Feedback from operational stakeholders who manage or respond to outbreaks is that they are often too busy to review literature or obtain relevant background information to assist them with acute response. Unlike a traditional analytical outbreak investigation report, ***Watching Briefs*** *are intended as a rapid resource for public health or other first responders in the field on topical, serious or current outbreaks, and provide a digest of relevant information including key features of an outbreak, comparison with past outbreaks and a literature review. They can be completed by responders to an outbreak, or by anyone interested in or following an outbreak using public or open source data, including news reports.*

Watching brief

Title	Re-emergence of poliomyelitis in the Ukraine, caused by circulating vaccine-derived poliovirus type 2 (cVDPV2)
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Date of first report of the outbreak	On October 2nd, 2021, the first human case was notified by the WHO (1)
Disease or outbreak	Circulating vaccine-derived poliovirus type 2 (cVDPV2)

Origin (*country, city, region*)	The current outbreak in the Ukraine is reportedly linked to an isolated strain of the virus affecting both paralytic cases and their contacts that originated in Pakistan. Notably, this was also the cause of several cases from Tajikistan in 2020-2021 (2).
Suspected Source (specify food source, zoonotic or human origin or other)	The source is still under investigation. However, human-to-human transmission is suspected due to the use of oral poliovirus vaccines (OPV) which contain a genetically unstable live-attenuated Sabin poliovirus strain (3). Due to genetic instability and the virus being excreted in the faeces, cases of vaccine-associated paralytic polio (VAPP) and circulating vaccine-derived polioviruses (cVDPVs) can occur in countries or regions with lower immunisation rates and poor sanitation (4).

Date of outbreak beginning	On September 1st, 2021, the onset of acute flaccid paralysis (AFP) in the first case was reported (5).
Date outbreak declared over	Ongoing
Affected countries & regions	Two Oblasts in Ukraine have been affected. 1. Rivne Oblast 2. Transcarpathia Oblast
Number of cases (specify at what date if ongoing)	Two confirmed cases of AFP caused by cVDPV2 in Rivne Oblast and Transcarpathia Oblast, Ukraine as of March 29th, 2022, (2, 6, 7). Confirmed cases of cVDPV2 without AFP linked to the index case in Rivne Oblast include 7 household contacts (siblings) and 8 community contacts in Rivne Oblast, plus 4 cousins from Transcarpathia (2). No further cases were isolated from the second case in Transcarpathia (7).
Clinical features	The initial clinical manifestations of poliomyelitis include numerous non-specific symptoms such as sore throat, fever, tiredness, nausea, headache and stomach pain that last for 2-5 days (8). However, over 70% of people who become infected with polio do not have visible symptoms (8). Progression to severe poliomyelitis involves symptoms affecting the brain and spinal cord such as paraesthesia, meningitis and paralysis (8). Severe poliomyelitis infection resulting in paralytic poliomyelitis can lead to permanent disability or even death due to progressive muscle weakness affecting the muscles supporting the respiratory system (8). Survivors of polio can develop post-polio syndrome (PPS) where decades after recovery, symptoms such as muscle weakness, lethargy and joint pain can re-appear (9). The clinical features in the current outbreak have been described in the first report in Rivne Oblast, where the 17-month-old unvaccinated infant reportedly became paralysed on the 1st September, 2021 (5). The second case in Transcarpathia of an unvaccinated 2-year-old boy reported symptoms on the 13th December 2021, then reported an onset of paralysis on the 24th December, 2021 (7).

