Polio Eradication in the Western Pacific Region

World Health Organization
Manila
# Table of Contents

Preface 1

## Chapter 1: Introduction
- Chanthy's story 4
- The World Health Organization and the Western Pacific Region 6
- Polio: the virus and the disease 7
- Western Pacific declared polio-free 8
- How the poliovirus circulates – and is stopped 9
- How the poliovirus was stopped in the Western Pacific 11
- Expanding from the individual to the population 12

## Chapter 2: The background to polio eradication activities in the Western Pacific 15
- Polio in history 16
- From endemic to epidemic 16
- Oral polio vaccine 19
- Inactivated polio vaccine (IVP) 20
- The vaccines against polio 20
- “Herd immunity” 22
- “Eradication” of infectious diseases 24
- Early beginnings of polio eradication efforts 25

## Chapter 3: Practical aspects and getting the people together 27
- Getting started in the Western Pacific 28
- Establishment of the Polio Eradication Task Force 29
- Drafting a plan of action 31
- Establishment of a Technical Advisory Group 32
- Strategies for eradicating polio 33
Chapter 6: Developing the surveillance system in the Western Pacific

- Situation at the beginning
- Introducing surveillance for AFP
- Population as compared to individual
- Monitoring surveillance: the non-polio AFP rate
- Passive surveillance
- Active searches for AFP cases; development of active surveillance
- Establishment of active surveillance in polio-endemic countries
- Active surveillance in polio-free countries: the “lesson of Malaysia”
- Monitoring of follow-up of AFP cases; link to the laboratory
- Establishment of the laboratory network in the Western Pacific
- Situation at the beginning
- Early meetings and training
- Coordination of AFP surveillance and laboratory activities
- Coordination of the laboratory network
- Laboratory accreditation and monitoring

Chapter 7: Routine immunization/health services

- The Expanded Programme on Immunization
- Universal childhood immunization
- Measuring immunization coverage
- Routine coverage with OPV during the polio eradication initiative
  - At the beginning
  - Effect of the polio eradication activities on routine coverage
- The role of routine immunization in keeping countries polio-free
- Another lesson from Malaysia

Chapter 8: Refining the strategies

- The pieces fit together
- Surveillance and response
  - AFP surveillance
    - Laboratory surveillance
- Targeting the response: high risk response immunization
- The Qinghai importation
Chapter 9: Certifying the Region as polio-free

Kyoto, 29 October 2000
The global process of polio-free certification
Appointment of the Regional Certification Commission for the Western Pacific
Planning the action
National certification committees
Criteria for certification
The impetus and timing of certification
Work begins in the countries
Developing openness and trust
Imported vs indigenous wild poliovirus
Can an imported virus become indigenous?
Laboratory containment
Developing a culture of analysis
Final efforts

Chapter 10: What next?

After certification
The Certification Commission continues...
Further containment work
Immunization continues
Surveillance continues
Vaccine-derived poliovirus detected

Chapter 11: The legacies of the Western Pacific’s polio eradication initiative

Benefits for the Western Pacific of the polio eradication initiative
Lessons learnt in the Western Pacific about polio eradication
Broader lessons of the polio eradication initiative

Annexes

Annex 1: Regional progress in polio eradication
Annex 2: Regional direction of polio eradication
Annex 3: International partnership in polio eradication
Annex 4: Surveillance for wild poliovirus
Annex 5: National progress in polio eradication: Recently polio-endemic countries
Annex 6: Maintaining and documenting polio-free status: Non-endemic countries
Annex 7: Certification of the Western Pacific as polio-free

Please see enclosed CD
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Everybody loves a good epic adventure story, especially one with a happy ending and many heroes and heroines. The heroes and heroines in this story are indeed many: dedicated health workers working long hours often under very difficult and even dangerous conditions; government officials supporting the eradication effort, often going house to house and boat to boat to give poliovirus vaccine; and not least, tens of thousands of volunteers selflessly giving of their time, without any financial benefit, to fight against a deadly disease.

The involvement of visionary organizations was also remarkable, with Rotary International providing the vision and initial financing to start the eradication effort, along with the USA Centers for Disease Control and Prevention (CDC), the Japan International Cooperation Agency (JICA), and the Australian Agency for International Development (AusAID), to name only a few of the important partners in the Western Pacific Region.

When talking of vision and mobilization of efforts, it must be mentioned that the Regional Committee for the World Health Organization in the Western Pacific provided the framework for polio eradication in 1998, with their historic resolution setting a goal of regional polio eradication by 1995. The list of individuals and organizations which fully supported the eradication effort, and made it possible, is too long to include in a short foreword. It is even not possible to include all the names within this short book. If some names are inadvertently left out, it does not diminish their effort, nor their importance to the regional effort and final success.
Of course, every epic adventure story must also have a villain. For this story, the villain is a tiny virus, which cannot be seen by the naked eye, which was hunted down, cornered in smaller and smaller areas, and then eventually eliminated by an organized, determined effort. This book tells the story of how that was done systematically, with good planning, strong efforts in national capitals and in millions of villages and households, a coalition of people and organizations, and constant evaluation and review of activities to improve quality and effectiveness, based on the best scientific evidence and, occasionally, good luck.

And like every good story, there should also be a moral. Polio eradication shows what can be accomplished in the area of health when all countries work together in a common effort towards a common goal. It is even possible to eradicate a disease, the second time that has been achieved in the Western Pacific Region.

This book, however, only records one milestone, albeit a very significant one, on the way to global eradication. The story is not yet over. Wild poliovirus still exists in other regions and can return to the Western Pacific Region if vigilance is not maintained. There remains much work still to be done, and more happy endings to reach, before we can declare final victory against this particular villain.

This story should stimulate us to take up other public health challenges. For if we can overcome two diseases then we can also achieve more successes. I hope that everyone will enjoy this epic adventure story and take pride in the great achievement it records. Then we need to get on with the remaining work of maintaining zero polio in the Region until global polio eradication is reached and to build further on that achievement.

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CHAPTER 1

INTRODUCTION
Chanthy’s story

Mom Chanthy was born in Cambodia in the mid-1990s. When she developed a fever at the age of 15 months, her parents were concerned: they knew how quickly young children could become very ill and even die. The illness did indeed progress. Despite their careful attention to the child, Chanthy developed muscle pain and stiffness of the neck. After the fever subsided, her mother noticed that little Chanthy was not moving around and playing as she usually did. She could not move her left leg.

The family was living at that time on the bank of a river across from the capital city, Phnom Penh. Her mother sold small amounts of vegetables in the neighbourhood, and her father travelled to the city every day to work. They were very poor, but they knew of a good hospital where care was free, so they made the journey to the city. After examining Chanthy and asking some questions, the doctor confirmed what her parents were beginning to suspect: their little girl was likely a victim of paralytic poliomyelitis.

That was what her parents had feared. They knew that disease well: growing up, they had seen many children paralysed by it, and even knew of some who had died. Their language had a special term for polio - krun svat dy cherng - which, translated directly, means “withered limb fever”. They also knew that doctors had no cure for the disease, although there were special exercises, massages and braces which could help victims to retain some function in the affected limbs.
While Chanthy was in the hospital, the doctors took some stool samples and sent them to the laboratory for tests. When they followed up on her two months later, after she had been discharged, they were not surprised to find that her leg was still paralysed. The tests had confirmed the presence of wild poliovirus - the virus that causes polio - in Chanthy's body.

Chanthy had, unfortunately, missed out on having the course of polio vaccine recommended in infancy, which would have protected her from the disease. She probably came into contact with the wild poliovirus while playing with other children. Because she was not fully immunized, the poliovirus could enter her system and attack her nerves, paralysing her leg.

After the initial mishap of having been infected with poliovirus, Chanthy was both fortunate and unfortunate. She was unfortunate to have developed paralysis because only about one in 200 people who are infected with the virus ends up paralysed. And at the same time she was fortunate because, in some of those who are paralysed (up to one in five), the paralysis affects their breathing muscles and may cause death.

Although it was too late to protect Chanthy from paralysis, it was good that the cause of her illness had been correctly diagnosed as polio. Upon that discovery, health workers went to the area where she lived and gave all the children there extra drops of a vaccine to prevent them from catching polio. Because a case of polio had been found in the area, there was a chance other children could become infected with the virus, and possibly develop paralysis too. Some might already have had the virus in their bodies without knowing it, and could pass it on to others. But those who were fully immunized would not become unwell or develop paralysis, even if the virus entered their systems. They would also be less likely to pass the virus on to others.

The health workers went looking for Chanthy again several months later, when it had become apparent that hers had been the last case of polio in the country. They could not find her for a number of years. By the time they did, the whole Region had been certified free of polio. Chanthy – by then five years old – attended a special ceremony in Phnom Penh in April 2001 to celebrate Cambodia’s polio-free status. Although she was coping quite well with her paralysis, health workers were able to offer her family surgical treatment to help her become more independent.

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The World Health Organization
and the Western Pacific Region

This book tells the story of how poliomyelitis was eradicated from a large part of the world: the Western Pacific Region of the World Health Organization. WHO, very much a global organization, nevertheless administers its work (technical advice, support and leadership on health matters) through six regional offices for Africa, the Americas, the Eastern Mediterranean, Europe, South-East Asia, and the Western Pacific.

The work of polio eradication, of necessity, is a highly coordinated global endeavour, involving every country in the world. It has, however, been guided by WHO largely at the regional level. The Western Pacific is the second WHO region (after the Americas) to have achieved polio-free status. Great credit for that must go to each of the countries in the Region, particularly those in which polio was most prevalent at the start of the eradication activities; but no country on its own could achieve polio-free status for the Region. This book is concerned with how the Western Pacific, as a Region, worked together to eradicate indigenous wild poliovirus from within its borders. It focuses on the role of WHO's Western Pacific Regional Office (WPRO) in guiding countries through that process.

The Western Pacific Region, with its office in Manila, the Philippines, is one of the largest, most populous and most diverse of the six WHO regions. It consists of thirty-seven countries and areas, from China in the north and west, to New Zealand in the south, and French Polynesia in the east. Over a quarter of the world's population lives in the Region, in a great diversity of settings: from wealthy nations, through emerging economies, to some of the least-developed countries in the world.
Polio: the virus and the disease

The disease known as polio (or, more formally, poliomyelitis) is caused by a virus called the poliovirus. It is sometimes referred to as “wild” poliovirus, to distinguish it from its tame cousin: the weakened poliovirus used in one type of vaccine which protects against the disease (“vaccine” poliovirus).

There are three strains, or “serotypes”, of wild poliovirus – types 1, 2 and 3. Each has slightly different characteristics, but any one can cause polio in susceptible people. Vaccine poliovirus also has three serotypes corresponding to those of the wild poliovirus, in order to protect people against any strain they might encounter.

An unimmunized person who becomes infected with any of the three strains of wild poliovirus may become ill with fever and develop paralysis: that is polio, the clinical disease. There is no cure for polio. Once paralysis develops, it is almost always present for life. The disease can also kill in some cases, particularly if paralysis affects the respiratory muscles and there is no means of supporting the patient’s breathing.

Most people infected with poliovirus, however, either do not develop any symptoms or experience only a short-lived feverish illness without subsequent paralysis. Type 1 poliovirus, for instance – the serotype which paralysed Mum Chanthy – leads to one case of polio in about two hundred infections of susceptible people. Although low, that is still six times the rate of paralysis caused by type 3 poliovirus.

Within each serotype of wild poliovirus, there are many different individual viruses, each slightly different from the next. They can be divided into families of similar viruses usually found in the same geographic area. When a virus is detected in its native region, it is called “indigenous”. When found far from its family, among genetically unrelated viruses, it is said to have been “imported” from elsewhere.

Mum Chanthy’s place in the story of polio eradication in the Western Pacific is as the last case of polio in the Region caused by an indigenous wild poliovirus. There is no longer any wild poliovirus indigenous to the Western Pacific Region: all have been eradicated.
Western Pacific declared polio-free

It is often hard to recognize significant events in history at the moment they occur. When Mum Chanthy was diagnosed with polio in March 1997, who was to know that was the last time indigenous wild poliovirus would be seen in Cambodia, or in the Western Pacific Region? It was only some time later, and with the benefit of other information from surrounding countries, that health workers could see that the wild poliovirus had ceased to circulate in the Region. And it was not until over three years after Mum Chanthy became sick that the Region was certified polio-free, on 29 October 2000.

However, the great thing about this story is not just that a little girl was diagnosed quickly and accurately with a dreadful disease; not just that the children around her were thus protected against it; and not even just that it happened to be the last time that disease was seen in one part of the world. The great thing about this story is that it was no accident that it was the last case of indigenous polio in that part of the world. The wild poliovirus was stamped out in the Region, systematically and thoroughly, over a period of less than a decade: from perhaps sixty thousand cases Regionwide in 1990, the annual number of cases was reduced to zero by 1998. Mum
Chanthy was only one of thousands of children diagnosed with polio during that time. The children around her were among millions of others who had extra doses of polio vaccine to protect them from the disease when polio was found nearby. Almost all children in the whole Region have been given polio vaccine to protect them against the disease and to stop the spread of the virus to others.

How the poliovirus circulates – and is stopped

The poliovirus needs human bodies in which to live and replicate. Within the body of a single infected person, the virus may live a few weeks before being cleared by the immune system. It must find a new susceptible host to infect within that time, otherwise it will die. The virus can only survive long-term by being passed from person to person. Ongoing transmission of virus between people is referred to as “circulation” of the virus.

The poliovirus enters the body through the mouth and reproduces in the throat and intestines. In some cases it is able to reach the cells of the nervous system, damaging them and causing paralysis; in other cases it causes a transient illness; but in most cases infection with the virus causes no noticeable problems for the person who hosts it.

The poliovirus lives and replicates within human bodies for variable periods of time: up to two months for people with normally-functioning immune systems, longer for those whose immune systems are impaired by disease, malnutrition or drugs. During that time the virus is excreted in the faeces and – to a lesser extent – in secretions from the nose and throat. If no susceptible person comes into contact with virus-containing faeces or secretions, the virus – outside its home, the human body - eventually dies. But if people are around and in close contact, and particularly when there is not much clean water for washing hands or flushing away excrement, the virus can often find its way back into the mouth of a susceptible person and begin the cycle again.

Children act as some of the best hosts for the poliovirus (as well as for many other viruses). They tend to share infections more readily than adults do, through playing in close contact with other children, putting fingers and other objects in their mouths, and being generally less concerned with personal hygiene. Young children are also more likely to be susceptible to the disease, as they may not yet have received a full course of vaccinations or encountered the virus naturally.

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1 In the context of this book, poliovirus refers to wild poliovirus.
It is important to note that only susceptible people – those who are not already immune to the poliovirus - can be infected with the virus. When the poliovirus encounters people who are immune – through either vaccination or previous infection – it may enter their mouths, and even pass through their digestive systems, but it cannot establish an infection in their bodies. That means that it cannot attack cells or cause illness in that individual, although it may replicate to a limited extent. The virus may be “carried” to other people during the period that it is excreted by the immune person, but if immunity is due to prior infection or to vaccination with oral polio vaccine, even that carrier phase is shortened and less intense as a result.

People who are immune to the poliovirus thus act as “roadblocks” to its circulation through a population. The virus cannot proceed (or at least, is significantly suppressed) when it reaches an immune individual, but must try to find a way around the roadblock, by finding another susceptible person. If no susceptible person is found during the time of replication in the infected person, the virus has reached a dead end and can travel no further. That particular virus will die out, although other polioviruses may continue to circulate elsewhere.

How the poliovirus was stopped in the Western Pacific Region

The poliovirus (as a single entity, encompassing all wild polioviruses) was stopped from circulating in the Western Pacific Region in a conceptually simple way, exactly as described above. “Roadblocks” of immune people (especially children) were placed in its way, until it could not travel any further. When all the children that the poliovirus came across were immune, the virus could not infect them or be passed on to any significant extent. Thus, without anywhere to live, it eventually died out. That happened all over the Region, to all the different strains of poliovirus that were indigenous to the area.

The conceptual simplicity of stopping poliovirus circulation belies the magnitude of the task in practical terms. Making sure that all the children in the Region were protected against polio was a huge undertaking, involving a great many people in a wide range of different roles. The work ranged from contact with individuals (for instance, health workers and volunteers giving vaccine drops to children), through support for such activities (such as by transporting vaccine to health centres), to
coordination of the programme at a central level within each country, and beyond that, overall coordination of individual countries’ efforts at WHO Regional Offices, and ultimately at WHO Headquarters.

All levels were vital. Without reaching the individuals, children could not be protected against polio, or diagnosed with it if they became unwell. Without support at a number of different stages, health workers and volunteers could not have carried out the vital task of giving vaccine drops to children. And without overall coordination, the final stages of reaching the last, hidden children would have been impossible.

Beyond the direct physical work of implementing the strategies to eradicate polio, strong leadership and political commitment were also vitally important, as was the financial support given by a wide range of organizations at both the national and international level.

In other words, children were protected from polio one by one – but that protection was by no means random or haphazard: it was a well-planned and highly organized endeavour. Just protecting some, or even many, children against polio would not have been enough. It was necessary to reach a very high proportion – almost all – of the population to ensure that the poliovirus could be completely stamped out.

Polio vaccine had been available for decades, and was already being used routinely in all countries before the decision to wipe polio out completely was made in 1988. It was, therefore, easy, in most countries, to give a course of polio vaccine to at least some children. Children who lived near health centres and/or whose parents were relatively wealthy and well educated got the vaccine, but children in poorer and more remote areas were less likely to have access to polio vaccine. In many counties of the Region, that meant that the majority of children were not being protected.

Moving from the level of protecting individuals to that of protecting populations required a quantum shift in both vision and action. For every stage in an individual child’s experience with the polio disease or vaccine, a corresponding system had to be set up to ensure that all other children could benefit from the same service. Only by aiming to cover all children could the very high population immunity needed to stamp out polio be achieved.

