Depolarizing the Vaccine Decision

You can't Google "vaccination" and not feel a bit helpless … tens of millions of webpages … a finite lifetime. So you sample a few dozen and make the big discovery.

Vaccination is a polarizing issue and the debate has never been hotter.

Up top are links to the Center for Disease Control's (CDC) website which states that vaccination may be the greatest success story in public health.[10] The World Health Organization states "The two public health interventions that have had the greatest impact on the world's health are clean water and vaccines."[11]

Further down the list you'll find anti-vaccine websites that agree the impact has been profound – just not positive. They claim vaccines cause great harm and do little if anything to prevent disease.[69]

Unfortunately, it's a little harder to find sources of information without these strong positions. When my daughter's doctor began discussing vaccination, I struggled unsuccessfully to find information for parents who weren't ready to jump on a dogma bandwagon.

In this article I will present straight information to help the intellectually curious parent evaluate each childhood immunization. If you finish this article feeling like I never really told you what to do, then I have succeeded. It may be frustrating and uncomfortable to be given information without persuasion, but this is the basis of informed choice.

Approaching the Vaccine Decision

Here are 6 relevant questions for a parent considering vaccination to ask:

1. How likely is it that my child might get the disease without the vaccine?
2. How serious is the disease if my child gets it?
3. What are the known risks associated with the vaccine?
4. What are the possible unknown risks associated with the vaccine that have yet to be studied?
5. How well does the vaccine prevent or lessen the severity of the disease? (No one believes vaccines are 100% effective, but they may reduce the severity of a disease.)
6. How does my vaccination decision affect my community/society?

In this article we'll explore some basic vaccine concepts, and then look at the latest research about individual vaccines to help you answer these questions. Most references include online links to allow you to do further research if you wish.

Polio and the Social Progression of Vaccines

Vaccine: Inactivated Polio Virus (IPV) **Disease**: polio **Introduced**: 1955(IPV)/1962(OPV)[11]

Annual U.S. cases[1]: 0 cases of paralytic polio

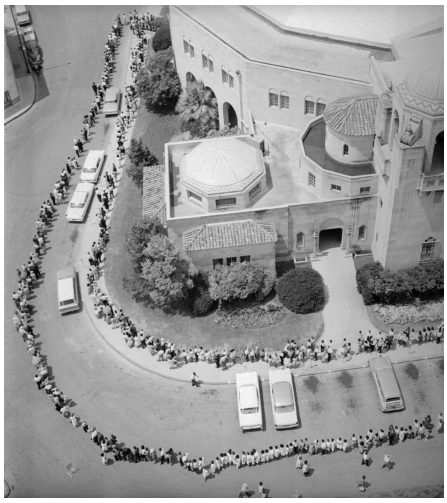
CDC-reported reactions: sore spot where shot given, no serious side effects reported.

Other reaction concerns: polio. The oral polio vaccine (OPV) causes polio in 1 in 2.4 million children (but is no longer generally used in the U.S.). IPV cannot cause polio.

Vaccines follow the "necessity is the mother of invention" rule. For example, before World War II, when polio disabled tens of thousands of people a year in the U.S., including President Roosevelt, there was a feverish search for an effective polio vaccine. It was in great demand even though several thousand children were likely infected by doctors trying to develop the vaccine[5].

After a vaccine became available, reports of polio incidence declined. So parents generally chose to vaccinate children.

By 1960, there were only 2,525 cases of paralytic polio in the U.S., and only 31 by 1970.[1] The last case of polio caused by transmission of wild virus within the U.S. occurred in 1979. The next 2 decades saw only 152 cases, almost all of which were caused by the OPV polio vaccine (no longer recommended in the U.S.)[6] No U.S. cases of paralytic polio have been reported since 1999.



A San Antonio Texas crowd awaits polio immunization (1962). www.vaccine information.org/photos/policdc006.jpg

While that's great news, it makes parents question the benefits and risks of vaccination. While no serious adverse reactions to the present IPV form of the vaccine have yet to be documented[7], the reputation of the older OPV vaccine persists – and even the CDC admits the new IPV polio vaccine might cause a rare serious allergic reaction.[12]

Why then does every mainstream medical association still recommend polio vaccination? Because polio still exists in parts of the world (e.g. India, Africa, the Middle East) and a large unvaccinated population in the U.S. could potentially lead to a new epidemic.

