

vaxplanations

Explaining the myths of vaccinations

Injection vs Ingestion. Myths and Facts.

So you're in a discussion about vaccines and their ingredients and somebody pulls out the conversation stopper. "The amount of xyz in a vaccine might be tiny, but you're *injecting* it. And injection is different to ingestion." You're stumped. You really have to stop and think hard about it. You *know* they're qualitatively different, but you don't know how to explain exactly *why* it's not particularly important.

Yes, they are different. However making a broad and sweeping claim like that without context; being exact about the substance, amount and **how** the body processes it, is vacuous. And the difference should not be overstated because vaccine ingredients are actually safe in these tiny amounts.

The ingredients considered by many to be the "toxic chemicals" in vaccines are really so tiny compared to other sources, that the route of entry difference does not negate the point that these amounts are not enough to do harm. And it's not like an injected substance just sits there. The body has processes through which it disposes of substances that penetrate the skin. For example, foreign particles can be eaten in a process called phagocytosis or they can attach to carrier molecules in the blood which are then excreted.

In order to be excreted, a substance must be absorbed into the blood first. Some substances aren't absorbed very well, or at all. Once an injected substance reaches the bloodstream, it's treated the same way by the body as an ingested substance that reaches the bloodstream. After all, where does our food go once it's broken down and processed by our digestive system? You guessed it, into our bloodstream. But do any of the vaccine ingredients even reach the bloodstream? Are they modified before they reach the bloodstream? Yes and yes. But I need to be really specific about that.

The ingestion/injection trope usually comes up when you discuss formaldehyde, aluminium or MSG. How the ingredient gets into the bloodstream is different for each substance, and you have to understand the **chemistry** of the substance, how **much** actually ends up in the bloodstream, how much is **retained** in the body and how much is **excreted**.

Formaldehyde

Formaldehyde from an injected vaccine would immediately start to be taken up by surrounding cells. Some of it would reach the bloodstream, but it is quickly broken down. [The amount in a vaccine would be metabolised in ~10 minutes.](#) Our bodies and cells are very familiar with formaldehyde. Every cell in the human body produces formaldehyde and the average adult produces between 50 and 55 g, or 50-55 000 000 micrograms every day.

Formaldehyde is already present in our blood and cells and the amount from a vaccine is so miniscule that the blood *does not even register a difference*. There is 120 times more formaldehyde in a pear than in a vaccine. But small amounts of ingested formaldehyde are not harmful either because the gut breaks it down. [The most harmful route for formaldehyde is inhalation](#), and it can be toxic where there is chronic, long term exposure eg. factory workers breathing in daily fumes.

Aluminium

The aluminium in vaccines is not a heavy metal. It is not even in metallic form as portrayed by vaccine fearmongerers. It is in the form of a salt, usually aluminium hydroxide. [The aluminium in aluminium hydroxide is not readily bioavailable and retention is extremely low from both ingestion and injection.](#)

Aluminium salts that you ingest (eg. antacids, buffered aspirin, some processed foods) are mostly excreted before they get to enter the bloodstream. In healthy subjects, [less than 0.3% of aluminium that you eat is absorbed via the GI tract](#) and the kidneys effectively eliminate aluminium from the body. [Intravenous infusion of products containing aluminium](#) (ie injection directly into the bloodstream via a drip connected to a vein, as with intravenous nutrition pouches for patients in a hospital) or renal dysfunction are the only real scenarios where aluminium has the potential to accumulate.

Once aluminium is in the bloodstream, it is processed similarly regardless of the source. It just depends on the amount received and if the kidneys can keep up. Continuous infusion, we are talking litres here, of a nutrition product delivered directly into the bloodstream, is much more of a deal than a miniscule amount of aluminium hydroxide in a 0.5 ml vaccine injected into muscle. Most of the injected aluminium from vaccines will eventually enter the bloodstream, but it's not taken up readily by the cells, it is not *bioavailable*.

Only a very tiny percentage of it will be “dissolved” in the blood – it's in the form of precipitate bound to carrier proteins. [Approximately 89 percent of this aluminium is processed by binding to a protein called transferrin, and the rest is bound to citrate.](#) The majority of the bound aluminium will be processed and eliminated through the kidneys, a small amount through bile and faeces, and a tiny amount is retained in tissues of the body.

[About 50% of the aluminium in the bloodstream is eliminated in less than 24 hours, more than 75% is eliminated within two weeks](#) and even more over time. A diminishingly small amount may be retained. But we're talking about a fraction of two hundredths of bugger all. The ability of the body to rapidly eliminate aluminium hydroxide accounts for its excellent record of safety as a vaccine adjuvant.

