



A CLEAN BILL OF HEALTH

The battle to eradicate polio is a story of invention, prejudice, hardship, violence – and hope, says **Todd Pitock**.

IN A MIGRANT SETTLEMENT in Uttar Pradesh, India, smoke rises from smouldering fire pits, suffusing the air with the smell of ash. The wizened people who live here are not as ancient as they look, despite their deep-set eyes and furrowed skin. In contrast, the young girls with kohl-lined eyes and adorned with bangles seem too young, biologically speaking, to be the mothers of the babes they balance on their hips. On cracked fields of dirt and rubble, homes are dark hollows in domes of frayed burlap and faded tarpaulins.

As I walk through densely populated districts here, 250 km east of Delhi, the sights and fetid odours can be shocking: open, untreated sewers; and people reduced by illness, accident and poverty existing in a frenetic, menacing bustle that makes good health seem an especially tenuous proposition.

Yet, on this National Immunisation Day in February 2012, there are signs of hope. Teams of workers from the World Health Organisation (WHO) and volunteers from Rotary International, a global club that spearheaded the cause of polio eradication more than three decades ago, are here to deliver oral polio vaccine, or OPV.

India, one of the last bastions of this old foe of humanity, hasn't had a new case of polio since January 2011. It's a landmark achievement in a 25-year campaign to be rid of the scourge, bringing total global eradication of the virus tantalisingly close. Just a few barriers remain: funding issues of the global vaccination program and political resistance that has become ever more complicated, bizarre and even deadly.

Despite some major donations, the 2013 budget of the Global Polio Eradication Initiative (GPEI) still falls short of the \$1.05 billion needed for this year. A recent draft report by the Independent Monitoring Board, a committee created in 2010 to oversee the program, highlights the problem: "Funding gaps... don't just push back the timeline, they jeopardise eradication altogether. Leaving children unprotected means heightening the risk of an outbreak, and the virus can 'take advantage' of such a situation, resurge and spread widely. As polio cannot be easily contained within a community or a country, such spread can threaten global eradication."

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With the political resistance and violence, this shortfall is a significant obstacle, so no one is taking anything for granted. "We're at a tipping point," says Carol Pandak, program manager of Rotary's PolioPlus vaccination program. "We need to finish the job."

POOR NUTRITION AND chronic diarrhoea in areas like Uttar Pradesh mean children under five need multiple dosages of OPV. Older children bring younger siblings and are deputised to find others to receive 'drops of life'. "Auntie, auntie!" a little girl calls out, eager to collect her reward of another pencil, sticker or sweet.

The Rotarians, traveling at their own expense, run stations at schools and clinics before fanning out to surrounding districts in five-person teams. They wear big parkas, sunflower yellow, to attract attention. The WHO workers keep meticulous logs, mapping every home in every camp and village lane, a detailed census of who has had and who still needs vaccine. "It is a blessing," Parveen Akhtar, a high school Urdu teacher, tells me. "Of all the blessings in the world, health is the most important!"

Progress to date has been monumental. At the start of the GPEI in 1988, there were 350,000 cases worldwide – about 1,000 new cases a day, spread over 125 countries. Before this, India had 200,000 new cases of polio per year. In 2012, there were 223 cases of polio in five countries, and it was endemic in just three countries, Pakistan, Afghanistan and Nigeria.

The scale of the GPEI, which is funded by the Bill and Melinda Gates Foundation, Bloomberg Philanthropies, Rotary International, the World Bank, UNICEF, the U.S. Centres for Disease Control and Prevention, and many national governments, including Australia's, is unprecedented. Healthcare workers have given more than 10 billion doses to 2.5 billion children – at a cost of US\$8.5 billion.

The WHO estimates that, as a result, more than 10 million children – about the

populations of Sydney, Melbourne and Brisbane combined – have been spared from paralysis. India, once considered polio's most intractable redoubt – and the very place that the endeavour's sceptics held up as 'exhibit A' – is rolling toward the WHO's 36-month term requirement of no new cases to be certified as polio-free.

"India was huge," says Sona Bari, a WHO spokesperson on polio in Geneva, Switzerland. "In 2012, we had the fewest number of cases in the fewest districts in the fewest number of countries. India was a big landmark. We're now at the closest point to eradication ever."

TO UNDERSTAND HOW fragile the eradication process can be, it helps to understand the disease itself. Poliovirus usually spreads by ingestion of water or food contaminated with infected faecal matter. It attacks the spinal cord and brain stem, and can paralyse the arms, legs, and the muscles that control breathing, swallowing and speech.

