

Smallpox: dispelling the myths



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Dr Donald A Henderson is a resident scholar at the Center for Biosecurity, University of Pittsburgh Medical Center and a Distinguished Professor and Dean Emeritus at Johns Hopkins University. Chief of the World Health Organization's global smallpox eradication programme (1966–1977), he has been recognized for his work by many institutions and governments, having received 17 honorary degrees and awards such as the National Medal of Science and the National Academy of Sciences Public Welfare Medal. He was instrumental in initiating the WHO Expanded Programme on Immunization that is now providing six vaccines to children and saving tens of millions of lives throughout the world.

Twenty years ago Henderson and his colleagues published an exhaustive account of one of the World Health Organization's (WHO) most successful campaigns, *Smallpox and its eradication*. The 1500-page tome with its trademark red cover became known as 'the Big Red Book'. Next year, Henderson will publish his own reflections on the campaign in a new book *Death of a disease*.

Q: In 1966, the World Health Assembly voted to undertake a global eradication programme for smallpox. What was the immediate impact of this decision?

A: There was considerable debate as to whether that was a good idea or not. Several countries felt that it was impossible to do the job, and some were reluctant to provide more money to WHO to accomplish this. The Director-General (Marcolino Gomes Candau) was very much opposed to the programme, because the malaria eradication programme wasn't doing very well. His view was that if WHO were asked to undertake a second eradication programme, it would fail and that would reflect very badly on WHO and the public health community. He felt that the [United States of America] had played an important role in the debate in the assembly in persuading delegates to vote for this so he asked that an American – and specifically me – be assigned to the job, so when the eradication effort failed, the responsibility for it would be seen partly as that of the United States.

Q: What did you say when you were first approached about this?

A: I was reluctant to accept the challenge because in November 1965 the US government had decided to sup-

port a smallpox eradication–measles control programme in 18 countries of western and central Africa. I was asked to assume the responsibility for doing that. It was a big job and I was reluctant to leave the Centers for Disease Control and Prevention (CDC) barely a year later to work with a global programme. Second, only US\$ 2.7 million was allocated by the World Health Assembly, not enough even to buy the vaccine we needed. So I could see some real difficulties in executing the programme.

Q: The eradication programme was originally conceived as a mass vaccination programme. Do you think that was the right approach?

A: The idea that this was conceived as a mass vaccination programme is a myth. It was not. Before 1966 special smallpox control efforts were primarily mass vaccination programmes. Little attention was paid to the reporting and control of cases and outbreaks, which we felt were the most important things. So when we worked to prepare a manual for the 18-country programme in western and central Africa – a manual that was printed in October 1966 – we made a very strong point about the need for surveillance of cases and their containment. That manual was used in western Africa, but when I went to

WHO we modified it so it would be appropriate for countries throughout the world.

Q: How did you get through all those initial challenges to a successful programme in the end?

A: To answer this requires an entire chapter in my new book! A host of problems had to be resolved – special measures were needed to persuade many governments to give the programme adequate support; vaccine production laboratories needed to be developed and improved in many countries; far more funds and personnel were needed than the budget would accommodate; the WHO bureaucracy was unaccustomed to dealing with a programme such as this; new strategies were needed; training programmes and teaching materials had to be developed. But, as in many programmes, personnel were key and we soon discovered a surprising number of very good young people, in particular, who were enthusiastic, working very hard and who were willing to sacrifice considerable time and effort. They were willing to look at difficult problems and create new solutions. We tried to keep in close communication with all our staff constantly, charting progress, encouraging them and illustrating the successes and possible new approaches. This was not easy without telephones, e-mail or other means of rapid communication. At our Geneva headquarters, there were only nine of us and we never had more than 150 international staff in the field. We served primarily as catalysts, as it was the countries themselves that actually did the job, that took an interest in the programme and that became increasingly enthusiastic and committed.

Q: Those challenges are familiar today for many public health programmes. Your work and the success of the eradication programme is an inspiration to people today.

A: I would hope it would be. The point we've also made is that there's no way in the world that this programme could have been implemented by any single country. It really required the World Health Organization. Interestingly it was during the time that the Cold War

was at its peak between the US and the Soviet Union. They both cooperated fully with the programme itself, and donated very generously to it. So we saw bridges being built where they didn't exist politically.

Q: Dr William Foege is sometimes credited with introducing the surveillance–containment approach to the programme. Is that a fair assessment?