MSG

[Monosodium glutamate \(MSG\) is also a salt – a salt of glutamic acid.](#) MSG is found naturally in common fruits and vegetables like tomatoes, mushrooms, peas and broccoli. MSG found naturally in these foods is the same as the MSG salt added to

foods as a flavour enhancer, is the same as the MSG found in vaccines. Extremely tiny amounts of MSG are used in vaccines to preserve them against light, acidity and humidity.

The nasal flu vaccine contains 0.188 mg, chickenpox vaccine 0.5 mg and one MMR/chicken pox combo shot has 0.4 mg of MSG. Such tiny amounts are harmless. MSG is **NOT** a neurotoxin as claimed by vaccine fearmongerers. In food, it works as a flavour enhancer by [stimulating the nerve endings on your taste receptors](#), reducing the need for added table salt. But it does not damage or destroy nerve endings in your brain. Injection does not change the fact that it harmlessly and readily dissolves in bodily fluids. It dissociates into sodium and glutamate *whether ingested or injected*.

Sodium and glutamate (an amino acid) are then readily used by the body. Some people report mild and transient symptoms after eating foods with added MSG, though human studies have failed to confirm the involvement of MSG in “Chinese Restaurant Syndrome”. However [food regulatory authorities do not discount the possibility of a sensitivity in some people. In these people, 3000 mg has triggered it](#). But it is not an allergy, it is not immune mediated, it is not toxin related. It appears to be a dose related sensitivity.

In any case, the MSG found naturally in foods or added to foods, is magnitudes higher than what is contained in vaccines. Half a cup of peas contains ~1490 times the amount and an average serving of Chinese food contains ~4000 times the amount of MSG in the chicken pox vaccine. Even in MSG sensitive people, the amount of MSG in the chicken pox vaccine is nearly 16 000 times less than the amount at which susceptible people have been found to be sensitive to.

So that’s the most controversial ingredients discussed. I will now talk about the antigens, the immune generating bits of the vaccine. (Feel free to ask questions about any other vaccine ingredients in the comments section.)

Antigens

Ultimately, the difference between ingestion and injection when we are talking about vaccine antigens, is an immune response that is required for immunisation to occur. That is why they are injected.

Vaccine critics say that vaccination “bypasses” the immune system (it doesn’t). Vaccines bypass the first couple lines of defence, because they need to. We want them to pass the first lines of defence to produce the desired effect – an effective immune response. (And in order to keep that response going to induce a memory response, aluminium adjuvants are used in the non-live vaccines).

The vaccine antigens – those dead or damaged bits of viruses and bacteria used to promote the immune response – are not left behind and do not reach the bloodstream in the same form. They are permanently altered by your immune cells, engulfed and rendered useless in the process of making antibodies.

[The process by which dead pathogens are permanently altered/destroyed by immune cells is depicted well in this simple cartoon.](#) Image credit: Maki Naro



I've heard vaccine critics compare vaccines to snake venom. This is a completely inaccurate comparison. Snake venom contains an active neurotoxin. Drinking snake venom is absolutely not the same as being injected with it. The gut will break down the venom in the same way it digests proteins in food, rendering it useless. If you consumed it, it would not hit the bloodstream in original active and potent form. If a snake bites you, there is nothing underneath your skin or in your muscle to neutralize the venom. It is not broken down so it is able to travel quickly to your lymph glands reach the blood stream and from there it can quickly get to your nervous system and heart.

Vaccine ingredients are not harmful just because they are injected. Vaccines are not even remotely like poisonous venom. Venom contains an active neurotoxin and vaccines do not. The antigens in a vaccine are only mildly active – they're either dead or damaged. They are active enough to cause an immune response, but not potent enough to cause harm. And the ingredients are inactive. They are not neurotoxic either. The tiny amounts of the ingredients found in vaccines are not toxic whether ingested or injected.

They don't need to pass through any magical natural wall of protection. The body can recognise them as foreign and phagocytose them. Or they end up in the bloodstream

and are excreted. I will explain exactly what happens to a vaccine after it is injected later on in this piece.

So why can't we have ingestible vaccines?

Because most would have difficulty getting past the hostile environment that is our gastrointestinal tract. The stomach acid, enzymes, gut bacteria and other potential antigen killers in our gut would render them useless. The exception here is the oral rotavirus vaccine, which happens to be a gut pathogen and so the vaccine works best delivered orally. The oral rotavirus vaccine is very effective in the prevention of wild rotavirus infection.