Fear of outbreaks is not pure paranoia. On September 29th, 2005, the Minnesota Department of Health identified the first outbreak of polio in years. Four children in a largely unvaccinated population of Amish children were affected. Ironically, DNA analysis was able to determine that the strain of polio these children contracted came from contact with someone who got polio from OPV vaccine administered in another country.[13]

Does Polio Vaccine Really Prevent Polio?

Some critics claim that polio (and other diseases) would have declined without vaccines. As evidence, they present graphs showing that polio deaths were rapidly declining long before the vaccine arrived, and were largely unaffected by vaccine introduction. The graphs come from a book "Vaccination: A Parent's Dilemma".[37] This otherwise well referenced book fails to provide references for the graphs, which form the very premise of the claim. Another website displays a series of similar graphs, each with references to unfortunately non-existent footnotes.[78]

The U.S. Census Bureau provides historical disease incidence (as opposed to death) data for several diseases online.[79] Dramatic drops in frequency of measles, polio, and diphtheria are easily seen shortly after their vaccines were introduced. Pertussis vaccination began in 1926[11], however a reduction in incidence is not seen until the mid-40's when the vaccine was first widely used as part of the DTP vaccine.[15]

Many serious diseases have in fact declined over the past few hundred years as a result of improved sanitation and clean water – and some diseases that were primarily caused by tainted water have been nearly eliminated. But viruses and bacteria that are transmitted from person to person do still

get many people sick. And in studies of disease outbreaks, children vaccinated against the infectious agent generally fare much better than unvaccinated children – though not always.

Critics of vaccination argue that nutrition, sanitation and hygiene are the keys to controlling disease. It is plausible that these factors would reduce disease frequency. But countries with large unvaccinated populations appear to be the only places where polio survives – an unlikely coincidence. And impoverished regions with poor nutrition, sanitation and hygiene, but higher vaccine coverage, see reduced polio rates.[38] Significantly, the polio incident in Minnesota occurred in an unvaccinated group of children.

Still, it is worth noting that polio has remained generally unproblematic in the U.S. despite high levels of travel and immigration, and despite the fact that 10% of U.S. children are unvaccinated for polio by 24 months of age.[14]

Why Does The Vaccine Controversy Exist?

The anti-vaccine movement often portrays vaccination as a scandal driven by profit-hungry pharmaceutical companies and blind allegiance from doctors afraid to challenge the medical establishment. While there may be truth to these assertions, they are difficult to prove, and are thus often presented as unsupported conspiracy-theories – unfortunately sometimes overshadowing more rigorous and legitimate arguments against vaccines. For example, the anti-vaccine movement quite legitimately argues that there is little research about the long-term safety of vaccines (most research is about reactions that occur shortly after vaccination), and that studies that instill doubts about vaccine safety are often dismissed without serious critical analysis.

By contrast, the pro-vaccine community rarely admits that there is a controversy at all. Why? When diseases are controlled to the point that vaccine side effects appear to be a greater risk than the disease, some parents might begin to reject vaccination, thereby reducing herd immunity and increasing public health risk. Thus it is important to dismiss the risk to individuals as insignificant, and to ensure that parents believe the risk of not vaccinating is real – in other words to place public health over individual health. This means there is a potential conflict of interest between parents and doctors.

The mainstream public health message can make it easy to decide to vaccinate because it's simple and you'll hear it from multiple trusted sources. But it also makes it easy for critics to attack vaccination, because valid concerns remain largely unaddressed. And that leads parents to question the mainstream message and seek out opposing viewpoints. For example, two leading parenting magazines recently incorrectly implied to readers that pertussis vaccination offers full protection, stating "children who haven't had all of their immunizations are vulnerable to the infection"[61] and "remain vigilant for signs of pertussis until full protection kicks in around 6 months."[62] As we'll see in the section on the DTaP vaccine, the reality is far more complex. But parents who read statements like these and subsequently read an article about vaccinated children getting pertussis may begin to question vaccines in general.

How Good Research Can Help

In 1990, the FDA and the CDC initiated a program called the Vaccine Adverse Event Reporting System (VAERS) which allows health professionals and parents to report possible reactions to vaccines.[39] However it only offers hints about risk, because reported reactions are not necessarily caused by vaccination (e.g., *un*vaccinated children can experience high fevers, inconsolable crying, and even seizures and extreme allergic reactions too).