Expanding from the individual to the population
For example, the basic method of protecting a child against polio is usually to ensure that he or she has a course of three doses of the oral polio vaccine (OPV) in infancy. (In some countries, an extra dose is recommended at birth, making a full course of vaccination four doses of OPV). Mum Chanthy, the little girl who was the last person in the Region to be paralysed by indigenous wild poliovirus, was one of the children who missed out on routine vaccinations. So, when she was exposed to the poliovirus, she became infected and developed paralytic polio. Protecting all children meant extending the reach of immunization services, which required trained health workers in health centres, an adequate supply of effective vaccine, transportation to get vaccines to health centres, refrigerators to keep them cool, systems to record vaccines delivered, and so on. In many countries, special vaccination campaigns had to be undertaken to supplement the routine services.

When Mum Chanthy became sick, she was taken to a hospital and examined by doctors who could recognize the signs of polio and carry out appropriate tests. Training health care workers to suspect and test for polio whenever they saw children with paralysed limbs, and to report the condition to public health authorities, was an important part of the programmes, as was the active search for previously unreported cases of paralysis. In that way, every possible case of polio could be identified to track any virus that was still circulating.
Stool samples collected from Mum Chanthy were packaged by national polio eradication programme staff and then sent to a regional reference laboratory in Japan, where it was confirmed that she did have polio. During the polio eradication initiative, a network of national and regional laboratories, specialized in detecting and differentiating polioviruses, was set up. That required training staff and monitoring laboratory standards, as well as setting up support systems, such as one to keep samples cool while transporting them.

When it was confirmed that Mum Chanthy was suffering from polio, health workers went out to her area and systematically gave extra doses of vaccine to all children. Administration of supplementary vaccine, known as “mopping up”, was carried out many times during the polio eradication initiative, for millions of children in a single day on some occasions. Such huge undertakings required detailed logistical planning, and help from many people from well beyond the health sector.

How did the vision – to extend protection against polio to every child in the Western Pacific Region – come about? And how was it put into practice? This book tells the story of those events – events which add up to one of humanity’s greatest achievements in the struggle against disease.
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 immobilised, 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.

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**Oral polio vaccine**

Tavita\(^2\) 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.

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\(^2\) 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.
Aumea\(^3\) 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.

\(^3\) Aumea is a representational character whose experience is used to illustrate the action of inactivated polio vaccine.
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.
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.
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 world wide 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.
CHAPTER 3

Practical Aspects and Getting the People Together
After the 1988 resolution to wipe out polio in the Western Pacific Region by 1995, there was a period of about two years in which work, while intensified, largely followed the same strategies as before in most countries and within the Regional Office. Routine immunization was encouraged, and reports of polio cases were monitored. It was expected that if those two systems were gradually improved in every country, polio would eventually disappear.

Dr Sang Tae Han, then the Director of the WHO Western Pacific Region, was deeply committed to the goal of eradicating polio in the Region by 1995. From the beginning, he sought to lead the Western Pacific according to the best evidence available from eradication initiative experiences in the Americas and elsewhere.

In August of 1990, WHO staff made a trip to Japan, where they met with Dr Isao Arita. Dr Arita had been involved in the eradication of smallpox in Africa in the 1960s and 1970s, and was the Chief of the Smallpox Eradication Unit at WHO Headquarters in Geneva for the final stages of that campaign. After smallpox had been eradicated, he had returned to Japan where he worked for the Ministry of Health and also headed the nongovernmental organization ACIH (Agency for Cooperation in International Health, which would become an important contributor towards polio eradication activities). Dr Arita, who was involved in the polio eradication effort in the Americas, was to play a very important role in polio eradication in the Western Pacific.
Region. During their visit to Japan, WHO staff again discussed the status of the polio eradication initiative in the Region, and the fact that success in the Americas had required supplementary immunization on a large scale.

Establishment of the Polio Eradication Task Force

In 1990, a review meeting was held in the WHO Regional Office for the Western Pacific to review the progress towards polio eradication. Judging that much more decisive action needed to be taken to achieve eradication by the 1995 target date, a Polio Eradication Task Force was appointed, with Dr Jong-Wook Lee as team leader. Dr Agostino Borra was operational officer, and the other original members were Dr Shigeru Omi, Mr Alan Schnur, and Dr Sima Huilan.

The Task Force was well qualified for the job. JW Lee was a skilled manager and, as Regional Adviser for Chronic Communicable Diseases, in charge of tuberculosis control and leprosy elimination activities. Agostino Borra was medical officer for the Expanded Programme on Immunization (EPI) and Control of Diarrhoeal Diseases, with many years experience in the Western Pacific Region. Shigeru Omi – who would go on to become the first Regional Adviser for EPI in the Western Pacific, and subsequently Regional Director – had a good knowledge of virology, having worked with hepatitis B virus. He had worked in a wide range of medical and public health positions, including serving as sole medical officer in remote islands in the Pacific, and was recruited from Japan as a medical officer specifically to help progress the polio eradication initiative. Alan Schnur had long experience in EPI cold chain and logistics, and had been involved in the smallpox eradication initiative in Ethiopia, Somalia, India and Bangladesh. Sima Huilan was the Regional Adviser in Health Laboratory Technology. She would become responsible for setting up a regional network of specialized polio laboratories.

That original Task Force worked long hours on its new task. Polio-free status for the Western Pacific must have seemed a long way off at that time, but they had been given a job to do and were confident that the goal could be achieved. Some were galvanized by their personal experiences and the success of other disease eradication efforts. Others, looking back, say there was never any thought of failing.
If the Americas could reach zero polio, then the Western Pacific could too. At any rate, there was no time to think about the possibility of failure. There was too much work to be done.

The Task Force was instructed to prepare a plan of action for the Western Pacific Region, based upon the experience with polio eradication in the Americas. By that time, poliovirus circulation had been drastically reduced in that Region; the last case of polio was to be found the following year (1991). There was, therefore, already a wealth of experience with strategies to combat polio.

It was recognized that the work required was well beyond the capacity of the small number of staff in the regional team who had formed the original Task Force. Many other people with different and specialized skills joined the team, and eventually the day-to-day polio eradication efforts were transferred to a newly formed Expanded Programme on Immunization (EPI) unit, with Dr Shigeru Omi as Regional Adviser.

As additional resources were mobilized, more key staff joined in and played crucial roles in the successful eradication effort. Dr Julian Bilous joined EPI in 1991, in time for the second Technical Advisory Group (TAG) meeting. He was to play a key role in the eradication effort, able to synthesize many widely different ideas and then calmly write them down into coherent documents and plans. He later succeeded Dr Omi as Regional Adviser for EPI. Mr Chris Maher joined the team in 1992 and immediately provided essential support, especially in the area of field activities. His tireless efforts were an important factor in the eradication efforts. He went on to play an important role in the certification work and to become the Regional Adviser until August 2000. Dr Ray Sanders joined the team in 1993 and oversaw the implementation of the highly successful regional polio laboratory network. His combination of laboratory and management expertise made that formidable task possible. Other staff who joined the regional team while
there were still polio cases included Dr Ville Postila, Dr Jacob Kool, Dr Yoshikuni Sato and Dr Sigrun Roesel.

It was recognized early on that placing experienced, motivated international staff at country level to support regional staff was essential for a successful eradication effort within the short time-frame before the target date. By 1992, it had become possible to assign international polio eradication staff in countries, funded by the Centers for Disease Control (CDC) Atlanta, Rotary International, the Japan International Cooperation Agency (JICA), the Agency for Cooperation in International Health (ACIH, Japan) or WHO. They included Mr Mauno Erkkila, Dr Yasuo Chiba, Dr Mact Otten, Dr Jessie Wing and Dr Lisa Lee in China; Dr Bernard Morinieres, Dr Kohei Toda and Dr Marcus Hodge in Viet Nam; Mr David Bassett in Cambodia and later in the Lao People’s Democratic Republic; and Dr Richard Nesbit and Dr Yang Baoping in the Lao People’s Democratic Republic.

JW Lee led the polio eradication team until 1994, when he left the Region to take up the post of Director of the WHO global programme for Vaccines and Immunization. Dr Omi took over the leadership of the Task Force when he became the Director of Communicable Diseases in 1995.

**Drafting a plan of action**

Dr Ciro de Quadros of the WHO Regional Office for the Americas (also known as the Pan-American Health Organization, or PAHO) had led the fight against polio in that Region, after also having been involved in smallpox eradication. He took time from his very busy schedule to travel to Manila for Thanksgiving weekend in November 1990 to meet with the members of the Task Force, share the Americas’ experience, and provide guidance for the preparation of the Western Pacific Region’s plan of action. Polio eradication had been identified as a priority in the Western Pacific Region and the development of the plan started immediately, based on the discussions with Dr de Quadros.
The true extent of poliovirus circulation in the Western Pacific Region was not known in 1990. The reporting systems in many countries were such that most cases (perhaps 90%) went unreported. Until then, there had been no analysis of the reported cases in the Region. In order to assess the situation accurately, Dr Omi prepared, by hand, a map of the Region showing, for each country, the number of reported cases of polio and the percentage of children given three doses of OPV, as well as other indicators. Countries were categorized into poliomyelitis-endemic and poliomyelitis-free, based on whether they had reported polio cases in the preceding three years. Those which were considered poliomyelitis-free were further divided into high-risk and low-risk, based on whether they had vaccinated at least 80% of their children in the same period of time.

Based on PAHO's plans and experience, as well as on what was known at that time about the conditions in the Western Pacific Region, the Task Force rapidly drafted a Regional Plan of Action for the period 1991-1995. Support in that effort was provided by Dr Sieghart Dittmann, who worked with the Task Force as a consultant for six months and helped to rewrite important surveillance and epidemiology sections of the plan.

**Establishment of a Technical Advisory Group**

A Technical Advisory Group (TAG) on EPI and polio eradication had played an important part in guiding the initiative in the Americas. Based on that experience, a similar group was appointed to carry out the same function in the Western Pacific Region. Six internationally recognized experts on EPI and polio eradication were invited to be founding members of the TAG: Dr Isao Arita (Chairman), Dr Ken Bart (Vice-Chairman), Dr Anthony Radford (Rapporteur), Dr Dai Zhicheng, Dr N. Sakai, and Dr Nguyen Hoang Thuy. The terms of reference of the TAG were as follows:

1. monitor the situation of EPI and poliomyelitis eradication in the Western Pacific Region and the formulation and implementation of regional and national plans of action;
2. evaluate current strategies and practices and recommend suitable strategies for acceleration of the EPI and poliomyelitis eradication initiative, specific to the Western Pacific Region;
(3) promote understanding and support for the programme goals among technical institutions and bilateral, multilateral and private agencies, as well as political leaders; and

(4) advise the WHO Regional Director for the Western Pacific on the above points.

The first meeting of the TAG was planned for April 1991 in Tokyo, Japan. After agreeing on its terms of reference and mode of operation\(^5\), its first task would be to approve a plan of action for polio eradication in the Region based on the draft prepared by the Task Force. As it turned out, the TAG was in full agreement with the strategies developed by the Task Force, and approved the plan of action without significant alteration.

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\(^5\) See Annex 1: TAG: TOR, members, summaries of meetings.
(2) supplementary immunization activities, such as immunization days and mopping-up operations, aimed at interrupting wild poliovirus transmission;

(3) strengthening of disease surveillance aimed at the prompt detection and investigation of all suspected poliomyelitis cases, and the identification of factors responsible for those cases; and

(4) aggressive outbreak control, including containment immunization.

The strategies above are covered in more detail in subsequent chapters. They are actually very simple and straightforward conceptually, if not easy in practice. In order to wipe out polio, it was simply necessary to reach and maintain (through vaccination) very high levels of immunity among children. Within a population with high immunity levels overall, any small areas of low immunity had to be detected so that extra vaccination could be offered to protect children there. The best indicator that an area had low immunity levels would be the occurrence of a case of polio there. Every case of polio had, therefore, to be detected and dealt with rapidly.

"Easier said than done"

By early 1991, the newly established Task Force had developed the plan of action for polio eradication in the Western Pacific Region, complete with strategies to cover all aspects of the work from 1991 through 1995. Having a plan and strategies in place was an important step, but there was still a lot more to be done. Many did not really believe that the success in the Western Hemisphere could be duplicated in the Western Pacific Region.

Well over a quarter of the world’s population lived in the Region, in a great diversity of settings. The country with the largest population – China, with well over a billion people – had just suffered a large outbreak of polio and still had widespread transmission of virus. Some of the least developed countries in the world – such as the Lao People’s Democratic Republic - were also in the Region. Polio was not high on their lists of priorities, among all the other problems they faced.

Several countries were embroiled in conflict. Cambodia was only just emerging, in 1991, from two decades of vicious civil war, which had destroyed much of the country. The outside
The world had had very little contact with Cambodians during that time. The Philippines and Papua New Guinea each had smaller-scale rebellions within their territories.

Some of the most rugged terrain and most isolated groups of people in the world were found in the Western Pacific Region. It was not unusual for people in Papua New Guinea to live several days’ hard walk away from the nearest health centre. In such settings it was impossible even to know how many cases of polio were occurring.

The Americas had had the advantage of a small number of common languages. By contrast, in the Western Pacific Region, Papua New Guinea alone had over eight hundred languages, and there were many more – some with different scripts – in the Region. Even something as basic as communication was going to be much more difficult in the Western Pacific.

Another advantage the Americas had possessed, which was lacking in the Western Pacific Region, was a large “moat” surrounding it on all sides, which tended to limit the spread of poliovirus from other regions. Countries of the Western Pacific, by contrast, bordered other regions containing some areas where polio was still heavily endemic.

Nevertheless, the Region had resolved to eradicate polio, and some people believed – no matter how great the obstacles - that it could be done. And so they set to work.

The first question was how to obtain all the extra vaccine that would be needed.

### Extra vaccine requirements

Most countries were already giving oral polio vaccine routinely to most of their children, but the plan was now to give extra doses to all children aged less than five years in large parts of the Region. In China alone that would amount to over a hundred million children. Each child needed two doses of OPV, a month apart, and that would be repeated each year from late 1991 until the end of 1995. Then there would be a need for smaller (but still large) amounts of vaccine to give to children in areas where polio was found or suspected (so-called “mopping-up” operations). Also, routine vaccination had not only to continue but also be extended to greater numbers of children.
The manufacturers of the oral polio vaccine were able to produce enough for requirements, but it would cost a lot of money to obtain all the vaccine. The first priority was China, as that was where 90% of the polio cases in the Region were occurring.

The cost of extra vaccine

At that time, a dose of oral polio vaccine cost about five cents American. The rough estimate for the regional Plan of Action, which did not take inflation or price changes into account (and also did not include Cambodia, which at that time was still in the midst of a civil war and cut off from the rest of the world), was that US $67 million would be needed for vaccine alone over the five years.

That was the amount that was expected to come from outside the countries. Those countries that were expected to carry out supplementary immunization activities were also the poorest countries in the Region (compared with their populations) and could not afford the huge amounts of extra vaccine.

It was recognized that countries would contribute most of the running costs of the operation. However, some extra funding would be required for laboratory and other equipment, specialized staff, training and supervision, etc. US $100 million was the estimate for the total amount that would need to come from external donors.

Establishment of an Interagency Coordinating Committee

Several organizations – both governmental and nongovernmental - had already given financial and other support to polio eradication activities in other parts of the world, and even – on a smaller scale – in the Western Pacific Region. Some - like Rotary International, the Centers for Disease Control and Prevention (CDC) in the United States, and the United Nations Children’s Fund (UNICEF) – were already very experienced in such work. The Western Pacific Region could look to them as senior partners in polio eradication. Many others – notably the governments of Australia and Japan - were to join the effort as particular supporters of the Region.

Contributions were welcome from any group, and the list of those who eventually participated in funding the polio eradication work in the Region is long and distinguished. In the early days, however, that strong coalition had not yet been established. Donors had first to be
convinced that countries of the Western Pacific Region had the will, capacity and appropriate guidance to carry out such a huge task, in order to ensure that their money would not be wasted. Once donations were forthcoming, it would be necessary to coordinate their use according to needs throughout the Region.

In the Americas, a multi-agency committee had been established to raise and coordinate the flow of funds needed for the polio eradication initiative. The Task Force knew that such a body would also be vitally important in the Western Pacific Region. Representatives of some potential donor organizations had, therefore, been invited to the first meeting of the TAG in Tokyo, where the concept was introduced in an informal meeting. It was decided to establish an Interagency Coordinating Committee (ICC) for the Region, and to hold its first official consultation alongside the next TAG meeting.

The Regional Interagency Coordinating Committee was duly established in Cebu, the Philippines, in December 1991, with the adoption of specific terms of reference around provision and coordination of support for the Expanded Programme on Immunization and the polio eradication initiative. Mr Brian Knowles of Rotary Australia was elected chairperson, a post he was to hold for over a decade, until the Western Pacific Region had been declared polio-free.

The Region was fortunate in having Brian Knowles to lead its ICC. A committed Rotarian since 1960, he had been on the international board from 1986 to 1988, the first intense fund-raising years when Rotary clubs around the world had raised US $240 million for polio eradication. As early as 1990, he had been involved, on Rotary’s behalf, in the establishment of a new facility for polio vaccine production in China, and was thus already familiar with the largest country in the Region. He brought to the position a great belief in the necessity and achievability of polio eradication, and a spirit of selfless voluntary service combined with a gift for facilitating cooperative collaboration. All those qualities helped the ICC to develop into a highly effective organization, without which the polio eradication initiative could not have achieved its ultimate success.

Rising costs of international vaccine

Before the second TAG meeting and the establishment of the ICC, the international manufacturers of oral polio vaccine had advised that the price of the vaccine would rise in 1992, from five to seven cents per dose. The cost of polio eradication activities would, therefore, rise considerably, unless vaccine could be obtained...
at a lower price. Up until that time, there had been no donations from external donors for the purchase of vaccine. Even after the establishment of the ICC, there was a period of about eighteen months before the first large donations for vaccine were secured (although smaller amounts of money had been made available for other aspects of the programme). The serious shortage of vaccine was forcing countries to establish contingency plans for supplementary immunization, including lowering the target age groups and selecting high-risk districts rather than holding full national immunization days. Some flexibility was needed, but cutting activities too much would put the success of the whole endeavour at risk.

