CHAPTER 2:

THE BACKGROUND TO POLIO ERADICATION ACTIVITIES IN THE WESTERN PACIFIC
Polio in history

Outside the American embassy in London stands a statue of Franklin Delano Roosevelt, one of the greatest presidents in the history of the United States. This statue portrays FDR standing on two strong legs – something he did not do for most of his adult life. President Roosevelt’s legs were crippled by polio, and he did not walk unassisted for his last twenty-four years. Very seldom did he, or others, acknowledge his disability during his lifetime. In January 2001, however, the first-ever statue of a world leader in a wheelchair was unveiled at the FDR memorial in Washington DC, at last making publicly visible this great man’s long struggle.

FDR may have been one of the most famous victims of polio, but he was by no means the only victim. There is evidence that polio has caused paralysis since ancient times, but it has only been recognized as an epidemic disease in the last 150 years. From the late 1800s, large and increasingly severe outbreaks of polio occurred in Europe and North America. Polio became one of the most feared diseases of the industrialized world because of its power to paralyse for life (or even kill), and the fact that there was little understanding of how to avoid the disease, and no cure. The best that the medical profession could offer, by the 1940s, was the “iron lung”, a large machine which kept patients breathing but immobilized, sometimes for years, when their respiratory muscles were paralysed.

From endemic to epidemic

Why did polio emerge as an epidemic disease (occurring in outbreaks) only comparatively recently, if the virus has been infecting humans for thousands of years?

Scientists now believe that, at least until the mid-nineteenth century, the poliovirus circulated freely (in an endemic fashion) among people in most parts of the world, and infected virtually everyone early in life. Those who did not develop paralysis would nevertheless be immune to the disease from the time they were infected onwards. Because children were infected as they reached the age of susceptibility, cases of polio occurred fairly regularly and were distributed evenly among the population, rather than being clumped together in time and space as outbreaks. Even in temperate climates, where transmission of the virus was slowed during cold weather, there was enough poliovirus in circulation to ensure that transmission continued through each winter.
The exception was among isolated groups of people, for example island and remote populations, such as the Inuit people in the Arctic. Such groups could have prolonged polio-free periods, but then experience large numbers of cases in people of many ages within short periods of time (outbreaks or epidemics) if the virus were reintroduced. The polio-free periods could occur when a very high proportion of people had already been infected by the poliovirus and had become immune to further infection, thus blocking the transmission of the virus. In effect, the virus had “blocked itself in”. Children born in the area during the polio-free periods would not be exposed to the virus and would, therefore, remain susceptible to infection. If a new poliovirus were later introduced from outside the area, it could circulate among the susceptible children and potentially cause a number of cases of paralytic polio within a short time-frame.

When sanitary and housing conditions began to improve in industrialized countries in the latter part of the nineteenth century, those countries developed an epidemic pattern of polio transmission similar to that seen previously in isolated communities (described above). Children were raised in less crowded households, and, with the availability of running water and sewerage systems, they could be kept clean more easily. They were, therefore, less likely to be exposed to poliovirus at an early age. The cold winters in those parts of the world also helped to slow transmission of the virus. More people avoided contact with the virus until they were older children or adults, and thus remained susceptible to infection for longer. When a poliovirus entered a population, it thus found large numbers of people whom it could infect within a short period. Thus, intermittent large outbreaks began to occur in Europe and North America in the late 1800s, and polio was recognized as an epidemic disease.
In the tropical developing countries, the poliovirus continued for a long time to circulate in an endemic fashion, aided by inferior sanitary conditions and year-round warm weather. Only much later did those parts of the world develop the epidemic pattern seen in the industrialized countries.

For many years it was thought that polio was uncommon in tropical areas because no outbreaks, and very few cases of polio, were reported there. That was a misconception. Although true that large epidemics were not occurring (for reasons explained above), there is evidence that cases of polio were occurring on a regular basis, but were simply not recognized or reported. From the 1950s on, special lameness studies in several developing countries found large numbers of school-age children with paralysis, most likely due to having had polio in the past. The findings from those surveys disproved the hypothesis that polio was uncommon in tropical areas by indicating that the low rate of reported polio in the preceding years had been due to underdiagnosis and/or underreporting, not to absence of the disease.

