

VACCINE MYTHS

False: Vaccination can cause autism

In 1998, U.K. doctor Andrew Wakefield published a study in *The Lancet* suggesting that the measles, mumps, and rubella (MMR) vaccine could trigger autism. In the years after, MMR vaccination rates among 2-year-olds in England dropped below 80%. But the claim began to unravel in 2004 after journalist Brian Deer reported undisclosed conflicts of interest: Wakefield had applied for a patent on his own measles vaccine and had received money from a lawyer trying to sue companies making the MMR vaccine. Citing further concerns about ethics and misrepresentation, *The Lancet* retracted the paper in 2010. Shortly after, the United Kingdom's General Medical Council permanently pulled Wakefield's medical license.

But the MMR–autism falsehood made headlines again in 2016 with the release of *Vaxxed*, a movie Wakefield directed that alleges a cover-up by the Centers for Disease Control and Prevention (CDC). The story features bioengineer Brian Hooker, who took issue with a 2004 CDC study that found no overall difference in vaccination rates between kids with and without autism. Hooker reanalyzed the data in 2014 and claimed CDC had hidden evidence that the vaccine could increase autism risk in black boys. In fact, CDC noted in the paper that rates of vaccination in the oldest age group were slightly higher in kids with autism. But CDC says that this effect was “most likely a result of immunization requirements for preschool special education program attendance in children with autism.”

Such claims prompted a slew of studies finding no evidence that MMR causes autism. For example, a 2014 meta-analysis in *Vaccine* examined studies involving a total of almost 1.3 million people. That same year, a paper in the *Journal of the American Medical Association* reported that no difference existed in autism rates between thousands of vaccinated and unvaccinated children. —Lindzi Wessel

says he can often tell within 30 seconds whether it's worth arguing. If parents are convinced of outrageous claims and think they already know everything, “I just bail,” he says. “I know it's not worthwhile.” Freed agrees but notes that giving up on hopeless cases can be hard: “These are kids. It's not their fault their parents refuse vaccines.”

SOME RESEARCHERS have studied the reasons why parents don't vaccinate their kids, in hopes of finding clues to the best strategy. Many parents talk about rumored health risks from immunizations or their negative view of the pharmaceutical industry, for instance, but those may not be the true reasons, says psychologist Stephan Lewandowsky of the University of Bristol in the United Kingdom. He says that's a lesson from his work on climate change doubters, whose real driver often isn't their beliefs about the role of carbon dioxide but rather their conservative political views.

In a study published in *PLOS ONE*, Lewandowsky reported that free-market ideology is a strong predictor of antivaccine sentiments; many libertarian parents oppose vaccinations, seeing them as infringing on parents' rights. (Despite popular perceptions, Lewandowsky found little evidence overall of a link between vaccine resistance and left-wing political views.) Understanding the political undercurrent is important, he says, because it can help choose the messenger: “Ideally you would want a bona fide, well-respected conservative who is speaking out in favor of vaccination.” Nobody seems willing to take on that role, he adds.

Less surprisingly, Lewandowsky also found a “shockingly high” correlation between conspiratorial thinking and vaccine rejection. “It is much higher than for climate change or genetically modified foods,” he says. On Infowars, a right-wing website that U.S. President Donald Trump has praised, parents find headlines such as “Most Dangerous Flu Vaccine Ever Being Pushed on the Public” and “Is the UN Using Vaccines to Secretly Sterilize Women All Over the Globe?”

Such myths pose a problem to scientists because believers often interpret evidence against a conspiracy theory as further proof of cover-ups, which means attempts to debunk a conspiracy can backfire, Lewandowsky says. Scientists should still make the effort,

he adds—not for the conspiracy thinkers, but for everyone else. “Debunking is important because if you don't debunk, then the antivaxxers have talking points,” he says.

Experience has taught the same lesson to Roel Coutinho, a former director of the Netherlands's national coordination center for infectious diseases in Bilthoven. When the vaccine against human papillomavirus was rolled out in the Netherlands in 2009, a surge of opposition and rumors about serious side effects took

Coutinho and others by surprise. “It's like a virus, it's contagious, the message spreads very fast, and if it's already very big, there is not much you can do about it,” he says. Authorities have to act fast, he says, by taking even the most bizarre rumors seriously and countering them with facts. “You cannot simply say, ‘This is bullshit;’

even though you sometimes think it is. That doesn't work.”

