Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Polio eradication: what kind of world do we want?

Achieving the 1988 World Health Assembly commitment of global eradication of poliomyelitis[1] will require ending the transmission of all three types (1, 2, and 3) of wild polioviruses and use of oral poliovirus vaccine (OPV).[2] Although extremely rare, OPV can cause vaccine-associated paralytic polio in immunologically naive recipients or close contacts upon first exposure.[3] In addition, when used in populations with low immunisation coverage, OPV can continue to circulate, instead of dying out, and lose its attenuating mutations as it spreads.[3] Continued transmission of OPV-related viruses can lead to polio outbreaks caused by circulating vaccine-derived polioviruses (cVDPVs) that behave like wild-type polioviruses.[3]

Countries and the Global Polio Eradication Initiative (GPEI) have made substantial progress toward polio eradication,[4] although as of early 2020 (before the COVID-19 pandemic was declared), GPEI was not on-track to succeed by the target year of 2023.[5] One major victory came with the last reported case caused by type 2 wild poliovirus in 1999, and certification of global eradication of indigenous type 2 wild poliovirus transmission in 2015.[6] After an extensive, multiyear planning process, GPEI globally coordinated the cessation of all routine use of type 2-containing OPV (OPV2) in April–May, 2016.[7] OPV cessation represented an essential step toward the promise of a world free of type 2 polio, but unfortunately OPV2 cessation did not end type 2 polio. Before OPV2 cessation, some countries failed to stop transmission of existing type 2 cVDPVs (cVDPV2s) or to achieve sufficiently high population immunity to prevent their emergence after OPV2 cessation, which necessitated outbreak responses using monovalent OPV2 (mOPV2) after mid-2016.[8] After OPV2 cessation, other countries reintroduced mOPV2 in response to outbreaks or environmental evidence of type 2 transmission.[8] In 2020, more than half of the 1073 global reported cVDPV2 cases occurred in 20 African countries (figure A), which far exceeded the 140 reported global cases of type 1 wild poliovirus in 2020. In early 2020, the increasing annual number of cVDPV2 cases reported since 2018 (figure A) and atypical outbreaks in 2019[8] led GPEI to restart OPV2 production.[5] Since 2016, 24 countries in Africa have reported cVDPV2 cases (figure B).

In *The Lancet Infectious Diseases*, Laura V Cooper and colleagues statistically model epidemiological data from 51 African countries to characterise median changes (with IQRs) in type 2 polio immunity in children under 5 years old for 6-month periods between January–June, 2016, and January–June, 2020.[9] Consistent with the timing of OPV2 cessation and

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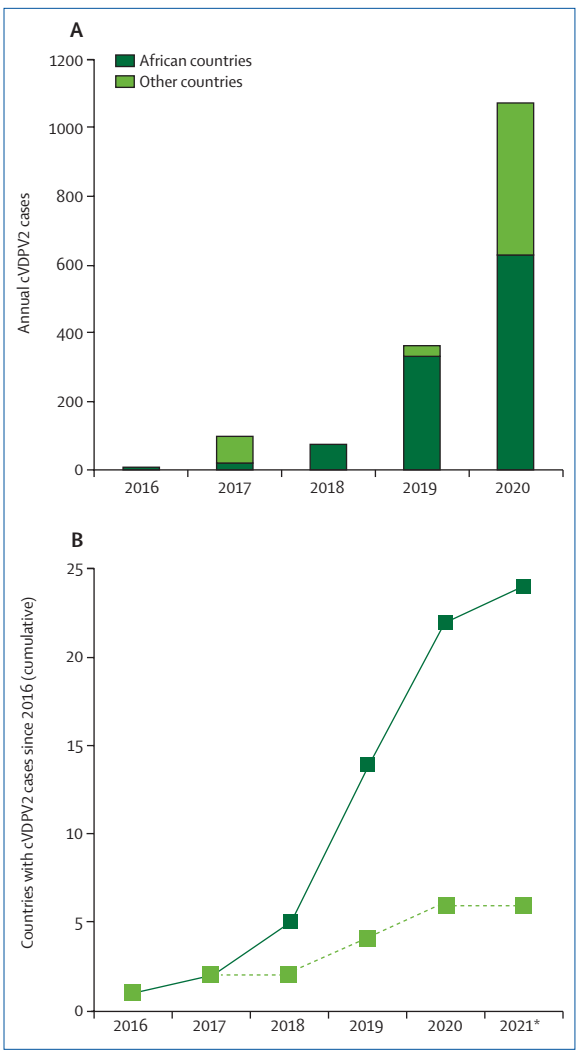

Figure: **Type 2 polio trends after OPV2 cessation**
Data source: WHO. (A) Reported annual cVDPV2 cases for 2016–20 in Africa and all other countries. One case each were reported in Nigeria and Pakistan in 2016. (B) Cumulative number of countries that reported at least one cVDPV2 case since 2016 in Africa and all other countries between June 1, 2016, and Sept 14, 2021. cVDPV2=circulating vaccine-derived type 2 poliovirus. *Up to Sept 14, 2021.