Mode of transmission (dominant mode and other documented modes)	The dominant mode of transmission is human to human via faecal-to-oral and oral-to-oral routes through viral shedding (10, 11). Where sanitation is poor, faecal-oral transmission dominates, while oral-to-oral transmission is more common where sanitation standards are better (12, 13). Children become most at risk if the virus spreads to household items and toys, then into the mouth and finally into the gut where the virus multiplies (14). Outbreaks of polio caused by cVDPV originate from back-mutations of OPV caused by vaccine serotypes 1, 2 and 3 (15). In rare situations, though particularly where vaccine coverage is very low, the live attenuated virus is shed into the environment by those who have been vaccinated and can mutate while continuing to be strong enough to infect (16, 17).
Demographics of cases	**Ukraine** - Rivne Oblast: one seventeen-month-old girl with AFP and 19 close contacts without AFP - Transcarpathia: one two-year-old boy with AFP
Case fatality rate	The case-fatality rates (CFR) reported for paralytics cases range from 5-10% in children and from 15-30% among adolescents and adults (18). In the current outbreak the CFR is 0%, as of March 29th, 2022.
Complications	The known complications rate in poliomyelitis cases is 1% for developing paralytic poliomyelitis (19). Of those diagnosed with severe poliomyelitis, 5-10% die when their breathing muscles become immobilised (20). Of polio survivors 25-40 out of every 100 develop PPS, however, unlike poliovirus, PPS is not contagious (9). In this outbreak, the complications have been severe, with two of 21 cVDPV2 cases being diagnosed with AFP (5).

Available prevention	Poliomyelitis is a vaccine preventable disease. There are two available vaccines – the live virus oral polio vaccine (OPV), and the inactivated polio vaccine (IPV). The preventative measures currently in place in Ukraine are routine immunisation through the free national immunisation schedule. It recommends 6-doses at 2, 4, 6 and 18 months, 6 and 14 years of age (21). The Ukraine recommends the first two doses be IPV with the remaining four doses OPV. In response to the outbreak, the Ukrainian government initiated the Ukraine Polio Outbreak Response Plan (21) to help boost vaccination coverage after several years of low vaccine uptake, This commenced on February 1st, 2022 (22). Additionally, the provision of clean water and improved hygiene practices and sanitation are vital for reducing the risk of transmission (19).
Available treatment	To date there is no cure or antivirals available, and the progression of disease is multifactorial, depending on the severity of acute paralysis, age of onset, and socioeconomic status (23). Only supportive treatments are available to manage the effects of the diseases through, antibiotics for secondary infections, pain relieving medications, portable ventilators to assist with breathing, medications to reduce muscle spasms and physiotherapy (24). In cases with severe disease in the acute phase, greater residual deficits are likely with the development of PPS in the future (25).
Comparison with past outbreaks	The Ukraine was certified polio free in 2002 after the last reported wild poliovirus case in 1996 (17). In 2015, an outbreak of cVDPV1 was reported in Transcarpathia in two unvaccinated children aged 10 months and 4 years on June 30th and July 7th respectively, with no linking features or further virus circulation (17). The last reported cVDPV2 outbreak was in 2016 in the Odessa province with one 3-year-old fully-vaccinated child being diagnosed with AFP, with no further virus circulation (1, 26). No fatalities were recorded in either outbreak. The geographical spread of poliomyelitis cases throughout the Ukraine from 2015 to the present included multiple areas of the country, with re-occurrence in Transcarpathia.