An Egyptian stele depicting a figure with a telltale drop foot (a result of partial paralysis, which causes the victim to walk by landing on the forefoot instead of the heel) indicates the disease has been around at least 35 centuries. Even so, it was only in the late 19th century that polio proliferated into full-blown epidemics.

Oddly enough, it came as an unexpected consequence of better hygiene and sanitation, especially clean water and sewage removal systems in cities. Back when more of the world lived like the communities I encountered in Uttar Pradesh, people

who were exposed to the virus built up their immunity. Most people who get polio never know they have it, experiencing symptoms as mild as a touch of 'flu', drowsiness or a sore throat. Paralysis is quite rare, hitting as few as one in 200 people who get the disease. But as the world became more populated and more sterile, less exposure meant that there was a larger population of unprotected people. In 1952, a worldwide outbreak peaked at 600,000 cases. Photos from the period show whole wards of >>

"We have to explain that it's not a political issue. We're coming to save the children."



Julie Jenkins, a Los Angeles-based polio survivor, joins WHO workers in Uttar Pradesh on National Immunisation Day.

>> people, unable to breathe on their own, encased in contraptions called iron lungs.

Three years later, American researcher Jonas Salk developed an injectable inactivated vaccine. In 1957, an American physician-researcher, Albert Sabin, tested an oral polio vaccine that contained a live, weakened form of the disease. Although the OPV can cause polio – in about one in 250,000 cases – it has practical advantages: it's cheap and doesn't require any expertise to administer, so it's relatively easy to deliver.

What encouraged people to think polio was eradicable is that, like smallpox, which was vanquished in 1979 after a 12-year campaign, humans are the only reservoir in which polio can survive. In other communicable diseases, a cycle of animal-human infection can make pinning down infection problematic. In 1979, Rotary International started a polio eradication campaign in the Philippines, led by the club's president at the time, Clem Renouf – an Australian who travelled to that country to convince its health ministry to allow a concentrated polio immunisation campaign to vaccinate 6.3 million children. This program's

success led to the genesis of Rotary International's PolioPlus program.

The last polio case in Australia was in 1977 – there was an infection in 2007 but the man had travelled from Pakistan to Australia – often leaving people with the impression that the disease was defeated long ago.

But polio's history is a thunderous warning of what could happen if eradication were to fail:

"India was a big landmark. We're now at the closest point to eradication ever."

a catastrophic blowback as a consequence of people worldwide not having been exposed. "Until it's completely eradicated, it can flare up again," says John Sever, an infectious disease specialist and vice-chairman of the PolioPlus Committee.

"If this spreads into populations that are not well-immunised, it could cross borders and re-infect areas that are currently polio-free."

An economic analysis published in the journal *Vaccine* in 2010 determined that, without total eradication, the disease



The oral form of the vaccine means less training is required for providers.



Children receive a mark on their finger to keep track of who's been vaccinated.

would run up a bill as high as US\$50 billion by 2035 – a figure that dwarfs the projected budget of US\$5.5 billion the GPEI says it needs to complete mission, including a post-eradication strategic plan that would run through 2018.

And seeing the human toll – as one does on the streets of Delhi and in alleys in West Africa – can make calculating costs, however necessary, seem inhumane. Those affected are young, diminished figures whose twisted, atrophic legs mean they cannot fend for themselves. The disease not only ravages their lives but those of the families who must support them. If eradication fails, the WHO estimates four million children over the next 20 years would fall prey.

OF THE REMAINING three countries where polio is endemic, Nigeria is the only

sees polio as a high priority, while the immediate concern for a local community might be for, say, a bridge that would connect them more directly to a nearby area – so they might say, "you can immunise our children if you build us that bridge".

Sometimes it's a wrestle over control of funds in the ever-present conflict in Nigeria between its national government and its 36 federated states. At the local level, people often don't trust the national government to administer programs or spend money in the most effective way.

The rumours about sterilisation have done real damage. In 2003, the resulting resistance halted eradication campaigns for 13 months and led to reinfection in 20 other African nations, with repercussions that were still rippling in 2010 – an event polio experts refer to as 'the Disaster'.

The Independent Monitoring Board offered a candid assessment of Nigeria in its most recent report: "Nigeria poses a substantial risk to the global goal, in part because it has many neighbouring countries that are vulnerable to the spread of infection. The risk of an exposure return of polio in Nigeria and West Africa is ever-present and raises the chilling spectre of many deaths and a huge financial outlay to regain control," it warns. The country's leaders "have made strong progress in the past", the report says. But they need to do so again.