In 1991, the CDC began a research program utilizing large HMO databases that included the medical and vaccine history for hundreds of thousands of children. Dubbed the "Vaccine Safety

Datalink", the project enables researchers to see if kids who get a vaccine are more likely to experience a particular medical problem than those who don't, or if certain problems tend to occur right after getting vaccinated. This project continues to yield interesting results.[33]

Despite the CDC's generally pro-vaccine bias, these two databases have added significantly to both sides of the debate – providing data for numerous studies whose results have both supported and implicated vaccines. VSD data is available to anyone with some time, a legitimate research proposal, and a couple thousand dollars.[67] VAERS data is available online for free use by anyone.[4,68]

Vaccine research is not really controlled by a single entity. It is conducted by scientists from industry, government, academia, and to a growing degree by ordinary citizens, from dozens of countries. A wide range of study results is evident in the references of anti and pro-vaccine resources. While many studies suffer from bias, if there is a vaccine research conspiracy, as some critics of vaccines claim, the diverse set of researchers and results would indicate that, overall, the conspirators have botched the job.

Thimerosal

One of the most contentious issues in recent vaccine history was Thimerosal, a mercury-based vaccine preservative. The press often portrayed the issue as paranoid parents vs. deny-it-all scientists.[16] But not only does the CDC not deny the link, they initiated the VSD program specifically to find these types of links. A 2003 study utilizing the VSD found that Thimerosal containing vaccines were, in fact, associated with an increased risk for tics and language delay (though no autism link was found).[17]

In 2005, another study used both the VAERS and the VSD data to explore how children were affected by DTaP vaccines with and without Thimerosal[18]. The VSD portion of this study found a statistically significant link between Thimerosal vaccines and tics, attention deficit disorder, language and speech delays and other developmental delays. The VAERS portion found possible links to autism, mental retardation, and various other disorders.

The CDC continues to support research on this question,[19] although childhood exposure to Thimerosal in the U.S. is now mostly limited to the flu vaccine,[21] and parents can check the Thimerosal content of any vaccine at the FDA's website.[20]

The MMR Vaccine

Vaccine: MMR **Disease**: measles, mumps and rubella (German measles).
Introduced: 1964 (measles), 1967 (mumps), 1970 (rubella)[11]

Annual U.S. cases[1]: mumps-256, measles-72, rubella-16

CDC-reported reactions: fever (1 in 6), mild rash (1 in 20), mild swelling of glands in cheeks or neck (rare), seizure (1 in 3,000), temporary pain/stiffness in joints (up to 1 in 4 in teens or adult women), low platelet count bleeding disorder (1 in 30,000), severe allergic reaction (1 in 1,000,000 or less). Unproven extremely rare association with deafness, long-term seizures, coma, lowered consciousness, and permanent brain damage.

Other reaction concerns: autism, aseptic meningitis, Crohn's disease.

A study of VSD data did suggest a possible aseptic meningitis risk, however, it was based on only 3 cases, and further analysis indicated that if a link existed, it was too small to detect.[22]

While the CDC asserts that the MMR vaccine used in the U.S. is safe, a different MMR vaccine used in Japan and Korea *was* shown to increase risk of aseptic meningitis,[29] leading Japan to drop

MMR use in 1993. Surprisingly, autism incidence in Japan *increased* dramatically right after MMR usage stopped, and continued to rise for several years.[23] Does this mean MMR vaccine was preventing autism? No. Would the opposite result have led to public concern of an MMR vaccine-autism link? Perhaps. The message is that studies such as this one should not alone be the basis of public or individual health decisions.

While other studies have disputed a connection between MMR and Crohn's disease,[25,70] just hearing about the many possible side effects of MMR makes it hard to feel enthusiastic about this vaccination – even if studies do say it's safe. So it is important to also consider how MMR benefits children. Two studies in Japan provide insight.

Without MMR, Japan now has 7,000 times as many cases of measles per capita than the U.S., and 88 Japanese died of measles in 2000. Furthermore, Japan is considered by the CDC to be the leading importer of measles to the U.S.[28]

Another Japanese study showed that MMR was not perfect at preventing mumps, but that vaccination significantly reduced risk. Of first graders, 88.5% of unvaccinated children got mumps vs. 6.7% of vaccinated children (though effectiveness was lower in older children).[26]

Since the U.S. has so few cases of these diseases, it is tempting to consider that the risk of contracting one of these diseases is miniscule (see sidebar 1). Furthermore, these diseases are not serious in the majority of cases. But the 'R' in MMR is a good example of the public vs. individual health balance. Rubella is not a serious disease, except that 1 in 5 children of infected pregnant women will be born with birth defects. Thus, the primary purpose for immunizing children for rubella is to protect pregnant women.