Polio is also a gut pathogen, and both oral and injected forms of polio work. (More on the difference between the vaccines and their immune responses later). Every disease that we vaccinate for has a preferred route of entry for how it infects the body. Some go through the oral/gut route (eg. polio and rotavirus) some through the oral/respiratory route (eg. diphtheria, whooping cough, influenza, measles, chicken pox) and some via the skin (eg. tetanus, rabies, chicken pox).

Pathogens that enter via the airways, like pertussis and influenza have injectable vaccines to combat them. Intranasal forms are also available. In the development of vaccines, the best route of delivery is studied and tested to achieve maximum benefit and highest level of safety.

Here is what happens to a vaccine once it's injected:

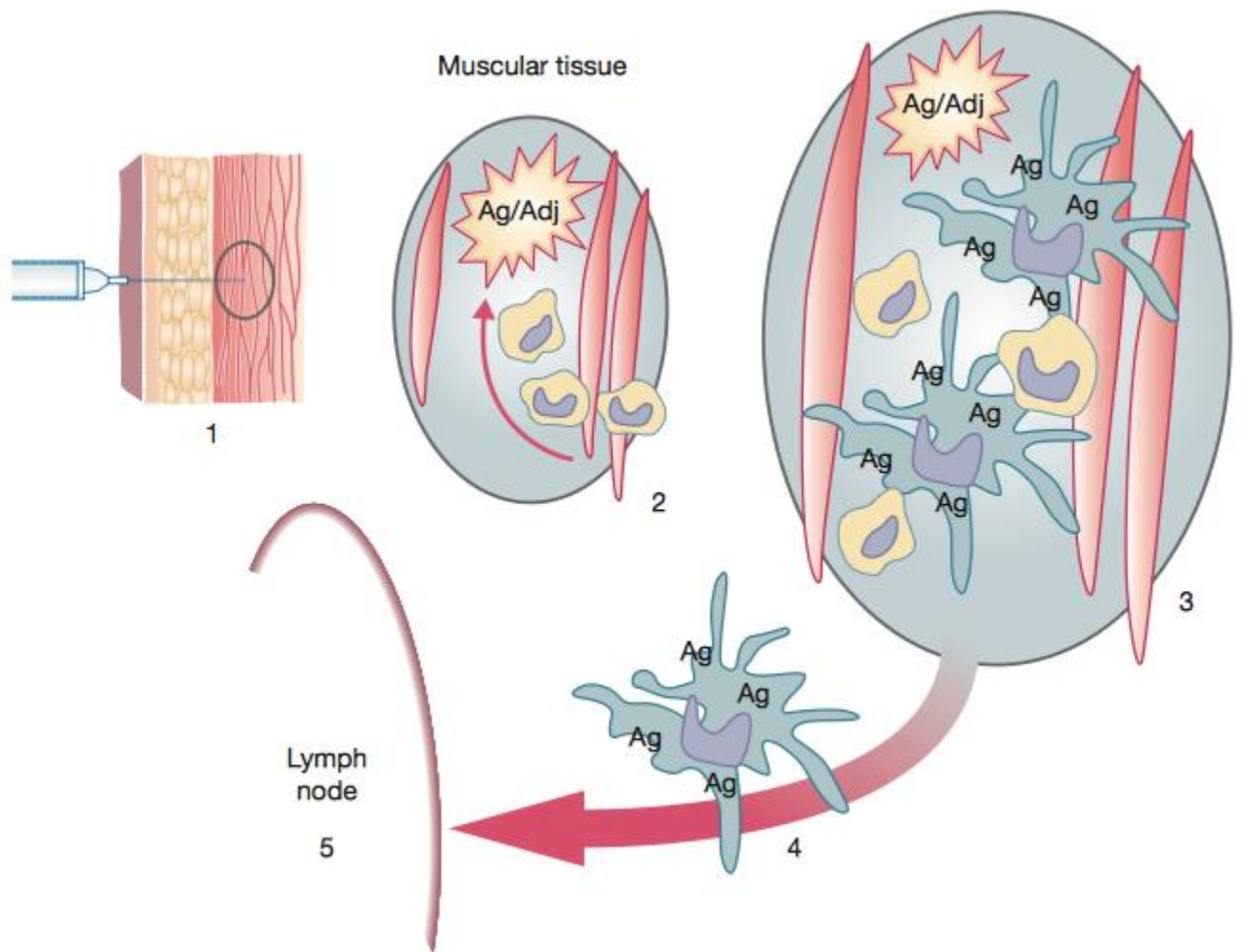


Image source

1. The vaccine penetrates through the skin barrier and the contents are released into muscle.
2. Inside the muscle tissue, the vaccine antigens attract immune cells such as dendritic cells, monocytes and neutrophils.
3. The immune cells change their surface receptors and start to migrate towards the lymph vessels.
4. These immune cells (which now have the “recipe” to make antibodies) arrive at the lymph nodes.
5. Lymph nodes produce antibodies to combat the antigen from the vaccine.
6. Antigen is phagocytosed (eaten) by a macrophage (an immune cell) as depicted above.

Common injection/ingestion myths:

Some of the common arguments that you will encounter with the ingestion/injection trope are:

Myth 1: Vaccines aren't ‘natural’ because they ‘bypass’ the immune system. The idea behind this is that vaccines bypass the skin barrier and this is not “natural”. But the skin is not

the body's **only** protective barrier. Or perhaps the thinking is that any immunity from vaccines is somehow inferior or 'artificial' because it is different to how it would happen *naturally*. This is not true.

(a) Vaccines don't 'bypass' the immune system at all. Nor do they 'trick' or 'cheat' the immune system. Vaccines penetrate through the skin barrier, sneaking past the cells and chemicals that will engulf and destroy it. But this is exactly what they are designed to do. The pathogens in the vaccine are so weak, if we didn't assist them across this barrier they would quickly be rendered useless. By injecting weak or dead pathogens through the skin and into the muscle, the vaccine goes straight to the level where specific immune cells are made. The nearest lymph cells immediately go to work on making antibodies to combat the germ. The memory B cells remember the antigen, and can store and retrieve this memory for a future invasion.

(b) Injections happen naturally. From mosquito bites and wasp stings to rose thorns and animal bites, there are plenty of injections in the natural world. Foreign invaders can enter through the skin or they can enter via your airways and get into your lungs or gastro-intestinal tract. They can also get in via your urinary tract and infect your bladder and kidneys; or they can be sexually transmitted and infect the body's reproductive organs. Whichever way germs enter, your immune system can mount an immune response.