**Locally-produced vaccine**

At that stage, China was already producing oral polio vaccine – in the form of solid sugar and milk balls or dragees - at a fraction of the cost of international vaccine. However, it did not meet the World Health Organization’s standards for heat stability. Therefore, any money donated through UNICEF or WHO could not be used to buy vaccine from those sources if the organization were to honour its own guidelines.

The Chinese vaccine met the standards except on one parameter – it was not quite stable enough when exposed to high temperatures. That meant that there was a risk of it being inactivated if it could not be kept frozen or cold enough until used. In all other ways it was acceptable – effective and safe. It had been used for routine immunization in China since the 1960s.

The Polio Eradication Task Force at the Regional Office had to decide which was better to use international funds to purchase the Chinese vaccine for national immunization days in China, or to risk not having enough vaccine to carry out those huge events at all. It was clear to them that using the Chinese vaccine was the best option. However, the Technical Advisory Group and the leaders of WHO’s global immunization programme needed to be convinced as well, and could not disregard the standards that had been set.

**Emergency situation**

The matter of vaccine supply for mass immunization in China was brought to the third TAG meeting in Beijing, China, in October 1992. There was discussion of different options, such as upgrading the Chinese vaccine
manufacturing facilities to produce liquid polio vaccine. Even if that proved feasible, it would take a year before improved production could begin. Eventually the TAG recommended that, given the emergency nature of the situation, WHO should accept temporarily procuring the Chinese vaccine in order to ensure that mass supplementary immunization could proceed. It was also agreed that countries could target age groups other than the officially recommended group of all children under five years for supplementary immunization – for example, depending on the circumstances, they could aim national immunization days at children under four years. Based on the fact that almost all cases of polio in China were occurring in that age group, and in order to make the best use of the limited resources, the Chinese authorities decided to do just that, and the Chinese vaccine manufacturers increased their production to meet requirements.

WHO continued to support local production of vaccine in Viet Nam as well as in China. Vietnamese-produced OPV was accepted for international funding from 1994 onwards. That was a much more cost-effective way of procuring vaccine. Apart from the fact that the price per dose was much lower, there were also lower transport costs involved. Moreover, by producing much of the vaccine needed within the Region, the Western Pacific was able to reduce its considerable demand on international vaccine suppliers. In the case of Chinese vaccine, an additional benefit was that considerably less vaccine was wasted because each dose was a discrete solid ball.
The first large donations for vaccine

By the time of the third TAG meeting and the second ICC meeting in Beijing in October 1992, the vaccine shortage was becoming a critical issue for the polio eradication initiative. Four years after the initial decision had been made to eradicate polio in the Region, and with only three years to go before the 1995 target date, no country had been able to carry out full-scale national immunization days. The TAG made an urgent call for increased support and expressed concern that an historic opportunity would be missed if additional vaccine were not provided for China. Member States were themselves providing additional funds from national sources, but were not receiving adequate external support.

Dr Lee, Dr Omi and Mr Schnur worked persistently to convince partner agencies to strengthen their vision. Dr Omi made several trips to meet senior officials in the Ministry of Foreign Affairs, Japan, literally begging for funds, at the same time collaborating with Senior government officials of Member States where the funds were badly needed. Due to the level of urgency, there were occasions when he would leave for Beijing from Tokyo in the early morning and return from Beijing late the same day, undaunted by any hazard.

As a result of collaborative efforts, donors were stimulated to increase their contributions. Rotary was able to divert one million dollars, destined for use in another part of the world, to China for vaccine. That Rotary funding, supplemented with Government support, enabled the purchase of enough vaccine to immunize every child under the age of four years in China. Although the age limit (four years) was lower than that recommended globally, epidemiological evidence from China indicated that the lower age limit would be adequate for China. Furthermore, the Rotary funding acted as a catalyst for further donations. Other organizations overcame the constraints of their funding and approval processes to make money available in record time.

The Japanese Government wished to support countries with long-term investment, and vaccine was seen initially as a consumable product. However, vaccination produces a long-term effect. Government officials from different agencies in Japan worked very hard to identify the critical needs for polio eradication. As a result of all their efforts, Japan began to provide support for vaccines in many countries of the Region. At that time, it was new for countries to request vaccine support from Japan in order to get the vaccine on time. Japan made great efforts to coordinate with the procurement agencies and the requesting countries. The
Japanese Government agreed to provide two million dollars’ worth of vaccine for China’s national immunization days in 1993, 1994 and 1995. Japan also continued to provide large amounts of funding for other countries in the Region through its Ministries of Foreign Affairs and of Health and Welfare, and through the Japan International Cooperation Agency (JICA).

There was also need for technical support in such areas as estimation of vaccine requirements, a task which WHO was able to fulfill.

**Continuing financial support**

The most difficult part of any endeavour is often simply getting started. After the first large donations were received, the work of polio eradication could enter a new phase, which itself attracted further support. At the same time, all the parties involved were learning to work together more effectively.

WHO changed its approach in presenting the needs for funding. Strong economic evidence was presented to show the benefits of eradicating polio. For instance, it had been calculated that the savings from reduced treatment and rehabilitation needs for polio sufferers would be enough to justify polio eradication on their own - even without taking into account the savings from being able eventually to stop vaccinating. Also, funding requirements were broken down into manageable chunks for presentation, and linked to use. Thus, instead of saying that a hundred million dollars was needed over the next five years, it would be stated that (for example) sixteen million doses of OPV were needed for national immunization days in Viet Nam in 1993. Donors could more easily imagine providing that kind of contribution, and also had confidence that the estimates were more accurate when presented in that way.

ICC meetings came to be held on the penultimate day of each TAG meeting, to allow the representatives of donor organizations to be present at the TAG meetings and hear all the presentations and discussions. The ICC also changed the format of its meetings to allow time for small group discussions. Both those changes proved very beneficial.

Brian Knowles remembers an incident at the third ICC meeting in Ho Chi Minh City, Viet Nam, in June 1993 as indicative of the spirit of cooperation that existed among the countries and the funding partners. The Government of Viet Nam wanted to hold its first national immunization days in that year, but was some two million dollars short of funding for vaccines. In order to plan the activities appropriately,
they needed a commitment of funds almost immediately. Through discussions in the coffee break, representatives of two major organizations discussed the possibility of each providing half the money, if the other could arrange to match the commitment. Amazingly, approval was gained overnight for each of those amounts. It was announced before the end of the meeting that Rotary International and JICA would meet the cost of the vaccines. Viet Nam could proceed with its preparations for national immunization days.

Non-monetary support

Of course, contributions other than money were also needed. The value of the time and energy given freely by millions of people through the course of the polio eradication initiative cannot be estimated. Other contributions included the use of business premises for vaccination posts, vehicles for transporting vaccine, courier services for shipping samples, airtime and advertising space for publicizing events, and so on. In the process of holding the first successful national immunization days, considerable experience was gained in mobilizing support in each country. From high-level government leaders to local people with time, skills or resources to share, a wide variety of people joined in and gave valued assistance.

Momentum builds

The first Chinese national immunization day, held in December 1993, was the largest public health event ever, and attracted political support from the very highest levels. The success of that event, following on from that of the national immunization days in the Philippines in April and May 1993, convinced many people that it could be repeated elsewhere in the Region, and gave hope that polio could be eradicated after all. Energy was created, which – along with experience – enabled other countries to hold their own successful supplementary immunization activities. Each of the large-scale, highly publicized events brought more people, more energy and more money into the work of polio eradication.
CHAPTER 4

SUPPLEMENTARY IMMUNIZATION
A mother’s memories

Maria\(^7\) can still remember that first day in Manila, when the children had to go and have the drops to make sure they would not get sick. How could she forget? At the time, it was a big deal.

For weeks people had been talking about it. Some of the women from church were working as volunteers on that day, helping people get to the places where they could get the medicine. The school, the petrol station, the fast-food restaurant around the corner, all had posters up, advertising that the medicine would be available on their premises. Even the children knew about it – one of their favourite singers had been on the television promoting the event. Ronaldo, who was already six, was very disappointed when he found out he could not have the drops. Even when Maria explained that he had already had the medicine, four times, when he was a baby, he was not consoled. "But the twins had it too, when they were little, and they’re getting it again!” he protested, with perfect logic. “You’re a big boy now,” she told him. “This medicine is only for little kids.”

It was never easy taking all the children anywhere – her own three, and her sister’s four. But on that day they did not have far to go - and there were plenty of people to help with transport. Everyone really seemed to care that her children got those drops. It was a good feeling. She looked forward to the next month, when the same thing would happen again.

All the mothers in the neighbourhood made sure to take their little ones to one of the places where they could get the drops. Maria heard that people were going out to give the drops to all the children in the Philippines. Even in the South, where there was trouble, everyone had agreed to stop fighting for a while so that the children could have their medicine. Some of those children had never had the chance to get the medicine in their lives, because of the social turmoil. She was glad that they were not being left out.

Maria’s children were among approximately nine million who received the polio vaccine that day.

\(^7\) Maria and her children and neighbours are representational characters invented to help describe real events.
**Extra doses of vaccine**

Supplementary immunization – one of the key strategies for eradicating polio – means, very simply, giving children extra doses of polio vaccine in addition to those they should have received as part of their regular health care. In routine immunization programmes, children are given three (or in some countries four) doses of polio vaccine in their first few months of life. Additional doses do not cause any harm. But why should children need extra doses of vaccine if they have already had enough to protect them from polio?

Sometimes the easiest way to make sure most people have enough of something – be it money, food or vaccination - is to give some to everyone, rather than looking specifically for those who have missed out. Those who already had some will get more, which they may not need, but those who had none will now have enough for their needs.

Although giving people vaccinations which they do not need means that some vaccine will be wasted, it may be more wasteful to spend time, energy and money trying to target the vaccine to only those who have not received any.

In many countries – even those with highly developed health systems - it is not easy to find out what vaccinations a child may have had. The parent or caregiver may not know or
remember, or may have lost the child’s immunization card. The information may be recorded in different health centres in different parts of the country, or not at all. If parents are asked to find information and bring the child back later, the opportunity for vaccinating may be lost. Vaccination can easily be put off or forgotten: there is no pressing need for parents to take children to the health centre if they do not show any signs of illness.

Finding out a child’s vaccination status is difficult and may cost a considerable amount, if it can be achieved at all. OPV costs only a few cents per dose and is not harmful even if more doses than are strictly necessary are given. Vaccination is as important for the community as it is for an individual child. It makes sense, therefore, to give a child extra doses of OPV when everyone else is getting it - even if he or she may already be individually immune - to ensure that the level of immunity in the community is raised.

**Reaching everyone together**

There are advantages in giving vaccine to all children at the same time. Clearly, if many children have not been vaccinated before, the level of immunity in the community will rise dramatically if large numbers are vaccinated together. Moreover, when large amounts of vaccine poliovirus are released into the population at the same time, the weakened live virus may circulate among the children, creating immunity even among some who were not vaccinated directly.

Practical considerations, too, make it a good idea to aim to reach all children at the same time. A large event can be organized and publicized widely, ensuring that everyone is aware of the time and place that vaccine will be available, as well as the importance of the occasion. Workers – both professional and volunteer - can be organized for short, intense periods more easily than for ongoing endeavours.

**Supplementary immunization activities**

Large-scale supplementary immunization activities in those countries which were still reporting cases of polio were the public face of the polio eradication initiative. They excited people’s imagination, and gained a lot of support for the endeavour. They were responsible for the most dramatic declines in the rates of polio in the Region.
However, countries in the Western Pacific Region were at different stages with respect to polio eradication at the beginning of the initiative. In some, polio had not been seen for many years. In others, it was still widespread. Clearly, different countries needed different approaches. Most countries in the Region did not need to carry out widespread supplementary immunization activities.

The countries which did carry out supplementary immunization activities were those in which polio transmission was endemic at the beginning of the initiative: Cambodia, China, the Lao People’s Democratic Republic, Papua New Guinea, the Philippines, Viet Nam and also Mongolia (which joined the Western Pacific Region later, in 1995). The formula was the same, but each country had to adapt it to its own requirements. Each had a different setting and different experiences, the sum being a great deal of learning about polio specifically, and large public health endeavours in general.

Getting started: early supplementary immunization in China

China had developed a national plan of action for polio eradication very early on, in 1988, even before the regional strategies were developed. In that year, reported polio cases were fewer than ever before. Emphasis was at first placed on routine immunization. That proceeded well, with more than 85% of children in each province having been vaccinated by 1989.

However, in 1989 a large outbreak of polio began in eastern China, occurring in pockets of underimmunized areas. That was to spread to large parts of the country over the next three to four years. Almost 10 000 cases of polio were reported by the end of 1990. Spurred on by that, six provinces implemented the first supplementary immunization campaigns during the winter of 1990-1991, with 71 million doses of OPV administered. Each province determined for itself the timing, location, target age groups and number of rounds that would be carried out. In the winter of 1991-1992, with the epidemic continuing, eighteen provinces each conducted at least one full round of supplementary immunization. A year later (1992-1993), 186 million doses of OPV were distributed in supplementary immunization rounds in twenty-nine of the thirty provinces.
Running a province-wide supplementary immunization campaign is no small task in China, where each province is larger than many countries in other parts of the world. However, a review in May 1993, organized by the Ministry of Health with WHO participation, showed that the provincial supplementary immunization campaigns had not been fully coordinated, with vaccine given in different months even within the same county, and relatively large numbers of children missing out on vaccination in some areas. The review recommended that a national immunization day was required in China to coordinate vaccination dates and ensure that a higher proportion of children was reached.

National immunization days

National immunization days (NIDs) had already been proven to be an effective strategy for stopping the spread of wild poliovirus in countries in which it was endemic, long before they were used in the Western Pacific Region. The formula which had been developed by WHO was to give a dose of OPV to every child in the country under the age of five years - regardless of previous immunization status – in each of two rounds, four to six weeks apart. Each round should be carried out over as short a time as possible. National immunization days should be carried out during the low season for poliovirus transmission – usually the cooler, dry season.

In the Western Pacific Region, variations on that theme were used for a number of reasons. Because of the shortage of vaccine, the target age group in some areas was children under four years of age, rather than all those up to five years. For the same reason, and also because some countries were not confident enough initially to organize such events on a nationwide basis, some provincial and subnational immunization days were held. In some areas it was found that conducting each round over one to two weeks, rather than in one day or a few days, meant that workers had time to reach more remote villages. And in some countries, different districts were targeted sequentially because of the limited numbers of skilled staff, or in different months because of climatic differences.

Planning for national immunization days

National immunization days did not just happen on their own. Each round took a lot of detailed planning to ensure that enough vaccine was available in the right place at the right time,
that trained vaccinators were present to give it to the children, and that the greatest possible number of children either came to the vaccination post or were found by vaccinators wherever they were.

The amount of vaccine needed had to be worked out by multiplying the estimated number of children in the target age group by the amount of vaccine needed for each child, and adding a wastage factor to allow for the fact that not all vaccine would reach the children it was intended for. (A little too much might be given to one child, or children outside the target group could be given vaccine, or some vials could be spoilt by being dropped or exposed to heat, or vaccine remaining at the end of the day would have to be thrown away.) Requests for vaccine had to be submitted to the Interagency Coordinating Committee, with clear documentation on how the estimates were derived, well ahead of time. Because of the early shortage of funds for vaccine and the very large amounts needed, calculations had to be as accurate as possible. The Western Pacific was the first Region to face those challenges on such a scale, and so was forced to develop very precise methods of planning for NIDs.

Then there was the matter of getting the vaccine to the places where children would be. Venues for immunization stations had to be organized in every area. That often involved detailed planning with maps, and required local knowledge of the transport routes and population movements. Enough cold boxes, ice, refrigerated vehicles, and other equipment to transport large quantities of vaccine around the country at the same time had to be procured.

In some countries there were enough trained health staff to administer vaccine to all children. In other places, volunteers had to be recruited and trained to give OPV. Volunteer time was needed everywhere to support the vaccinators by bringing parents and children to vaccination stations, taking mobile teams to isolated settlements, finding unvaccinated children, translating between different languages, and giving assistance in many other ways.

Leading up to each round of each immunization day, mass publicity was needed to inform parents of where they could take their children, and why it was important for children to receive OPV.
In countries where injectable vaccines were given during national immunization days, arrangements were even more complicated. Needles, syringes, steam sterilizers and trained health staff had to be available at each post.

Every national immunization day also had to be evaluated so that the next one could be improved. Careful records had to be kept of the numbers of children immunized so that coverage (the percentage of children in the target age group vaccinated) could be calculated. Coverage surveys were carried out after each NID to assess whether reported coverage accurately reflected the actual situation. That practice was established starting with the first NID in the Philippines in April 1993. In China, a rapid assessment tool was later developed to check the immunization status of a sample of children in a range of areas, including expected problem areas, immediately following the NID, to assess coverage and whether any areas had been missed.

Planning for national immunization days took months and involved people at many different levels, from senior health staff to volunteers in remote villages.

**The first national immunization days: the Philippines**

The first full-scale national immunization days in the Western Pacific Region were held in the Philippines in April and May 1993. They were a great success, with about nine million children (over 85% of all children aged under five years) receiving additional doses of OPV.

Political support from the highest levels was very important. President Fidel Ramos signed a proclamation launching national immunization days for the next three years. The Secretary of Health, Dr Juan Flavier, personally negotiated the “Ceasefire for Health” to allow immunization of children in rebel-controlled areas, as well as working tirelessly at promoting the NIDs through public appearances, media interviews and personal visits to staff and volunteers at all levels of the campaign. At the provincial and municipality levels, many governors and mayors served as NID coordinators.
The involvement of many different people and sectors was necessary. Fortunately, the Philippines already had a strong tradition of collaboration between different groups. International partner agencies such as Rotary and UNICEF provided vaccine for the NIDs. The Department of Health led the organization of activities, and other government agencies, such as the Departments of Education, National Defence, and Social Welfare participated actively. The business community also contributed, both financially and through direct involvement in NIDs, for example by lending their shops or offices as venues for immunization, or their vehicles and personnel to help with transport. Members of civic organizations gave money and volunteered their time. Local celebrities produced promotional messages, which were aired on TV and radio and at movie theatres.

