BMJ

Polio: an end in sight?

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BMJ 2007;335;852-854
doi:10.1136/bmj.39367.426655.AD

POLIO: AN END IN SIGHT?

Eradication of polio is proving more difficult than WHO expected, as the recent outbreak in Nigeria shows. **Toby Reynolds** takes a look at the current global situation

By the end of 2001 a massive immunisation campaign had driven poliomyelitis out of all but a few isolated pockets of resistance, and the world looked set to rid itself of one of the most feared diseases of the 20th century. Cases of paralytic polio had fallen from more than 350 000 in 125 infected countries in 1988 to under 500 in 10 endemic countries in 2001: India, Pakistan, Nigeria, Afghanistan, Niger, Somalia, Egypt, Angola, Ethiopia, and Sudan.[1] Optimists hoped that the next three years would be entirely free of infection, meaning that by 2005 the virus could be consigned to history books alongside smallpox—the only disease to be eradicated by a vaccination programme.

Those hopes were dashed as the disease flared up first in 2002 in northern India, where vaccination efforts had been scaled back, and then in northern Nigeria a year later, after rumours that the vaccine caused infertility led to a sharp fall in coverage. These outbreaks meant the 2005 goal for a polio-free world was not met, even though it had already been put back five years. By 2006, at least 20 countries had become reinfected and the number of cases worldwide had risen to almost 2000 (figure).[1]

Signs of hope

However, things may be looking up. So far this year there have been 545 cases of polio, most of them in countries with endemic disease, compared with 1353 for the same period last year.[1] Eight countries (Nepal, Cameroon, Bangladesh, Kenya, Ethiopia, Namibia, Indonesia, and Yemen) that had polio cases in 2006 have not yet had a case this year, although they must have no cases for three years before they can be said to be polio free.

Dr Bruce Aylward, a Canadian epidemiologist and director of the World Health Organization's polio eradication initiative, says the programme has shifted its focus to the more virulent type 1 poliovirus and is now back on track.

"After our big setback in northern Nigeria and after problems with the efficacy of the vaccine in the northern part of India and the security issues in Afghanistan and Pakistan, we shifted our tactics enormously in late 2006," he said.

Previously the eradication effort had mostly used the trivalent oral vaccine, which protects against all three wild poliovirus types, he said. "We decided to go preferentially after the eradication of type 1 polio using a monovalent vaccine. Part of the problem with the trivalent oral vaccine is that the viral strains compete with each other. Type 2 tends to be the strain that you get the best serological response to, and that compromises the response to type 1 and type 3.

P VIROT/WHO

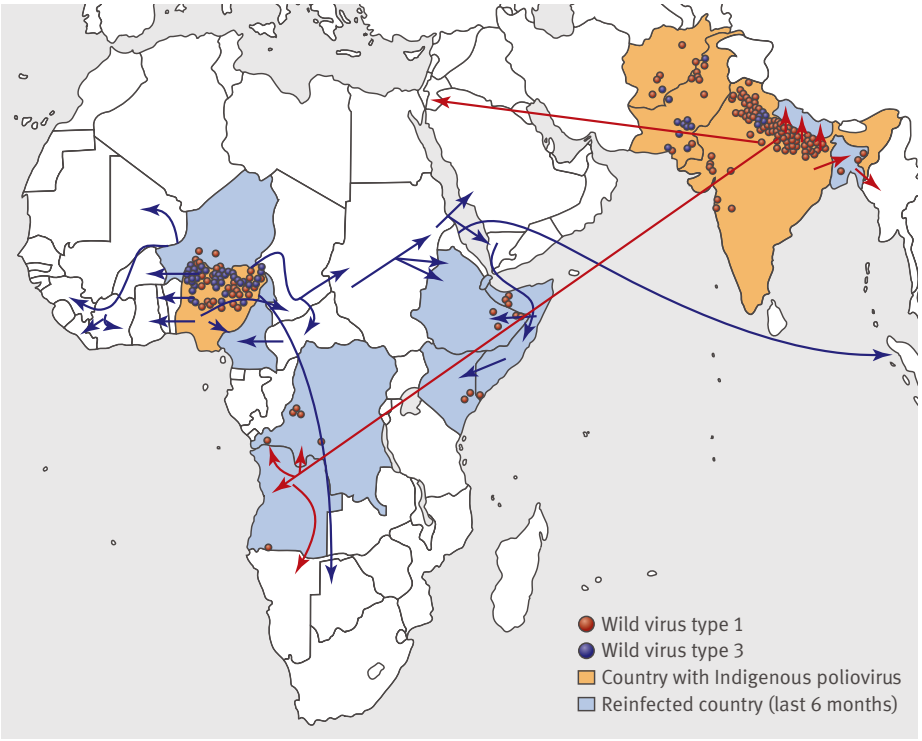
"Now in most places we do monovalent type 1 rounds and intersperse them with rounds of trivalent vaccine or monovalent type 3 vaccine just to keep type 3 under control while we try to get type 1 finished.