Of course, if you accept the studies showing that the vaccine works, then the frequency of disease is a product of vaccination coverage. In 2003, MMR vaccination coverage peaked at 93%[2] for infants aged 19 to 35 months. But that means 7% of these children (about 400,000 of 5.7 million[3]) were unvaccinated. Overall, about 30 million people in the U.S. are unvaccinated. And since areas of poor vaccination coverage tend to be grouped in certain social demographics, the potential for small outbreaks still exists – especially if you live in such an area or if more people decide to avoid this vaccine.

Sidebar 1: *Estimated lifetime risk of acquiring various diseases*

Mumps	1 in 14,000
Rubella	1 in 225,000
Hib disease	1 in 2,000
Chickenpox	1 in 9
Diptheria	Less than 1 in a million
Polio	Less than 1 in a million
Tetanus	1 in 88,000
Pertussis	1 in 300
Hepatitis B	1 in 500 (70% of cases have high risk factors)
Lyme disease	1 in 180
Tuberculosis	1 in 230

Assumes average life expectancy of 75 years and constant disease rates. Individual risk is affected by many factors, and disease severity varies by age. Risk is calculated as: 1 in 1/(1-((P-A)/P)^{75}) or 1 in P/75A, where P=Population, estimated at 27 million, and A=average annual caseload in early 2000's.

The Hib Vaccine

Vaccine: Hib **Disease**: *Haemophilus influenzae* type b **Introduced**: 1985[80]

Annual U.S. cases[3,43]: 260

CDC-reported reactions: redness, warmth or swelling where shot was given (1 in 4); fever over 101F (1 in 20).

Other reaction concerns: diabetes.

Hib disease is believed to have been the leading cause of bacterial meningitis, causing 400-500 deaths a year at its peak. Hib causes numerous other infection-related problems, is fatal in about 5% of cases, and causes long term problems, especially with hearing, in 20% of cases. Before the vaccine was introduced in the late 80's, incidence of Hib was about 1 in 1,500 children under 5. It is now about 1 in 75,000.[43] Prior to vaccination, 60% of serious Hib infections occurred in children under 12 months with a peak risk from 6 to 11 months of age.[73]

However, despite this apparent success, Hib vaccine has been accused of causing diabetes. The British Medical Journal (BMJ) published a large study of Finnish children that concluded that Hib vaccine was not associated with diabetes risk.[74] But in another analysis of the same data, the BMJ presented a report by Drs. Classen that did find a link. This report noted that Finnish children who received 4 Hib vaccine doses experienced 58 (17%) additional cases of diabetes per 100,000 children as compared to a group of children who received none – a fact the original study authors failed to point out. Still, the BMJ also mentioned another large Swedish study and several others that failed to find a diabetes link.[76]

This controversy led the CDC to present a website to counter claims of a diabetes link.[42] In rare form, the CDC addresses the Classen report and presents conclusions from an Institute of Medicine (IOM) study review that rejected the diabetes link.[42] (As an aside, the IOM review did find weak evidence for a theoretical association between multiple vaccines and allergies and asthma.) However, the CDC incorrectly reports the incidence of diabetes in the 4-dose and 1-dose groups, and misleadingly states that the first study compared 3 groups while Classen only compared 2 (in reality, the 2 groups Drs. Classen compared were the two that showed the most obvious link to diabetes that the first study neglected to compare). Drs. Classen maintain their own website which claims that several regions, including Finland, have experienced increases in diabetes corresponding with Hib vaccine introduction.[41]

The Varicella/Chicken Pox Vaccine

Vaccine: Varicella **Disease**: Chickenpox **Introduced**: 70's in Japan, 1995 in U.S.[81]

Annual U.S. cases: before 1995, 4 million cases, 11,000 hospitalizations (1 in 360 cases) and 100 deaths (1 in 40,000) per year. In 2005, about 400,000 cases.[44,45]

CDC-reported reactions: soreness where shot was given (1 in 5), fever (1 in 10), mild rash up to 1 month later (1 in 20), seizure from fever (1 in 1,000), pneumonia (very rare), unproven extremely rare association with severe brain reactions and low blood count.

