

Chapter

12

Do Vaccines Cause Medical Problems?

In This Chapter

- ◆ How the debate about autism and the MMR vaccination began
- ◆ What researchers now think about MMR and autism
- ◆ Other medical concerns some people have about vaccines
- ◆ Why vaccines contain certain ingredients

Vaccination has been extremely successful at preventing certain diseases, especially diseases that can harm children. Vaccine-preventable diseases such as diphtheria, measles, and *Haemophilus influenzae* type b (Hib) are now extremely rare in the United States. Some people wonder, however, whether antigens and other vaccine ingredients can cause other diseases, especially diseases common in childhood. You might have heard that vaccines cause autism, sudden infant death syndrome (SIDS), asthma, multiple sclerosis (MS), and other serious medical problems.

Are these claims true? Researchers have investigated all of them, and have not found evidence of a link between vaccinations and serious medical problems such as autism and asthma. Very rarely, a person's immune system might respond poorly to a vaccine, causing an illness (this topic is covered more in Chapter 14). But there is no evidence that receiving one or more vaccines can put you or your children at increased risk for developing a chronic illness.

Understanding Cause and Effect

When your child becomes seriously ill, you want to know why he or she became sick. If something happened to your child just before becoming ill, you might think that event caused the illness. Sometimes this reasoning is true. If your child has an asthma attack when pollen counts are high in your area, for example, the pollen might have triggered the attack. If your child's asthma worsens after she sprains her ankle, however, the asthma is not related to the sprain. The two events happened around the same time, but one did not cause the other.

What if your child develops a serious illness after receiving a vaccination? You might think that the vaccination caused the illness. Most likely, however, this is not true. Young children frequently become ill because their immune systems are exposed to different viruses and other pathogens. Colds, ear infections, rashes, and other problems are common in young children. Some children develop more serious medical problems in childhood as well.

Young children are also vaccinated against many different diseases by the time they turn two. Almost every child in the United States receives some or all of his or her recommended childhood vaccines. In the first two years of life, a child will visit the health-care provider at least eight times to receive vaccinations and get checkups. It's likely that a child will receive a vaccination around the time he or she develops a cold, an ear infection, or a more serious health problem. Just because an illness happened around the time that a child was vaccinated, however, does not mean that the vaccine caused the illness.

Vaccines and Autism

Over the past decade, a possible link between vaccination and autism has received enormous attention from both the media and researchers. The debate began with a small study published in a medical journal in 1998 that suggested that the live, weakened viruses in the measles, mumps, and rubella (MMR) vaccine might cause autism in children. Other people, concerned about vaccine ingredients (such as the mercury used in a vaccine preservative), have blamed vaccine ingredients for autism as well as other medical problems.

This debate has been complicated by a number of factors. First, parents and health-care providers often notice the symptoms of autism when a child is less than two years old, often around the time that the child receives a vaccination. The first dose of the MMR vaccination, for example, is given to children when they are 12 to 15 months old. If a young child develops autism, it may seem like the vaccination caused the problem if symptoms happened to occur around the time of a vaccination.

Second, many of the concerns about vaccines and disease have been raised by people outside the scientific community. Although concerns about a link between the type or number of vaccinations and autism have been disproved by scientific studies, some people do not believe the studies. Sometimes they misunderstand the research or believe that researchers have political or financial motivations. As a result, they refuse or limit the number of vaccinations their children receive.

What Is Autism?

To understand the debate about vaccinations and autism, you first need to understand what autism is and why it is such a concern today.

Autism is one type of developmental disorder within a group of related problems called Autism Spectrum Disorders (ASDs) or Pervasive Developmental Disorders (PDDs). Children with autism usually have problems with communication, socialization, and behavior. A child with autism might not understand nonverbal cues, such as looking in the

direction someone points, or might not respond when spoken to. The child also might have trouble understanding facial expressions, or interpreting someone's tone of voice. The child might not be able to tell the difference between a smile and a harsh word from a parent. Behaviors such as repetitive head-banging or obsession with a topic or task are also common in children with autism.

Vaccinating Facts

The word autism was coined by the Swiss psychiatrist Eugen Bleuler in the early 1900s. Bleuler based the word on the Greek word *autos*, meaning "self," to show that people with autism can seem absorbed in themselves and disconnected from the world around them. Bleuler used the word autism to describe some symptoms of schizophrenia. In 1943, Leo Kanner, an Austrian doctor and psychiatrist, used the word autism to describe certain types of socially withdrawn children. Eventually, autism was seen as its own disorder, unrelated to schizophrenia.

