Polio's moving target

Finding and vaccinating Nigerian nomads may be one of the last obstacles to the eradication of polio.

BY EWEN CALLAWAY

Mohammed Abubakar's home is not on any map — at least not yet. To reach his settlement in a desolate part of northern Nigeria, four health workers creep over deep-rutted roads in an old Peugeot for an hour, then ride motorcycles over narrow dirt trails for another 30 minutes — stopping only for the odd herd of cattle. Finally, they spot a cluster of mud-brick huts, known to the Fulani nomads who live there as a ruga.

"*As-salamu alaykum*," — peace be with you — says Ardo Babangida, a traditional leader accompanying the team. Children swarm around the visitors, and Daniel Santong, an easy-going veterinarian and leader of the group, asks to meet Abubakar, the head of the household. Meanwhile, a young colleague whips out a smart phone and uploads the settlement's Global Positioning System coordinates into a database. Abubakar arrives, clad in a lavender tunic and white skull cap, and Santong tells him that they are trying to eliminate polio in nomadic people. Abubakar clasps his guest's hands in appreciation. He says that he cannot remember the last time that health workers came to vaccinate his children. It is a story that Santong and his colleagues are now accustomed to hearing, even though door-to-door immunization campaigns happen on a near-monthly basis in the region.

These dusty paths are the front lines of polio eradication. A 25-year, US$10-billion global effort has taken the number of polio cases from hundreds of thousands per year to just hundreds, but it is now struggling to stamp the virus out of its final strongholds in Pakistan, Afghanistan and Nigeria, where transmission has never been interrupted. Of these, Nigeria was the only one to see an increase in cases from 2011 to 2012, and public-health experts worry that the virus's recalcitrance here will prevent global eradication, and eventually lead to a wider resurgence of the disease.

The barriers to polio eradication in Nigeria are complex and numerous. The country does not have a working public health-care system, and some local government officials are less

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Vaccinators reach a child in Bauchi, Nigeria.

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than committed to the cause. In urban centres in the north, widespread distrust of the government leads many parents to refuse vaccination for their children. What is more, in February several polio workers were murdered — for unknown reasons — at health clinics in Kano, northern Nigeria's largest city.

But epidemiologists have identified one barrier that might be overcome cheaply and safely: locating and counting remote populations, including the nomadic livestock herders who drift through the region with the changing seasons. Records of their numbers and movements are incomplete, but the population is thought to include hundreds of thousands of young children, many of whom have received none or only some of the multiple oral polio vaccine doses required to achieve full protection. Proponents of the programme say that nomads are a polio reservoir, spreading disease around the country during their migrations. So in June 2012, the National Stop Transmission of Polio (N-STOP) programme, organized through the Global Polio Eradication Initiative (GPEI) and supported by the Nigerian government, started a census of Fulani nomads and other hard-to-reach populations, as part of a global emergency action plan against polio.

"Until we solve the problem of these unvaccinated nomads, we're not going to fix polio," says Frank Mahoney, a veteran field epidemiologist leading the project from Abuja. "We're not going to be able to eradicate it."

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Many Fulani migrate twice a year, making it difficult for vaccination programmes to find them.

ROADBLOCKS AHEAD

On a scorching, cloudless December day, a procession of several hundred livestock has taken over a road running between the states of Bauchi and Kaduna in northern Nigeria. Men walk alongside their cows and sheep, while women and children creep along on motorcycles. It is the height of the dry season, the landscape is parched, and the group is heading south to graze its livestock. Lere, a local government area (LGA) in Kaduna is travelled by a sizeable population of Fulani pastoralists like these during their biannual migrations. It is also one of dozens of 'high-risk LGAs' on which N-STOP teams are focusing their efforts. No polio cases have yet been detected here, but Lere is not far from the borders of Kano and Bauchi, which both recorded cases in the past year.

Mobile and remote populations are often strongholds for disease. Somali nomads contained some of the final cases of smallpox, and the vaccination of herds in remote patches of east Africa was crucial to eradicating the cattle disease rinderpest, completed in 2011.

In Nigeria, Fulani nomads receive little education or health care from the government. "Nobody looks after them, nobody takes primary health care to them, nobody remembers they exist," says Endie Waziri, a member of one of the N-STOP teams. When polio vaccination workers do visit their remote settlements, she says, they tend to visit only the first ruga they see and not look for others in the vicinity.