A: Foege was one of the first to begin to apply the surveillance–containment strategy that is described in the Director-General's Report to the 1966 World Health Assembly and outlined in the first training manual as mentioned above. The concept of infectious disease surveillance was introduced in 1950 and fostered by Dr Alexander Langmuir at CDC in Atlanta. In simple terms, it calls for the continuing, routine collection of data about cases and deaths due to infectious diseases; the regular analysis and interpretation of this material; and its regular distribution to those responsible for disease control. Simple and logical – but for smallpox control before 1966, countries made little or no effort to routinely collect reports of cases, to determine how the disease was spreading or to evaluate their vaccination control efforts. A WHO Expert Committee in 1964 stated that it really couldn't tell how many smallpox-endemic countries there were or how many cases were occurring because the reports were so poor. Foege was one of the people who was trained at CDC for the programme in mid-1966. Then he went to eastern Nigeria and, in December, they came across some outbreaks. They didn't have much vaccine or transport. So they decided to vaccinate in the area where outbreaks were occurring. By June 1967, the outbreaks had pretty well stopped in eastern Nigeria, even though they had vaccinated only about 750 000 of the 12 million people in the state. This demonstrated that the surveillance–containment approach could be effective in a setting such as Africa.

Meanwhile we supported a team in the state of Tamil Nadu in India, which had a population of 50 million people. With Dr A Ramachandra Rao heading this team, transmission was stopped in four or five months – another indication that surveillance and containment could be effective even in a populous Indian setting. Classical medical textbooks of that time talked about small-

pox spreading like a wild fire. But the disease did not transmit that readily, so one could break the chains of transmission by vaccinating possible contacts in areas where there were cases.

Q: In 1972, you flew to Belgrade during the last smallpox outbreak in Europe. Can you talk about what you saw there?

A: In former Yugoslavia there were some 170 cases. It was the largest outbreak in Europe in 20–25 years. The concern was how well they were succeeding in stopping the spread. Initially, they were using an unsatisfactory vaccine and so they asked WHO to provide a new vaccine. We provided a couple of million doses and they took very heroic steps to stop the spread. They stopped cars along the road to vaccinate people; they went from village to village, vaccinating almost the entire country – 18 million out of 20 million people. The secretary of health was deeply concerned as to whether they were succeeding so he asked me to come and review what was going on. I did, and I told him they had done a really fine job and I agreed to say so on the radio to reassure the country.

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Q: Did you really send a jeep tyre to a WHO official who said he would eat one if the India smallpox eradication campaign were successful.

A: [laughs] I reminded him later on of his bet and said that we had a tyre waiting and where should we send it. He laughed and said “No, no, I really didn't mean it.” So the tyre never got sent.

Q: Is it true that you were in favour of destroying the remaining stocks of smallpox?

A: Yes, that's correct. A WHO international committee has met in many different sessions since 1986 and held intensive discussions about whether to

destroy the virus: is it valuable genetic material? Is this ethically appropriate? We recommended that a library of cloned fragments of selected strains be prepared. Later, we recommended that selected strains be sequenced. Of the 10-person committee, eight voted to destroy the known stocks immediately and two argued to wait for three years. As far as we could tell then, there had been no research using the smallpox virus for at least 10 years. The developing countries that had been plagued with smallpox said, “Look, we have played a major role in getting rid of this disease and we think we should have a say as to whether we are going to destroy the virus or not. We think the virus stocks are unnecessary and ought to be destroyed.” The Assembly eventually agreed but has repeatedly postponed the date of destruction. No one could be absolutely certain that the virus was not being retained in laboratories other than in the two WHO Collaborating Centres in Novosibirsk (the Russian Federation) and in Atlanta (USA). A deterrent, however, would be a resolution to say that any country, laboratory or scientist found with smallpox virus after that date would be guilty of a crime against humanity. That, we believed should reduce the likelihood of smallpox being released.

Q: But the World Health Assembly decided not to go ahead and destroy those known stocks. Were there valid arguments for keeping them, for example, for research in case of a bio-terror attack?

A: We are not proposing to destroy the vaccine. One doesn't need the virus to conduct studies to develop an antiviral agent or a vaccine. One justification for keeping the virus is that one day it might be needed for studies not now foreseen. This has to be weighed against the possible escape of the virus from the laboratories now holding the virus – unlikely perhaps, but not a zero risk.

Q: What do you believe are the prospects for future eradication programmes such as polio?