Sometimes, symptoms of autism are present at birth. A child with autism might not reach certain developmental milestones, such as babbling and pointing at objects by 12 months old. In other cases, a child who is developing normally starts to lose certain skills or change his behavior. For example, the child might start forgetting words he or she has already learned or become withdrawn. The symptoms of autism vary with each child, who can be mildly, moderately, or severely

impaired by autism. Some children with mild autism have minor symptoms and can grow up to lead normal lives.

Although autism can't be cured, it can be treated. Treatments for autism might include therapy to learn better communication, behavioral, and social skills, and medications to control anxiety and other problems.

There is no test that can prove that a person has autism. Instead,



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You might be familiar with another, less common autism spectrum disorder called Asperger's syndrome. Children with Asperger's syndrome can communicate well verbally, but they have trouble understanding how to interact with other people in social situations and controlling their behavior.

health-care providers often suggest an evaluation for autism if parents, teachers, and caregivers have noticed autism-like behavior in a child. A pediatric neurologist, psychologist, speech therapist, and other experts might observe the child and talk to the parents about the child's behavior. Evaluation should also include a hearing test because the child's behavior could be caused by a hearing problem rather than autism.

In the United States, the Centers for Disease Control and Prevention (CDC) estimates that about 1 in 150 children have autism, and autism rates appear to be increasing.

Because autism can be difficult to diagnose, however, researchers do not know whether rates have truly increased or whether it is simply being diagnosed more often now than in the past.

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Autism is four times more common in boys than in girls.

The definition of autism has changed over the years, making it difficult to compare today's autism rates with past autism rates. The American Psychiatric Association uses a list of symptoms in the *Diagnostic and Statistical Manual* (DSM) as a guideline to diagnose autism. The DSM did not list autism as a diagnosis until 1980, and the DSM's definition of autism has changed over the years to include a wider range of symptoms in revisions since 1980.

The causes of autism are still unknown. Many researchers believe that some children are genetically inclined toward developing autism, but don't develop it unless there is an environmental "trigger," such as a viral infection. Some people have suggested that vaccines might be this trigger.

A lot of scientific evidence indicates that autism has a genetic cause. For example, history of autism-like behaviors or emotional disorders in a family might increase the chances that a child will develop autism. If one child has autism, his or her sibling is at increased risk for developing the disorder as well. In studies of twins published in medical and psychiatric journals, if one identical twin has autism, the other twin (who has the same genes) has a much higher chance of developing autism than a fraternal twin would (a fraternal twin shares far less genetic material with his or her sibling).

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The Autism Coordinating Committee coordinates federal services for children with autism and their families. The committee works with the Department of Health and Human Services, the Centers for Medicare and Medicaid Services, the Office on Disability, and the Department of Education, among other organizations.

Whatever the cause, autism can be an enormous challenge for a family. Children with autism often require intensive interventional treatment to help them develop as normally as possible. They might become upset if their daily routine changes, not want to be touched or spoken to, and they might have trouble communicating what they need.

The Wakefield Study

In 1998, an English gastroenterologist named Andrew Wakefield and 12 colleagues published a study on gastrointestinal disease and autism in the British medical journal *The Lancet*. The study looked at 12 children, ages 3 to 10, who developed normally at first but then developed both intestinal problems and behavioral problems. Nine of the children were diagnosed with autism. The parents of eight of the children in the study said that behavioral symptoms began after their child received a measles, mumps, and rubella (MMR) vaccination.

As you know by now, the MMR vaccine is a live, attenuated vaccine. Wakefield and his colleagues came up with a *hypothesis*, or theory, that the weakened viruses included in the MMR vaccine might be a trigger

for a disease that causes both intestinal and developmental problems. They thought that the intestinal problems might cause damaging substances to enter the bloodstream from the intestines. From there, the substances might reach the brain, causing developmental problems such as autism.

def•i•ni•tion

A **hypothesis** is a theory about a scientific process or an illness that a researcher tries to either prove or disprove through laboratory research and data analysis.

The Wakefield study caught the attention of the media and triggered an international debate about vaccines and autism. Along with questions about the MMR vaccine, some people questioned the safety of vaccine ingredients (such as the preservative thimerosal) and the number of vaccines given to young children (issues addressed later in this chapter). As a result of the Wakefield study, some parents refused the MMR vaccination for their children.