Pakistan's Ministry of Health runs a polio eradication program, and all of its political parties support it, but in Waziristan, a region bordering Afghanistan, rumours spread that the

one that had an uptick in new cases in 2012 – almost double the number of new infections in 2011. Although the raw number, 101, is small, any uptick is worrying, since past experience shows that things can get much worse in a hurry.

Although the head sultan of Nigeria is very supportive of the vaccination campaign, rumours have periodically circulated that the vaccine is a plot to sterilise children. Still others have used the issue as a political and budgetary negotiating chip, holding out access to children for other needs. The West

U.S. CIA (Central Intelligence Agency) is using health campaigns to gather information for drone strikes.

"People in those areas say, 'Eradicating polio is a mission of the U.S., so before you come to complete that mission, ask them not to blow people up with drone attacks,'" Aziz Memon, the PolioPlus committee chairman for Pakistan, told me. "We have to explain that it's not a political issue. We're coming to save the children."

Suspicious about the true aims of health programs were reinforced after revelations that the doctor who helped lead American special forces to Osama bin Laden obtained his intelligence information by setting up a fake vaccination clinic. In June 2012, the Taliban pressured families in the region to stop immunising their children, cutting off a campaign that would have reached 200,000 children.

As if it wasn't hard enough to convince reluctant communities, in October 2012, events took an even darker turn when nine polio workers were killed in Pakistan and two police officers escorting polio workers were gunned down in Nigeria. A spate of similar incidents followed in the next few months in both countries. Dozens of polio workers have died. No one has claimed responsibility, but suspicion has fallen on extreme Islamist factions.

Campaigns were temporarily stopped, and are now being conducted with more security and as quietly as possible. Bari is quick to point out that though all the resistance is from Muslim sectors, the overwhelming majority of Muslims have been robust in their support. Saudi Arabia requires proof of vaccination for children younger than 15 as a condition of coming on haj (annual pilgrimage) to Mecca. The Islamic Development Bank has made financing available to Pakistan; and Malaysia, Qatar and Kuwait have helped with financing and technical assistance. Experts and religious leaders have gone to Pakistan

to give public discourses on the benefits of vaccination. Abu Dhabi hosted a major eradication summit in April 2013.

"We've worked with leaders across the Islamic world who have brought out religious teachings from the Koran about the responsibility of parents to protect their children, with edicts that specifically talk about vaccines, and about them being safe and effective," Bari says.

Aziz Memon insists that, if anything, the viciousness of the recent attacks strengthened the resolve of workers. "It didn't intimidate the other workers," Memon says. "It went the other way." He recounted meeting with a family in Karachi whose daughter was one of the victims. "The younger sister said she wanted to do the work her sister was doing." Memon recalls her saying: "I'll do it for the sake of my sister. She's in Heaven and she'll see that the mission she didn't live to complete will carry on."

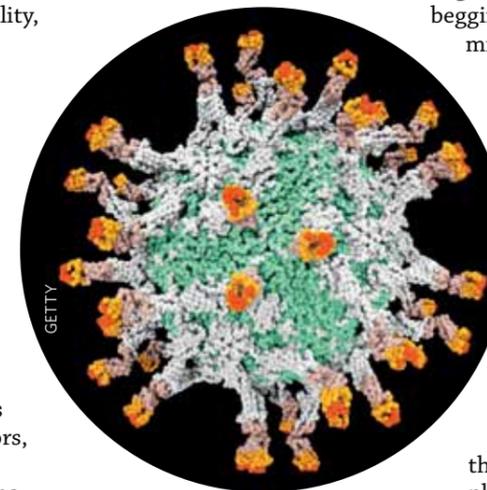
THERE IS A SENSE, speaking to GPEI veterans, that they've seen this all before. Almost since the first day, they have been working in conflict zones, begging for money,

missing deadlines, and absorbing the blows and told-you-sos of doubters. In short, they seem inured to discouragement.

The hope is that the fight will have been a 30-year war – that polio will have no more victims by the end of 2014, starting the post-eradication phase, with the WHO certifying success in 2018. The plan is wide-ranging,

marshalling technology, laboratory resources, and political leverage like parts of an engine to roll the massive effort across the finish line – then applying the lessons learned to new disease targets.

GPS, for example, is being used to find communities in Africa that do not exist on official records, yet contain tens of



One of the three types of poliovirus is gone, with a second expected to follow this year.

>> thousands of people. When polio does appear, teams are dispatched to interview families and get samples that geneticists at the U.S. Centres for Disease Control and Prevention can study to pinpoint the source of infection, how long the virus has been circulating and the route on which it travelled. They can then mobilise polio workers to those places with more vaccine.