The primary reason for the NIDs was to give polio vaccine. Starting from the second NID, however, the opportunity was also taken in some areas of the Philippines to give measles vaccine and vitamin A to children to help their immune systems, and tetanus vaccine to women to protect them and their babies from contracting tetanus during childbirth. They were also given as supplementary doses, that is, regardless of whether people had received them before. Not all immunization posts gave the extra substances. Vitamin A was only ever given during one of the NID rounds: two supplementary doses of vitamin A one month apart would be too much for children and could lead to side effects.

The Philippines’ national immunization days were successful on several levels. They achieved their objective of reaching almost all children under five years with OPV. That undoubtedly contributed to eradicating wild poliovirus in the country; the last time the virus was found in the country was between the two rounds of the first NIDs. They also provided the first health service ever to some people in the rebel-held areas, and certainly reached many other people normally beyond the reach of regular health services. The NIDs model was used further in the Philippines for other health programmes. “National micronutrient days”, in which a follow-up dose of vitamin A was delivered to all children aged one to four years, six months after each of the NIDs, were the most successful. Soon after the first NIDs, the Government tripled the budget for vaccine purchases. Thereafter, the Philippines was much less dependent on outside help for provision of vaccines.

Full-scale NIDs were run in the Philippines for five consecutive years, from 1993 to 1997, followed by further supplementary immunization in selected areas in 1998 and 1999.
By late 1993, China had considerable experience in running supplementary immunization activities in many provinces. The first full-scale, national immunization days in China were held in the winter of 1993-1994.

In September 1993, with approval of the State Council, a national conference was held to review the 1988-1995 National Plan of Action for Polio Eradication, and to discuss strategies for implementation of the first of three coordinated NIDs. Participants included high-level political leaders, such as Ms Peng Peiyun, State Councilor; Professor Chen Minzhang, Minister of Health; and Vice-Governors and Secretary-Generals from 17 provinces. During the meeting, Professor Chen Minzhang, Minister of Health, clearly stated that all children should be immunized, regardless of order of birth and registered place of residence. Dr Omi led a WHO team to attend the meeting and presented the regional situation of polio eradication, as well as WHO’s recommendations on polio eradication of China. Many years later, he recalled, “this event can be considered as a very important turning point from the planning and preparation stage to the real implementation stage”.

Seventy-four million children aged under four years of age were given OPV in each round of the NIDs, a massive effort, not only in terms of numbers, but also
logistically, as vaccinators reached children all over the country, including many very remote settlements. It is said to have been the largest public health event in the history of the world up to that time, and only narrowly missed making the Guinness Book of World Records when India subsequently immunized a greater number in one of its polio NIDs.

JW Lee, Shigeru Omi and Alan Schnur of the original Polio Eradication Task Force at the Regional Office in Manila were in China for the great event, along with other international colleagues. On the evening of the first day they were gathered in Dr Omi’s hotel room to review the day’s events, when suddenly, to their surprise, President Jiang Zemin appeared on the television. He had been filmed that day giving OPV to children in Beijing. He had also inscribed a message of encouragement for parents, which was widely reproduced: “Express your love for children through immunizations.”

That gave a great boost to the polio eradication effort. Much publicity was given to the President’s involvement in the NIDs, and that encouraged greater participation by government leaders at all levels. The next day, the WHO visitors were met by provincial governors and higher officials than had previously been involved. The unexpected endorsement by President Jiang Zemin gave the Regional Office team strong reassurance that the polio eradication efforts in China would continue and would succeed. And once China, the giant of the Region, had shown it could be done, other countries would have to follow.

It was not until some time later that the WHO team found out how President Jiang had become involved in the NIDs. In such a huge country, the President could not be personally involved with every issue. Polio, although a serious disease, was not the most important cause of human suffering. As in many countries, the Ministries of Finance and Education tended to hold more sway than that of Health. Recognizing the importance of working with other groups, Ministry of Health staff had mobilized support from many sectors and groups, including an organization for the disabled, which had many members crippled by polio.-headed-by the son of a former president of China, the group was quite influential and had a lot of experience in lobbying for its cause. Apparently, it had been able to inform President Jiang about the NIDs and convince him of the importance of the polio eradication effort as a way of preventing disease and disability.

China carried out further NIDs in the following two winters, and then went back to subnational immunization days, which were carried out in all provinces (although not simultaneously and not always province-wide) annually for the following four years.
As is often the case, looking back on things makes the picture much clearer; it is very hard to see the end of a chain of events while living through them. The last case of polio in China caused by indigenous wild poliovirus occurred in September 1994, between the first and second sets of NIDs. Since the second NIDs in December 1994 and January 1995, no indigenous wild poliovirus has been detected in China, despite intensive searching. It seems, therefore, that the first two sets of NIDs in China – building on the previous supplementary immunization work that had been carried out - eradicated wild poliovirus from almost a quarter of the world’s population (1.2 billion people) and a huge geographical area.

**National immunization days spread throughout the Region**

After China, the largest country in the Region and with arguably some of the most difficult conditions, had carried out its first successful round of NIDs in December 1993, many former sceptics began to believe that the remaining polio-endemic countries could also succeed in holding NIDs. Only the Philippines (April and May 1993) and Viet Nam (November 1993) had preceded China in holding NIDs. The Lao People's Democratic Republic held its first round of NIDs the month after China’s, in January 1994. Mongolia followed in May of the same year. Cambodia began in February 1995, and Papua New Guinea in September 1997. Each country had prepared for its first NIDs by undertaking smaller-scale supplementary immunization activities (subnational immunization days or SNIDs), and had followed them with further rounds of supplementary immunization – either SNIDs or NIDs.

Each of the countries holding NIDs adapted the general strategy to its own requirements, and each was able to hold very successful, and progressively better, events. Countries shared their experiences through the forum of TAG meetings, while the regional institutions kept track of overall progress and provided technical advice and financial support. The multiple rounds of supplementary immunization in every recently polio-endemic country in the Region undoubtedly raised the level of immunity in the population, and contributed significantly to stamping out the wild poliovirus where it was circulating.
CHAPTER 5

SURVEILLANCE – TECHNICAL ASPECTS
Polio eradication strategies can be summed up as “protect and detect” – protect children against polio by vaccinating them, and detect any poliovirus that continues to circulate. The big supplementary immunization efforts may have been the public face of the polio eradication initiative, but they were driven and supported by the equally important activity of detecting the wild poliovirus wherever it was. As the end drew nearer, the work gained in relative importance until the emphasis was reversed: the approach became “detect and protect”. Poliovirus could only circulate in areas where significant numbers of children were not protected by vaccination. Therefore, when the virus was detected in a community, it was an indication that the level of immunity needed to be raised by further vaccination.

The detection system for polio eradication was pioneered in the Americas and used throughout the world, but was developed into a more precise and powerful instrument in the Western Pacific Region. In order to appreciate that achievement adequately, it is necessary first to understand some of the technical aspects of the system. This chapter describes the science underpinning the system for detecting wild poliovirus. The following chapter describes the implementation and development of the system in the Region.

Disease surveillance: “information for action”

Keeping a close watch for cases of a given disease or condition is known as “surveillance” and is one of the most important activities of any public health system. Surveillance can detect outbreaks, monitor trends in the occurrence of a disease, or generate hypotheses about possible risk factors for developing a disease. Intrinsic to the concept of surveillance is the need for the information gathered to be disseminated to the people who contributed to its collection, as well as to those who can use it appropriately. There is no point collecting data if it is not used, and those who collect it are not likely to be very thorough if they do not see any outcome from their work.
Surveillance for polio - difficulties

There are several problems with polio – the disease caused by poliovirus and characterized by paralysis - as a candidate for surveillance in a programme intending to eradicate the disease by wiping out the virus which causes it.

Detecting polio is not a sensitive indicator for the presence of the poliovirus in the community. As fewer than 1% of susceptible people infected with poliovirus develop paralysis, it is possible for the virus to circulate "silently" for a considerable period of time before manifesting itself in a case of the disease.

Moreover, the clinical diagnosis of polio is not straightforward, as other diseases can produce very similar symptoms. Thus, a clinical diagnosis of polio (without laboratory evidence) is not a very specific indicator for the presence of the virus either. In 1991, at the beginning of the polio eradication activities in the Western Pacific Region, there was no agreed case definition for polio, so clinical diagnoses could be based on differing criteria. Laboratory tests, which can give a definitive answer, were not available for most cases of suspected polio at that time.
The solution: surveillance for acute flaccid paralysis

The solution was found in the use of an alternative surveillance indicator: acute flaccid paralysis (AFP). That type of paralysis – which comes on suddenly, and makes the affected limb floppy or flaccid (as opposed to the rigidity seen in spastic paralysis) – is seen in polio, but also in a number of other conditions. The advantage of using AFP as an indicator lay in the fact that it was more easily defined than polio, and could therefore be reported almost immediately upon detection, without waiting to confirm the finer details. Even more importantly, the level of reporting of AFP could be monitored to assess the performance of the system in practice.

Experience in the Americas had shown that, even when polio had been reduced to extremely low levels or eliminated, acute flaccid paralysis still occurred, caused by other diseases: there was a “background” rate of AFP beyond that caused by polio. Through observation in many countries, the background rate appeared to be 1:100,000 under the age of 15 years. In other words, at least one child under the age of 15 out of every one hundred thousand would develop the condition every year in the absence of the wild poliovirus. (Where polio was still common, the rate of acute flaccid paralysis could be much higher.)

Therefore, the rate of one AFP case per 1,000,000 under 15 came to be used as a standard. The number of AFP cases expected in a country or area each year could be calculated from the number of children less than 15 years of age in the population. If fewer cases than expected were reported from an area, it could be an indication that the surveillance system was weak, and measures could be taken to strengthen it.

Sorting the polio cases out from among AFP cases

Acute flaccid paralysis surveillance is very sensitive (although not very specific) as an indicator for polio: if all AFP cases are investigated, all paralytic polio cases will be among them (along with many others not due to polio). However, even a very highly-performing AFP surveillance system will still lack sensitivity for detecting wild poliovirus. That is difficult to avoid in view of the silent nature of most poliovirus infections, but makes it even more important that every polio case is detected. A single missed case of polio could mean overlooking poliovirus circulation among hundreds of people.
An adequate laboratory test to look for evidence of poliovirus is the most definitive way of determining whether a case of AFP is caused by polio. It is not always possible, however, to carry out such tests. Particularly early in the polio eradication activities, many AFP cases were not investigated in the laboratory. Any one of the following alternative criteria was, therefore, deemed sufficient to confirm the diagnosis of polio in a suspected case: residual paralysis at sixty days after onset; a link to another suspected or confirmed case; death; or lack of follow-up. Every case of suspected polio was expected to be classified as “confirmed - polio” or “discarded – non-polio” within ten weeks after onset of paralysis. In that way, countries – and the Regional Office – could keep track of the likely number of polio cases, even without laboratory results for all cases.

The role of the laboratory: tracking the wild poliovirus

The laboratory played an increasingly important role in the surveillance system as the polio eradication initiative progressed. With that increased contribution, the system could focus much more accurately on surveillance for the wild poliovirus.

Options for detection of poliovirus

Two kinds of laboratory test results can clinch a diagnosis of polio in a suspected case: finding and growing poliovirus in samples of faeces (stool) or throat secretions; or a four-fold or greater rise in the level of antibodies against poliovirus in the blood. The latter test is rarely carried out because of the difficulty of obtaining two blood samples at the right interval and because it cannot distinguish between antibodies produced in response to wild poliovirus and those produced by vaccination. Throat secretions are also not commonly tested: virus can be found in secretions from the throat in the first few days, but it is a much smaller amount of virus than that found in faeces, as well as being present for a shorter time.
The major laboratory test for polio is, therefore, to try to isolate poliovirus from stool samples. Patients infected with poliovirus continue to excrete the virus in their faeces for up to a month or longer, but the excretion can be intermittent, and the amount of virus excreted is higher in the early stages. Thus, the recommendation is that two stool samples should be taken at least 24 hours apart, within two weeks of the onset of paralysis. Taking two samples on different days lessens the chance of missing the poliovirus if the patient is indeed infected.

**Isolating poliovirus from stool specimens**

When a stool sample suspected of containing poliovirus is received in the laboratory, it is treated with chloroform to inactivate bacteria, fungi and other contaminants, and then spun in a centrifuge to separate solid material from the liquid which might contain the virus. The liquid portion is then inoculated onto sheets of special cells in tubes or flasks. The cells are of two specific types in which poliovirus can grow readily, and certain other viruses (particularly other viruses which, like poliovirus, grow in the gut – i.e. other enteroviruses) can also grow.

The cells are examined under a microscope every day for evidence of damage caused by virus growth. If no evidence of damage to either of the two types of cell is seen after fourteen days of examination, the sample can be deemed to be free of poliovirus and other enteroviruses.

One of the two cell types – known as L20B and derived from mouse cells genetically altered to contain human poliovirus receptors - is more selective for poliovirus, and shows a characteristic pattern of damage. If such damage is seen in L20B cells, it is almost certainly due to poliovirus.

The other cell type, derived from human cancer cells and known as RD, is susceptible to a wider range of enteroviruses. Damage to RD cells can be due to poliovirus or to other types of enterovirus. If a sample produces damage in RD cells without having caused damage to the L20B cells, it should be inoculated again onto L20B cells to re-test for poliovirus. A second negative L20B test confirms that the RD cell damage was due to non-polio enteroviruses. Detecting other enteroviruses in a certain proportion of samples is a sign that good specimen transport and laboratory techniques have been used. It is estimated that between 5% and 25% of children in any area have non-polio enteroviruses in their digestive systems. If the viruses have survived and have been detected by the laboratory, any poliovirus present would also have been likely to be detected.
Any sample, therefore, which produces the characteristic cell damage in L20B cells on either initial testing or re-testing, most likely contains poliovirus. To confirm the result, another test is undertaken, which also determines which of the three types of poliovirus is present in the sample.

**Identifying and typing poliovirus**

The primary aim of the laboratory with respect to poliovirus eradication is to positively identify polioviruses isolated from clinical specimens. That is done by testing the viruses isolated as described above, and those thought to be poliovirus with antibodies specific to poliovirus. The antibodies used in the test are obtained from animals exposed to each of the three different serotypes of poliovirus (types 1, 2 and 3).

The virus grown on cells, as described above, and thought to be poliovirus, is mixed with the test solution containing antibodies to all three types of poliovirus. If the unknown virus is indeed poliovirus, it will be inactivated by the antibodies. When the mixture of poliovirus and antibodies is then re-inoculated onto cells of the same type, it will no longer be able to cause cell damage. Thus, if no cell damage is observed in the test over a period of several days, it may be concluded that the original virus sample contained poliovirus of one or more serotypes.

By using different combinations of antibodies (e.g. to types 2 and 3, 1 and 3, and 1 and 2), the serotype of the unknown virus can be determined. A type 1 poliovirus will cause cell damage when inoculated with the first mixture (containing antibodies to type 2 and 3), but not with either of the other two combinations – since each contains antibodies which will neutralize it. Likewise, type 2 and 3 polioviruses will cause damage only when inoculated with mixtures which do not include their respective type-specific antibodies. By inoculating cells in multiple wells at the same time, with mixtures of the unknown virus sample and each possible combination of antibodies, it can be determined whether the sample contains a single, multiple or no poliovirus serotypes.

**Intratypic differentiation: distinguishing wild and vaccine-type poliovirus**

When a poliovirus of any serotype (type 1, 2 or 3) is found using the antibody tests described above, it is still not clear whether it is a wild (naturally-occurring) or a vaccine-type
poliovirus. Both wild and vaccine viruses occur in all three strains. The antibodies used in the tests cannot, therefore, distinguish wild from vaccine poliovirus.

That is a crucial distinction to make, as it determines the course of action to be taken. If wild poliovirus is found in the stool of a child with AFP, it indicates that the virus is circulating and could cause further cases of polio. The response must be rapid and thorough: immunization of all children in the vicinity of the case. If, however, the virus is found to be from oral polio vaccine (also referred to as Sabin-type or Sabin-like virus, named after the developer of the vaccine), it is very unlikely to cause further cases of polio. No response is normally needed: vaccine-associated paralytic polio is a rare, but recognized consequence of vaccination with OPV.

Distinguishing between wild and vaccine strains of poliovirus is known as “intratypic differentiation”, because it is carried out within serotypes (i.e. with the prior knowledge of the serotype involved). There are several tests which can make the initial distinction between wild and vaccine strains, without going to the extent of looking at the whole genetic sequence of the virus. They fall into two broad groups: antigenic and genetic (or molecular).
Antigenic methods make use of very specific antibodies to distinguish between wild and vaccine polioviruses. The vaccine virus (in any serotype) has a distinctive shape to its surface coat, which is part of the reason it is weak and ineffective in infecting human cells. The change was made deliberately when the vaccine was being developed from its wild poliovirus ancestors. Specific antibodies can be made, by rabbits exposed to vaccine virus, which target parts of (or antigens on) the surface coat of the vaccine virus. Because of the difference in surface coats between the vaccine and wild strains, even within the same serotype, the antibodies to vaccine virus will not bind to wild virus of the same serotype. Likewise, antibodies made by rabbits exposed to wild-type poliovirus will not bind to vaccine virus.

The identified, typed poliovirus is exposed to the two different kinds of antibody to determine whether it is of wild or vaccine origin. If an antibody made in response to a vaccine virus neutralizes the typed poliovirus, it indicates that the poliovirus is also a vaccine virus. Likewise, if an antibody made in response to a wild-type virus neutralizes the typed poliovirus, it indicates that it is a wild virus. There are various ways to determine whether an antibody has neutralized a virus – for example, by using enzymes, which cause visible reactions when they detect the presence of bound antibody-virus complexes. (That is where the name of the most widely used antigenic test comes from: ELISA, for enzyme-linked immunosorbent assay).