Myth 2: "70–80 % of the body's immune system is situated in the gut, therefore nature intends for pathogens to enter only this way".

There wouldn't be so many immune cells there otherwise, right? They think immunity acquired through the gut must somehow be superior, because the germ or substance must evade a natural **filter** of sorts, the mucosal barrier, and that this was what the body was designed to do, and it protects the body from ALL harm. This is faulty thinking. Immunity acquired via the gut is not superior.

The immune system of the digestive tract ([the gut-associated lymphoid tissue](#), or GALT) works to protect the body from invasion via the gut. The digestive tract is an important component of the body's immune system. In fact, the [intestine possesses the largest mass of lymphoid tissue in the human body at around 70 to 80%](#). But there are so many immune cells there because our gastro-intestinal system has an **ENORMOUS** surface area. The gastro-intestinal mucosa has the continuous task of making, breaking up and absorbing nutrients. We shovel foreign matter into our GI tract several times a day – so it is very active!

The lining of the GIT is the largest surface that faces our external environment, so it needs to have lots of immune cells. The human intestine is 10 times longer than the length of the body, at [17 to 35 feet long](#). Just like our skin is a barrier to things in the air or on surfaces getting inside us, the mucosal layer of our intestines prevent oral pathogens getting through our digestive tract, and the mucosal layer of our mouth, nose and lungs try to prevent respiratory pathogens getting into us.

But not every infectious agent comes in through our mouths and intestines and the suggestion that we're only able to fight off infections that do is downright silly. You have immune system locations all over the body which are prepared to combat pathogens. Many of the diseases we

vaccinate against enter via the mouth, nose and lungs and do not target the gut. eg. pertussis and measles. Other diseases can enter via the skin eg. chickenpox and tetanus. And the gut mucosa is not a perfect barrier – pathogens get past the gut mucosa all the time. Food poisoning anyone? Norovirus? Gastro? Polio and rotavirus?

Our MALT ([mucosa-associated lymphoid tissue](#)) is the rest of the body's lymphoid tissue outside of the gut. And the immune cells that are present in the mucosal surfaces are also present in the skin and muscle. The immune cells of our gut reside in our digestive tract looking for invading germs are the same ones in our respiratory tract (mouth nose and lungs) are the same ones under the skin. If immunity was only successful because it passed through the mucosal layer first we'd all be dropping like flies from cuts, scratches, rose thorn pricks and animal bites.