Unusual features	In 2017, the Ukraine was demonstrated as "the first country with a temperate climate, good sanitation, and generally well-developed, albeit problem-ridden health infrastructure to document a cVDPV outbreak" (17). It is clear this outbreak is not an isolated occurrence with potential for ongoing transmission to occur. More importantly, the current outbreak has occurred against the backdrop of suboptimal vaccination coverage across the Ukraine since the previous outbreak that saw a serious vaccine push across the country. Many factors could be contributing to this poor coverage, such as inefficient vaccine procurement, lagging legislation and practices, inefficient budget for health including immunisation, hostile anti-vaccine media environment and ongoing military conflict (17). Additionally, the source of the outbreak is not yet known, though sequencing has been linked to Pakistan which is over 3,785 kilometres away and an environmental isolate from Tajikistan which is also over 3,352 kilometres away (1, 27). For an outbreak to occur crossing multiple borders a link between the countries should be prevalent. Furthermore, the first recorded case during this outbreak in Rivne Oblast is 480 kilometres from Transcarpathia where the second case was recorded. Of interest, genetic sequencing of the latest detection in Rivne indicates this outbreak is unrelated to the 2015 and 2016 isolations (1).
Critical analysis	Poliomyelitis outbreaks have occurred infrequently throughout the Ukraine since 2015. Such outbreaks are directly attributed to suboptimal vaccination coverage. Chronic under-vaccination has resulted in the accumulation of susceptible children to polioviruses creating conditions favourable to cVDPV emergence and circulation in the Ukraine (17). In the absence of high vaccination coverage by inoculation with IPV, generated serum immunity against all three types of poliomyelitis cannot occur (28). Conversely, inoculation with OPV can also generate adequate levels of seroconversion, however, VAPP can occur due to the reversion of the vaccine strain to a more neurovirulent profile of a wild poliovirus with the use of OPV (28). In rare instances, such strains contained in the OPV have become both neurovirulent and transmissible, resulting in infectious poliomyelitis (28). Therefore, high vaccination coverage to reach herd immunity is required using IPV first as VDPVs arise when lower vaccinations rates are reported in countries using OPV. When higher vaccine coverage rates are reported, cases of polio do not occur. Vaccination coverage across the Ukraine took a sharp decline in 2009, from 91% in 2008 to less than 50% in 2014 to 15% by mid-2015 (17). This was caused by a failed measles-rubella vaccination campaign in 2008, when the death of a child was incorrectly attributed to immunisation (17). The current vaccine coverage in the Ukraine varies according to age and province, ranging from 70-96% for the most susceptible children under 1 year of age as of March 29th, 2022, up from between 40.7-48.9% on the 7th October, 2021 (29). A polio vaccine catchup immunisation campaign was scheduled to commence on February 1st, 2022. However, prior to this in early December 2021, Russia had begun initiating threats of war against the Ukraine by amassing military forces around the Ukrainian border. By February 24th, 2022, Russia had officially

	begun a strategic invasion of the Ukraine disrupting routine and catch-up immunisation programs and disease surveillance throughout the country. The current outbreak of cVDPV2 has spread across two different regions in the Ukraine with the index case of AFP from Rivne Oblast and a second AFP case from Transcarpathia (1, 6). However, no further circulation has been reported as of March 29th, 2022. The literature shows varying reports of the basic reproductive number to be between 5-7 for poliomyelitis (30). An additional 19 cases of cVDPV2 were reported as contacts of the index case with no cases linked to the second child. The vaccination history of these 19 cases remains unknown (6, 29). Interestingly, of the 19 contacts of the index case, 4 reside in Transcarpathia indicating there may be unknown transmission sites linking the second AFP case. Furthermore, reporting indicates the two cVDVP2 AFP cases may be linked, with a genetic similarity evidenced between both samples (6). Reporting within the EPIWATCH system on Ukraine has seen a dramatic decline since the Russia-Ukraine war commenced. Poliomyelitis, among other vaccine preventable diseases, may be spreading at a faster rate among children in homes, shelters and border crossings while attempting to flee the conflict. Furthermore, the conflict has hampered access to medical care for displaced citizens, limiting their ability to access life preserving and routine treatments. Additionally, COVID-19 case reporting has ceased in the Ukraine since February 18th, 2022, and with a two-dose COVID-19 vaccination coverage rate at 35.7%, the Ukraine is highly susceptible to an epidemic surge and potential for new variants to emerge (31). Finally, public health syndromic surveillance activities monitoring vaccine-preventable and other communicable diseases cannot operate effectively when reporting comes to a standstill, as it appears to have done in Ukraine.
Key questions	1) What can be done to mitigate the effects of the Russia-Ukraine war to resume vaccination programs including polio and COVID-19? 2) How can we monitor the re-emergence of poliomyelitis in the absence of public health surveillance in the Ukraine? 3) In the absence of formal polio surveillance, will open-source intelligence be enough to detect polio? 4) What risk mitigation strategies can be used to prevent further transmission of poliomyelitis among displaced children? 5) What can be done to protect vulnerable and displaced families throughout the Russia-Ukraine war to ensure continuity of care while preventing complications due to their medical preconditions?

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