Several studies have shown that casting doubt on the credibility of sources of misinformation can help, Lewandowsky says. That's why it's still important to point out that an influential 1998 paper in *The Lancet* claiming to show a link between autism and vaccines was fraudulent and has been retracted, he says. (Its main author, Andrew Wakefield, was barred from treating patients in the United Kingdom.) “It was such a paradigm case of overt fraud that dismissing Wakefield is relatively easy now, and we have to do that,” Lewandowsky says (see sidebar, left).

Another helpful tactic is appealing to consensus among scientists. A 2015 paper in *BMC Public Health* showed that telling parents that “90% of medical scientists agree that vaccines are safe and that all parents should be required to vaccinate their children” significantly reduced concern about vaccines. (Similar results have been shown for climate change.) That approach has the advantage that it avoids repeating myths in order to debunk them, which some studies suggest can reinforce the myths.

Betsch has explored the power of telling parents that their choice could hurt other people's children. As long as enough people are vaccinated, even those who won't or can't get a vaccine—for medical reasons, for instance—are protected in an effect called herd immunity. When too many people refuse a shot, herd immunity breaks down and vulnerable



Scientists disagree on whether showing pictures of kids with measles is helpful.

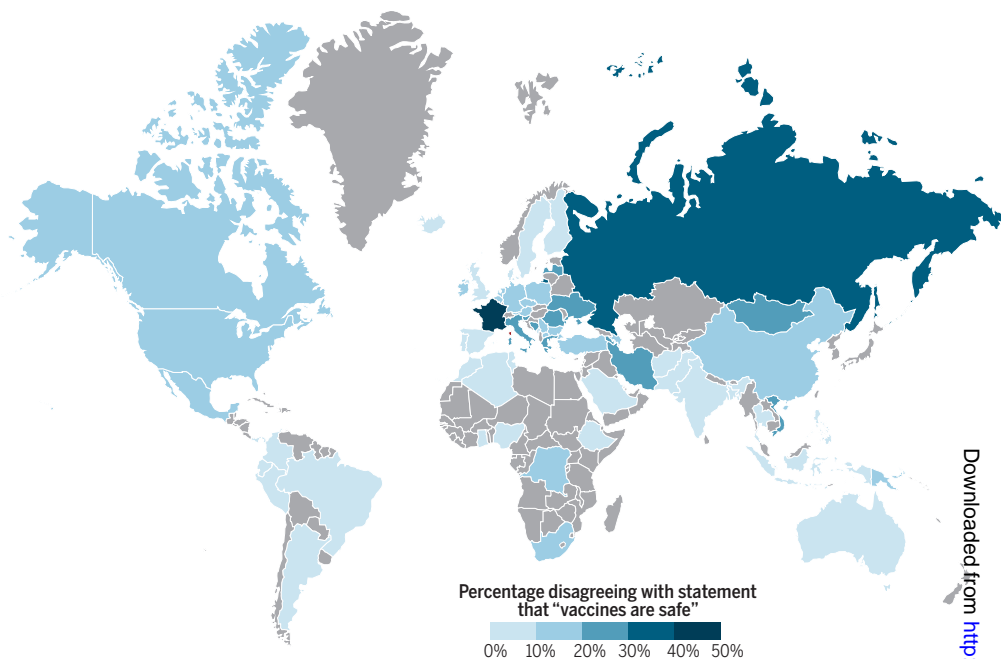
people get sick. That happened with a 6-year-old German girl who died from a rare measles complication last year; she was infected when she was 3 months old, too young to be vaccinated.

Betsch's study recruited more than 2000 participants from three Western and three Asian countries. Some were informed about herd immunity, either in a text or through an interactive game, whereas others weren't. All were asked about their intention to vaccinate against a fictional disease afterward. In South Korea, Hong Kong, and Vietnam, an average of 61% said they would get vaccinated, regardless of whether they had learned about herd immunity. In Germany, the Netherlands, and the United States, only 45% of those who weren't told about herd immunity would get the shot; for those who were, that number was 57%. The higher numbers in Asia might be due to the fact that people in collectivist societies adhere to norms more strictly, Betsch says—or perhaps the Asian participants were already aware of the benefits of immunization to the society as a whole. "Whatever the reason, the data shows that an appeal to herd immunity is especially important in individualistic societies," she says.

THE SCIENCE OF PERSUASION may be uncertain, but immunization advocates have other approaches to help increase vaccine coverage. "People always talk about the antivaxxers, but there are so many things in the medical system that keep some people from getting immunizations," Betsch says. Some people delay or skip vaccines not because they are opposed to them, but simply because they find it hard to get an appointment at a convenient time. Making vaccinations as convenient as possible can further increase vaccination rates, Betsch says.