Oral polio vaccine

Tavita was born in Niue. Like virtually all other children on the island, he received three doses of oral polio vaccine as drops in his mouth before the age of four months. They were spaced out at six, ten and fourteen weeks of age.

The oral polio vaccine (OPV) contains a weakened form of the poliovirus, which does not cause the disease. Tavita’s immune system responded to the weakened virus in the OPV in very much the same way as it would have responded to a natural infection with wild poliovirus. Antibodies were formed in his throat, his intestines and his blood. Because the vaccine virus was a mixture of the three different strains, the antibodies would protect Tavita in the future against all three strains of poliovirus. (A natural infection would usually be only one strain, so the antibodies produced would not protect against other strains of the poliovirus that might come along later.)

Because Tavita had developed antibodies in his throat and intestines, any wild poliovirus he might swallow in the future would be largely inactivated before it could pass through his system. Therefore, not only was Tavita protected against polio, but his immunity would also break (or at least markedly impede) the cycle of spreading the virus to others.

As the weakened virus from the OPV was the first poliovirus that Tavita was exposed to, it was not stopped by antibodies, but passed through his digestive system and was excreted in his faeces. A little was also excreted in his throat secretions. That meant the virus could then be passed on to others if they came into contact with Tavita’s faeces or with secretions from his nose and throat.

2 Tavita, his mother and sister, and the nurse who vaccinates him, are representational characters. This story illustrates experiences common to children receiving oral polio vaccine.
Inactivated polio vaccine (IVP)

Aumea was born in Tahiti, French Polynesia. Instead of the polio vaccine drops, she had a course of injections in her arm to protect her against polio. The vaccine was an inactivated, or killed, form of the poliovirus, which could never cause the disease because it could not replicate or change in any way inside the body. It would also protect Aumea against any of the three strains of poliovirus.

Because the vaccine was injected into Aumea’s arm and therefore did not pass through her digestive tract, Aumea’s body made antibodies in her blood, but not so many in her throat or intestines. That meant that if she ever swallowed any wild poliovirus, it would not be attacked straight away and might pass through her digestive system. However, the antibodies in her blood would inactivate the virus before it could reach her nerves. Aumea would not become sick or paralyzed, but she could still potentially pass the virus on to others.

Aumea was one of the few children in the Western Pacific Region to be given the injected polio vaccine, IPV. That vaccine has been used in France, and in the French territories in the Pacific (French Polynesia, New Caledonia and Wallis and Futuna) and also the United States territories (Guam, the Northern Mariana Islands and Palau). All other countries and areas in the Region – as well as most countries in the world – use the very effective and much less expensive oral vaccine, OPV.

The vaccines against polio

When two different vaccines against polio became available from the mid-1950s, they were embraced enthusiastically, particularly in the industrialized countries. Here at last was a way to avoid the terrible disease, with either just a few injections or drops of vaccine to swallow.

The vaccines differed in two aspects: the form of virus used in preparation, and the method of delivery. One vaccine was prepared using inactivated, or killed poliovirus and came in an injectable form (inactivated polio vaccine or IPV). The other vaccine contained live, weakened poliovirus and was given orally (oral polio vaccine or OPV).

The inactivated polio vaccine (IPV), was available in 1955; the oral vaccine (OPV) became available by 1960 and was rapidly adopted in many countries after initial use on a huge scale in the then Union of Soviet Socialist Republics (USSR). In the Western Pacific Region, Australia, Japan and New Zealand were
among those countries which embraced vaccination against polio as soon as it became available, beginning with IPV. In every country which gave either type of vaccine to a high proportion of its population, the rates of paralytic polio dropped rapidly and outbreaks were stopped within just a few years. Thus, by 1965, many developed countries had brought polio under good control, although occasional cases continued to occur.

