decades. By using aluminum salts, some inactivated vaccines require fewer booster shots for the body to mount an adequate immune response.

Are there any health concerns with aluminum in vaccines? No. There is significantly less aluminum in vaccines than what babies are exposed to in the environment. Both the National Vaccine Program Office and the World Health Organization have determined that the aluminum content in the childhood vaccination series is safe. Humans rapidly eliminate aluminum salts from the body. The small amount of aluminum that accumulates in human brains (about 50-100 mcg in an adult brain) comes from food sources.

Does aluminum poisoning cause autism? No. People with aluminum poisoning have bone problems (osteomalacia) and anemia, as well as neurologic issues. These include memory loss, fatigue, depression, behavioral changes, and learning impairment. Aluminum has also been proposed as the cause of Alzheimer's Disease. To date, however, there is little evidence that aluminum causes that disorder.

REALITY CHECK

If vaccines contain ingredients like aluminum or formaldehyde, wouldn't it be better if vaccine makers got rid of these additives? Shouldn't vaccines be "greener?" This is a red herring argument against vaccines—current vaccines are safe, even with tiny/trace amounts of preservatives or additives like aluminum. And your baby is exposed to many of these ingredients every day...simply by eating or breathing.

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Why is formaldehyde in vaccines?

Small amounts of formaldehyde are used to sterilize the vaccine fluid so your child doesn't get something like flesh-eating strep bacteria when he gets his shots.

We know when you think of formaldehyde, that ever-present smell wafting from the anatomy lab in high school comes to mind. But what you probably don't know is that formaldehyde is also a naturally occurring substance in your body. And if you use baby shampoo, paper towels, or mascara, or have carpeting in your home, you've been exposed to formaldehyde. The small amount used in vaccines is not a health concern.

Is it true that anti-freeze is used in vaccines?

No. There is a chemical used in some vaccines (called polyethylene glycol) that is also found in antifreeze, as well as toothpaste, lubricant eyedrops, and various skin care creams. Polyethylene glycol is used in the production process to purify vaccines (it is used in one flu vaccine, and mRNA COVID-19 vaccines, among others).

Is it safer to delay vaccines or space them out?

Easy answer: no. Any "alternative" vaccination schedule is more appropriately termed "delayed vaccinations"—because it truly is a delay in getting protected.

The CDC publishes a recommended vaccine schedule for American children. Many, many doctors, scientists, and researchers work together with the CDC to decide what is the best timing to give shots. The goal: protect babies as soon as it is safe and effective to do so. This schedule was not created out of thin air.

More about Aluminum

How much aluminum is in vaccines? Very little. If your baby follows the standard immunization schedule, they are exposed to about four to six mg of aluminum at six months of life. By comparison, they are also exposed to 10 mg of aluminum if they are breastfed, 40 mg if they are fed cow's milk-based formula, or 120 mg if they are fed soy formula. None of these are very large amounts, by the way. To put things in perspective, there's about 200mg of aluminum in a standard antacid tablet. In fact, the average adult ingests seven to nine mg of aluminum everyday. Here's a look at how much aluminum is in breast milk/formula, compared to vaccines:

Amount of aluminum exposure (milligrams per liter)

AMOUNT OF ALUMINUM

Breast milk	0.01–0.05 mg/L
Cow's milk based infant formula	0.06–0.15 mg/L
Soy based infant formula	0.46–0.93mg/L
Pneumococcal vaccine	0.125 mg/dose
DTaP vaccine	0.17–0.625 mg/dose
Hib vaccine	0.225 mg/dose
Hep A vaccine	0.225–0.25 mg/dose
Hep B vaccine	0.25–0.5 mg/dose
DTaP/IPV/Hib vaccine	1.5 mg/dose

Is it a good idea to space out vaccinations that contain aluminum salts?

No. Since aluminum-containing vaccines do not cause any health risk, separating or spacing out these vaccines has no benefit. In fact, there is a risk to spacing out the vaccines—your baby will go unprotected against real vaccine-preventable disease.

Sketchy anti-vax online influencers, collectively called "The Disinformation Dozen," often cry "too many shots, too soon." They also conveniently sell vitamin "immune boosting" product lines as an alternative to vaccinations, by the way. But, it makes new parents wonder if it would somehow be safer to wait on shots altogether or stagger them out.

Here's a nasty little truth about alternative vaccination schedules: they are all fantasy. There is absolutely no research that says delaying certain shots is safer.

In fact, studies have shown there is absolutely no difference in children's development when vaccinations are delayed compared to children who receive their shots on time. Studies also show that giving numerous shots at the same time and giving the recommended vaccination schedule has no impact on a child's risk of autism.⁸

I'd much rather follow a schedule that has been extensively researched for both safety and effectiveness by experts in the field of infectious diseases.

What we do know about alternative vaccination schedules is that delaying shots is playing Russian Roulette with your child. The simple truth is that you are leaving your child unprotected, at a time when they are the most vulnerable.

We realize that parents who choose to delay or opt out on vaccines are not bad parents. They are scared parents. What we are trying to help you realize is that the fear you should have is for the diseases that vaccines prevent. If you are on the fence about vaccinations, please take the time to research the diseases (see www.vaccineinformation.org).

If I want to space out my baby's shots, how should I do it?

I suggest setting up a consultation with your own pediatrician to discuss what both of you feel comfortable with doing. Remember, the ultimate goal is to have your child vaccinated in a timely manner.

More pediatricians are increasingly adamant about protecting their littlest patients. Many refuse to deviate from the recommended schedule just to appease a nervous parent. It may be difficult to find a board-certified pediatrician willing to modify or delay shots. It's our job to protect kids. Following the recommended schedule is the best way to do that.

► HELPFUL HINTS – Where to get more information

Our advice: don't type in "vaccinations" in a Google search. You will end up with inaccurate information from concerned groups who do a great job of creating parental anxiety. The following sites will provide accurate information:

- CDC: www.cdc.gov/vaccines/parents/index.html
- American Academy of Pediatrics: www.healthychildren.org
- Immunize.org at www.immunize.org and www.vaccineinformation.org
- Vaccine Education Center, Children's Hospital of Philadelphia www.vaccine.chop.edu

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