Vaccination and Immunity

BIO 228 Term Paper

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I grew up in a house in which my parents were old enough to remember the nightmare that was polio. Now ask yourself, when was the last time you heard of a patient ending up at Munson for Polio? Nowadays, there's just a few isolated cases of it that have popped up in the last 60 years, with the most recent one in the United States having been found in NYC in 2022, which was almost certainly contracted abroad. In recent times, however, we've dealt with an entirely different nightmare, Covid-19.

If you're reading this prior to 2040, I doubt that I need to remind anyone reading this of what happened in the early part of 2020. The lockdowns were a necessary nightmare that will soon be forgotten. This is because of how contagious Covid-19 is, and how lethal it is to the elderly and immunocompromised. In order to offer the masses a means of protection, and in order to return our society to a state of normalcy, there was a rush to develop a means of vaccinating against Covid-19.

I. https://medlineplus.gov/genetics/understanding/therapy/mrnavaccines/

The method of choice in the development of the vaccine was to go for an MRNA vaccine. This type of vaccine works by taking a piece of Messenger RNA from the surface of a virus and introduces it to the body of the vaccinated individual. Once inside, the body's neutrophils rush to the site of the injection, recognize the antigens, and trigger the body's B-lymphocytes to begin producing antibodies.

While the mRNA approach started off experimentally, this approach has luckily worked out. However, because of the rapid pace at which technology was developed, many were concerned about the overall safety of the vaccines.

II. https://www.nejm.org/doi/full/10.1056/NEJMra2206573 (Copy and paste) and https://www.nature.com/articles/d41586-021-01557-z

Linda Brown was going to get her son vaccinated against Covid-19 back in August, but backed out at the last second for this exact reason, as well as how many who are vaccinated against Covid-19 are still contracting it. My response to her concerns is as follows.

Yes, the Covid-19 vaccine was developed over the course of about a year, whereas most other vaccines are developed over the course of a decade. However, to cite a University of Maryland article on Covid Vaccine Development, they still go through the same studies and testing as other vaccines. In the case of Covid-19, ***Emergency Authorization*** was used in order to expedite the process. So things that would normally be shelved for months or years at a time, were prioritized in order to address the crisis at hand.

As for her concerns about individuals who've been vaccinated against Covid developing it and showing symptoms. That does happen, as it does with many other viruses. However, the symptoms are often comparatively muted as people who've been vaccinated have an ***innate*** immunity to Covid, are protected against the more severe symptoms of the virus.

Now, she is probably also wondering why there is a need to administer booster doses of vaccines. After all, if the vaccines already provide protection against a virus, why does it deteriorate over time?

After an initial infection, the T/B cells that were used to combat it are placed into a dormant state. These cells remain dormant within the body, and provide the host with a degree of protection against the virus. The purpose of the booster is to trigger this pre-existing response and strengthen the host's preexisting immunity. And thus, hopefully I would alleviate some of Linda's fears with this explanation.

Herd Immunity

Now, with that said, The ultimate goal of vaccination, on a mass scale, is to achieve herd immunity. This is the phenomena where by having X% of a population immunized against a particular pathogen, we are able to have a reasonable degree of protection for the remaining population. Did this happen with Covid-19? Yes and no. The goal was to get approximately 70% of the population vaccinated against Covid-19 (gao report Sept '23). This happened in some places, but was not widespread enough to have been considered successful. However, we've reached a point as a society where Covid-19 is no longer considered to be the existential threat that it once was. And in that way, could be said to have achieved herd immunity.

While the focus of this paper has been Covid-19, it's worth remembering that vaccines have saved millions of lives in the last century, and will continue to in the world moving forward. Diseases such as smallpox and polio, that were once feared as plagues have been all but eradicated by them, and conditions like measles and others are under control due to them. And the simplicity of it is amazing. After all, the fact is that by introducing a tiny sample of viral DNA into the body, we are able to trigger a long lasting immune response is incredible. And why vaccines will be a part of the medical landscape moving forward.

I have basically been working non-stop since the 7th, and in a bit of exhaustion, did not see the bit of the length, or immediately recognize that I could've answered the above with single paragraph responses.

Answers of A-C

A:

Covid-19 is the virus that was responsible for causing the Covid-19 pandemic that stretched from early 2020 to 2023, with the peak occurring between winter of 2020 and spring of 2021. It primarily functions as a respiratory virus, spreading by way of aerosolized droplets, and infecting the lungs of the patients who contract it. As a result, it primarily kills its victims through viral pneumonia, and an inability to clear their lungs. Luckily in most cases Covid-19 is a mild disease. Something that symptomatically resembles a cold or a low grade flu. Which led to the common joke amongst young people of being the "one cold that *could* kill you".

Were that the case for everybody, Covid-19 would've remained a joke, instead of being the global nightmare that it ultimately was. There are two populations that are particularly vulnerable to Covid-19. The elderly (people over the age of 65), and the immunocompromised. The reasons for this are the same as the mortality rate(s) for other infectious diseases, people who have compromised immune systems are unable to fend off the disease and succumb to it. Now, the kicker is this, Covid has about a 3-5 day incubation period in which you can have/spread it, yet not be symptomatic. Which is what made it so dangerous to the elderly/ immunocompromised. And it's why there was the effort that there was to rapidly develop the vaccine.

B:

The quick 4-1-1: Vaccines work by introducing an insert sample of a pathogen into the hosts body in order to create a limited immune response.

In the case of the mRNA vaccines that were used to combat the Covid-19 pandemic, this involved taking a sample of the *surface antigen* that is found on the Covid-19 virus, distilling it into the vaccine, and injecting a sample of said vaccine into the patient. At the site of the injection, *neutrophils* rush in to absorb the foreign bodies, and encode the pathogen's presenting sequence. This information is then taken to *B/T cells, which form antibodies,* attack the pathogen, and create the underlying immunity.

Now, as discussed in the above article reviews, what is the point of getting a vaccine if you can still get the disease you're vaccinated against? After all, isn't the point of getting a shot to become immune to a disease? And to a certain extent why did I get sick/feel awful after getting the shot?

Vaccines create a limited immune response. So the symptoms of a slight fever, feeling lethargic, like one had their butt kicked by a night club bouncer, are basically the responses that the body would otherwise have to the initial infection of the virus. Now, let's just assume for a moment that you're a vaccinated person who has caught the latest strain of Covid, that it's an offshoot of the version you were vaccinated against, and that you're just stressed out enough to catch it. You're probably going to feel awful for a day or two. But because you already have *acquired immunity* to the

base virus, you're probably going to have a reaction that is a lot more like the one you had to the shot, instead of ending up on a ventilator in the intensive care unit.

Conversely, imagine the same symptoms that you'd experience with the vaccine. Now give the idea that you lack a preexisting immune response to the virus a thought. Your body wouldn't know how to respond, and the virus would have a chance to spread, and infect the rest of your body. Not a pleasant thought now, is it?

C:

The aforementioned patient is actually about a year younger than my actual father was when the Covid vaccination effort began, and with the same underlying health profile. Now I did not have to convince my actual father to get the vaccine. But I had to I would structure my argument as such.

"You're already in your 60s. And while I know that you're in good health, and happy with how it's going. I think we'd be making a mistake to not address a few things. For one. You're at an age where things could go from 0-360 because of one event. Covid-19 is famous for being a kicking off point for major health concerns in people of any age. According to a report published by the CDC, you're also right on the precipice of where more than half of all Covid hospitalizations and deaths occur. So with that in mind, is a tiny prick that bad?"

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