To many, the Varicella (Chickenpox) vaccine seems unnecessary. Most parents of today's children had Chickenpox themselves, and considered it to be a mild disease. Our parents knew that Chickenpox was serious for adults, so they made sure we got it as kids (which generally conferred future immunity). They employed childhood exposure to Chickenpox as a "vaccine" against adult Chickenpox.

Today, a vaccine is available that guarantees neither full nor long-term immunity. Many physicians and parents express concern that avoiding Chickenpox as a child is not a good idea if it increases the risk of getting it as an adult. The counterargument is that although vaccinated individuals might contract Chickenpox, their illness will, in about 97% of cases, be much less serious.[27]

Although vaccine coverage in the U.S. is only 80%,[45] Chickenpox has become much less common. Thus, many of the unvaccinated 20% will reach adulthood having never contracted Chickenpox. Unvaccinated adults who contract Chickenpox face a more serious disease, so some parents plan to vaccinate their child if they reach 10 years of age without having gotten Chickenpox. Of course, some will not remember to follow through with this plan.

One peculiarly mathematical study analyzed the benefits of Varicella vaccination based on various assumptions about long-term effectiveness of the vaccine and various levels of vaccination.[30] In a twist of the "public health" concept, the results unsurprisingly predict the vaccine will have significant detriment to millions of unvaccinated people. Surprisingly, however, it also predicted the lowest mortality of children and adults would occur by vaccinating children at 10 years of age (although child mortality alone was minimized by vaccination at 12 months of age).

So what about our parent's technique of "exposure parties" to ensure that children get Chickenpox before adulthood?

The CDC states that the vaccine is safer than the disease. While reported adverse reactions to the vaccine seem worse than Chickenpox to many parents, the disease actually has more frequent serious results. Complications from Chickenpox (e.g. pneumonia, potentially fatal group A streptococcal disease, arthritis, hepatitis, and brain inflammation) used to occur far more often than serious vaccine reactions do today.[31] It also appears likely that shingles, a side effect of Chickenpox that normally occurs much later in life, is likely to be less common for vaccinated people.[77] Still, if you don't plan to vaccinate your child, early exposure may be a better option than risking getting the disease as an adult.

The DTP/DTaP vaccine

Vaccine: DTP/DTaP **Disease**: diphtheria, tetanus, pertussis
Introduced: 1923 (diphtheria), 1927 (tetanus), 1926 (pertussis)

Annual U.S. cases: diphtheria-1[1], tetanus-41[44], pertussis-11,173[1,57,58]

CDC-reported reactions: fever (1 in 4), redness, soreness or swelling where shot was given (1 in 4); swelling of entire limb in 4th or 5th dose (1 in 30), fussiness (1 in 3), tiredness (1 in 10), vomiting (1 in 50), seizure (1 in 14,000), non-stop crying for 3+ hours (1 in 1,000), fever over 105F (1 in 16,000), severe allergic reaction (less than 1 in a million), unproven extremely rare association with long-term seizures, coma, lowered consciousness, permanent brain damage.

Other reaction concerns: SIDS

Pertussis, or whooping cough, is a serious illness in children. It can be contracted from adults, in whom the disease is less serious, or from other children. Illness lasts for 6 to 14 weeks. Pertussis disease can lead to pneumonia, brain damage, seizure, mental retardation, and death (1 in 200). Before vaccination began in the U.S., there were between 150,000 and 260,000 cases per year with an estimated 9,000 pertussis-related deaths per year. By comparison, from 1990 to 1996, 57 people died of pertussis, (86% of whom were under 6 months of age).[44]

The DTP vaccine had the most reported adverse events in the VAERS system until 1993, when DTP was phased out and replaced with DTaP.[4] DTP vaccine included whole *Bortadella pertussis* cells, while DTaP uses just a component of the bacteria. The goal was to reduce side effects, though some researchers claim DTaP is less effective than DTP.