The other broad method of distinguishing between vaccine and wild strains of a particular poliovirus type is the genetic, or molecular method. Here, the genetic material of the virus (RNA or ribonucleic acid – analogous to the DNA in human cells), rather than its surface appearance to antibodies, is the basis for the test. Essentially, small pre-prepared fragments (“probes” or “primers”) of specific genetic material which exactly match sections of the poliovirus RNA – in either the vaccine or the recently-circulating strains of wild virus of the relevant type – are mixed with the identified, typed poliovirus. Whichever one finds an exact match will bind to the poliovirus RNA and cause some type of reaction which can be used to determine (through colour, size of product, etc) the identity (wild or vaccine) of the poliovirus.

Both the antigenic and the genetic methods of intratypic differentiation give reasonably accurate and reliable results, although the genetic methods are generally more sensitive when it comes to confirming a relationship to the vaccine virus. Neither, however, is 100% accurate. Each is based on specific characteristics of parts of the poliovirus or of its genetic material, rather than on the whole entity. The most definitive way to determine
the identity of a poliovirus is to directly examine larger parts of its genetic material in a process known as sequencing.

**Genomic sequencing: the gold standard**

Genomic sequencing is the process of determining the exact makeup of the nucleic acid (RNA or DNA) in an organism. The entire strand of nucleic acid in a cell or organism is known as its genome: it contains all the genes for that entity. Nucleic acid is made up of nucleotides (or bases) which code for amino acids, the building blocks of proteins for cells. Thus, genomic sequencing is the process of determining (“mapping”) the order of nucleotides in a given strand of nucleic acid.

Poliovirus is an RNA virus, which means that its nucleic acid is in a “ribo” form, as compared to the “deoxyribo” form that is DNA. Thus, RNA is the blueprint for the poliovirus, and determines all its properties, just as the DNA in human cells codes for the myriad of characteristics that make each individual unique. The complete genome of the poliovirus consists of approximately 7500 nucleotides. Most genomic sequencing, however, focuses only on a small portion.

The most commonly sequenced part of the poliovirus genome is that which codes for an important part of the surface coat of the virus. Known as the VP1 section, it is about 900 nucleotides in length, thus representing about 8% of the virus genome. That is a reasonable sample of the whole, enough to provide the information that is usually required. In some circumstances, other parts of the genome are also sequenced.

**Relationships between polioviruses**

Every wild poliovirus has a different sequence of nucleotides, even within the small sample that is usually sequenced. The characteristic appearance is sometimes called the “oligonucleotide fingerprint” of the virus. Just as every human being has a unique fingerprint, so every wild poliovirus has a unique nucleotide sequence by which it can be identified and distinguished from other viruses. Vaccine polioviruses, by contrast, start out with very similar nucleotide sequences or fingerprints, since they have been developed from the same original strains and do not evolve during the processes of virus production.
In its natural environment, the human digestive tract, the poliovirus is one of the most rapidly evolving organisms on earth. All polioviruses – both wild and vaccine-type – evolve as they replicate in the human gut, so that their nucleotide sequences are constantly changing. Viruses recently descended from a common ancestor are very similar in nucleotide sequence and can be considered to be “related”: a genotype or family is a group of viruses which are at least 85% similar in their nucleotide sequences in the VP1 section. The relationships can be mapped on a dendogram, a kind of family tree. Genomic sequencing can thus accurately determine the relationships between polioviruses, in a way that no other test can.

Vaccine viruses, being weaker and less transmissible, do not persist for as long as wild viruses, and so do not have a chance to accumulate as many changes. Even by passing through one body (that of the vaccinated child), however, a vaccine virus may develop one or a small number of changes to its genome in the sequenced area. It is thus no longer a vaccine virus, exactly, but rather vaccine-like or vaccine-derived. In rare circumstances (approximately once for every million first doses of OPV given), the vaccine virus is able to mutate enough within one person’s body to cause paralysis of the vaccinee or a close contact. That is vaccine-associated paralytic polio. In exceptionally rare circumstances (only two confirmed episodes worldwide in the twenty years for which it is possible to examine the question), notably in the presence of low population immunity rates, the mutated virus can regain enough activity to be transmitted further, and even cause paralysis in a number of people. That is known as circulating vaccine-derived poliovirus.

Wild polioviruses, persisting as they do for much longer, are able to mutate much more than vaccine viruses – although the evolutionary pressure on them to increase their fitness is nowhere near as great, and they do not seem to mutate into more virulent strains. The rate of poliovirus mutation appears to be relatively constant through time, whether viruses are replicating in one person or being transmitted among many. It is thus possible, by plotting the date of detection of the particular virus against the number of mutations in the genome (as compared to a common ancestor), to determine when a particular branch of the virus family diverged from the trunk.

Genomic sequencing is thus an extremely powerful tool for characterizing and tracking wild polioviruses. Its application in the polio eradication initiative, in conjunction with the other weapons in the armoury of the surveillance system, is described in the following chapter.
CHAPTER 6

DEVELOPING SURVEILLANCE SYSTEM IN THE WESTERN PACIFIC REGION
The two major technical components of the surveillance system – surveillance for acute flaccid paralysis and laboratory surveillance for wild poliovirus – like other activities of the polio eradication initiative, were far simpler in theory than in practice. Making sure that the two components were integrated and ran smoothly together, and that the system as a whole extended to all parts of the Region, was an amazing feat of organization and management. The Western Pacific Region, following on from lessons learned in the Americas, was able to fine-tune the system and provide a working demonstration to all other regions of an extremely effective surveillance network.

**Situation at the beginning**

When the decision was made in 1988 to eradicate polio, the basic infrastructure needed for the job was not present in the Western Pacific Region. The goal of polio eradication required that poliovirus be detected and identified wherever it was circulating – yet there were no universally accepted criteria for diagnosis of polio; no consistent system for reporting of cases or suspected cases of polio; and no standardized methods for investigating such cases or following them up. Many countries had no access to laboratories which could test for poliovirus. Even where laboratories were available, it could be extremely difficult to arrange for samples to be transported there quickly enough and under the correct conditions – especially from more remote areas.

Systems for all the varied operations of surveillance had to be planned and developed at the same time, or the system as a whole would not be functional. Even 100% detection of AFP cases would not be useful if the appropriate follow-up was not carried out for each case. The most accurate and advanced laboratories could not detect poliovirus if they did not receive samples from patients with paralysis. Thus, although different parts of the system were given emphasis at different times, none could be dropped at any stage. Coordinating them required vision, planning and a lot of hard work.

**Introducing surveillance for AFP**

One of the most important parts of the surveillance system designed for polio eradication was the simple decision to request reporting of acute flaccid paralysis rather than of polio or “suspected polio”. AFP was much more easily defined, and could be identified by a simple clinical examination. Cases could be reported immediately upon detection, rather than waiting for confirmation.
It took a little time for the strategy of AFP surveillance to become clear. The original Plan of Action for the Region provided case definitions for “suspected” and “confirmed” polio; a suspected case was “any patient with acute flaccid paralysis... for which no other cause (could) be immediately identified”. That final clause was what confused the issue and prevented clinicians from reporting all cases of AFP. By 1992, however, the polio-endemic countries in the Western Pacific Region had begun surveillance for AFP specifically, rather than for polio or suspected polio.

However, the concept of reporting all cases of AFP, regardless of cause, was not easy to teach to clinicians used to deciphering the root of any symptom. Their natural tendency was to investigate any case of paralysis to determine what lay behind it. Some cases were clearly not polio, but due to some other cause. Many clinicians could not see the point of reporting such cases to a system designed to track polio, or of taking stool samples to look for the poliovirus when they were sure it would not be found. A considerable amount of explanation and education was needed to convince the people who would be seeing the cases of AFP – primary care and emergency room physicians, paediatricians, neurologists and other health staff – that it was important that they take part in the surveillance system by reporting all AFP cases.
Population as compared to individual

The reasoning that it was better to pick up all polio cases among all AFP cases – even if most proved not to be polio – than to miss some polio cases by not reporting some AFP cases – was on a level with which many health care workers were not familiar: the level of the population. Health workers are trained to think first and foremost about the patient in front of them, rather than about groups of people: their question would be “Does this patient have polio?” If the answer was no, in their estimation, they would see no need to report the case.

Thinking on the level of the population, however, there was a good reason to report cases of AFP even if they were not, or were very unlikely to be, polio. The reason had nothing to do with whether a given individual case of AFP turned out to be polio or not. The reason was: the rate of AFP reporting was a way of measuring whether the system was sensitive enough to pick up polio if it were circulating.

Monitoring surveillance: the non-polio AFP rate

The “background rate” of AFP of at least one case per hundred thousand children under 15 provided the AFP surveillance system with its strongest asset – the ability to be monitored. When the system was first being established, the rates of detection of non-polio AFP were much lower than the target in almost every country. Some countries argued that the standard rate found in the Americas might not apply to their populations, who were from different backgrounds and living in different environments. As surveillance improved, however, it was found that every country could indeed find at least one case of AFP per 100 000 children under 15. That, therefore, came to be the universally accepted benchmark of AFP surveillance performance: when a country or area fell below that rate, it was a sign that further work was needed.

As time went by and the system was refined further, the area to which the target was applied was progressively reduced. Thus, rather than simply requiring that countries meet or exceed the rate overall, each province and then each district had to individually reach the target.
Passive surveillance

In “passive” surveillance systems, health authorities wait for reports to come in of cases of a given disease. There may be some requirement or incentive for health workers to file such reports when they see cases of the disease, but there is no follow-up to ensure that all cases are indeed reported. When the polio eradication initiative began in the Western Pacific Region in the early 1990s, all countries already had a passive surveillance system in place, with polio as one of a number of notifiable conditions. There was, however, no rapid collection of that information at the regional level.

The first step, therefore, was to implement a passive surveillance system in the Region. Starting in March 1991, all polio-endemic countries - with the initial exception of Cambodia - were asked to report to the Regional Office every week, by telex or fax, on the number of suspected, confirmed and discarded cases of polio, as well as the number of cases which had had stool samples taken. Reports were expected every week, even if no cases had been detected. The polio-free countries did not have to submit weekly reports, but were required to report any suspected cases of polio to the Regional Office immediately. That arrangement was recognized from the beginning as only the first phase. Later stages would include weekly reporting by all countries (including zero reporting) and computerization of the system.

In order to collect the information required by the Regional Office, countries had to establish their own internal chains of communication. Clinicians at each level needed to know how to notify the relevant health authorities when they found a suspected case of polio, and often had to be reminded of the importance of doing so. National-level authorities had to develop systems for monitoring the reporting rates. Meanwhile, the object of reporting was clarified so that clinicians began to report AFP per se, rather than suspected polio. Gradually, the rates of reporting improved in each country, as did the timeliness of reports and the proportion of cases investigated.

A passive surveillance system, however, was not enough for the work of polio eradication. Despite widespread publicity about the polio eradication strategies, many AFP cases were still going unreported, and AFP rates were well below the target of one case per 100,000 children aged under 15. In many countries, hospitals were outside the routine public health reporting system - yet hospitals were prime locations for people to present with paralysed children. Therefore, a more active system, including hospitals as reporting sites, had to be developed.
Active searches for AFP cases: development of active surveillance

One of the early projects for improvement of surveillance in the Region was carried out in Shandong province, China, by the Provincial Epidemic Prevention Station in association with the Japan International Cooperation Agency (JICA). The project began in 1991, at the request of the Chinese Government, in the midst of an outbreak of polio. JICA experts, together with Chinese staff, visited about 1000 health facilities in cities, villages and even remote areas in the mountains to help health workers learn to diagnose AFP. They re-examined cases reported as AFP, and checked clinical records in hospitals for cases of paralysis which might not have been reported. The active searches of hospital records revealed that many cases of AFP associated with conditions other than polio were not being reported. The visits and training sessions by the teams educated and encouraged the local health workers, and the rates of reporting of AFP improved considerably. Afterwards, the project was extended to four neighbouring provinces and another five southern provinces which included border areas between China and its neighbours, such as the Lao People’s Democratic Republic, Myanmar and Viet Nam. That long-term cooperation at the grassroots level contributed greatly to polio control in China, while also fostering increased understanding between the Chinese and Japanese peoples.

At the fourth meeting of the Technical Advisory Group in Manila in 1994, the results of active searches in Shandong and the Philippines were presented. Following that, the TAG formally recommended that countries improve surveillance methods, including active surveillance, and use active searches to assess AFP surveillance.
There is an important difference between active searches and active surveillance. An active search is an isolated, often retrospective, study looking in hospital records for AFP cases that have been missed over the preceding (relatively long) period. Active surveillance is an ongoing activity in which hospitals and other health facilities are visited regularly on an ongoing basis for the specific purpose of searching for AFP cases. Early active searches in a few countries led to the initial recognition of the need for active surveillance. Thereafter, special active searches were used on occasion when the active surveillance system appeared weak in an area.

Establishment of active surveillance in polio-endemic countries

Gradually, active surveillance systems were established in all the polio-endemic countries in the Region, superseding the previous passive reporting systems. Specially designated AFP surveillance officers were trained and set to work visiting all hospitals, rehabilitation centres and other facilities where children with paralysis would be likely to present. Their job was to visit health facilities to review medical records, interview physicians and check patients once every week, follow up each reported case of AFP, and ensure that the appropriate investigations were done. Often they would take the stool samples, and arrange for their transport to the laboratory, themselves. At sixty days after the onset of paralysis, each child with AFP had to be re-examined to determine whether residual paralysis was present. The AFP surveillance officers made sure that happened and that the result of the examination was reported to health authorities.

In addition to following up reported cases, the surveillance officers would scour admission records, looking for mention of conditions which could possibly be AFP, but might not have been reported as such. If confirmed as AFP, they would be recorded and investigated in the same way.

The sites visited by surveillance officers had to be facilities where AFP cases could present. They also had to reflect the population distribution in the area. Initially, in some countries, “sentinel” surveillance sites were established: in other words, certain hospitals or facilities were chosen to represent larger areas. Searches at those locations could give an indication of the AFP rate for the area, but would not detect every case, since not every potential presentation site was searched. Although that was a necessary first step in some countries, active surveillance was rapidly extended to all relevant facilities that could be identified.
Active surveillance in polio-free countries: the “lesson of Malaysia”

Countries which had been polio-free for some time were also encouraged to set up active AFP surveillance systems, and almost all of them did so, even although the urgency was not as great there as for the recently-endemic countries. The importance of continuing surveillance in those countries was underscored in 1992, when wild poliovirus was isolated from two cases of AFP in Malaysia, with one further case of AFP thought to be polio, based on epidemiological linkage.

Malaysia had been considered polio-free for some time, having had its last case of polio – clinically confirmed – in 1986. Overall immunization coverage rates were very high, but as it turned out there were groups in the country with much lower coverage. The poliovirus was detected initially in a child living in a minority population group with low immunization rates and frequent contacts with travellers returning from polio-endemic countries – prime conditions for importation and re-establishment of indigenous transmission. The second confirmed case, occurring just a month after the first, was a child who lived next door to a family from the same minority group.

Genomic sequencing of the virus confirmed that it was related to polioviruses circulating in the Indian subcontinent – the virus had indeed been imported. All children in the communities and districts where the cases had occurred were offered immunization. At the same time, the coverage in those areas was assessed.

Fortunately, as no further cases were detected despite further investigations, it appeared that only the three children had been affected and that the imported virus had not spread far. Nevertheless, it was a wake-up call for Malaysia and for many other polio-free countries.

Monitoring of follow-up of AFP cases: link to the laboratory

Active surveillance for AFP was monitored using other criteria in addition to the overall AFP detection rate: for example, the percentage of stool specimens collected within 14 days of the onset of paralysis and the percentage of specimens arriving at the laboratory in useable condition (intact, at temperatures less than 8°C Celsius, not dried out). As the polio eradication initiative went on, progressively higher standards were required with respect to those
indicators. With a great deal of effort, and under difficult circumstances in many countries, standards were improved to previously inconceivable levels as the AFP surveillance system developed. With more and better samples thus arriving at laboratories throughout the Region, the laboratory network had to be prepared to deal with the increased workload.

Establishment of the laboratory network in the Western Pacific Region

By the time samples began arriving in large numbers, and the ability to accurately identify and track the poliovirus had become crucial to the progress of the polio eradication initiative, the laboratories were ready. The importance of a highly functioning laboratory network had been recognized from the very beginning of the initiative, and work on its development had commenced early. By the end of 1991, the first two regional reference laboratories and the first five national laboratories had been designated as the laboratory network. The network was eventually to grow to include three regional reference laboratories, ten national and thirty-one subnational laboratories, covering the whole Region. One of the regional reference laboratories also became a global specialized laboratory, with responsibilities which extended beyond the Western Pacific Region.

Laboratories at each level were given clearly defined roles. The national and subnational laboratories were primarily responsible for testing samples for the presence of poliovirus, and for determining the serotype of any virus detected. Any poliovirus samples found were to be sent to the nearest regional reference laboratory, where they would undergo intratypic differentiation to determine which were wild poliovirus and which vaccine virus. Any wild poliovirus found would be referred further, to one of the global specialized laboratories, where genomic sequencing would be carried out in order to investigate the genetic relationships between poliovirus strains.

Situation at the beginning

In 1991, only China and Viet Nam carried out laboratory diagnosis of polio. Laboratories in some other countries had the capability to isolate poliovirus, although most did not routinely do so. Members for the polio laboratory network were thus chosen from among the existing laboratories in the Region
on the basis of potential, as well as actual capacity and experience. In order to cover every country in the Region, some national laboratories would have to serve several countries.

The concept of a public health network on that scale was new, and very few of the laboratories selected had any real appreciation at the beginning of what would be required of them. Many were primarily research laboratories; some were clinical diagnostic laboratories; others played a part in national public health systems, but many were underfunded, understaffed and ill-equipped. Very few of the laboratories were prepared for the exacting requirements that the polio eradication initiative would impose on them.

Early meetings and training

The nascent laboratory network held its first regional meeting in December 1991, alongside the second meeting of the Technical Advisory Group. In attendance were staff of the two regional reference laboratories in Australia and Japan, and representatives of CDC, as well as Dr Sima Huilan of the original Polio Eradication Task Force. A tradition was started of smaller meetings of laboratory experts being held alongside the TAG meetings.

