Poliomyelitis and Smallpox Eradication

for *World Health*

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Ten years have passed since a WHO Commission declared that for the first time in history, a disease - smallpox - had been eradicated from the globe. Smallpox hospitals are no longer needed and vaccination everywhere has stopped. The annual savings are at least U.S. $1,000 million, more than three times the cost of the entire program. Given these extraordinary benefits, it was logical for scientists to ask whether other diseases might be candidates for eradication. After lengthy discussions, poliomyelitis was decided upon as the best prospect. Accordingly, the World Health Assembly in 1988, agreed on a global poliomyelitis eradication campaign to be completed by the year 2000.

The two diseases, poliomyelitis and smallpox, differ in many ways, as do the vaccines for preventing them and strategies for their eradication. Knowing what we do about the problems in eradicating smallpox, what can we say about the prospects for poliomyelitis eradication? In some respects, polio eradication should be easier but there are far more difficult technical problems, especially in the detection and diagnosis of cases and in the quality of vaccine available. Research is urgently required to address these.

On the positive side, the infrastructure of transport, communications and health services has improved greatly over the past two decades in essentially all countries. There are far larger numbers of trained health staff; radio, telephone and even television are found in areas where none existed 20 years ago; and air and road transport leave few populated areas on the globe which are truly inaccessible. Admittedly, there are larger populations and a greater movement of people who may spread disease but these are not major problems.

Most encouraging is the already demonstrated political commitment on the part of governments throughout the world, as well as international assistance agencies, to assign a high priority and resources to the effort. I sense a greater commitment than there was to smallpox eradication when it began. This may appear puzzling because smallpox, notably in Asia and Africa, caused many times more cases and deaths than does poliomyelitis. However, smallpox patients who survived returned to normal health. Most poliomyelitis victims, in contrast, are sentenced to life-long paralysis and dependency. In the poorer countries, most survive as beggars. Poliomyelitis is thus a more constantly visible disease, and, not surprisingly, greatly feared.

The first national efforts to defeat poliomyelitis began in the U.S.A. during the 1930s. These were encouraged by the President, Franklin Roosevelt, who had been crippled by polio as a young man and thereafter was confined to a wheelchair. With his support, the National Foundation for Infantile Paralysis (as polio was then called) raised large sums of money for prevention research and treatment. Meanwhile, the numbers of

cases each year rose steadily until, during the early 1950s, 30,000 to 50,000 cases were being reported annually in the U.S.A. alone. During the summer polio season, theaters, swimming pools and other facilities were frequently closed to prevent children from gathering and spreading infection. The discovery and introduction of an inactivated (Salk) vaccine in 1955 and soon thereafter, of a live oral (Sabin) vaccine were celebrated events. In little more than a decade, polio cases in the industrialized countries dropped from more than 75,000 per year to less than 1,000.

Until the 1970s, many scientists believed that paralysis due to poliomyelitis was primarily a problem of the industrialized countries. They believed that children in the developing countries were infected early in life and did not experience paralysis. When rehabilitation centers developed, however, it soon was apparent that poliomyelitis victims accounted for most of their patients. Special surveys to detect lameness in children quickly revealed that it was an important problem in all developing countries. Thus, when the Expanded Program on Immunization began (1974), polio vaccine was one of the vaccines to be included.

The effects of poliomyelitis itself have served to foster a political commitment to the program and now, international and national authorities alike know that global disease eradication can be accomplished. They have confidence that national health services can be effectively mobilized, even in the least developed parts of the world. With added resources for the polio campaign, it has also become apparent that other community-based programs are strengthened, such as those for immunization, family

planning, diarrheal disease and Vitamin A deficiency. Thus, many agencies which did not contribute to smallpox eradication are providing important support for the polio campaign. These include UNICEF, the Inter American Development Bank and many bilateral agencies. Rotary International Foundation, in addition to providing volunteer support, pledged to raise U.S. $125 million, an unprecedented type of collaboration by private citizens. Indeed, Rotary has already raised more than twice this sum!

The better infrastructure and more favorable response to polio eradication is counterbalanced by two important problems which make the task of eradication more difficult than it was with smallpox. The first pertains to difficulties in detecting the presence of polio virus in an area and in containing its spread - the important surveillance-containment strategy of the smallpox program. The second problem is that polio vaccine is less efficacious and less heat stable than was smallpox vaccine thus making it more difficult and costly to conduct necessary large-scale vaccination programs.