Nigeria made significant headway against polio after starting an eradication programme in 1996. But those gains were erased in 2003, when Muslim clerics in the northern state of Kano called for a boycott of the polio vaccine over fears that the eradication campaign was a Western conspiracy to sterilize the population. Soon, Kano, Kaduna and other northern states had halted all polio vaccination campaigns. The boycott ended a year later, but by then polio had exploded across northern Nigeria and started to seep into nearby countries, such as Cameroon and Côte d'Ivoire, that had previously vanquished the virus. Nigeria has since made lurching progress against the disease. Cases fell from more than 1,000 in 2006 to 21 in 2010, before rising again to 122 last year. Many more cases probably went undetected.

Religious opposition to vaccines among settled populations has now given way to refusals driven by disenchantment. "People want things other than polio vaccination," says David Heymann, chairman of the advisory board for Public Health England and the former head of the polio-eradication efforts for the World Health Organization (WHO). "They can't understand why people are coming once a month to give them vaccination when what they want are treatments for their children with fever or diarrhoea."

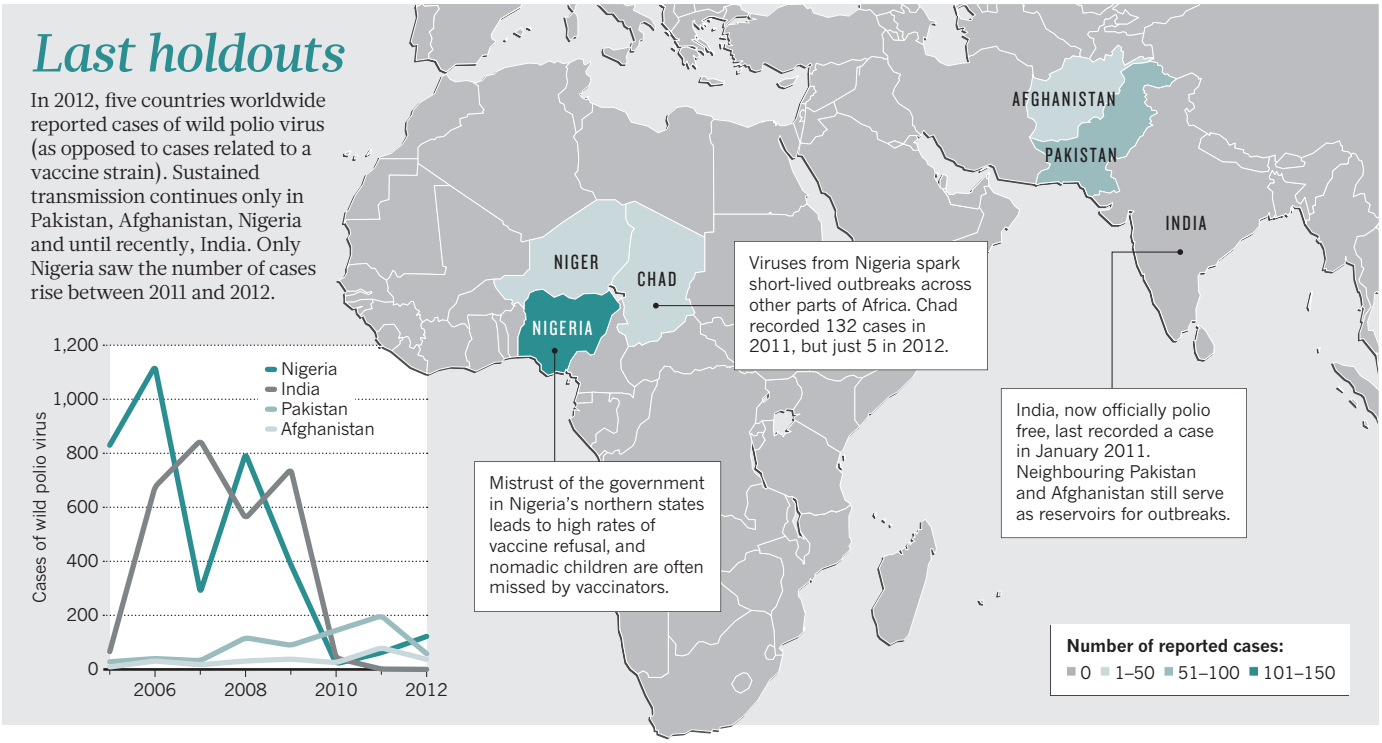
The nomads, however, rarely refuse polio vaccination for their children, and they are eager to receive other health and veterinary services. "If we hit these areas, we get a much bigger bang for the buck," says Chima Ohuabunwo, a Nigerian epidemiologist who took a sabbatical from his position at Morehouse School of Medicine in Atlanta, Georgia, to serve as the field coordinator of the nomads project.