In July 1992, the first training courses in the standard method of isolation and identification of polioviruses were held for all laboratory staff involved in the network. By now there were ten national laboratories and twenty-eight subnational laboratories, as well as the two regional reference laboratories and one global specialized laboratory. The WHO manual for the virological investigation of poliomyelitis was used and distributed. Laboratories took their first proficiency tests, with excellent results. That was an important step: laboratories could begin carrying out their primary function as network members with confidence, knowing that they were using the methods recommended and used throughout the Region.

Coordination of AFP surveillance and laboratory activities

One of the early issues highlighted by the small group of laboratory experts at the TAG meetings was the importance of communication between laboratory staff and EPI epidemiology units in each country. The task of those two groups of people had traditionally been seen as quite separate, but the polio eradication initiative was forcing them together.
EPI epidemiology units in each country carry out a number of functions related to many different diseases. In the polio eradication initiative, they were entrusted with several important tasks, including monitoring coverage with routine and supplementary doses of OPV; organizing, implementing and monitoringAFP surveillance activities; and keeping track of theAFP cases and which ones were confirmed as polio. In the early stages of the initiative, many cases were confirmed as polio by clinical examination or through epidemiological linkage alone. It was only later in the initiative that laboratory diagnosis gained in importance. The EPI epidemiology units were not, therefore, accustomed to having much interaction with the polio laboratories.

Laboratory staff, for their part, had traditionally viewed their work as separate from the activities in the “field”. They received specimens, carried out tests and reported results. Rarely did they hear anything about the public health implications of what they had found. If specimens arrived at the laboratory in unusable condition, laboratory staff could not be held responsible, and neither did they see it as their job to ensure that specimens reached them intact. Most virologists and laboratory technicians are not trained to work as part of a disease eradication initiative. For them to see their role in a broader context required a shift in culture.

In the Western Pacific Region, however, the two groups managed to develop a close and effective working relationship and also to collaborate well with those planning and implementing the supplementary immunization activities. The integration of the two essential arms of the surveillance system, achieved to an impressive degree in the Western Pacific, was perhaps one of the greatest feats of the polio eradication initiative in the Region and a major factor in its success.

**Coordination of the laboratory network**

A key factor in the successful collaboration of AFP surveillance, laboratory and immunization programme staff was that, from 1994, the Region gained a full-time laboratory coordinator. That allowed continuation and expansion of the work that Sima Huilan had begun on a less than full-time basis, while attending to other important responsibilities. The laboratory network received greatly increased attention at a crucial time, when the surveillance system was gaining in importance in the polio eradication initiative.
As the network developed, it became important for laboratory staff in the Region to meet and consult on directions and developments, and to plan the strategies for further development of the network. Regional meetings on laboratory surveillance for poliomyelitis eradication were held from 1995 onwards, and were attended by representatives of all laboratories. Meetings were also held in China by the Chinese Academy of Preventive Medicine (CAPM) each year for staff from the provincial polio laboratories. Those laboratory meetings were essential in strengthening the sense of collaboration and ownership of the network by the laboratory staff involved.

**Laboratory accreditation and monitoring**

Although the laboratories chosen for the network were working to generally high standards, by 1997 it became necessary to document the performance quality of each laboratory through a laboratory accreditation system. That required laboratories to document the procedures they were using and report on their performance, as well as passing an annual proficiency test. Site visits were also undertaken as part of the accreditation process. Laboratories were accredited on an annual basis, and each year the expected level of performance was raised a little so that, by the time of regional certification in 2000, the overall performance of the network was high enough to meet the requirements of the Regional Certification Commission.

Once granted, the accreditation status of each laboratory was formally reviewed each year. As part of the accreditation process, proficiency test panels were sent out. Laboratories had to test those samples and achieve 80% accuracy. Various performance indicators—such as percentage of results reported within 28 days of receipt of specimen, percentage of intratypic differentiation results reported within 28 days of specimen receipt in regional reference laboratory, and percentage of specimens from which non-polio enteroviruses were isolated—were also monitored on an ongoing basis.

The accreditation process itself led to an improvement in laboratory standards, as extra efforts and resources were dedicated to strengthening weak areas. By the end of 1999, all laboratories in the Region had been reviewed for accreditation and the accreditation system, developed and piloted in the Western Pacific, had been adopted by the Global Polio Laboratory Network and was in use in all WHO regions.
CHAPTER 7

ROUTINE IMMUNIZATION/HEALTH SERVICES
The Expanded Programme on Immunization

Immunization – not just against polio, but against a number of vaccine-preventable diseases - is a core part of health services in any country and one of the safest and most effective interventions in modern medicine. The World Health Organization established the Expanded Programme on Immunization (EPI) in 1974 to take vaccination against six target diseases – polio, measles, tuberculosis, tetanus, pertussis (whooping cough) and diphtheria – to the children of the world. At that time, vaccination of some type was already commonplace in some countries, but only 5% of children worldwide had been protected against those six diseases. There had been no coordinated global effort to make vaccination available to all children. The word “expanded” referred to the addition of polio and measles vaccines, which had not previously been part of the immunization programme.8

Universal childhood immunization

In 1982, the World Health Assembly resolved that, by 1990, at least 80% of children in the world should be protected against the six diseases targeted by the EPI. That was to occur...
by strengthening routine immunization systems in each country, rather than by the use of any mass immunization campaigns. There was no plan, at that time, to eradicate any of those diseases. Vaccines were delivered by regular health services.

The polio eradication initiative was developed with the EPI, and therefore routine immunization against polio, as a background. An integral part of the goal of eradicating polio was that it must be done “in ways that strengthen the Expanded Programme on Immunization, fostering its contribution to development of the health infrastructure and of primary health care.” The (in some ways) narrower goal of polio eradication could not be allowed to interfere with the broad goal of making vaccination against all the EPI-targeted diseases available to all children.

In the Western Pacific Region, the EPI had been established in 1976 and had made remarkable progress by the time, twelve years later, that the Region resolved to eradicate polio. The “universal childhood immunization” target of 80% was probably reached ahead of the 1990 deadline in the Region as a whole. However, there was still more work to be done in many areas where coverage was lower.

Strengthening routine immunization services in the Region was among the less glamorous aspects of the polio eradication initiative, and did not have such clear indicators of success as other parts of the programme. Its legacy may, however, be as valuable as any other outcome of the huge endeavour.

Measuring immunization coverage

It is not always easy to determine the percentage of children vaccinated in an area (the immunization “coverage”). The number of children in the target age group is often not known exactly, with many countries having out-of-date and possibly unreliable census data, and no universal birth registration system. The number of vaccinations given is usually reported, but is also often plagued with inaccuracies in recording and transcription as the data are aggregated up to the national level. Therefore, with uncertainty in both the numerator and the denominator, immunization coverage is inevitably somewhat uncertain.

To get a more accurate idea of immunization coverage in a country, a special coverage survey can be undertaken. That is done by asking the caregivers of some children in certain age groups which vaccinations they have received, and checking the information on immunization records if possible. WHO has developed a
standard way of conducting such surveys, using special methods to randomly select the children to be included, in order to ensure that they are representative of all children in the country or area.

Another alternative is a “seroprevalence survey,” which estimates the percentage of the population with antibodies to poliovirus. If wild poliovirus has been absent for long enough, that will be equivalent to the percentage of people who have been exposed to polio vaccine. However, WHO recommends the use of coverage surveys to assess coverage, and serosurveys are not commonly used.

Both coverage surveys and seroprevalence surveys provide a more accurate indication of the true immunization coverage in an area than simply dividing the number of children vaccinated by the total number of children in the target age group. However, they require time and expertise to be carried out and the results can only reflect coverage of previous years, instead of ongoing progress. Countries, therefore, usually use the best information available, without doing special studies, to estimate coverage. Studies are carried out only occasionally, and can be used to check the accuracy of the routine reporting system.

Routine coverage with OPV during the polio eradication initiative

At the beginning

By 1988, close to 90% of children in the Region as a whole were reported to have been given three doses of OPV through the regular health system. In EPI shorthand, the “OPV3 coverage” was almost 90%. That was a great achievement, even acknowledging that the figures might not be completely accurate. However, the overall high rate of immunization concealed a great deal of variation: there were still areas with very low coverage within the Region in which the poliovirus could continue to circulate.

Most of the non-endemic countries and areas had good OPV3 coverage. The countries with continuing or recent endemic transmission of poliovirus, not surprisingly, had lower coverage. In the Lao People’s Democratic Republic, reported coverage was only 25%, while Papua New Guinea had 43%, Viet Nam 57% and the
Philippines 65%. Cambodia at that time was still not open to the outside world and the immunization rates were unknown, but likely to have been very low. China was the only one of the polio-endemic countries with very high OPV coverage, at 96%.10 As the country with the largest population, it would have had a great influence on the overall regional coverage. However, it was in China that a huge outbreak of polio began the following year, showing that there must still have been large parts of the country with low immunity levels.

Effect of the polio eradication activities on routine coverage

One of the initial concerns about supplementary mass immunization with OPV, and about focusing such a great effort on one disease, was that routine immunization might thereby be neglected. The impact of the polio eradication programme on primary health care services had been analysed in the Americas, and both positive and negative effects had been found. However, they would not necessarily apply to the Western Pacific Region, where conditions were quite different. The EPI team at the Western Pacific Regional Office, therefore, carried out an analysis of the trends in routine immunization coverage from 1990 to 1994 in the five recently polio-endemic countries that had carried out national and subnational immunization days11.

Rather than looking at OPV coverage, they investigated the coverage with three other vaccines which were common to all five countries: BCG (bacille Calmette-Guerin, against tuberculosis, normally given at birth); DTP (against diphtheria, tetanus and pertussis, given three times in the first year of life); and measles vaccine (given towards the end of the first year of life). Some countries – the Philippines and Viet Nam - had given measles vaccine as a supplementary dose (not recorded on immunization cards and not included in

calculations of routine coverage) during national and subnational immunization days. One country – the Lao People's Democratic Republic – had given both measles and DTP vaccines along with supplemental OPV to selected children, and had counted those doses towards routine immunization coverage. Therefore, only BCG was considered representative of routine coverage.

In all countries studied, routine coverage either remained high or increased over the period during which supplementary OPV immunization was carried out. No country suffered a significant decrease in routine immunization coverage. In China coverage with each vaccine remained above 90%. In the Philippines it remained above 85%. In Viet Nam coverage for all three vaccines rose from around 85% to 95%.

The most dramatic improvements were seen in the countries with initially low coverage. In the Lao People's Democratic Republic, BCG coverage rose from 26% to 69%, while measles and DTP coverage also increased dramatically. As BCG was not given during supplementary immunization activities, that indicates that the overall increase in coverage was due in large part to strengthening of routine immunization services and not just to the national and subnational immunization days. Cambodia also saw marked increases in coverage: BCG coverage rose from an average of 54% between 1990 and 1993, to 78% in 1994, while DTP3 and measles coverage rose from 36% to 53%.

The role of routine immunization in keeping countries polio-free

Most countries in the Region – of those that were not polio-endemic, or recently so, at the start of the initiative – maintained control of the disease purely through routine immunization. Wild poliovirus, having disappeared from those countries some time earlier, did not re-establish transmission. We can surmise, therefore, that either it was never brought back to those countries or – perhaps more likely – any virus that was carried back by travellers was quickly stopped from circulating by the high levels of population immunity it encountered, and so was not able to cause any cases of paralytic polio.
Another lesson from Malaysia

The exception was Malaysia, where – as described in the previous chapter - an imported wild poliovirus did manage to circulate to a limited extent, causing three cases of polio. The second major lesson to be learnt – apart from the importance of surveillance, as noted above – was the necessity for routine immunization to be maintained at a high level, and to reach all segments of the population. Overall high coverage figures should not be allowed to mask the existence of underimmunized populations.

In Malaysia, the poliovirus had circulated among a group which had low immunization coverage rates because of its members’ opposition to vaccination. However, after health workers visited them and explained the importance of vaccination and the consequences of failing to vaccinate, many of those parents were happy for their children to receive OPV.

Many other polio-free countries also contained sections of population which were ambivalent about, or actively opposed to vaccination. Those groups needed to be educated about the continuing possibility of reimportation of poliovirus, and the associated risk to susceptible people. Health workers had to take care not to systematically miss certain population groups, whether because of their geographical, social or cultural isolation, perceived opposition to vaccination, or other reasons.

Malaysia’s experience highlighted the need for polio-free countries to maintain high coverage with routine immunization in order to prevent the poliovirus spreading should it be reintroduced, as well as the need for high-quality surveillance to detect any importation rapidly. No country could afford to let its rates of immunization fall, even if polio had not been seen for many years.
CHAPTER 8

Refrining the Strategies
By early 1997, the polio eradication initiative in the Western Pacific Region had almost achieved its goal, although just how close it was could not be seen at the time. Each aspect of the work – immunization, AFP surveillance, laboratory testing - had been developed into a mature programme. The Region now began to reap the benefits of the whole system functioning in harmony.

The pieces fit together

It hit them like a thunderbolt when they finally realized it – the common factor linking all the cases of polio in the last few months. It was the roads and the waterways. All the patients, spread out all over the country as they were, had travelled the same routes to the cities looking for work in the dry season, and back to the provinces to plant when the rains began again. Along the way they had congregated in market towns and spread the poliovirus.

It was early 1997, and the people involved in the polio eradication effort in Cambodia had been puzzling over 15 cases of polio which had occurred over the previous six months, but had only come to light in late 1996 because of delays in receiving results from the laboratory. The cases were from nine provinces, and initially did not appear to be linked. On closer examination, however, it was found that almost all cases occurred on or near waterways, and two were found along National Route 4, the main road linking Phnom Penh with the port city of Kampong Som.

That deceptively simple realization was the key to gaining final control of the wild poliovirus in its last remaining bastion in the Western Pacific Region: the Mekong Delta area of Cambodia and southern Viet Nam. The virus had persisted there despite several well-conducted rounds of supplementary immunization.

By that time it was known that those areas represented a common reservoir of wild poliovirus: genomic studies had shown that the virus strains isolated there were closely related to each other, and quite different from other strains found in northern Viet Nam and surrounding countries. How the virus had survived in spite of high coverage with OPV, however, remained a mystery. Theoretically the supplementary immunization should have been enough to stop the virus in its tracks. Yet, time and again, cases were found scattered all over the country, in remote villages, not just confined to one area. That would normally indicate widespread transmission, and the only solution would be further mass immunization nationwide.
When it was realized that the virus was travelling with people along the roads and waterways, in season, the whole picture was seen in a different light. There must be some people who were being systematically missed by all the routine and supplementary immunization efforts. Those people could pick up the virus in the city slums when they travelled there looking for work in the dry season, then, when they returned to their homes, they would take the poliovirus with them. A few scattered cases of polio might occur in the provinces, but with the low population density there would not be much transmission of virus. Poliovirus would die out naturally in the rural areas each year, but would be brought back from the cities the following wet season when people returned from the cities to plant the fields.

Where were those children who were being missed by OPV vaccination? They were moving around with their families, living on the water for much of the year, in places few people knew about. The health workers who were running the polio eradication initiative had not known about them until they went down to the river banks themselves, and saw the floating homes, the makeshift dwellings connected by flimsy footbridges, the communities of transient people with no connection to regular health services in the city. Those settlements were invisible from the streets of Phnom Penh. Hidden from view by the respectable buildings lining the river, they could only be found by following narrow tracks
down to the river’s edge. The homes were not signposted, nor were they on any map — until the maps were hand-drawn by polio eradication workers for use by mobile vaccinators.

Another important realization dawned. Ninety percent of the target population was considered very good coverage during a supplementary immunization activity. But the idea behind that had been that, if almost everyone were reached each time, and several rounds of supplementary immunization were undertaken, eventually everyone would be covered and all children would be immune. The original architects of the strategy had not counted on the same 90% being vaccinated each time; the same 10% being missed each time. It now seemed that was what had happened. Supplementary immunization, as well as the routine services, had systematically missed the same children every time, leaving a percentage of children completely unimmunized and able to harbour and transmit the poliovirus.

With those two insights — that there was still a population of mobile unvaccinated children who were carrying the poliovirus, and that the virus travelled with those people along the main roads and waterways — the polio eradication effort moved into its final stages in Cambodia, and in the Western Pacific Region. In those stages, all the strategies that had been developed for polio eradication had to work together harmoniously.

**Surveillance and response**

**AFP surveillance**

The experience of tracking the poliovirus to its last hiding places in Cambodia is a textbook example of how disease surveillance can guide an eradication or control effort. The AFP surveillance system had, by that time — and not without a great deal of work - been developed into a sensitive instrument. Cases of AFP were being picked up by active surveillance at health centres all over the country, and exceeded the minimum expected rate of one case per 100,000 children aged under 15 years. The rate of stool sample collection had improved to the point where Cambodia was ready to start using laboratory results, rather than clinical case classification, to guide its eradication efforts.

**Laboratory surveillance**

Cambodia did not have its own polio laboratory, and so a laboratory in a neighbouring country had been functioning as the national polio laboratory for Cambodia. This became an issue in mid-1996. By mid-1996 there did not seem to be much polio left in Cambodia and the health workers were ready to begin identifying remaining wild polio viruses foci so that activities could be concentrated in these areas. The healthworkers intended to rely
on laboratory results to guide
them in this work. Unfortunately,
when the health workers tried to
do this it was found out that the
laboratory findings were not being
reported in a timely manner and
that the reports themselves were
conflicting and difficult to
understand. In short, the
information could not be used to
carry out an effective eradication
effort. For example, it was not
until August 1996 that the first
wild poliovirus isolations for the
year were reported. They were
from cases which had occurred in
January and March of that year.
Such a time delay seriously
compromised the ability of the
polio eradication unit to respond
to WPV cases when they were
found. A solution had to be found for this
problem, and it was. From October 1996,
Cambodia began sending its samples directly
to the nearest regional reference laboratory
instead.

The change of laboratories caused a rapid
change in the picture of polio eradication in
Cambodia. In December 1996, the first results—
which included re-analysis of some earlier
samples—were received. An additional 11 cases
of polio had been found, with date of onset in
every month from June to November. By
January, another two cases from 1996 had been
discovered. Suddenly, it seemed that there was
much more wild poliovirus still around than had
been thought.