“We learned the importance of looking at the most vulnerable people – the least served by any health or public service authority,” Bari says. “The people who lived in slums in remote areas didn’t have running water; they’re the immigrants, the underserved. They’re the ones who fall through the cracks. You need to ask:

is it because the government doesn’t reach them with service? Or is the problem that they don’t trust the government? You need to know so you can address the issues.”

The vaccine itself is under revision. The poliovirus comprises an RNA genome enclosed in a protein shell called a capsid. There are three variations – types 1, 2 and 3 – each with a slightly different capsid protein. Type 1 is the most severe and widespread. Type 2 has been gone since 1999. There were just 17 cases of type 3 in 2012, none in the first three months of 2013, and it could be eliminated this year. Until now, the vaccine was a trivalent, meaning it was designed to fight all three forms. With type 2 gone, the GPEI is switching to a bivalent that targets types

1 and 3. It will also switch from oral drops, which contain live virus, to the injectable form, which doesn’t, eliminating any chance of infection through inoculation.

Innovation, though, isn’t just what happens in the laboratory. Because of the resistance, the GPEI learned that communicating had to come through people within the communities – workers, clerics and local leaders – not emissaries from abroad. But political will had to be there at the top, as well. The decisive advance in India, say Bari and others I spoke with, came when the prime minister began receiving reports directly.

What’s clear, Bari says, is that eradication is beyond the power of the health sector alone. “You have to have

the entire civilian structure behind you. You want to reach children in migrant communities. Who do you need for that? Some countries have specific ministries. You need the ministry of transport: roads and highways, for example, may have tollbooths, which is a great place to immunise. You need education ministries to reach kids in schools and day care centres. You need veterinary authorities for nomads, who bring their herds in for care because that’s their wealth. So while they’re doing that, why not immunise? You need religious leaders. It has to be a total approach.”

THE LEGACY OF POLIO eradication within particular countries, advocates say, is an infrastructure of people and systems that other health programs inherit. Polio

helped build up the capacity of countries with poor health systems, including a global laboratory and communications network. Also, there are now tens of thousands of health workers.

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Measles and malaria are in epidemiologists’ sights. They present different challenges; for one, they can live in other hosts. Measles requires injections, which require trained personnel, raising logistical and cost hurdles. Efforts against malaria have so far been environmental, including cleaning up pools of stagnant water and supplying bed nets. But vaccines are clearly the way to go. The search for a malaria vaccine is being supported by, among others, the U.S. military, which is motivated to protect troops in endemic areas.

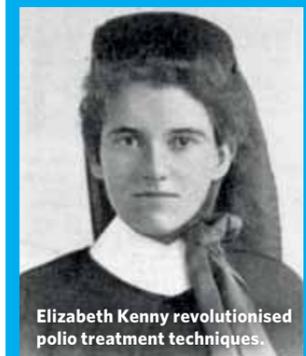
For those who have been in the struggle for years, it’s an exciting time. “I truly believe we’ll be successful,” says Pandak, “and when I think about it, to have had the opportunity to be involved in something this historic is incredibly gratifying.”

Most people who have participated in the polio effort can recall a moment when they became wedded to the mission. An 87-year-old California man who volunteered in 2011 told me it was a life-changing experience. And it was something I felt in the migrant camp in Uttar Pradesh, when someone passed me a swathed baby girl and handed me a dropper. Her tiny mouth was already open as I placed the drops of vaccine between her lips, and she smacked them gently as if I’d given her something tasty. Given the conditions of where she lives, I knew that she would have a lot of challenges ahead of her – but I also knew that polio at least would not be one of them.

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Physical therapy for polio patients was introduced by a nurse who developed the exercises in rural Australia.



Elizabeth Kenny revolutionised polio treatment techniques.

CHANGING TREATMENTS

THE EARLY TREATMENT for polio was to make sure patients got rest. Health workers would apply splints, or put patients in body casts, in the hope that it would keep the body from getting tight. In 1940, an Australian nurse named Elizabeth Kenny came to America challenging the conventional wisdom.

She’d spent a dozen years treating polio patients in rural Australia with a physical therapy regimen she’d developed. She advocated movement and exercise to strengthen muscles or muscle fibres the disease hadn’t affected and recruit whatever nerve cells the virus hadn’t killed. She

used moist hot packs to reduce the effects of spasms.

In Minnesota, she founded the Sister Kenny Rehabilitation Institute to promote her approach, which by mid-century had been adopted by the medical community worldwide and remains the therapeutic standard for polio.