A matter of trust

A 2016 survey in 67 countries found that trust in vaccines is high overall but varies by country. Safety concerns were highest in Europe and Russia; in France, 41% disagreed with the statement that vaccines are safe.



The opposite is also true. In the United States, parents have to get an exemption—on medical, religious, or philosophical grounds—if they want to send an unvaccinated child to school. According to a recently published study, states where that process is harder had higher vaccination rates. Michigan had a high rate of unvaccinated kids, but in 2015 it began requiring parents to consult with local public health departments to obtain a waiver, and exemptions plummeted by 35%.

Other factors are impossible to legislate, or even measure scientifically: the human interactions whenever a doctor meets a hesitant parent. Freed says being forceful is

important. For instance, when people say it might be healthier for their kids to have diseases than not, he says he has a firm answer: "There are very few children paralyzed with polio who feel it was healthier for them to get the disease."

Offit agrees that doctors need to be more outspoken and proscriptive. His wife runs a private practice and initially wasn't very successful in convincing wary parents, he says. "Then she basically laid it on the line: 'If you can't do this, I can't see you. I can't stand that your child is at risk like this.'" Many more parents now agree to the shots, Offit says. "I think passion works." ■

VACCINE MYTHS

False: Mercury in vaccines acts as a neurotoxin

In 2005 the magazines *Rolling Stone* and *Salon* copublished a story by environmental lawyer Robert F. Kennedy Jr. (nephew of former President John F. Kennedy) alleging a government conspiracy to cover up evidence that thimerosal, a mercury-containing preservative once used in vaccines, can cause brain problems, including autism. Multiple corrections soon appeared, including one noting that Kennedy had incorrectly stated the mercury levels. In 2011 *Salon* retracted and removed the story, noting "continued revelations of the flaws and even fraud tainting the science behind the connection."

Kennedy has continued to use his name to promote the idea, and in recent months vaccine skeptics have called for a new "vaccine safety" commission with Kennedy at its head. Yet according

to the Centers for Disease Control and Prevention (CDC) in Atlanta and the World Health Organization, no evidence exists that thimerosal from vaccines causes health problems in kids.

In 2001, well before Kennedy's article or his related book, thimerosal was removed from all childhood vaccines in the United States except multidose vials of flu vaccine. "If it did cause autism, the prediction would be that once thimerosal was taken out of vaccines that then the numbers of cases of autism should have leveled off or gone down. But that did not happen," says Frank DeStefano, director of CDC's Immunization Safety Office. A rumor that autism incidence dropped in Denmark after it removed thimerosal in 1992 also is not true. The rumor apparently arose from a misinterpretation of epidemiological data. —Lindzi Wessel

VACCINES ON TRIAL

The U.S. vaccine court weighs real versus bogus risks

By Meredith Wadman

Leah Durant was cleaning the unfinished basement of her home in Falls Church, Virginia, one day in October 2010 when she scraped her hand on a rusty nail. Not long after, the then-37-year-old lawyer was seated in her doctor's office, preparing to receive a tetanus vaccine—a preventive measure that since 1947 has reduced U.S. fatalities caused by the soil-borne bacterium *Clostridium tetani* 500-fold.

Her physician stood to her left and leaned over her shoulder with the needle.

The pain was immediate, and so excruciating that Durant screamed.

"I knew right then and there that something had gone terribly wrong," she recalls.

Six years later, driven by that painful jab, Durant has become a vaccine injury lawyer with a bustling practice in Washington, D.C., half a mile from a red brick building that houses what is popularly known as the vaccine court. Thirty years ago, federal law established that court—part of the U.S. Court of Federal Claims—to remove vaccine injury cases from the civil courts, where a wave of lawsuits had spooked vaccine-

makers and was threatening to cause vaccine shortages.

That law, the National Childhood Vaccine Injury Act of 1986, limited the legal liability of vaccinemakers and created the National Vaccine Injury Compensation Program (VICP) in the Department of Health and Human Services. The VICP is a no-fault route for people injured by vaccines to win damages from a government trust fund financed by an excise tax on vaccines. (Despite the law's title, adults, too, can win compensation for vaccine injuries.)