The health workers had been trying to carry
out the very difficult task of tracking the wild
poliovirus without the information they needed.
The laboratory results were absolutely crucial
for them to assess the situation accurately and
be able to plan targeted responses. Now at last,
having received the laboratory results, they
could see the pattern in the cases.
Targeting the response: high-risk response immunization

Once it had been realized that the polio cases were distributed along the waterways and main roads, the polio eradication unit began to focus its energies on those areas. A boat was hired to investigate the Phnom Penh waterways. Large numbers of people were found living in those areas, and the immunization levels of children in the target age group were very low. Later, an aeroplane was hired to fly over the Tonle Sap lake to find hidden waterway communities. Aerial photographs were taken and used by health workers to plan routes for vaccination teams. A number of large communities, which had previously not received priority targeting, were found.

Intensive efforts were made to immunize those children in six further rounds of supplementary immunization: two sets of specially targeted subnational immunization days, known as “high-risk response immunizations” (HRRIs) in May and June 1997, and then February and March 1998, with an intervening set of national immunization days in November and December 1997.

During the high-risk response immunizations in Cambodia, the polio eradication unit developed a useful way to assess the effectiveness of the activities among the target populations. It came to be known as the “search for zero-dose children”. Beginning late in the morning of an immunization day, monitors would actively search for children in the target age group who had not been vaccinated that day. They would then ask the parents how many doses of OPV the child had received previously. A tally of such children was kept, according to their number of previous doses. Initially, 35% to 50% of children in those difficult areas were reported never to have had OPV before – those were the “zero-dose” children. During later rounds, it became hard to find any area with greater than 10% zero-dose children. That indicated to the monitors that the vaccinators were being effective in finding previously unreached children.

Mum Chanthy, who had the last case of polio in the Western Pacific Region, lived in one of the areas targeted for the multiple rounds of supplementary immunization. Her illness began in March 1997. There is no doubt that wild poliovirus was circulating in the area at that time – nor that the multiple rounds of supplementary immunization around that time and in subsequent months put an end to its circulation.

By 1999, it had become apparent that indigenous wild poliovirus had almost certainly ceased to circulate in the Region. The countries, and the Regional Office staff, were looking
forward to the time when the Western Pacific Region could be declared polio-free. It was, therefore, a shock when a case of polio caused by wild poliovirus was discovered in China. The fact that it was subsequently shown to be an imported virus provided only partial consolation.

The Qinghai importation

When wild poliovirus was reported from Qinghai province in December 1999, the Chinese authorities were devastated. Intensive polio eradication activities had been carried out in China for more than ten years. The last case of indigenous wild poliovirus in China had been in 1994, and the last case in the Western Pacific Region had occurred in March 1997.

The Chinese response was immediate and thorough. National and international resources were mobilized to investigate the case, carry out a thorough search for further cases, and deliver supplementary OPV to children in the surrounding areas. Over 5 million children were quickly vaccinated in an area with a radius of 450 kilometres around where the case of polio had been found. Meanwhile, retrospective reviews of hospital records for the last two to three years were undertaken, as well as an intensive house-to-house search for missed cases of AFP. Within the next few months, large areas of the country were covered, with further supplementary OPV given to almost 40 million children.

In the meantime, the details of the case emerged. The patient was a sixteen-month-old boy from the Sala minority group, who had never been vaccinated. His four-year-old cousin, who remained healthy, also had poliovirus, of the same strain, isolated from a stool sample. No other cases were found, and there was no evidence that the virus had been transmitted further. Neither child, nor any member of the family, had travelled outside the country. The strain of poliovirus, however, was found to be quite different from other polioviruses isolated in China, and 98% similar to a strain found in the Indian subcontinent in 1998. Therefore, it was concluded, based on evidence from the laboratory, that the virus had been imported.

Although the chain of transmission of the virus from the Indian subcontinent to the children in the interior of China was not clear, members of their ethnic group travelled widely as traders in different provinces of China, as far as the border with Nepal. It was, therefore, surmised that the poliovirus had been brought back by one of those traders, who had been in contact with someone from outside the country.
For religious reasons, many people in the Sala group refuse immunization, and coverage was estimated to be 50-60%. That had certainly contributed to the conditions which allowed a case of polio to appear.

The Chinese system’s handling of that case was exemplary in many ways. From the health workers who detected the case of acute flaccid paralysis and reported and investigated it immediately – to the laboratory which, in close collaboration with CDC, NIID and the RRL in India, provided rapid and accurate results – to the response in terms of both immunization and enhanced surveillance – everything was handled efficiently and correctly.

That was a case in which the laboratory played a key role in helping public health workers understand the movements of the wild poliovirus. Had the laboratory not been able to identify the virus as having come from outside the country, China – and the Region - would have suffered a major setback. A finding of indigenous wild poliovirus would have had far more serious implications.
CHAPTER 9

CERTIFYING THE REGION AS POLIO-FREE
Kyoto, 29 October 2000

“We, the Members of the Regional Commission for the Certification of Poliomyelitis Eradication in the Western Pacific conclude today, 29 October 2000, that the transmission of indigenous wild poliovirus has been interrupted in all countries and areas of the Western Pacific Region of the World Health Organization, and therefore the Region is certified polio-free.”

The seven men and one woman who signed their names to the above statement must have felt a mixture of emotions on the day that they declared the Region polio-free. The meeting in Kyoto, Japan, at which the momentous declaration was made, had a strong triumphal feeling. A very important milestone had been reached, through the determination and hard work of a great many people. How far the Region had come, from the beginning of the initiative – when the poliovirus had been circulating among much of the population and paralysing thousands of children every year – to now, when no indigenous virus had been found for over three years despite very thorough searching. It was indeed an impressive achievement. And yet, how weighty the responsibility of declaring that the Region was indeed polio-free at last. Professor Tony Adams, the chairman of the Regional Certification Commission, speaking several months after certification, said “We had to put our hands on our hearts and say “yes, we believe the virus is gone” – knowing that there was still a chance – no matter how small – that another case of polio could be found the next day.”

Nothing in science is absolute. The available evidence must always be assessed and weighed and used sensibly to reach the soundest possible conclusions – but the conclusions can still be overturned by the arrival of fresh evidence. Dr Adams was not expressing doubts about the quality of the decision he had made in collaboration with the other members of the Commission: all of them had examined the evidence rigorously and been satisfied that it was sufficient. He was simply acknowledging the inherent uncertainty of any such decision.

After Kyoto (as those in the field came to refer to the certification meeting), the declaration of the polio-free status of the Western Pacific Region was submitted, along with a report summarizing the supporting evidence, to the ultimate authority on polio eradication: the Global Commission for the Eradication of Poliomyelitis. It was accepted. The Western Pacific became the second of the six World Health Organization regions to be certified polio-free.
The global process of polio-free certification

As with earlier phases of the polio eradication initiative, the Region of the Americas had led the way in developing a process for ensuring and certifying that the wild poliovirus had been wiped out in all its countries and areas. And as with other parts of the initiative, that had been guided in turn by the experience gleaned from smallpox eradication. The smallpox eradication effort had shown that what might appear at the time to be the “last case” in an area was not necessarily the final case there. It was prudent to allow a period of time to elapse after transmission was thought to have been interrupted, before announcing that the last case had occurred. For smallpox, a two-year period was arbitrarily chosen and proved to be an adequate safety margin: the virus did not reappear (unless reintroduced) when it had been absent from an area for two years. Towards the end, it appeared that one year without cases would be enough to confirm the virus absent. However, the two-year margin was retained in order to err on the side of safety.

For polio, which, by its nature, would take longer to show up in a population if the virus were circulating, a period of three years was chosen. Thus, in the Americas, the International Commission for the Certification of Poliomyelitis Eradication had waited for three years after the last case of polio had been detected in the Region before asserting, in 1994, that the Americas were indeed polio-free.

The following year, 1995, the World Health Organization established the Global Commission for the Eradication of Poliomyelitis. The Commission established the blueprint for certification of polio-free status in the rest of the world. It decided that certification would proceed on a regional basis initially, and thus five new Regional Commissions were established in the five remaining WHO regions where polio was still occurring – including the Western Pacific, which had already made great progress towards wiping out polio.

Appointment of the Regional Certification Commission for the Western Pacific

Eight highly qualified professionals – some from within the region, some from outside - were chosen for the Regional Certification Commission for the Western Pacific, and appointed by the Regional Director. Their backgrounds ranged from virology, through neurology and paediatrics, to public health. All had considerable experience in the field of polio...
eradication and related fields. Membership in the Commission, however, came with a different kind of responsibility than most of them had ever experienced.

They would have to consider, in great detail and taking into account multiple factors, evidence of the absence of wild poliovirus from all the widely differing countries and areas in the Region - a task formidable not only in breadth, but also in depth. Perhaps more importantly, they had to guide the countries through the process: first by outlining the overall strategy for the certification of polio-free status in the Region, and then by specifying in more detail what kind of evidence that would require, and when.

Fortunately, the Regional Certification Commission did not have to carry out all that work on its own. Some broad guidelines had been developed by the Global Certification Commission. Within the Western Pacific Region, the Technical Advisory Group on the Expanded Programme on Immunization and Poliomyelitis Eradication had already been active for more than five years, and the Commission resolved to liaise closely with it. The Commission also had the help of the same Secretariat that had served the TAG so well: the Expanded Programme on Immunization staff, both those in the Regional Office and those based in the country offices. That group had already begun to move into a new phase of operation.
Planning the action

In Manila, the Secretariat had done its homework. Having had input into the Regional Director’s decision on whom to appoint to the Regional Certification Commission, it had then been charged with the task of preparing a draft Plan of Action for the process of certification in the Region, and a proposed timetable for the work of the next five years (towards the target date of 2000). They were ready for the Regional Commission at its first meeting, and were approved with very little modification.

Looking back, now that certification has been achieved, at the original drafts from early 1996 of the Plan of Action and the proposed timetable, it is remarkable – and a testament to the planners as well as those who carried out the work - how closely everything went according to plan.

The first step was to set up a structure of institutions to manage the process. The Regional Commission had been appointed for the overall coordination of certification in the Western Pacific, but it could not communicate directly with all those involved in the work of polio eradication in every country. Some intermediate level needed to be set up.

National certification committees

One of the key elements of the strategy for certification in the Region – in fact a prerequisite for attaining certification – was the establishment of certification committees at the national level. The Regional Commission recommended that appointments commence as early as the end of 1996. Those committees would be responsible for collecting, validating and submitting to the Regional Commission the evidence that their respective countries were indeed polio-free.

The 20 Pacific island countries and areas, because of the small populations of each, would be difficult to assess individually using the criteria that had been developed. A single Subregional Certification Committee was therefore recommended for that group of countries, and they were considered – for the purposes of certification – as a single epidemiological block.

The sixteen national committees were to be appointed by the Ministers of Health in each country and were to consist of experts in
relevant fields (laboratory science, clinical medicine, public health etc.) who had, however, not been directly involved in the work of polio eradication in the country. The Subregional Certification Committee was to consist of similarly qualified and independent professionals, and would be appointed by the WHO Regional Director.

Criteria for certification

The Regional Certification Commission followed the guidelines set out by the Global Commission and retained the three-year safety margin from the time of the last detection of indigenous wild poliovirus, until certification could proceed. Of course, during that time there had to be an active search for the virus so that if it were present it would be detected. Thus, the criteria for certification were simply:

(i) There has been an absence of circulation of indigenous wild polioviruses for at least a three-year period, in which surveillance activities have been maintained at the levels of performance needed.

(ii) A national certification committee in each country has validated and submitted the documentation required by the Regional Commission

(iii) Appropriate measures are in place to detect and respond to any importation of wild virus.

The levels of performance required of the surveillance activities were defined very clearly. Briefly, all countries were expected to have reached the highest standard of surveillance as described previously, including showing that their system could detect AFP at a rate of at least one case per 100 000 children aged under 15 in the population, and carrying out all virus isolation studies in an accredited laboratory.

The impetus and timing of certification

Most of the countries in the Western Pacific Region had been free of wild poliovirus for many years before the certification process began. Some had participated actively in the polio eradication work in neighbouring polio-endemic countries; most had simply tended to their own affairs. They had cooperated, within their own borders, in the regional effort to eradicate polio, by continuing immunization and by setting up surveillance systems to detect poliovirus. Most carried out AFP surveillance along with the recently-endemic countries; a few used alternative methods of surveillance.
For most of the course of the polio eradication initiative, there was little urgency to the work within the non-endemic countries. As polio became progressively less widespread globally, and faded further from the public’s memory in those countries, any urgency felt there tended to diminish also. The establishment of the processes for certification brought the focus back on to polio eradication work for many countries. For countries – including the Pacific island subregion - which had long been polio-free, there was an accelerated timetable for certification. Having completed much more than the three-year safety period since the last detected case of polio, each now had to formally demonstrate the adequacy of its detection system and of its plan for responding to any importation of wild poliovirus. The documentation was expected to be presented at the third meeting of the Regional Commission, scheduled for August 1998.

For the recently-endemic countries, too, the establishment of the certification process lent a fresh clarity to their efforts. Some had already completed the three-year period since their last isolation of wild poliovirus. The others had achieved massive reductions in their numbers of cases, and were well on their way to wiping out the virus. The timetable would differ
slightly for each of the recently-endemic countries, depending on when their last cases of polio were detected – but the end was in sight. It was a very appropriate time to be focusing on documenting the quality of the systems.

Within a year after the Regional Commission’s first meeting, what turned out to be the last isolation of indigenous wild poliovirus in the Region had occurred. By the time of the Commission’s second meeting, the Regional Director had sufficient data at hand to announce that polio was on the verge of eradication. The certification process thus seems to have been established in the Western Pacific at exactly the right time.

Work begins in the countries

Once the national and subregional certification committees had been established, by early 1997, each set to work on its first task: preparing a plan of action for certification. Non-endemic countries were requested to submit their plans to the Regional Commission in time for its meeting that November, while the recently polio-endemic countries had until 1998 to submit their plans.

The staff of the Secretariat assisted the certification committees in the countries (and the Pacific subregion) in developing their plans of action. That was an important process for the countries to go through as it raised awareness among the people working in the relevant fields that the work of polio eradication in the Region was coming to fruition and that there were imminent deadlines to be met. The standard of documentation required by the Regional Commission would necessarily be very high, and no country would want to risk holding back certification for the whole Region. They, therefore, had a big task ahead of them.

Developing openness and trust

In a situation of needing to prove the quality and accuracy of one’s work, there must often be a certain amount of pressure to selectively present the evidence of how well the systems are working, and to de-emphasize any difficulties. That, however, can be dangerous: problems may not be shared early enough, and can worsen without the benefit of consultation or outside assistance; others, working in isolation, can unwittingly repeat the same mistakes; the group as a whole does not learn
as quickly as it could. The Regional Certification Commission and its Secretariat worked hard to create an atmosphere in which difficulties experienced by individual countries could be shared openly for the benefit of all.

Members of the Secretariat were also closely involved in the process of certification at the country level. As during earlier stages of the polio eradication work, WHO EPI staff in each of the recently-endemic countries, as well as in the Pacific island countries and areas, worked closely with their counterparts in the Ministry of Health (or equivalent) and were well aware of local and national conditions. To the ongoing work was added liaison with the national certification committees. The EPI staff based at the Regional Office also travelled extensively and worked closely with the relevant people in the countries, both recently-endemic and non-endemic. In that way, networks of connections were developed and strengthened, and communication between WHO staff, national certification committees and polio eradication workers in each country became easy and frequent.

In the annual progress reports that each country presented at the Commission meetings, they were encouraged to discuss problems as well as successes. That was made easier for the presenters by the fact that the members of the Secretariat were closely in touch with the work in each country and were able to assist at an early stage with any difficulties that did arise.

Gradually a strong culture of openness developed both during and between meetings. That stood the Region in good stead on many occasions.

**Imported vs indigenous wild poliovirus**

The Regional Certification Commission placed a great deal of importance, right from the beginning, on countries’ readiness to deal with potential importations of wild poliovirus. Countries were constantly reminded that they could not afford to become complacent about polio after having stopped transmission of the strains native to their territory. As long as wild poliovirus still circulated anywhere in the world, there was a chance that a “foreign” strain could be brought in. If that should happen, unimmunized children would again be at risk of polio; the virus could even re-establish circulation.

The Western Pacific Region was particularly vulnerable to the threat of virus importation as it shared long land borders with the WHO South-East Asia Region, where wild poliovirus remained heavily endemic in some areas. A known importation of a virus from the Indian subcontinent had already occurred in Malaysia in 1992. As the indigenous wild poliovirus was
wiped out in larger and larger areas of the Region, reintroduction from areas with continuing virus transmission became more of a threat.

The Commission’s emphasis on that issue was unfortunately vindicated by the discovery of another importation of wild poliovirus in Qinghai, China – as described in the preceding chapter - late in the certification process, when the Region appeared to have been polio-free for almost the required three years. Because the virus had been imported rather than being indigenous, however, and because the systems had worked so well to limit the impact of that chance occurrence, the certification of the Region was not delayed as the Chinese authorities had initially feared. The incident also provided an opportunity for reinforcement of the important lesson on the ever-present danger of importation.

Can an imported virus become indigenous?

Long-term immigrants anywhere eventually become part of the local culture – if not when they first arrive, then at least through the succeeding generations born in the new land. The Qinghai importation raised an important question: what would constitute re-establishment of indigenous transmission of poliovirus?

Although it had caused only one case of paralysis, the virus isolated in Qinghai and originating from the Indian subcontinent had unquestionably been transmitted within China: at a minimum, from a traveler to the paralyzed child and his more fortunate cousin. That level of transmission – limited to a short time, a small area and very few people - was not considered to constitute establishment of indigenous circulation. At least not such that it would prevent certification of the Region as polio-free. However, the extent of transmission which would constitute indigenous circulation had not been precisely defined up until that point. It was decided that, if transmission of an imported virus were to continue uninterrupted for one year, that would be considered re-establishment of indigenous circulation and would thus jeopardize certification. If circulation were stopped within a year of importation, the certification process could proceed. By that definition, the Qinghai importation was clearly not a threat to the certification of the Region.
Laboratory containment

As wild polioviruses were wiped out, the situation arose in country after country in which there was more wild virus stored in laboratories than circulating among the population. Those virus samples, even if they had been frozen for long periods, could still potentially infect and cause disease.

