Polio Biology VI
The Polio War and Vaccine Strategy

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The beginning of the end for polio arrived in 1955 when the Salk vaccine was released for general use. The Salk vaccine is a concoction comprised of killed polio virus yet it still retains the capacity to stimulate the immune system to produce humoral immunity to live polio virus. Humoral immunity means that the immunity is restricted to the blood. A person with humoral immunity is protected from live polio virus migrating from the intestine, where it begins multiplying, to the Central Nervous System, where it does lasting damage. The Salk vaccine is produced by subjecting live virus to formaldehyde until it is damaged enough to prevent it from causing a polio infection but not damaged enough to prevent it from stimulating an antibody response in the blood. It is delivered by injection intramuscularly. During those early years of Salk, from 1955-1961, there were many cases of polio, a significant number of which occurred in individuals who had already been vaccinated with the Salk vaccine. Like all vaccines, it wasn't 100% effective, and in the midst of an epidemic it slowed the rate of infection somewhat but didn't eliminate new cases of polio as quickly as we would have liked.

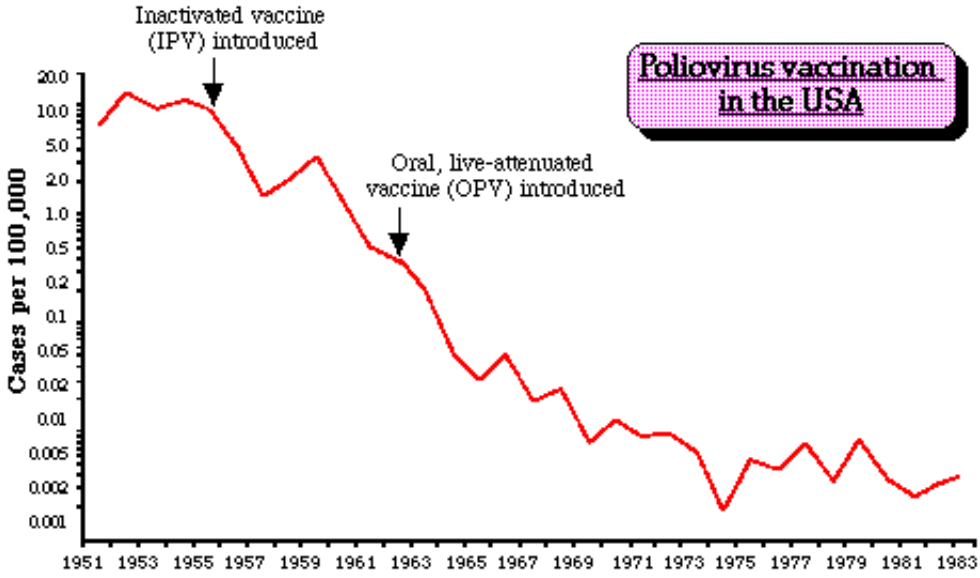
The only other way to produce immunity in 1955 was to become infected with polio and recover from it. This produces a stronger and longer lasting "active" immunity. The body responds with a potent immune response if it is infected with a live polio virus. But even if you became infected naturally and recovered, you would have strong immunity to only one of the three strains of polio, the strain you were infected with. The Salk vaccine would give you a weaker but effective "active" immunity and it would work against all three polio strains because the vaccine is trivalent (which means it contains all three strains).

The use of vaccines like the polio Salk vaccine to immunize an "individual" against a polio infection is only one of the considerations of an epidemiologist trying to eliminate the disease from a "population". The Salk vaccine produces humoral immunity so it protects the inoculated individual, but how well does it protect the "population"? How well and how fast can it diminish the prevalence of polio? During an epidemic the virus is entering and exiting hosts. Some individuals have "silent" infections and never show symptoms. Some have mild symptoms that abort and resolve quickly while others have muscular symptoms without paralysis.

Of course, in an epidemic, many develop lasting symptoms of paralysis. The common thread that runs through all of these categories of polio is that in each type the virus enters the body orally, grows in the small intestine, and exits in fecal material. In order to stop an epidemic you must concentrate on interrupting this virus life cycle. You must stop the virus from multiplying and exiting the body. This

reproductive process is the mindless engine of a polio epidemic. This is also what epidemiologists think about when they want to stop an epidemic. It is interesting to note that the epidemiologist is thinking about prevalence in populations while most of us are thinking about infected individuals.

In 1961 Albert Sabin's live polio vaccine was introduced in the United States. This vaccine is different than the Salk vaccine in that the polio virus is alive, can infect individuals, but is attenuated (weakened) so that the virus becomes impotent to harming the Central Nervous System, except in extremely rare cases. There is a low, but finite chance of contracting paralytic polio from Sabin live virus vaccine. The chance of infection is in the vicinity of 1 in a million or so vaccinations. This past year the Centers for Disease Control in Atlanta recommended that all new vaccinations in the United States be done with the Salk vaccine since there have been no cases of natural polio in the Western Hemisphere in years. The CDC recognized that Sabin vaccine associated cases of polio were the only cases that had occurred. It made more sense to avoid vaccine related cases and to use the dead virus Salk vaccine which produces good blood (humoral) immunity to protect individuals. The epidemics of the past were gone.



Source:"Summary of Notifyable Diseases--United States, 1992" in Morbidity and Mortality Weekly Report,41(55):46, September 1993, CDC, Atlanta, Georgia.

What is the advantage of the Sabin live vaccine then? Should we get rid of it all? Can it offer any advantage in the war on polio that cannot be had with Salk vaccine? The Sabin vaccine is the epidemic killer. It is the vaccine that can go beyond protecting an individual. It interrupts the life cycle of polio virus. Sabin is given orally and infects the small intestine. Once this begins the body responds with a cascade of biochemical events triggered by this gut infection. The end result is high cellular and antibody mediated durable immunity inside the intestine. So, if wild polio happens to be ingested it is killed in the gut. It cannot multiply and be eliminated in fecal material. The life cycle of the virus is stopped. The Salk vaccine does not do this. One can be immune from paralytic polio due to the Salk vaccine and yet still take in wild virulent polio, have it multiply in the gut, and eliminate millions more live wild polio virus particles into the environment to infect others. Epidemiologists have speculated that we might still have epidemic conditions in the Western Hemisphere now if it were not for the Sabin vaccine. It can put out the fire of an epidemic affecting a population, producing gut as well as humoral immunity, and even be passed on to others who may develop some immunity even though they have not been vaccinated. Of course the price of all this is the rare yet tragic cases of vaccine related polio. But in the face of an epidemic, as we now have in Angola, Sabin will work there as it did in the United States and continues to in those regions of the world where the polio virus can still spread rapidly through an unprotected population. Soon there

will be a glorious day when we will have eliminated polio. I hope that when this comes to pass we all understand that the most potent weapon we had in our arsenal against polio virus proliferation and spread, was the epidemic killing Sabin vaccine.

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