In the years following the Wakefield study, Britain's MMR vaccination rates dropped by about 20 percent, and measles outbreaks occurred in both Britain and the United States. Measles is extremely contagious, and measles outbreaks have occurred here when an unvaccinated person has caught the virus in another country and then entered the United States. In a study of measles cases in Colorado from 1987 to 1998, unvaccinated people were 22 times more likely to catch measles than those who were vaccinated. In 2008, over 100 Americans caught measles. Most of them were unvaccinated, either by choice or circumstance.

Questioning Wakefield

Many studies have been done on vaccines and autism since 1998. Over the years since Wakefield's study, studies of larger populations of children with autism, which provided more accurate data than studies of just 12 people, did not find evidence that the MMR vaccine causes autism.

For example, a 2002 study of over 500,000 Danish children, published in *The New England Journal of Medicine*, found that MMR-vaccinated children had the same rates of autism and ASDs as those who were not vaccinated. A 2004 review by the Immunization Safety Committee of the Institute of Medicine (IOM), an independent agency that advises the federal government on science policy,



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The Institute of Medicine (IOM), a division of the National Academy of Sciences, was created in 1970 to advise the U.S. government and the public about medicine and science. Members of the IOM, who are experts in their fields, create reports, studies, and policy statements about medicine, usually at the request of the federal government.

reached similar conclusions. The committee reviewed studies and found no evidence that the MMR causes autism.

Wakefield himself was also investigated for breaches of medical ethics. In 2005, England's medical association filed charges against him, claiming that he had improperly recruited patients and had conducted unapproved invasive tests (such as spinal taps) on children, among other charges. A reporter in London found evidence that Wakefield was funded in part by a personal injury lawyer, who represented some of the children in the study, a connection that Wakefield later admitted. Because their families were looking for evidence that the MMR vaccination had caused their child's autism, Wakefield's 1998 study was considered biased due to a conflict of interest.

Most of the original authors of the Wakefield study later retracted their opinions because they were concerned about the allegations against Wakefield and the study's impact on vaccination rates. Wakefield did not retract the study and now works with autistic patients in the United States.

Mercury

Although a possible link between weakened vaccine viruses and autism has been disproved, some people believe that other vaccine ingredients might cause autism. In particular, they have raised questions about thimerosal, a mercury-containing preservative that has been used to prevent the growth of contaminants such as bacteria in vaccines since the 1930s. Thimerosal is also used as a preservative in some other medical and health products, such as contact lens solutions.

Fish and shellfish that live in mercury-polluted waters absorb the mercury from the food they eat. If people eat the fish, a type of mercury called methyl mercury can build up in their bodies as well. If enough mercury builds up in your body, you can develop problems walking, hearing, talking, and concentrating, as well as muscle tremors.

Some of these symptoms may appear similar to the signs of autism, although mercury poisoning is not the same as autism. As the number of childhood vaccines has increased over the years, each child's exposure to thimerosal, which contains a different type of mercury called

ethyl mercury, through vaccination has also increased. Parents, activists, and some researchers raised questions about whether the amount of thimerosal in current childhood vaccines could cause autism.

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The preservative thimerosal is made of ethyl mercury, which has a different chemical composition than the type of mercury sometimes found in fish (called methyl mercury). Ethyl mercury is less toxic than methyl mercury, and is less likely to build up to harmful levels in a child's body. There have been more studies of methyl mercury than ethyl mercury, however. As a result, thimerosal exposure guidelines are based on data about the more potent methyl mercury.

The Food and Drug Administration (FDA) looked at the amount of ethyl mercury in childhood vaccines and found that the amount of thimerosal children were exposed to through vaccinations exceeded the amount of more toxic methyl mercury considered safe to eat in fish. In 1999, in response to both public concern and in an effort to decrease mercury exposure in young children, the American Academy of Pediatrics and other health organizations asked vaccine manufacturers to remove thimerosal from vaccines given to children. Vaccine manufacturers reformulated their vaccines to remove thimerosal from almost all vaccines given to children under seven years old. Some versions of the inactivated influenza vaccine (the “flu shot”) still use thimerosal as a preservative. Since 2001, however, all the other childhood vaccines now either do not contain thimerosal or contain only trace amounts of it.

This move did not affect autism rates in the United States. The IOM's Immunization Safety Committee report on autism and vaccines in 2004 found no evidence that the thimerosal in vaccines caused autism. A study of statewide autism rates in California from 1995 to 2007, published in the *Archives of General Psychiatry* in 2008, also found that the number of children who developed autism did not decline after thimerosal was removed from childhood vaccines.