Still, the lack of a working public health-care system has been a problem, says Heymann, who points out that neighbouring countries with large nomadic populations such as Chad have successfully interrupted transmission. "Other countries with migrant populations have done the job," he says. India, for instance, offered polio vaccinations at train stations to catch migrants, and Chad offers combined veterinary and polio vaccination services to encourage Fulani nomads — who depend on the health of their livestock — to take part.

"Other countries with migrant populations have done the job."

N-STOP's census programme was designed to support on-going vaccination efforts, uncovering areas of need and directing resources and local vaccination teams to them. In fact, so as not to interfere with local efforts, N-STOP teams didn't bring vaccine stocks with them until the federal government asked them to. Since August, the N-STOP surveys have uncovered more than 32,000 settlements and identified more than 700,000 children — nearly 40,000 of whom had never been vaccinated against polio.

Although little more than 3% of the 122 polio cases reported last year in Nigeria occurred in nomad children, the teams discovered more than 100 probable cases that went unreported,



supporting the idea that nomads form an important link in the chain of transmission. When not on long migrations, Fulani nomads interact with other people at markets. More than one-third of confirmed polio cases in 2012 were among children who lived in close proximity to nomadic communities. And nomad migration routes are hotspots of low vaccination coverage, according to data from the US Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia. The surveys are "really a strategy that's been missing in the tool box for a long time, and it needs to be urgently done", says Mahoney. But Mahoney also notes that the project is a work in progress. Emmanuel Musa, the WHO coordinator in Lere, is not sure that it will be feasible for his district's vaccination team to reach all the nomad communities that N-STOP teams are uncovering.

> *"If we hit these areas, we get a much bigger bang for the buck."*

"There are inadequate funds," he says.

At a catch-up in December, Fureratu Zakari, the WHO coordinator for Kaduna state, also questioned whether the mapping data will be enough to allow health workers to locate nomadic communities. "They should be showing teams where settlements are and not just writing it down," she tells Olaniran Alabi, the programme's field coordinator for Kaduna. Zakari complains that the N-STOP programme isn't coordinating its day-to-day activities with local health authorities, which could result in confusion and duplicated efforts.

The sheer scale of the GPEI initiative may explain some of the tensions. The public–private effort, which includes the WHO, CDC, the United Nations Children Fund (UNICEF), Rotary International and the Bill & Melinda Gates Foundation, has become the world's costliest public-health initiative, and one of the longest running. Since it started in 1988, it has missed three deadlines for halting transmission — in 2000, 2005 and 2012 — and it now burns roughly $1 billion per year chasing the last remaining pockets of disease.

CAUSE FOR OPTIMISM

Organizers are optimistic about winning the war, however. India was long thought of as the Waterloo of the initiative because its high population density and poor sanitation provided ideal conditions for the virus to spread. But it celebrated its second year without a case of polio in January. And Pakistan and Afghanistan both saw significant reductions in cases between 2011 and 2012 (see 'Last holdouts'), despite deep security challenges that limited the reach of vaccination campaigns.

Programme officials in Nigeria say that national and state governments are increasingly committed to eradication, but that complacency and corruption are still common among the officials in charge of local immunization campaigns. In October 2012, for instance, dozens of officials in Kano state were fired for treating the eradication programme as a "money-making venture", in the words of the state's governor, Rabiu Musa Kwankwaso.

Counting and vaccinating nomads will not solve all Nigeria's polio troubles, but it is easier to achieve than tackling domestic terrorism, vaccine refusal and other challenges.

When asked how N-STOP will measure the success of the nomad programme, Mahoney puts it simply: "Stopping polio transmission. That's the big indicator." But he also points to the thousands of settlements and children that have been mapped and counted so far.

As *Nature* went to press, Nigeria had recorded 11 cases of polio this year; it had 17 in the same period last year. President Goodluck Jonathan has vowed to bring that number to zero before his term ends in 2015. Michael Galway, senior programme officer at the Bill & Melinda Gates Foundation in Seattle, Washington, is optimistic that the push to reach remote populations is paying off. "The work of the nomads project has been extremely beneficial in opening the eyes of the [polio eradication] programme to this additional piece of the puzzle," he says.

The Nigerian project could hold lessons for future efforts to eradicate disease (measles is on some agendas), which are likely to hinge on reaching mobile and remote populations.

Targeting vaccination efforts on nomadic children is the right strategy, says Paul Rutter, a spokesman for the independent monitoring board set up to evaluate global efforts at polio eradication in 2010. But it will be the people behind it who ultimately dictate its success. "This kind of dogged determination to reach every last child will be what rids Nigeria of polio." ■

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