In most developing countries, immunization against polio was not introduced until much later. That was due partly to the fact that polio was, at that time, not thought to be a significant problem in those countries, as well as to a lack of the necessary support systems, and the expense and difficulty of introducing any new programme. By the time most developing countries began offering vaccination against polio to their populations, the oral polio vaccine was the clear favourite for widespread use. Almost all of those countries have, therefore, always used OPV exclusively.

There were a number of reasons for the ascendance of the oral vaccine. OPV had been shown to be at least as effective as IPV in preventing paralytic polio in individual children, and it was safe, easily administered and inexpensive. Moreover, when given to large numbers of children at the same time in mass campaigns, it appeared to be more effective than IPV in stopping intense transmission of poliovirus. The vaccine virus, although weakened and less transmissible than the wild poliovirus, could spread to some extent from vaccinees to their close contacts, providing a sort of secondary immunization effect. Large amounts of that weakened virus among the child population could, therefore, block the circulation of wild poliovirus.

The one drawback of OPV compared with IPV is the fact that, in extremely rare cases (approximately one for every three million doses, or every million first doses given), the oral polio vaccine can actually cause the disease, either in the vaccinated child or in a close contact. The weakened vaccine virus – as it is still a live virus - replicates inside a person’s body. In rare cases, it changes slightly in such a way that it regains the ability to attack nerves and causes paralytic polio. Paralysis associated with oral polio vaccine (vaccine-associated paralytic polio, or VAPP) is so extremely rare, however, that the benefits of OPV far outweigh the risks. That is particularly the case when OPV is given to large numbers of children at the same time, as has been done in many countries during the polio eradication initiative. In such circumstances, VAPP occurs at an even lower rate.
“Herd immunity”

Most diseases are treated or prevented for the most part on an individual basis. People with high blood pressure or diabetes must take medicine or change their lifestyle. What others do around them, and whether or not they suffer from the same conditions, does not have a direct effect on the health of those individuals.

Infectious diseases such as polio are different. Children’s risk of catching polio is intimately connected to whether people around them are infected with the virus. It is also connected to whether those others are immune to infection— as well as, of course, whether the children themselves are immune.

Children who are not immune to polio are far less likely to catch it if most of the people around them are immune, whether from having been vaccinated with OPV or from having been infected with the poliovirus in the past. In such a situation, if somebody infected with the poliovirus comes into the village and the virus is spread to his or her close contacts, they are likely to have antibodies against it. Their antibodies will inactivate the virus and stop it from being passed on to the next set of people. As long as the non-immune children do not have close contact with the infected person during the time that he or she is excreting the virus, they are not likely to become infected. If no non-immune host is found before the infected person stops excreting the virus, the virus cannot continue to replicate and will die out.

If each infected person transmits the infection to just one other person during the time that he or she is excreting the virus, the virus can continue to circulate. If each infected person transmits the virus to at least one other susceptible person, the virus will spread among the community, reaching ever-larger numbers of people. But, statistically speaking, if each infected person transmits the virus to - on average - less than one other susceptible person, the virus will eventually die out.

When enough people in a community are immune, people infected with poliovirus will transmit the infection to (on average) less than one other person each. Therefore, even if a virus is introduced, it will not spread far. Most people in the community will never encounter the virus, much less become infected with it. Thus, even those who are not individually immune will be protected. It can then be considered that the community as a whole is safe from sustained circulation of virus, and is a secure environment for the few non-immune people within it. That is known as “herd immunity”. The overall high level of immunity in the group protects the few who are not individually immune.
The proportion of people who must be immune to a disease in order for herd immunity to benefit the community depends on how contagious the disease is and on the conditions which allow it to spread. A highly contagious disease in conditions favourable for spread (for example, in an area with high population density) will require a very high proportion of people to be immune before herd immunity can protect the non-immune.