Next Steps

Several children who developed autism after an MMR vaccination recently had their cases heard in a special vaccine court (more about the vaccine court in Chapter 14). The court reviewed almost 1,000 medical articles and considered extensive expert testimony from both sides. In early 2009, the court ruled that neither the weakened viruses in the vaccine nor other vaccine ingredients such as thimerosal had caused the children's autism.

Some people still believe that some other part of vaccines might cause autism. Most researchers do not believe that vaccines cause autism and believe that research funds and studies should now focus on other possible causes, such as the role of genetics in autism.

The CDC is currently conducting a five-year Study to Explore Early Development (SEED), designed to learn more about developmental disorders such as autistic spectrum disorders. The study includes almost



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You can learn more about the CDC's ongoing SEED study of autism and other developmental disorders on the CDC website at www.cdc.gov/ncbddd/autism/seed.htm.

3,000 children and their families from across the country. The study will look at the impact of genetics, family history, hormones, lifestyle, environment, and other factors as they relate to developmental disorders. This research might lead to treatments that could cure autism or improve the lives of children with autism and their families.

Links to Other Diseases

Because many vaccines have been added to the immunization schedule in the past 30 years, infants and children receive more vaccines now than their parents did. Some parents whose children have developed health problems believe that certain vaccines, or the increased number of vaccines, caused the health problems. Some researchers have also developed hypotheses about links between certain vaccines and certain illnesses. They have examined these theories to learn more about a

disease, learn more about a vaccine, or learn more about how the immune system works.

Researchers have not found evidence that the vaccines currently recommended for children and adults cause serious health problems. Despite that fact, you might have heard of possible links between the following illnesses and vaccinations.

Sudden Infant Death Syndrome (SIDS) and the diphtheria, tetanus, and acellular pertussis (DTaP) vaccination: SIDS is the sudden, unexplained death of an infant under one year old. It is the most common cause of death among children in this age group. Most SIDS deaths occur when the child is two to four months old, around the time he or she receives doses of several vaccines, including the DTaP vaccine.

These deaths often occur during sleep and might be caused by a breathing problem in the infant. A national campaign to decrease SIDS, encouraging placing young children on their backs to sleep, has cut the SIDS rate by over 50 percent since 1992. While SIDS rates have fallen since 1992, the use of the DTaP vaccine has increased over that time period. The vaccine was first licensed in 1991, and the current five-dose version has been used since 1997. Because the rate of SIDS has not increased as the number of DTaP vaccinations has increased, DTaP vaccination does not seem to be linked to SIDS deaths.



Health Advisory

To protect your baby from SIDS, follow these tips from the National Institute of Child Health and Human Development's "Back to Sleep" campaign: Always put a baby to sleep lying on his or her back. Make sure the baby sleeps in a crib, bassinet, or other safe place on a firm surface, and remove any pillows, loose bedding, or soft toys. Keep the room where the baby sleeps comfortable, dress the baby lightly, and don't let anyone smoke near the baby.

In a 2003 report, the IOM's Immunization Safety Review Committee found no evidence that certain infant immunizations, including DTaP, can cause SIDS. To collect more data, a large study of DTaP and breathing and heart problems is now underway.

Asthma and vaccinations: Asthma is a very common chronic illness in children, affecting about seven million children, especially those ages five and older. Asthma is an inflammation of the airways, causing symptoms such as wheezing, coughing, and trouble breathing. Allergies, exposure to tobacco smoke, air pollution, and colds and influenza can all cause asthma, which is usually controlled with medications.

The rates of childhood asthma have been increasing in the United States since the 1980s. Some people believe that childhood vaccinations might have contributed to the asthma rates. Several large studies, however, have not found a link between asthma rates and the number or type of vaccines that children receive.



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Researchers are still studying why asthma rates have increased so much in all age ranges since the 1980s. Asthma is most common among African Americans, children whose parents have asthma, and people who live in urban environments (which can have worse air quality than rural and suburban environments). These factors suggest that asthma might have genetic and environmental causes.

Multiple sclerosis and the hepatitis B vaccination: Multiple sclerosis (MS) is a neurological disorder in which the immune system damages nerves in the body, causing symptoms such as trouble walking, fatigue, and numbness. About 400,000 Americans have MS. Some people have suggested that receiving the hepatitis B vaccine might increase the risk for developing multiple sclerosis. A recent study of children with and without MS, however, did not find a connection between hepatitis B vaccination and the onset of MS.