Since its first case in 1988, the vaccine court has adjudicated more than 16,000 petitions and dismissed two-thirds of them. To the successful petitioners, and their lawyers, it has awarded about \$3.6 billion. The system has attracted scores of attorneys, who are paid hourly legal fees of up to \$430 regardless of whether a claim succeeds. The court's website lists 195 lawyers nationwide who are willing to take vaccine cases, although petitioners can hire others. Many are clearly in search of their piece of the \$3.7 billion sitting in the trust fund today. A sampling of the bold proclamations on vaccine lawyers' websites include these:

"WE HAVE RECOVERED MILLIONS FOR OUR CLIENTS"; "Pursue Compensation"; and "NO COST to you."

Durant's website makes the same point, although in smaller fonts and classier prose. Yet she might be unique in that her own experience drove her into vaccine law. Once an immigration lawyer at the U.S. Department of Justice and later the outspoken director of a nonprofit advocating for stricter enforcement of immigration law, she changed her career course and ultimately became a full-time vaccine injury lawyer after that tetanus shot gone wrong.

Durant's injury, her legal practice, and the petitions filed at the vaccine court offer a window into the real risks of vaccination. Those risks can be as severe as extremely rare, dramatic deaths from anaphylaxis—an overwhelming allergic reaction—or as quotidian as shoulder injuries like Durant's. And although petitions to the court do include the kind of bogus injuries that frighten parents, the most common, and prominent, of those has not been warmly received: Not once has the court compensated a petitioner claiming that a vaccine caused autism.

VACCINE MYTHS

False: Countering mercury from vaccines can make children better

In the mid-2000s, riding the wave of concerns about thimerosal, a mercury-containing preservative, Maryland doctor Mark Geier and his son, David, began to promote a theory that a pathological interaction between mercury and testosterone explained many symptoms of autism. That claim came after the Geiers published a few studies suggesting a link between thimerosal and autism—studies that the Institute of Medicine characterized as having "serious methodological flaws." Despite that review, the Geiers proceeded with their controversial work. They established an unapproved treatment that involved daily injections of leuprolide (Lupron), a drug used to treat prostate cancer and to chemically castrate sex offenders. In children, the drug is approved only to treat precocious puberty, a rare condition in which puberty begins before the age of 8 years. Side effects in kids can include bone and

heart damage. Leuprolide also carries a risk of exacerbating seizure disorders, a condition commonly associated with autism. The Geiers sometimes paired those injections with chemical chelation, a risky treatment for patients with heavy metal poisoning. To peddle their treatments to parents and insurance companies at a cost upward of \$5000 a month, the Geiers improperly diagnosed children with precocious puberty—without performing the necessary diagnostic tests. They also misled parents into believing that the regimen was approved to treat autism, according to a 2011 investigation by the Maryland Board of Physicians. The board revoked Mark Geier's state medical license, saying his practice "far exceeds his qualifications and expertise," and other states followed suit. His son, who holds only a Bachelor of Arts degree, was charged with practicing medicine without a license. —Lindzi Wessel

VACCINE MYTHS

False: Spreading out vaccines can be safer for kids

Some vaccine skeptics contend that the Centers for Disease Control and Prevention's (CDC's) current vaccination schedule, which protects children from 14 diseases before age 2, requires too many vaccines in too short a time—overloading children's immune systems early in life. That overload, the skeptics argue, leaves children prone to a host of disorders, including neurodevelopmental delays and diabetes. Experts roundly dismiss those claims. A child's immune system must cope with thousands of foreign antigens each day, whereas the 2014 recommended vaccine schedule exposes a child to only about 300 antigens by the age of 2, according to CDC. One estimate, by vaccine expert Paul Offit of the Children's Hospital of Philadelphia in Pennsylvania, suggests 11 vaccines given to an infant at one time would temporarily “use up” only 0.1% of the child's immune system. And although the number of recommended vaccines has risen over the years, advances in vaccine development mean that the number of antigens contained in those vaccines has decreased—yet rates of autism and diabetes have not.

In a 2015 survey of 534 pediatricians and family doctors published in the journal *Pediatrics*, only about 1% agreed that vaccines should be spread out. But almost all of them had sometimes given in to parent requests to do so, and some doctors have published “alternative” vaccination schedules. But alternative schedules pose many problems, Offit says. The most obvious is that extending the schedule leaves children vulnerable to dangerous diseases for longer. Spacing out vaccinations also makes it more likely that kids will not get all their shots. One proposed alternative schedule would require 19 doctor visits over 6 years—12 of those by age 2. Requiring more visits increases the burden on parents and could expose children to more illnesses from sick patients in waiting rooms, Offit says.