The level of immunity in the population can be raised either through epidemics of disease, or through vaccination. The latter, of course, is much safer and less painful. In order to gain the full benefit of herd immunity, however, a very high proportion of people must be vaccinated. For each disease and population, it is possible to calculate the proportion of people who must be vaccinated in order to ensure that the disease cannot spread. If a higher proportion is vaccinated, the disease will gradually shrink in scope and die out; no epidemic will occur.
For polio, it has been calculated that 80-86% of children need to be vaccinated to stop the spread of the virus. The exact proportion necessary will vary slightly from place to place, depending on local conditions. It is important to note that the critical proportion of population immunity must be maintained in every community and area in a country, not merely at an overall national level; otherwise outbreaks will still be possible in some places.

“Eradication” of infectious diseases

The word “eradication” has a very specific meaning when used in reference to infectious diseases like polio. It refers to the ultimate level of control, in which the organism (in this case the poliovirus) which causes the disease is completely and irreversibly stopped from spreading in all countries of the world and dies out, becomes extinct. When the disease-causing organism is eradicated, the disease will not come back even when vaccination against it is stopped.

Only one disease has ever been declared eradicated: smallpox, in 1980. That was achieved through widespread vaccination, which could then be discontinued. Generations of children already have had no need of being vaccinated against smallpox, and – barring the deliberate criminal misuse of remaining laboratory-based virus stocks, which for most of the period since 1980 has been little more than a theoretical possibility - no risk of catching the disease.

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Most infectious diseases cannot realistically be eradicated, for a number of reasons – for example, the ability of the causative organism to survive outside the human body. Some diseases, like leprosy and tuberculosis, have been targeted for particularly tight control without mention of eradication. Only five diseases apart from smallpox – yellow fever, yaws, malaria, dracunculiasis (guinea-worm disease), and polio - have ever been marked for eradication. Of those, the first three were shown to be ineradicable after major efforts against them failed. Efforts to eradicate the latter two (guinea-worm disease and polio) have achieved considerable success and are still ongoing. Future candidates for eradication will have to undergo very stringent selection processes, as much has been learnt about factors necessary in order for a disease to be eradicable.

Strictly speaking, the term eradication implies a global scale. It has also been used, however, for smaller areas such as continents. When the latter usage is employed, it should always be made clear that, unless a disease is truly eradicated globally, “eradication” in any part of the world, however large, cannot be guaranteed to be final.

Early beginnings of polio eradication efforts

Polio eradication was first considered by the scientific community as a global goal in the early 1980s. Polio fitted most of the criteria as a target for eradication: it was a serious disease with no non-human reservoir, an effective intervention existed, and eradication could be shown to be cost-effective.

A few years earlier, members of Rotary – a world-wide service club for business people – had already begun efforts to vaccinate large numbers of children against polio in the Philippines and other developing countries. When Rotarians in America heard of the devastation that polio was still wreaking elsewhere in the world, despite the existence of a simple, safe preventative vaccine, they rallied to raise funds and participate personally to protect children.

Thus it was that, in 1985, two major decisions were made which would give birth to the polio eradication initiative in earnest. The
Pan-American Health Organization, the World Health Organization's branch in the Region of the Americas, resolved to eradicate polio from the Western Hemisphere by 1990. And Rotary International committed all its clubs worldwide to a single cause for the first time, with the bold goal of raising US$120 million to purchase polio vaccine for poor countries.

By 1988, significant progress had been made towards interrupting the transmission of wild poliovirus in the Americas. And Rotary International had raised twice as much as it had aimed for - a massive US$240 million – while raising awareness all around the world of the cause of polio eradication. In that year, the World Health Assembly – the governing body of WHO – committed the Organization to eradicating polio from the world by the year 2000. Later in the same year, the equivalent body for the Western Pacific – the Regional Committee – endorsed the global commitment in Resolution WPR/RC39.R15, dated 16 September 1988, but added an accelerated time-frame for the Region. Polio was to be eradicated from the Western Pacific by 1995.