DTP has been accused of causing SIDS. But while the 2003 VAERS report states "Carefully controlled epidemiologic studies consistently have not found any association between SIDS and vaccines", the report's list of references does not include two studies that did suggest significant connections.[4]

The first study, from 1983, tracked children in Los Angeles who died of SIDS. Of 53 SIDS cases in which a child had a DTP vaccination, over 10% had received a DTP vaccine dose in the previous 24 hours, and a third within the preceding week.[32] These numbers are unexpectedly high, even considering that SIDS is most common around the time of vaccination (for both vaccinated and

unvaccinated children). A second study showed that in the 3 days following DTP vaccination, SIDS rates were also significantly higher than expected.[34]

The CDC's website falls a little flat on the SIDS-vaccine relationship. Their website "SIDS and Vaccination" answers the question "How do we know that some SIDS deaths are not due to vaccines?" by referencing one unpublished study and studies based only on anecdotal VAERS data.[54]

Still, it isn't clear if DTP actually increase overall SIDS risk. A German study suggested that pertussis may be a frequent cause of deaths reported as SIDS, and therefore preventing the disease might reasonably reduce SIDS frequency. It also found nearly identical SIDS rates in two groups of children with significantly different vaccination rates.[35] A British study showed a strong connection between increased vaccine usage and a significant reduction in SIDS incidence.[36] Furthermore, pertussis used to kill more babies than currently die from SIDS in the U.S.[52] Parents concerned about SIDS should be sure to review the well proven recommendations from the American Academy of Pediatrics for reducing SIDS rates.[53]

How does all this relate to the DTaP vaccine which has replaced DTP in the U.S.? According to Robert Davis, Immunization Safety Officer for the CDC, "…the Institute of Medicine addressed the possible relationship between pertussis vaccination and SIDS and felt that the cumulative evidence favored rejecting a causal relation between DPT[sic] and SIDS. We are currently in the planning phases for studying DTaP and SIDS within the CDC Vaccine Safety Datalink Network, and anticipate that results from this study would be available in the next few years."[40]

As always, vaccine risk must be compared to benefits.

In 1998, The Lancet Journal of Infections Diseases published an important article that addressed the worldwide effect of anti-vaccine movements on pertussis. In it, the authors examined the history of pertussis vaccination in a dozen countries based on incidence reports to the World Health Organization. In well referenced graphs, the authors show extremely convincing data that pertussis vaccination is an extremely effective tool for combating pertussis. For example, neighboring countries with high and low pertussis vaccination rates have very low and very high pertussis incidence respectively. Countries that have experienced anti-vaccine movements that led to sudden drops in vaccination rate experienced 10 and 100-fold increases in pertussis rates. And in cases where vaccination was reinstated, disease rates plummeted once again.[46]

The vaccine is not perfectly effective – only 69 to 80% of vaccinated individuals are protected in an outbreak – but it reduces the severity of the disease in most cases, and the herd immunity effect is responsible for a significant reduction in disease outbreak frequency.[47] One study that examined vaccine effectiveness of various DTP and DTaP vaccines also noted other risk factors for acquiring pertussis including getting the final vaccine dose before 14 months, living with older children, and getting fewer than 4 doses. Most dramatically, families with parents under 25 had an unexplained 6.8 times greater infant pertussis risk.[48]

Because vaccinated children can get pertussis, one Italian study measured how the disease affected vaccinated vs. unvaccinated children. For vaccinated children, the coughing portion of the disease was on average 22 days (40%) shorter and the spasmodic coughing portion was on average 11 days (35%) shorter.[49]

A study in the New England Journal of Medicine followed an outbreak of pertussis in Cincinnati and reported in its conclusion that, since 74% of children who had pertussis had received 4 or 5 doses of vaccine, the vaccine was clearly not providing full protection – implying that the vaccine failed.[50] The implication, however, does not agree with the math. Assuming that vaccination rates

for children were about 90%, the vaccine in this study was actually about 68% effective at preventing pertussis[51] – not perfect, but well within the claimed range of effectiveness.

How significant is the recent rise in pertussis cases? In 2001 through 2004, there were 7,580, 9,771, 11,647, and 19,000[57,58] cases respectively. Although some theorize that vaccines don't work or that the DTaP vaccine is less effective than DTP was, the CDC offers a rosier explanation. Most of the increase has affected adolescents and adults rather than infants (the vaccine's effectiveness is known to wane after a few years).[59] Furthermore, pertussis is more likely to be diagnosed as such because the definitive laboratory test, PCR, has only recently become widely available. For example, Massachusetts reports the highest number of cases of any state – a fact that is more likely related to their sophisticated surveillance program than to higher disease frequency.[58]

The PCV Vaccine

Vaccine: PCV **Introduced**: original vaccine in 1977, current vaccine in 2000[82]

Disease: Pneumonia, meningitis, otitis media (middle ear infection), pneumococcal-related diseases

CDC-reported reactions: redness, soreness or swelling where shot was given (1 in 4); fever over 100.3F (1 in 3), fever over 102.2F (1 in 50).