The diseases we vaccinate against all possess 'secret weapons' to get past our body's defences. They have tools to deceive or disable our immune cells and make us very, very ill. There is a reason why we vaccinate against these diseases – they can cause us serious harm. Vaccination prepares us for combat.

Myth 3: Vaccines overstimulate one part of the immune system (Type 2 responses – production of antibodies) and weaken another (Type 1 responses – cell mediated).

This is simply not true. The reality is, vaccines stimulate several different types of immune responses. (it depends on the vaccine). This myth stems from how the immune system was crudely understood well over a decade ago. The old model of the T1/T2 immune system went out the window with the [discovery of the follicular helper T cell \(Tfh\)](#) which is truly the type of T helper cell involved with antibody responses, not Th2 as the very-wrong-and-oh-so-outdated model described by vaccine critics.

It was once thought that Type 1 responses were *only* of the **cell mediated kind** [cell mediated responses release cells like phagocytes – the 'pac man' cells that eat and destroy foreign invaders, cytotoxic T-lymphocytes – a type of white blood cell that 'poisons' the foreign invader and cytokines – which regulate, modulate and act as mediators and promote or suppress inflammation] and Type 2 responses could *only* produce **antibodies**.

Vaccine critics therefore proposed that vaccines overstimulate Type 2 responses; therefore Type 1 responses become 'lazy'. However Th1 and Th2 responses actually [overlap and interact with each another](#). Scientific studies have established that Type 1 responses are not strictly cell mediated and Type 2 does not just stimulate antibodies. Type 1 cells can also stimulate antibodies and Type 2 responses can order other cells around. [T1 and T2 actually work together in a dynamic relationship](#), giving and receiving feedback to one another. They regulate each other's function and are capable of coordinating a variety of immune responses. Each can elicit both cell responses *and* antibody responses. It's an extremely complex area of immunology.

Aside from that, it just doesn't make sense that vaccinating for a mere fourteen diseases would significantly decrease the immune challenge a person is exposed to. [There are literally thousands of infectious pathogens](#) including rhinoviruses, adenoviruses, parainfluenza viruses and bacterial pathogens, many of which you are exposed to on a daily basis, through breathing,

eating or cutting your skin, which can exercise your immune system away from any perceived bias.

Myth 4: (ties in with Myth 3) Vaccines overstimulate one part of the immune system and weaken another, and this is why we are seeing an increase in allergies, asthma and autoimmune diseases.

This myth has no basis and studies actually show that [vaccines do not increase the risk for allergic diseases](#). It is an established fact that children in developing countries are less likely to develop allergies such as eczema and asthma compared with children in developed countries. And this is very likely because children in the developing world are more likely to be exposed to and challenged by worms and parasites as well as pathogen-producing bacteria and viruses early in life – the very part of our immune system that is not getting much exercise. This is known as [the hygiene hypothesis](#).

The incidence of food allergies in developed countries has also increased. Early exposure to food antigens may be an additional important factor in the prevention of food-borne allergies. Early familiarisation may mean a tolerance and an affinity is developed. [It is no longer advised that you delay feeding your baby solid food](#). Recent research shows there is [no benefit from delaying the introduction of solids longer than 4 months](#).

There are other reasons why an increase in allergic disease has more to do with the hygiene hypothesis and nothing to do with vaccination, the biggest being that vaccine preventable diseases occur independently of the level of hygiene in the home and sanitation level of the country. Measles, mumps rubella and chicken-pox occurred almost universally in every household, regardless of the country they lived in, before vaccination programmes began to eliminate these diseases.

And so there is the key. Our highly sanitized, first world lifestyles are preventing gut exposure to germs, worms and parasites which exercise our IgE antibody system and prevent allergic disease, and upregulate other parts of our immune system as well which play a role in prevention of autoimmune diseases. Our IgE antibody system is the part that overreacts when a generally harmless, common and non-infectious substance comes along, setting off an allergic reaction. Asthma and allergic reactions result from an overproduction of histamine sparked by an overreaction by the IgE antibody system. The body then produces inflammation, mucus, swelling and sometimes a rash.

So what kind of antibodies are produced with vaccination? And would these be the same type that are made if the exposure occurred naturally?

