Is Polio Coming Back?

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Date : September 12, 2023

It was an unwelcome surprise in 2023 when the news broke that Canada had detected the polio virus in wastewater. The Canadian sample analysis was reported to the WHO in December of 2022 as part of a follow-up investigation after the polio virus was found in the US in 2002 in New York State (PAHO, 2022). Yes, the polio virus is still around even though it has almost been eradicated. The key word is “almost”; out of the three wild types, two have been declared eradicated, and the last one is still seen in Afghanistan and Pakistan (PAHO, 2022).

Now, even though we were, or still are, very close to eliminating the wild-type poliovirus, another source has appeared over time. The “new” poliovirus causing outbreaks is a vaccine-derived poliovirus type (VDPV). The keyword is “vaccine-derived,” and it requires a little bit of background and history of our fight against the poliovirus to understand.

Polio Paralyzed More Than 1,000 Children Every Day Before The Global Initiative Started

Polio or poliomyelitis is a highly infectious disease caused by the polio virus. The virus attacks the central nervous system and damages nerve cells that are necessary for muscle function. One of the severe consequences is paralysis in children. Polio is not necessarily high on our agenda anymore since the global polio eradication initiative has reduced global incidence by 99%. It is worthwhile noting that polio paralyzed more than 1,000 children every day before the global initiative started (Polio Global Eradication Initiative, 2022). With such a success rate over the decades, what is happening that we see poliovirus in North America again?

Over the years, polio symptoms have been caused by mutated viruses originating from the vaccine-derived polio virus used in the oral polio vaccine (OPV). The vaccine strains used in the OPV are attenuated, meaning they are weak but still active viruses that can infect cells and replicate while also inducing an immune response. However, they do not have severe symptoms and outcomes. Because of their strong immune response and ease of application (oral) they have been the cornerstone of polio vaccination since the 1950s.

The question is, how can a vaccine-derived polio virus cause poliomyelitis? While the vaccine strains are weakened (by intentional mutation), they can regain their full infectivity if allowed to replicate, mutate and/or recombine with other viruses. One of the key benefits of the OPV is that the virus is being shed and can be used to induce immunity in others. However, if OPV is used in severely under-vaccinated populations or immunocompromised individuals are exposed, the virus's full ability to replicate and become highly infectious again through repeated replication cycles in new hosts is potentially enabled (Polio Global Eradication Initiative, 2023). This has been seen now for many years, where VDPV2 (vaccine-derived polio virus type 2) has appeared and caused cases of poliomyelitis. In fact, a recently

released study has shown VDPV2 in many countries for a number of years (Yi et al., 2022). This “circulating” vaccine-derived poliovirus, or cVDPV2, is the only form of polio virus currently affecting the African region.

Why not stop the use of attenuated virus vaccines if they can mutate back?

One of the other advantages of the attenuated polio vaccine is its strong immune response and ease of application. However, because of the risks of potentially becoming more virulent again, many countries have stopped using OPV and only apply the inactivated poliovirus vaccine (IPV), administered via an injection. Because the IPV does not replicate, it must be administered directly into the vascular system to initiate an immune response, while the OPV infects cells in the lower intestinal tracts and, through limited replication, triggers a robust immune reaction and is eventually eliminated from the body. During the replication phase, OPV is also shed in the fecal matter, and that is how it can spread to others, via a fecal-oral transmission route. That’s the same with the wild-type poliovirus. This is the most likely explanation for unvaccinated individuals in the US becoming infected without even having received OPV. (Link-Gelles et al., 2022)

Covid-19 Pandemic Resulted In A Significant Drop In Vaccinations Worldwide

Unfortunately, the COVID-19 pandemic resulted in a significant drop in vaccinations worldwide, and it is time to catch up. This can be done with IPV in developed countries with robust children's immunization programs. In developing countries, a combination of OPV and IPV is preferred, and the development of a new OPV that is far less likely to convert, combined with the ease of application, will certainly help.

Now, back to the initial question: Is Polio coming back?

Maybe it never really left, and it not only lingers around but has shown a resurgence through our own activities, as laudable as they are. On the other hand, we have the tools to get rid of it once and for all. It’s a matter of will and resources. On that note, what scares me the most is the huge stockpile of polio samples worldwide in laboratories. But that’s another story for another time. In the meantime, here are a few take-home messages:

1. Vaccinations are most helpful if they are made available to all in a similar time frame. As we have seen with COVID-19 already, vaccinating one part of the world does not help folks in other parts. On the contrary, it can make it actually worse.
2. Viruses don’t wait for us. When they replicate, they very often change and not for the better.
3. Any lapses or postponement of needed vaccinations will cause problems in the future with less immunized populations.
4. Attenuated vaccines must have several safeguards to prevent the virus from regaining its full strength again, especially in out-of-control replication situations.
5. Applying new vaccine strategies like mRNA or viral vector vaccines can help prevent the resurgence. However, the application method is as important to reach the world population.

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