The PCV vaccine is a recent addition to the vaccine schedule. Although most childhood vaccination websites report high pneumococcal disease mortality rates, this is misleading because most deaths are in the elderly or immunocompromised – not in children. That said, this vaccine does reduce the frequency of some serious diseases in children as well.

The most oft-cited study on PCV looked at vaccine effectiveness.[55] In a Northern California group, PCV was shown to reduce ear infections by 7% (similar to a Finnish group and a Tennessee group that both reported a 6% decrease); pneumonia decreased 11%; invasive pneumococcal disease decreased 94% in one group and 69% in another (corresponding to a drop of about 1.3 cases per 1000 children). For unclear reasons, ear infections dropped in a smaller study group in New York by 20%.

Many mainstream websites questionably report the New York statistic to promote the value of the PCV vaccine.[56] But while the drop in ear infections and pneumonia seems modest, the drop in meningitis and other invasive pneumococcal diseases is more impressive since these diseases can be serious, and even fatal. Furthermore, many of these diseases involve strains of bacteria that are more frequently resistant to antibiotics – making prevention more significant.

The Hep B Vaccine

Vaccine: Hep B **Disease**: Hepatitis B **Introduced**: 1985[11]

Annual U.S. cases[1]: 7,850

CDC-reported reactions: soreness where shot was given (1 in 11), fever (1 in 14), rare serious allergic reactions

Other reaction concerns: neonatal death

Hepatitis B is a dangerous disease for infants. Approximately 1/4th of infants who contract the disease will die from related liver disease later in their life. The disease is passed when blood from an infected person passes into an uninfected person. It is not spread by food, water, shared utensils, breastfeeding[63], kissing, sneezing, or casual contact. The risk factors include IV drug use, sex with an infected partner, hemophilia, or working with blood at your job. The vast majority of infants acquire the disease from their parents.[60]

Some parents question the need for early Hepatitis B vaccination for infants who are not at high risk of exposure. The problem is that parents don't know if they or other family members have Hepatitis B without blood tests, because many people with the disease have no symptoms.

If a mother is a Hepatitis B carrier, vaccination of a newborn is recommended within 12 hours of birth. Since newborns are rather sensitive, researchers have studied VAERS reports of sudden death after infant vaccine administration. Although the study found no obvious link, the authors admitted that VAERS data did not provide strong evidence one way or the other – of 17 VAERS reported deaths in 8 years, 12 were classified as SIDS deaths within an average of 24 hours of vaccination.[64]

The Flu vaccine

Annual U.S. cases[65]: 25-50 million cases per year, 150,000 hospitalizations, 30-40,000 deaths
Introduced: 1945[83]

CDC-reported reactions: soreness where shot was given, aches, fever, rare life-threatening allergic reactions, possible rare link to Guillain-Barré Syndrome (1 or 2 per million)

Flu vaccine changes every year in an attempt to track the latest flu risks. Effectiveness varies, and the risks may vary as well. Guillain-Barré Syndrome (GBS), a disease in which it is believed the body's immune system attacks the coating around nerves, has been implicated as a possible rare side effect of flu vaccination. One study based on VAERS data concluded there was a possible causal relationship between the vaccine and GBS.[66] In addition, flu vaccine continues to be the only common childhood vaccine that contains the mercury-based ingredient Thimerosal (although Thimerosal-free options exist).

Sidebar 2: Statistical Terms

Most of us would prefer not to think too much about statistics. But if you decide to read scientific papers, there are 3 statistics terms especially worth understanding.

Relative Risk (RR) – Measures how a particular risk factor (e.g. getting a vaccine) affects an outcome (e.g. brain damage). An RR of 2.0 means the outcome is twice as likely. An RR of 0.5 means it's half as likely. An RR of 1.0 means the factor does not affect the outcome.