The immune system responds to an antigen whether exposed in the wild or through ‘artificial’ means – vaccination. It’s just that different parts of the body specialize in making a particular antibody. One memory B cell (the cells that remember the vaccine or the infection) can give rise to many antibody producing cells. Each antibody producing cell will produce antibodies of a particular type (A, G, E, M or D), depending on the location in the body. For example most ‘IgM’ (immunoglobulin M) and ‘IgG’ type antibodies are found in the blood circulation. ‘IgA’ type antibodies are found in mucosal surfaces eg the gut, the lungs, nose and mouth. Depending

on the germ and site of the infection, the body will *prefer* to make one antibody type over another.

Vaccines taken orally (like the oral polio vaccine and rotavirus) will induce production of IgA antibodies. Vaccines injected intramuscularly will induce IgG. [Vaccines have been studied and tested to ensure the best route to provide the best immune response](#) with the least side effects. The body is equipped for disease entry or antibody production from vaccines regardless of the route.

The antibodies produced through vaccination may be qualitatively different to those produced through natural exposure, but it doesn't matter as they are *cross protective*. For example, if you are exposed to pertussis naturally the pertussis bacteria enters your nose stimulating an IgA antibody response in your mucosal linings and secretions. A pertussis vaccination will stimulate production of IgG antibodies near the surrounding muscle that will circulate in the bloodstream.

Even though the antibody types from natural infection differ to vaccination, it can be enough that there are pre-existing antibodies, even if they're not of the same isotype that an initial infection would produce. When it comes down to it, vaccine-induced immunity is *always* qualitatively different to that induced by an infection. But that doesn't change the fact that vaccines are effective. This is proven in the data we see in population level studies.

Another example of cross protection is when the switch was made from oral to injectable polio vaccination. The oral polio vaccine stimulates a good gut IgA response. However it's live-attenuated and so comes with a very tiny risk of developing paralytic polio. The inactivated polio vaccine is injected and promotes a good circulating IgG response, without the same risk. This circulating IgG means that on exposure, a person will be protected from systemic polio infection, as pretty much the whole circulatory system has some anti-polio antibodies, but that person could still get a gut infection, and pass it on, before developing enough of a local response to clear it from their system, whereas the IgA response from the oral vaccine helps prevent that initial colonisation in the first place.

It should be no surprise that disease pathogens that enter via the skin (tetanus, rabies, chicken pox) can be defended against via vaccines injected into the skin.

As for the increase in autoimmune diseases being due to vaccines, this theory doesn't make sense either. Indeed, the evidence has rejected the link between vaccines and most autoimmune diseases. Only in a few extremely rare cases has a particular vaccine been implicated in triggering an autoimmune disorder.

[Guillain-Barre syndrome](#) was associated with a small increase in risk with a particular 1976-1977 swine flu vaccine. [Autoimmune thrombocytopenia](#) has been reported after measles vaccination, but with a much lower frequency than that seen after wild measles virus infection (one in 30 000 vs one in 5000) and the MMR associated condition is self-limiting, recoverable and non-life threatening.

There is [nothing to support the theory that vaccines are associated with an increased risk of multiple sclerosis or Type 1 diabetes](#).

The increase in autoimmune diseases is also highly likely to do with the hygiene hypothesis. [The infections thought to play a role in the hygiene hypothesis have nothing to do with vaccination, and include several species of bacteria and a variety of parasitic worms, or helminths.](#)

Vaccines are injected but this does not make them dangerous. They do not overstimulate the immune system, nor do they weaken the immune system. They exercise and prepare the immune system for a specific attack against a specific disease.

There are diseases that infect via your airways (pertussis, diphtheria, measles, influenza, chicken pox) but giving a vaccine into muscle can provide blood antibodies to prevent infection from these respiratory illnesses. There are diseases that infect via the stomach and gut (polio, rotavirus etc) AND so giving a rotavirus vaccine orally makes sense in terms of building protection, but polio protection can be given either orally or injected. Rotavirus vaccination is only effective when given orally.

If you think obtaining 'natural immunity' is better, you are assuming that your child's immune system is strong enough to fight off the diseases naturally. If that is the case, then it's strong enough to fight off the tiny amounts of dead or disabled pathogens present in vaccines.

Ingestion vs injection is irrelevant as an objection not to vaccinate. The risks from vaccines are outweighed a million fold by the risks from the diseases we vaccinate against.

Credit: This article was compiled and written by me after nearly two years worth of collaboration and consultation with medical doctors, epidemiologists, microbiologists, virologists, immunologists, biologists and other scientists.