Diabetes and vaccinations: Diabetes, a disease that affects the body's ability to maintain sugar levels in the body, affects about 8 percent of all Americans, and the rate of diabetes continues to increase. Diabetes can be caused by genetics, lifestyle, and other factors. Researchers have not found evidence that vaccinations can cause diabetes.

Vaccine Ingredients

Unlike the first vaccine for smallpox, which contained only a pathogen, modern vaccines contain antigens as well as a variety of other ingredients. Several common extra ingredients a vaccine might contain today include:

- ◆ Preservatives to prevent contamination with bacteria and other substances.
- ◆ Stabilizers to keep the vaccine potent until its expiration date.
- ◆ Adjuvants to improve the human immune response to a vaccine.
- ◆ Residual materials left over from the vaccine manufacturing process.

Vaccines may contain aluminum (used as an adjuvant), formaldehyde (used as a preservative and used to create toxoid vaccines), antibiotics (used as a preservative), gelatin (used as a stabilizer), and monosodium glutamate (MSG, used as a stabilizer). Some vaccines also contain small amounts of yeast and egg protein that were used during manufacturing.

Some people believe that certain vaccine ingredients, either alone or in combination with a vaccine's weakened or inactivated pathogen, can be harmful to your health. But these ingredients are present in vaccines in very small amounts. For example, infants are exposed to much more aluminum through the environment around them than through vaccines. Formaldehyde is naturally present in the environment at higher quantities than is found in vaccines as well.

Vaccinating Facts

Adjuvants, used only in inactivated vaccines such as the DTaP vaccine, improve your immune system's response to a vaccine by acting as chemical irritants. Your immune system responds more strongly to the vaccine because your body wants to get rid of the adjuvant. Without the adjuvants in certain vaccines, the immune system might not notice the antigens, and you might not develop immunity to the disease. Adjuvants also help vaccine developers use fewer antigens in each vaccine. This decreases the chances of certain side effects and saves money in vaccine production.

In rare cases, however, a vaccine ingredient can cause an allergic reaction in a child or adult. If your child has an allergy to foods or medicines, tell your health-care provider before he or she receives a vaccination. You and your health-care provider can then discuss the risks and benefits of giving your child vaccines that might contain these substances. Often, the problem ingredient is present in such a small amount in a vaccine that it most likely will not cause an allergic reaction.

Multiple Vaccinations

Many childhood vaccines are now available as combination vaccines. The multidose DTaP vaccine and MMR vaccine are both combination vaccines. Some newer vaccines available include a DTaP and Hib combination vaccine and a DTaP, hepatitis B, and polio combination vaccine. Using a combination vaccine decreases the number of shots that your child needs to achieve immunity to vaccine-preventable diseases.

Because children are vaccinated against so many diseases when they are young, they often receive a mixture of both combination and single vaccinations in one office visit. At a child's two-month visit, for example, he or she might receive a hepatitis B, rotavirus, DTaP, Hib, pneumococcal, and polio vaccination, receiving antigens against eight different diseases at once. Some people are concerned that giving a young child many vaccines at once might damage rather than strengthen their immune system by overloading it with antigens (the part or parts of the pathogen that cause disease).

Children do receive more vaccines today than they did a generation ago. Because vaccine science has advanced over the past few decades, however, these vaccines can create immunity using far fewer antigens than vaccines used in the past. As a result, although children are receiving more vaccines than their parents did, these vaccines expose them to fewer antigens than their parents received as children. Also, infants are exposed to pathogens every day in their environment. There are bacteria on food and objects that they place in their mouths and viruses in the air they breathe. Every day, their immune system successfully fights off potential infections. The additional amount of antigens in the vaccines young children receive is small compared to the amount of pathogens that they encounter daily.

Today, vaccines protect children from many more potentially dangerous infectious diseases than their parents were protected from. The number of deaths, disabilities, and hospitalizations from diseases such as Hib, hepatitis B, and chickenpox have decreased with the introduction of new childhood vaccines.

The Least You Need to Know

- ◆ Medical conclusions about the MMR vaccine indicate it does not cause autism.
- ◆ Research shows that vaccines do not cause other diseases such as asthma or SIDS.
- ◆ The vaccine preservative thimerosal, which contains mercury, has been removed from most childhood vaccines.
- ◆ Children today receive more vaccinations but fewer antigens than generations ago.