Confidence Interval (CI) – Statistics are generally only estimates, so studies try to determine the probable range of a statistic. For example, if you flip a coin 100 times you can say that 50% of the time you'll get heads. But if you perform a study, you'll rarely get exactly 50% heads. But you can report that 95% of the time this study is conducted, heads will come up between 40% and 60% of the time. In a study, this might be written as 50% heads, 95% CI (40% to 60%). The expression RR 1.7, 95% CI (0.5 to 2.5) means that the study estimated a relative risk of 1.7. However, statistically, the researchers concluded that natural randomness only allowed them to conclude that there's a 95% chance that the real relative risk is somewhere between 0.5 and 2.5. In this example, despite the 1.7 estimated RR, this study does not provide strong evidence of an increase or decrease in relative risk.

Statistical Significance – This measurement states that a result is likely the result of a factor other than random chance. For example, if we flip a coin 100 times and get 42 heads, we could report that heads comes up 42% of the time and that the coin is imbalanced. However, this result would not be statistically significant because it could easily just be the result of chance. If the coin is flipped 1 million times and 42% of the time heads results, this would be statistically significant. Significance is often reported as ($p<0.05$) or ($p<0.01$). These mean the reported result only has a 5% or 1% chance, respectively, of having occurred by chance.

Delaying Vaccination

Some parents choose to "compromise" and get vaccines, but on a delayed schedule (e.g. starting a few months or even a few years later). There are arguments in favor and against this idea, although these arguments were in theory considered in the current CDC recommendations for immunization schedule.

The logic of one argument in favor of delay goes like this. Many vaccines are *not* recommended for children who have already had a serious reaction to a previous vaccine dose[9] because a subsequent dose is then more likely to cause a more serious reaction. Many reactions that children might have

(e.g. pain, behavior changes, fussiness, etc.) are more difficult to pinpoint as a result of vaccination in a young infant. By waiting, parents and doctors are more likely to spot sensitive children before a serious reaction occurs.

Another argument in favor of delay is that some parents believe that their older child will be better able to deal with the emotional and physical stress of shots and any associated reactions. It is worth noting, however, that most research indicates that there is no reduction in frequency or severity of reactions with older children.

One more argument for delaying vaccination for some children is that young children who do not get exposed regularly to other children (or to siblings with such exposure) may be at less risk of contracting childhood diseases until those exposures begin – and thus less in need of immediate vaccination.

The main argument against delay is that many of the diseases that vaccinations are meant to protect against can occur in very young infants – in fact are often most serious in infants. So waiting until your child is older may increase disease risk without ultimately offering any significant protection from the risk of adverse vaccine reactions.

Vaccine Effects on the Immune System

One of the most elusive concerns about vaccines is their general effect on health. Critics argue that injecting babies with toxins can cause allergies, asthma, immune system dysfunction, diabetes, autism, and personality disorders. Although the evidence is thin that these associations exist, it is also thin that they don't – mostly because cause and effect are difficult to measure in the long-term. For example, diabetes has increased, but so has obesity, a primary cause of diabetes. Recent autism rates have soared. But a changing definition of autism and countless other potential causes make placing the blame on long-used vaccines seem arbitrary. There are theoretical reasons why allergies and asthma might be linked to vaccines – but no evidence that vaccinated children suffer more from these problems.[42]

One study examined the question "Do vaccines overwhelm the immune system?"[71] Since the function of a vaccine is to teach the immune system how to respond to antigens, they explore how many antigens children have been historically exposed to from vaccination. Because technology has improved, vaccines now contain fewer, more specific antigens, which gives the immune system less to "learn". For example, the older DTP vaccine contained about 3,000 antigens, whereas the newer DTaP contains about 5. While they postulate that the immune system can handle many thousands of antigens, they note that today, all childhood vaccines combined contain fewer than 130.

The study also discusses the theory that vaccines might generally weaken the immune system. It references four short-term studies[72] that examined "unrelated-to-vaccine disease rates" (UTVDR) in vaccinated and unvaccinated children. All studies found that UTVDR was the same or lower for vaccinated children. Study authors postulated that this was because vaccinated children are occasionally protected from opportunistic diseases that accompany vaccine-preventable diseases. Unfortunately, no long-term studies of UTVDR are referenced. Furthermore, many would argue that the question of long-term effects of vaccination on the human system is so complex that research will never be able to provide comprehensive answers.

Final Thoughts

There is a tiny child in your life whose chubby little face can make the vaccination decision seem overwhelming to the average perfectionist parent. It can be a mentally and emotionally challenging process. Either way, you'll face potential judgment for your decision – from society, and, if you are

so inclined, from yourself. But make your decision and move on – parenthood is full of challenging decisions, and childhood is full of unknowable risks.

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