"As of mid-2007 there have been some major developments. Not only is type 1 way down around the world, but we are seeing hardly any international spread, and the key reservoir area of western Uttar Pradesh in India has now gone nearly 11 months without a type 1 virus.

"If this continues, we will soon be able to say definitively from a technical perspective that polio can be eradicated with the tools we now have available and the tactics countries are using to deliver them."

But with the major setbacks experienced, Dr Aylward is careful not to overstate progress: "It can turn around overnight, with a news story in northern Nigeria, with an outbreak of violence in Pakistan or Afghanistan, with the monsoons in India—whatever. It is fragile: that is the nature of an eradication programme." Dr Aylward said. "All those caveats aside, the programme is actually in very good shape and I think very few people would have ever expected that we would be where we are today given the setbacks of the last couple of years," he added.

The main requirements now are cash, mostly from rich countries that are free of polio, and political determination from those poorer countries that still have the disease. The programme has cost at least



International spread of wild polioviruses, 2003-2007 (data from Global Polio Eradication Initiative)

WILD VIRUSES

Poliovirus is a non-enveloped RNA virus, spread mainly by the oral-faecal route. Most infections are asymptomatic or resolve after brief feverish symptoms, but in a small percentage of cases the virus invades the nervous system and can cause irreversible paralysis, usually in the legs. It can strike at any age, but affects mainly children under 5 years. There are three types of wild poliovirus:

- Type 1 causes paralysis in about 1 in 200 infections. It also spreads most easily and was responsible for almost all of the reinfections seen in 2003-6
- Type 2 was last recorded in 1999
- Type 3 is found only in northern Nigeria, Afghanistan, Pakistan, and India. It is less virulent than type 1, causing paralysis in about 1 in 1000 cases.

Source: Global Polio Eradication Initiative.

$5bn (£2.5bn; €3.5bn) since it was started in 1988. "It is expensive. At this point we are spending $700m a year. That is going to be for a very short period, but that is what it is going to take to implement these massive campaigns and sustained global surveillance capacity to find polio and get it finished," Dr Aylward said.

Dr Margaret Chan, WHO's director general, called in February this year for a surge of donor commitment for the eradication drive, saying the world may never get another chance to rid itself of the virus. In particular the initiative is chasing funds from the G8 countries, which said in 2005 that they would support the eradication programme by at least continuing 2003-5 funding levels into 2006-8, but have yet to do this.

Questions of approach

"Not everyone is as optimistic as Dr Aylward," said Samuel Katz, emeritus chairman of paediatrics at Duke University in North Carolina, in the United States.

"There are optimists and pessimists," he said. "The pessimists say that despite enormous efforts, in some areas where there is intense crowding, where there are enormously high birth rates, where there is poor sanitation, and where children are infected with other intestinal organisms, seven, eight, or nine doses of the vaccine have not been successful in eradicating the virus, and population objection to these programmes is rising.

"They say that families are hiding their children from the vaccinators, and in some instances the vaccinators themselves have been attacked or driven away."

Despite the drop in number of recorded cases of polio this year, the WHO meeting in February this year did not set a new deadline to replace the 2005 target for disease eradication.

Going after a single disease with such determination may have other costs, points

ORAL VERSUS INJECTED VACCINE

- Polio immunisation can be achieved with a live attenuated oral polio vaccine or an inactivated polio vaccine, which has to be injected and is more expensive
- Until recently, the Global Polio Eradication Initiative predominantly used a trivalent oral polio vaccine that protects against all three wild poliovirus types but most efficiently for type 2 and least efficiently for type 3. In 2005 the initiative started using two new monovalent oral polio vaccines against type 1 and type 3, and this development has allowed its current strategy, focusing on type 1 polio
- Because the oral vaccines use virus that is weakened rather than killed, in rare cases the vaccine can cause disease in the vaccinated person or spread to others
- Inactivated vaccine cannot cause disease, but unlike oral vaccine, it triggers very little immunity in the intestinal tract. Although it protects against paralytic disease, it does not prevent the spread of the virus via stools
- Only oral vaccine is proved to stop polio transmission, particularly in tropical, developing countries, and it is thus preferred for controlling a polio outbreak, even in countries that exclusively use inactivated polio vaccine for routine immunisation.

Source: Global Polio Eradication Initiative.

out Dr Craig Burgess, senior programme officer for health systems strengthening at the GAVI Alliance, which brings together public and private resources to help introduce vaccines and bolster health systems to deliver them. "Everyone, of course, would like to see polio eradicated, and I believe that it is logistically and epidemiologically possible to eradicate polio. It is a question of at what cost," he said, speaking on his own behalf.