—Lindzi Wessel

Durant, who says she makes her living by winning compensation for genuine vaccine injuries, emphasizes the point. “Vaccines keep us healthy. They eradicate disease. If I had children, I would get them vaccinated.”

THE VACCINE COURT'S DATA show that bona fide vaccine injuries are rare. For every million vaccine doses eligible for compensation that were distributed in the decade beginning in 2006, the court compensated one injury victim. Depending on the gravity of the disease in question, receiving a vaccine is orders of magnitude less dangerous than staying unvaccinated. The tetanus vaccine that Durant received causes a life-threatening allergic reaction in at most 0.0006% of people who get the shot. The U.S. case fatality rate from tetanus, by contrast, is 13.2%.

“One injury from vaccines is one too many, but it is also important to keep perspective,” says Sarah Atanasoff, a physician at the VICP in Rockville, Maryland. “The benefits of vaccination to the individual, the local community, and the nation as a whole far outweigh the risks.”

Petitions filed with the court suggest that among those real risks, shoulder injuries have become by far the most common. Rarer injuries include Guillain-Barré syndrome (GBS), a neurological malady associated with some influenza vaccines; anaphylaxis, a life-threatening allergic reaction that almost any vaccine can cause and occurs 1.3 times per million vaccinations; intussusception, an intestinal blockage that occurs in between one and five of every 100,000 infants vaccinated against rotavirus; and brachial neuritis (also called Parsonage-Turner syndrome), a painful inflammation of the nerves supplying the hand and arm, which afflicts up to 10 of every million tetanus vaccinees.

Vaccination also can provoke (as well as prevent) febrile seizures, which occur in up to 5% of toddlers who become feverish for any reason. Those seizures are most common after measles, mumps, and rubella (MMR) or the combined MMR and chickenpox vaccine, occurring in up to 300 of each million children vaccinated. Typically lasting 1 to 2 minutes, the seizures can be frightening to witness. But they are transient and almost always without lasting effects.

A cadre of medical experts at the VICP initially assesses injury claims, calling in lawyers from the Department of Justice to defend the government if they think the facts don't support a vaccine injury claim. Eight senior attorneys—called special masters and appointed by judges on the U.S. Court of Federal Claims—rule on the claims. The court is rarely asked to deter-

mine whether an injury has occurred—that is virtually always abundantly clear—but whether a vaccine caused that injury. Where the evidence shows that a vaccine did serious or fatal damage, as with a 4-year-old girl who died of anaphylaxis the day after receiving several childhood vaccines, the court awards substantial damages. Her parents received the maximum death benefit under the law: \$250,000.

But the court also draws lines when petitioners and their lawyers present weak, implausible cases—like that of a 4-month-old boy who was vaccinated and that night died, facedown, while sleeping under the same heavy covers as his mother. An autopsy found clear evidence that the baby had suffocated—and no evidence of vaccine-induced injury. The case was dismissed.

And in 2010, the court declined to award compensation in an omnibus proceeding that grouped more than 5000 autism claims. Such petitions continue to fail. One typical, recent opinion reads: “The factual record simply does not support Petitioners' contention that the MMR vaccine had any connection to R.A.'s ASD [autism spectrum disorder] diagnosis.”

THE STABBING PAIN in Durant's left shoulder worsened in the days after her tetanus shot. “I felt like my arm was falling off,” she recalls. She couldn't carry her purse or hold a cup of coffee. She couldn't lift that arm above her head or place it on the steering wheel of her car. She contacted her doctor and relayed her fears that, whatever was going on, the vaccine had caused it. “That's not possible,” she recalls him saying. “Needles aren't long enough to do that kind of damage.”

In fact, needles can do precisely that kind of damage if a vaccine is improperly administered too high on the upper arm, and the needle pierces the deltoid muscle and continues into the shoulder joint. There, physical damage from the needle and, more important, an immune reaction to the injected vaccine can provoke an inflammation that damages tendons, ligaments, and the fluid-filled sacs called bursas that reduce friction in the joint. Late in 2010, scientists in the government's VICP published a description of such injuries and gave them a name: shoulder injury related to vaccine administration.

The government physicians, led by Atanasoff, had identified 13 adults who between 2006 and 2010 petitioned the court for compensation for shoulder injuries and submitted voluminous medical records. None had previous shoulder problems, but each had developed sudden, acute pain and a limited range of motion in a shoulder

Science

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Lindzi Wessel

Science **356** (6336), 368-372.
DOI: 10.1126/science.356.6336.368

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