It is critical in an eradication campaign to know where cases are occurring and how the virus is spreading in order to allocate resources optimally and to make necessary changes in strategy. For smallpox, this was comparatively simple. Each infected person developed a characteristic rash which was seldom confused with any other disease. Laboratory studies to confirm the diagnoses were unnecessary until the end of the campaign. Cases were reported by health units and others were detected by special searches. When a smallpox patient was found, other cases could be discovered by tracing his contacts. Each of those infected could be

isolated and all contacts vaccinated, thus erecting a barrier against further spread. By blocking spread of disease in this manner, it was possible to stop transmission over large areas even when as few as half the population was vaccinated. These were the elements of the important surveillance-containment strategy.

We cannot detect and contain the spread of polio virus as readily as we did smallpox. Of those infected with polio virus, less than 1 in 100 children develop paralysis. The others have no symptoms. Thus, a patient paralyzed with poliomyelitis represents only the tip of the iceberg of infection in the community. If one case is discovered, it must be assumed that there are many other infected children. Laboratory studies could identify them but such studies are time-consuming and impracticable as they would require examining hundreds, if not thousands of contacts. Thus, the simple technique of contact tracing of cases and containment of outbreaks which was so effective in smallpox eradication, is not feasible in polio eradication. The task of polio surveillance is also more difficult because there are some paralytic illnesses which mimic poliomyelitis but are not caused by polio virus. To be certain that a paralytic illness is caused by polio virus, the virus must be isolated from a stool specimen. This requires moderately sophisticated laboratories which can not only isolate the virus but which can determine whether it is a vaccine virus or a so-called "wild" virus.

The countries of the Americas, which began a hemisphere-wide campaign in 1985, are using new strategies for polio surveillance and containment. Thus far, they appear to be working. Each health center and hospital is

required to report promptly each case of flaccid paralysis in children less than 15 years old. An epidemiologist visits each case within 48 hours and collects a stool specimen. If there is no other apparent diagnosis, the case is called a "probable" polio case and intensive vaccination is immediately performed throughout that village or section of a city. It is believed that this inhibits further spread of the virus but there is no way to measure the success of each effort. Specially equipped and trained laboratories require between 30 and 60 days to examine each specimen. Finally, sixty days after onset, the epidemiologist with a neurologist visits the patient to decide whether or not the clinical findings and the laboratory results permit confirmation of the diagnosis. During 1988, more than 6,000 stool specimens were examined - a very large task indeed.

Progress in the Americas is encouraging. During 1988, less than 50 wild polio viruses were isolated and polio cases were found in less than two percent of all counties/districts. Even fewer cases are being discovered in 1989. Epidemiological evidence so far suggests that the wild polio viruses, like smallpox, do not spread readily over great distances and that the principal reservoirs for transmission are the more densely populated lower socioeconomic areas. In these areas, special house-by-house vaccination campaigns are now being conducted.

The second major problem in the polio campaign is the vaccine. The freeze-dried smallpox vaccine was very stable even under tropical conditions; a successful vaccination always caused a pustule to form on the arm and subsequently a scar. Moreover, a single vaccination conferred

nearly complete protection for at least five to 10 years. The success of the vaccination program and the immune status of a population could thus be readily determined by a survey for scars and/or pustular responses following vaccination.

For a number of reasons, including cost, the oral polio vaccine is being used. It has the advantages of being inexpensive and easily administered even by lay persons - a few drops being placed in the mouth. The vaccine virus, a greatly weakened polio virus strain, grows in the intestine and causes protective antibodies to be produced. It can spread to contacts of the vaccinee and immunize them as well. However, the vaccine is rapidly destroyed by high temperatures and thus refrigerators and ice chests are needed to transport it into the field. High levels of protection require as many as four or five doses but, even then, other viruses growing in the intestinal tract may prevent its growth and the needed protection of children. Finally, there is no simple way to determine whether or not a child is protected. If, for example, the vaccine has been destroyed by heat, it will appear perfectly normal but will be of no more value than a few drops of water.

Despite the drawbacks of the vaccine, it can serve to stop polio spread. In the U.S.A., for example, wild virus transmission stopped in the early 1970s at a time when only about 70% of preschool age children were vaccinated. Similarly, in South America, intensive one- to two-day vaccination campaigns with good coverage have served to dramatically reduce polio incidence and in some countries to stop transmission within a matter of a very few years.

The prospects for polio eradication would be greatly enhanced if we had a more heat stable vaccine producing higher levels of immunity with fewer doses and if we had simpler, more rapid laboratory diagnostic tests. Scientists now believe that these problems could be solved comparatively quickly but additional funds for research will be necessary to do so.

The achievement of global polio eradication by the year 2000 is by no means a certainty. It will require a high level of sustained commitment and resources and close collaboration between politicians, public health field staff and laboratory workers. Strategies will need to be continually adapted and modified as more is learned. However, the success of polio eradication would be a major achievement in realizing could well be the most significant step toward achieving a quality of life for children which still remains a dream.

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