"When you initiate a disease specific initiative, such as polio or measles or others, it requires resources, both human and financial, and sometimes the political prioritisation of those single disease initiatives can skew the health priorities at global and country level."

In India, he said, there are 25-26 million children born every year who require new polio drops given to them. In areas of polio transmission, such as Uttar Pradesh and Bihar states, children must be reached up to eight times a year. "It takes one week to plan, one week to implement, two weeks to follow-up. Basically there are up to about 8 months a year in northern India when much of the health system is paralysed to deliver anything else," he said.

"I would argue that single disease priorities have generally weakened the health system in many different countries, to the extent where in northern India routine immunisation levels fell between 1999 and 2005," he added.

Dr Burgess predicts that people implementing disease specific approaches will require strong links with health systems planners to achieve a sustainable decrease in mortality. "The disease by disease approach is promoted by epidemiologists and quite often by politicians, because politicians and donors want to see instant impact for their investment, and it is much easier to do that with a disease specific approach."

A downside to the campaign in some people's minds is that the funding and energy put into wiping out polio might have had huge benefits if directed into other causes, such as control of malaria, HIV, or malnutrition, Dr Katz said.

He added that these concerns have started to make a difference to vaccine delivery campaigns. "More and more they have come to rely not just on polio immunisation. In parts of sub-Saharan Africa where malaria is a major problem they have tried to incorporate the distribution of insecticide impregnated bed nets," he said. "In a number of places they have added measles vaccine to the programme and vitamin A administration for children, and in other places they have incorporated anti-helminth medications. I think this has made it much more acceptable to people."

Single disease priorities have generally weakened the health system in many different countries

Donors' patience is also starting to wear thin. Exhorting donors to commit to eradication, Paula Dobriansky, US under secretary of state for democracy and global affairs, said earlier this year that the target was frustratingly evasive. "Donor fatigue is real. The WHO claimed we would have eradicated polio by a set date, not once, but twice before," she said.

Even a successful campaign that managed to wipe out wild poliovirus might not necessarily mean an end to vaccination, says Oliver Razum, an epidemiologist from Bielefeld University, Germany. "That creates the need for an apparently paradoxical post-eradication immunisation strategy," he said.[2]

Following such an "eradication," the continued existence of poliovirus in, for example, vaccine laboratories, would present a source of potential reinfection.

But the situation is complicated further by circulating vaccine derived polioviruses, which are rare but nevertheless caused at least nine polio outbreaks in the past 10 years, according to the global eradication initiative. One such outbreak is currently occurring in Nigeria and may damage community enthusiasm for vaccination.

Although outbreaks of vaccine derived virus have proved easier to contain than wild virus, these recent episodes indicate that widespread use of the oral polio vaccine to maintain immunity against accidental or deliberate release of poliovirus could potentially keep generating vaccine derived disease outbreaks. Maintaining immunity with injections of inactivated poliovirus instead, as some western countries have done, would be much more costly, perhaps too much so for resource poor countries.

Dr Aylward and colleagues have suggested that countries would have to stop use of oral polio vaccine simultaneously to minimise the risk of vaccine derived polio spreading in unvaccinated populations and would need to maintain rigorous disease surveillance and strict controls on procedures using polioviruses, including vaccinations.[3] All of these measures would require sustained global cooperation.

To those losing heart, and arguing that a containment strategy might be a better bet, Dr Aylward says that option would be far more costly. "If we have learnt anything in the last three years it is that polio will not stay controlled. To control polio right now costs $700m a year. When you back off even slightly, as in northern Nigeria, then the whole world will get reinfected very quickly," he said. An economic analysis published earlier this year came to a similar conclusion, that failure to eradicate the virus now would lead to greater cumulative costs.[4] "When I read that people are saying we should switch to a control programme, I think, 'Hang on a minute, in the midst of an eradication programme, India managed to have an epidemic last year, Nigeria managed to have not just a national, but an international epidemic during 2003-5.'

"To pretend that you could cut back activities and suffer anything other than epidemic disease, at different rates in different areas, is a false premise. That is part of the reason for having launched an eradication programme at the start."

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Competing interests: None declared.

Provenance and peer review: Commissioned; externally peer reviewed.

1 Global Polio Eradication Initiative. *Wild poliovirus 2000-2007*. www.polioeradication.org/content/general/casecount.pdf.
2 Razum O, Mittal O, Priya R, Nayar KR, Sathyamala C. Language use in public health. *Lancet* 2004;363:2190-1.
3 Aylward RB, Sutter RW, Heymann DL. OPV cessation—the final step to a "polio-free" world. *Science* 2005;310:625-6.
4 Thompson KM, Tebbens RJ. Eradication versus control for poliomyelitis: an economic analysis. *Lancet* 2007;369:1363-71.