A: Even towards the end of smallpox eradication, the senior staff never talked about potential eradication of any other disease. There's a reason for this. No other disease had so many of the attributes that made smallpox amenable to eradication. The polio vaccine can be

expensive and requires several doses and even then protection is not guaranteed. Protection against smallpox for 10 years or more is possible with a single vaccination. The smallpox vaccine could be kept at 37 °C for a month, whereas the polio vaccine has to be kept cold up until it is actually administered in the field. This is difficult to do in developing countries. We knew exactly where smallpox was because each infected individual had a distinctive rash. With polio, there are 200 infected children for one paralytic case, so the other 199 are perfectly able to transmit it to others. And they could spread it, undetected, to many different parts of the country. You could not do what we did with smallpox in terms of focusing specifically on an outbreak and on vaccinating the people around that to prevent spread.

Q: If we hadn't eradicated smallpox at that time, would it still have been possible to vaccinate so many people given the emergence of HIV/AIDS?

A: The question is raised because complications of vaccination can be more serious among those with advanced HIV infection. However, we now give live vaccines, such as those against measles, polio and yellow fever, to people with AIDS and they seem to handle those vaccine infections quite well. This

is undoubtedly true for many of those who are given smallpox vaccine. In Africa, for example, where health conditions are challenging, individuals with severe immunodeficiency disease, don't live very long. I think that even with AIDS – and evidence indicates that by as early as 1970 some areas had already been infected with HIV – smallpox still could have been stopped.

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Q: Was there any turning point in the smallpox campaign when you knew you were going to succeed?

A: Yes. During 1973 and early 1974 we were doing really well: Latin America was free, Indonesia was free and Africa seemed pretty much free, except for Ethiopia. The problem was in India, where we were simply not succeeding. So in late 1973, WHO and Indian government staff worked out a plan to visit every house in India in the space of 7–10 days. The concept was that if we could discover the cases more quickly

than before, the containment teams could interrupt the chains of transmission. The results were astounding. One state had been reporting about 500 cases a week, but the search teams found 10 000 cases. This was really a black day. We had no idea it was this bad. But in January and February, searches were steadily improving. India reported the largest number of cases in about 20 years. However, we sensed that we were successfully implementing the right strategy and, if we could defeat the disease in India, we could defeat it in Bangladesh, Pakistan and Ethiopia. And indeed the last case in India occurred little more than a year later.

Q: Is there anything you would like to add?

A: The most important legacy of smallpox eradication was its demonstration of how many people could be protected through vaccination, so rapidly and inexpensively with a well planned programme and quality-control monitoring. This is what led us to organize the first meeting that would propose an Expanded Programme on Immunization and which, in turn, led to the polio eradication campaign and a rapidly growing global interest in immunization as a highly cost-effective programme worthy of investment by every country. ■

Recent news from WHO

- WHO said, on 13 November, that it was launching an intensive operation with its health partners to prevent and control a **cholera outbreak** in the eastern part of the Democratic Republic of the Congo. Insecurity, massive population displacement – at least 250 000 people since early August – weak health services and a lack of safe water and proper sanitation facilities have caused a marked increase in the number of people with cholera in North and South Kivu. As yet, no data are available on the number of deaths linked to the current outbreak, but in complex emergencies the case fatality rate can surpass 30%. WHO sent 60 tonnes of medical supplies to the Democratic Republic of the Congo in collaboration with the Italian and Norwegian governments.
- WHO's Regional Office for Africa said, on 6 November, that it had provided training to 46 laboratory staff from across Africa, in collaboration with WHO headquarters and the Kenyan Medical Research Institute, to **build capacity to identify dangerous pathogens**.
- WHO welcomed the decision of the United Nations General Assembly on 3 November to **ban smoking and tobacco sales** at United Nations headquarters in New York.
- A WHO study that provides a comprehensive picture of people's health around the world, including the top 10 causes of death, was published on 27 October. **The global burden of disease: 2004 update** is available at: http://www.who.int/healthinfo/global_burden_disease/2004_report_update/en/index.html
- On 31 October, WHO's Office for the European Region published a manual for young public health students on planning, conducting and publishing the findings of **epidemiological research in environmental health**. The manual, a collaborative effort with the United Nations Development Programme and the United Nations Office for Programme Support, draws on the experience of the Sumgayit Cancer Study in Azerbaijan.
- WHO sent medicines and other **supplies to eastern Yemen** to treat over 50 000 people for diarrhoeal diseases, malaria and other conditions after floods on 3 October.

For more about these and other WHO news items please see: <http://www.who.int/mediacentre>