For **WHO data** see https://polioeradication.org/polio-today/polio-now/this-week/circulating-vaccine-derived-poliovirus/

the introduction of inactivated poliovirus vaccine (IPV), the analysis shows a substantial decline in OPV2-induced immunity in children under 5 years from 87% (IQR 81–93) in January–June, 2016, to 14% (9–37) in January–June, 2020, while IPV-induced immunity for type 2 for the same time period increased from 3% (IQR <1–6%) to 35% (IQR 24–47).[9] Decreased levels of OPV-induced and IPV-induced immunity represented notable risk factors for cVDPV2 cases in the next 6-month period.[9] Considering the role of mOPV2 outbreak responses, Cooper and colleagues report lower risks of cVDPV2 cases associated with mOPV2 use in the previous 6 months, and showed that outbreak response vaccination campaigns in Africa did not stop the spread of cVDPV2s.[9] Overall, they estimate that, within 6 months, the actual outbreak response campaigns in Africa covered only 11% of the predicted at-risk population of children under 5 years.[9]

Sadly, these sobering results should come as no surprise. Extensive prospective modelling done to support OPV2 cessation risk management identified threats and essential risk management strategies.[10] Notably, studies highlighted the need to increase population immunity in some countries using trivalent OPV before stopping OPV2,[10,11] and anticipated that IPV introduction could slightly reduce poliomyelitis cases in the event of outbreaks, although IPV use would not prevent or stop transmission, and could delay the detection, of cVDPV2s.[10,12] Other studies emphasised the need to respond aggressively to evidence of transmission of OPV2-related viruses with rapid, high-coverage, and sufficiently large mOPV2 campaigns to quickly shut down outbreaks;[10,13] and demonstrated the expected increasing vulnerability of populations to restarting transmission of type 2 polioviruses with increasing time since OPV2 cessation.[10,14] The analysis of epidemiological evidence by Cooper and colleagues[9] provides a retrospective confirmation of the predictions of the prospective models that anticipated the consequences of failures if poliovirus policy makers did not manage risks well.

What went wrong, and why was the GPEI not on track to meet targets even before the disruptions caused by the COVID-19 pandemic? While some might blame predictive models for suggesting that optimal outcomes were achievable, actual public health outcomes depend on the actions and decisions of policy makers and their implementation.[15] For example, prospective modelling suggested that aggressive mOPV2 use in well performed, rapid, and sufficiently large immunisation campaigns shortly after stopping OPV2 could shut down transmission,[13] and this strategy worked where implemented (eg, Syria).[8] However, as Cooper and colleagues showed,[9] poor implementation of cVDPV2 outbreak responses led to disappointing consequences in Africa. In addition, the unexplained emergences of OPV2-related viruses in Africa and Pakistan in 2019 raise even more difficult questions about OPV cessation and global poliovirus containment, and point to the absence

of accountability in a global programme that requires a winning strategy, aligned partners, effective tactics, necessary and sufficient resources, and meticulous management of globally interdependent risks to succeed.

As the post-COVID-19 polio endgame unfolds, global leaders need to decide how the world will manage the globally interdependent risks posed by some infectious diseases, including polio, COVID-19, and future pandemic threats, at a time of increased focus by some on non-communicable diseases, decentralisation, regionalisation, and nationalisation. The current situation with polio eradication and the global experience with COVID-19 show that the current management approach for globally interdependent risks, at least those posed by some infectious diseases, is not working. The analysis by Cooper and colleagues[9] should serve as a reminder that polio is still not gone, including from Africa, despite its recent victory of regional certification as free of transmission of all three types of indigenous wild polioviruses—and that the world continues to miss an opportunity to rid current and future generations of a once terrifying disease. Despite many setbacks, eradication of polio is possible in our highly imperfect and inequitable world if global leaders can negotiate the path as they once did with smallpox. Now is the time to ask: what kind of world do we want, and how do we get there from here?

I declare no competing interests.

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