Laboratory containment of wild poliovirus – the securing of all potentially infectious samples under conditions in which they would not be accidentally released – had not been strongly emphasized in the initial phases of the certification process in the Western Pacific Region. The global emphasis on the pre-regional certification phase of containment arose only in late 1998, when the Western Pacific was already well on its way to achieving certification. The main tasks of the first phase of containment were set as: developing inventories of laboratories containing wild poliovirus infectious or potentially infectious materials; and instituting enhanced safety procedures for handling those materials.

The Regional Certification Commission, at its fourth meeting in August 1999, requested all countries to begin work immediately on laboratory containment of wild polioviruses. Because of the short time-frame until final certification was expected, the Commission decided to accept evidence of significant progress towards developing the inventories, rather than requiring the task to be completed before certification could proceed. For some countries, developing an accurate inventory was a formidable task and should not be rushed.

Developing a culture of analysis

Early in the certification process, the Secretariat had developed a manual of operations to assist countries in compiling the final documentation required for submission to the Regional Commission. The manual laid out all the requirements following a very clear structure. In practice, however, it was not equally appropriate for all countries. The danger was that it could make the preparation of reports a mere “form-filling exercise” and result in documentation which was technically complete, but in which the main points were obscured by detail.

Towards the time when the final documentation would be requested from national committees, the Secretariat convened a “working group on documentation for certification of poliomyelitis eradication”, which met alongside the tenth TAG meeting in April 2000. A new structure was proposed for the documentation. The Commission endorsed the
new format and defined the main areas for input by national committees. Immediately following the TAG meeting, a three-day workshop was held, in which countries were introduced to the new concept and started working, in a collaborative spirit, on their documentation. That was felt to be a very useful way to approach the task.

Essentially, the national committees were now asked to answer a few critical questions about polio in relation to their countries, giving sufficient background information to explain their answers to the Regional Commission:

- Where and how do the populations live that we are concerned about?
- When and where did the last cases of polio occur?
- Where could undetected circulation of poliovirus theoretically occur? (Which areas have low immunization coverage and/or poor surveillance?
- If a poliovirus were to be imported, where would that most likely occur? How quickly would it be detected there? And how far would it be likely to travel?

**Final efforts**

The preparation of the certification documentation in each country required an increased effort in the months between April and July 2000. Those responsible travelled far and wide, and worked day and night to ensure that the documentation would be complete and acceptable to the Commission. Many of the documents were the size of theses submitted for postgraduate degrees, and undoubtedly represented a similar amount of work (if not more).

The Commission, at its fifth meeting in August, considered all the reports in great detail. It was impressed with the high standard of the documentation, and, more importantly, with the thoroughness of the work which had been done in each country. However, in order to do its job with the rigour and exactitude required of such a weighty responsibility, it did not accept any lapses in logic or evidence. Several of the countries were asked for yet more evidence of the quality of their systems for maintaining the absence of wild poliovirus. They were given less than three months to provide it: the Commission was scheduled to meet again to reach its final decision on 27 and 28 October. The certification announcement – if it came that year – would be made on 29 October.
For those countries with more work still to do, activity intensified even more. Some had to carry out new epidemiological studies to validate their estimated immunization coverage levels. Others had to search for more data on various aspects of their reports. No country wanted to be the one which failed to meet the standards of the Regional Commission and therefore delayed certification of the Region as polio-free. Through incredible effort, every country managed to fulfill the requests of the Regional Commission. The amended final reports were all re-submitted to the Commission by the final deadline. Now all that the countries could do was to wait in anticipation for the Commission’s verdict.

Professor Tony Adams presented the certificate, signed by each member of the Certification Commission, to the Regional Director, who read it to the hushed crowd with hardly a tremor in his voice. It was very appropriate that the man given the honour that day of making the momentous announcement was Dr Shigeru Omi, founding member of the regional Polio Eradication Task Force, visionary and tireless worker for public health. Ten years after first dedicating himself to the work of eradicating polio from the Western Pacific Region, he was able to declare to the world that the Region had been certified polio-free.

In his speech at the Meeting on Polio Eradication in the Western Pacific Region, Kyoto, Japan, on 29 October 2000, Dr Omi stated: “This success can be attributed to many vital factors. First of all, I would like to mention the extraordinary efforts made by the Member States of the Western Pacific Region. To illustrate this, I would like to give you just one example. During the first National Immunization Day in China in December 1993 and January 1994, over 80 million children were immunized within a one-week period. This enormous undertaking was the largest public health intervention ever, having no parallel anywhere in the world at that time. It was mirrored, though on a smaller scale, in many other countries. I would like to offer my sincere congratulations to all Member States for their unwavering commitment and strong leadership.

My second tribute goes to the health workers, volunteers, and many thousands of others who drove this initiative forward at the community level. They dedicated their lives to this cause, by crossing rivers, climbing mountains and by walking for days to carry the vaccine to the children in the most remote areas. A few workers even died in this heroic endeavour. We owe our success to these selflessly dedicated and often unrecognized veterans of the long war that we have waged against this disease.
I am also profoundly thankful to the international community for its vital role. The strong partnership demonstrated by partner agencies was both unique and critical. Through an interagency coordinating committee, led by Mr Bryan Knowles of Rotary International, all the partners involved laid aside the differences in their organizational cultures to meet the extremely demanding challenges that faced us.

All these partners deserve recognition, but my special thanks go to UNICEF, to the Governments of Australia, Japan, and the United States of America, Rotary International, and Rotary International Districts 2640 and 2650 of Japan. They were not alone. The Governments of Canada, Finland, France, Italy, Malaysia, the Republic of Korea and Sweden and several other nongovernmental organizations also played important roles.

I would also like to thank the Technical Advisory Group, or TAG, on the Expanded Programme on Immunization and Poliomyelitis Eradication, chaired by Dr Isao Arita, of the Agency for Cooperation in International Health of Japan. The TAG has provided invaluable inspiration and insight to all of us. I still recall the serious and even heated discussions that sometimes extended into the early hours of the morning during those legendary TAG meetings.

May I also take this opportunity to thank two of the previous Regional Directors of the Western Pacific Region, first Dr Hiroshi Nakajima, for the support he provided when he was Director-General of WHO. I would particularly like to acknowledge my immediate predecessor, Dr S.T. Han, for launching this initiative and for pursuing it with vision, strong leadership and his personal commitment.

Last, but not least, I would like to congratulate and thank WHO staff at all levels of the Organization, past and present, for their dedication and their tireless hard work, literally day and night.

Together, we have travelled this far. But there is an extra mile to go before all the children on this planet can be safe from this disease. Let us remain united and vigilant until global eradication is achieved.

Ladies and Gentlemen, this achievement opens a new page in the book of human endeavours for health. Not only have countless children been saved from polio - we have also set an example for the future. No matter how daunting a goal may be, it can be achieved if we share the same vision, commit ourselves to achieving it, and work together in a spirit of solidarity. This is the message that we can all take from today’s historic event.”
CHAPTER 10

WHAT NEXT?
After certification

After the intense, sustained effort of firstly interrupting the transmission of wild poliovirus in a quarter of the world, and secondly verifying and proving that had been done, it was quite understandable that the countries of the Western Pacific Region would look forward to finally relaxing a little and enjoying their achievement. That was not possible, however. As long as wild poliovirus still circulated in other parts of the world – and some could potentially remain in laboratory freezers within the Region – there was still the potential that the virus could re-establish circulation in the Western Pacific.

The only way to prevent that was to continue with the work of immunization, surveillance and laboratory containment. Thus, the risk of accidental virus release would be minimized, and if any virus – whether from a laboratory or from another Region - did enter the population, it would be detected quickly and the high levels of immunity would block its spread.

Meanwhile, at the global level, discussions continued about the eventual strategy for stopping vaccination against polio after the expected eradication of the poliovirus from the world. The Western Pacific Region, entering its post-certification phase, was to provide additional experience to inform the debate.
The Certification Commission continues...

Neither was the job of the Regional Certification Commission over yet. The Commission itself had decided, and recommended to the Global Certification Commission (which agreed), that it should keep functioning to oversee the maintenance of the Region’s polio-free status. The national certification committees would also need to continue.

That was an historic decision. No certification commission existed in any country or region which had been declared polio-free. The equivalent bodies in the Americas had been dissolved in 1994, once the stage of certification had been reached. Since then, the World Health Organization had continued to oversee polio immunization and surveillance activities through its Regional Office in Washington (PAHO), but no specific institution had been charged with undertaking regular, independent reviews of the polio-free status of the Americas. The Western Pacific, in retaining its Regional Certification Commission, was thus breaking new ground in yet another way in the global fight against polio.

Further containment work

One of the Commission’s primary tasks in the post-certification era was to ensure that the process of laboratory containment of polioviruses, begun in earnest as a prerequisite for certification, was completed satisfactorily. Many countries had already completed inventories of their poliovirus and potentially poliovirus-containing specimens; some innovative methods for identifying sites to search had been developed and shared among the countries. A small number of countries, however – mainly those with many or large laboratories – would require more time to search all of them. Containment was proving to require more time and resources than initially anticipated, but it was not a task which could be rushed or done in a haphazard fashion.

At its first post-certification meeting in October 2001, the Commission was satisfied with the progress that had been made in the process of laboratory containment of poliovirus, and requested the Secretariat to work further with the countries to validate its completeness and accuracy. A prototype national database had already been developed at the Regional Office for countries to use in recording their
potentially infectious materials; that was to be tested in practice before finalizing the format for a regional database. Meanwhile, at the global level, various guidelines and procedures for containment were still being developed. The Western Pacific Region was certainly not falling behind - in fact it was ahead of other regions in the process.

**Immunization continues**

After certification of the Region as polio-free, all countries had to continue with their routine immunization services to ensure that their populations were still protected against reintroduction of the poliovirus.

Almost all countries continued to use OPV. New Zealand, however, had made the decision to change to IPV to eliminate the risk of vaccine-associated paralytic polio (VAPP). Although that is an extremely rare event, there were concerns that, in the absence of wild poliovirus, the use of OPV could create a situation in which the risk of VAPP was actually higher than the risk of polio caused by wild poliovirus. New Zealanders would thus join a small minority of the Western Pacific’s population (those residents of the French and American territories in the Pacific) in using IPV rather than OPV.

Some countries also continued with supplementary immunization activities in selected areas, based on analysis of the quality of surveillance, the history of supplementary and routine immunization, and the risk of reintroduction of wild poliovirus.

**Surveillance continues**

All countries had to continue high-quality surveillance after the certification of polio-free status in the Region. In fact, surveillance quality had to improve. A new target was set by the Technical Advisory Group for the time between onset of paralysis and reporting of intratypic differentiation results by the laboratory: at least 80% of results should be received in 60 days (down from 90 days). Any suspicious AFP cases (e.g. those in children under five years, with fever at onset, or with a history of fewer than three doses of OPV) should be prioritized for investigation, with regular (monthly) analysis of AFP surveillance data and mapping to allow early detection of clusters (cases close together in time and location). All AFP cases for which the final classification differentiation result had not been received 90 days after the onset of paralysis must be carefully tracked; expert panels should continue
to review all cases with inadequate stool samples who were found to have residual paralysis or had died or been lost to follow-up.

A high standard of surveillance was maintained throughout the Region in the immediate post-certification period. Unfortunately, the need for such vigilance was further underscored when the surveillance system in the Philippines detected four vaccine-derived polioviruses between March and September 2001.

**Vaccine-derived polioviruses detected**

The four isolations of wild poliovirus shared an unusual attribute: the two different initial laboratory tests for intratypic differentiation gave conflicting results for each. The molecular (genetic) method indicated that the virus isolates were “Sabin 1”, i.e. vaccine virus, while the antigenic (ELISA) method reported them as “non-Sabin”. Upon genomic sequencing it was found that the three isolates, while not identical, were very closely related to each other, as determined by genomic sequencing. They were indeed derived from the vaccine virus, but their genetic material had changed about 3% from the vaccine virus. That change was enough to make them antigenically different from the vaccine virus – in other words, to change their surface coats enough that the antibodies used in the ELISA test could no longer recognize them as vaccine viruses: hence the “non-Sabin”
result with the antigenic test. With that degree of change from the original vaccine virus, it was estimated that each isolate could have been replicating (and gradually evolving further from the virus strain) for about two years.

The isolation of these four related, vaccine-derived viruses from children in three provinces of the country indicated that the vaccine-derived poliovirus had regained the ability to cause polio, and had been circulating among the population. From limited previous experience in other regions, that should only have occurred if the immunization coverage was low – not necessarily in the country as a whole, but in pockets of the population. It was analogous to an importation of wild poliovirus, with subsequent circulation within the country.

The response, likewise, had to be equivalent to that which would have followed an importation of wild poliovirus. A national public health emergency was declared, further investigations were undertaken, and planning for mass immunization was commenced. It was the first time that vaccine-derived poliovirus had been confirmed, while circulating and causing polio, in the Western Pacific Region. It was only the second time such a thing had been seen in the world. The unexpected occurrence of that situation in a country with very high reported immunization coverage provided an opportunity to learn more about the conditions that would allow circulation of vaccine-derived polioviruses.
CHAPTER 11

THE LEGACIES OF THE WESTERN PACIFIC REGION’S POLIO ERADICATION INITIATIVE
The true importance of great achievements often becomes apparent only some time later, with the benefit of hindsight. It is probably too early, one year after polio-free certification of the Western Pacific Region, to attempt more than the simplest overview of the ways in which the polio eradication initiative in the Region has contributed to the world. Moreover, polio eradication cannot truly be viewed as a regional endeavour: the ultimate success of all the efforts and achievements in the Western Pacific Region depends on the world as a whole reaching and sustaining polio-free status until immunization against polio can be stopped. Only then will the greatest benefits of polio eradication work in every country be realized.

Nevertheless, it is possible – even at this early stage – to recognize some important outcomes of the polio eradication work in the Western Pacific Region. These benefit the Region itself in numerous ways, as well as providing helpful direction to polio eradication work in other parts of the world. Broader lessons from the polio eradication work everywhere are also of interest in the Western Pacific Region.

Benefits for the Western Pacific Region of the polio eradication initiative

The most important benefit for the Western Pacific Region in having achieved polio-free status is the tens of thousands of children spared paralysis and death each year, and the families who will not have to mourn or care for victims of polio. In economic terms alone that adds up to huge savings; the human benefits are even greater.

In some areas, polio eradication activities had a direct impact on other health problems too, by the provision of vitamin A and immunizations other than OPV during supplementary immunization activities.

Other benefits relate to the increased enthusiasm, support and funding, from a wide range of sources outside the health sector, for the Expanded Programme on Immunization and health programmes in general. Polio eradication work has excited the imagination
and tapped the energy of millions of volunteers, as well as political and societal leaders at all levels. It has also attracted large amounts of money and many valuable donations in kind, which may otherwise not have been available for health-related projects.

The skills in epidemiology and management gained by large numbers of health staff in the Region through their involvement in the polio eradication work can be – in many cases have already begun to be – utilized in other programmes for disease control or elimination. As seen earlier with smallpox eradication, having been involved in a successful public health endeavour on a huge scale leaves a cohort of workers with vision, confidence and almost missionary zeal – an invaluable asset to any organization.

The surveillance system set up for acute flaccid paralysis, and the network of laboratories which has been developed with experience in a regional endeavour, can also be used to advantage in programmes for the control of other diseases, such as measles and neonatal tetanus.

Lessons learnt in the Western Pacific Region about polio eradication

“The Americas showed the world roughly how to eradicate polio from a region; the Western Pacific gave the detail” is a statement heard from many of those who know global polio eradication work well. Building on
the successful strategies of the Americas, it is widely acknowledged that the Western Pacific Region led the way in developing those into more precise instruments adapted for a wider range of conditions.

The process of learning about polio eradication in the Western Pacific Region has been a major theme of this book. It is, however, worth highlighting here just a few of the innovations that were made in this vast and diverse Region.

The early shortage of vaccine for supplementary immunization activities meant that they had to be planned much more carefully. Precise calculations of numbers of children in target age groups and areas were necessary and were pioneered in the Region, as was the strategy of adjusting the target age group based on local epidemiological data.

The formula for the implementation of national immunization days was adjusted according to local circumstances: for example, sequential rounds in different areas to allow for improved supervision of vaccinating teams. Schedules for routine immunization were also adapted, shaped by the campaign approach used in NIDs, with some very remote areas receiving outreach visits four to six times a year rather than continuous service.

The high degree of integration of the acute flaccid paralysis and laboratory arms of the surveillance system developed in the Western Pacific Region was exemplary and crucial for the success of the polio eradication initiative. The laboratory accreditation system was first applied in the Region. The tools of molecular epidemiology were used to good effect in the later stages of the polio eradication initiative in the Region, and helped develop the understanding of the concept of “reservoir” and “indicator” communities. Additional fine-tuning methods, such as the search for “zero-dose” (unimmunized) children, were developed during the final stages of the initiative in the Region.

The surveillance system as a whole was thus able to function as the “eyes” of the programme in the later phases of the initiative, efficiently guiding supplementary immunization activities. In such ways, the polio eradication initiative was able to effectively identify, and extend services to, communities which had been systematically missed by other health care providers.

The process of certification was more stringent in the Western Pacific Region than it had been in the Americas, and set a very high standard for other regions to follow. The continuation of the certifying institutions in the post-certification period helped the Region to maintain focus, further the work of laboratory containment of poliovirus, and reach for still higher standards.
Broader lessons of the polio eradication initiative

The story of the world’s efforts to eradicate polio is the story of learning to work together in unity. It is a story of science, but more so, of people. In trying to detect the poliovirus wherever it circulates, health services have had to learn to reach people traditionally beyond their scope—the most isolated, marginalized or non-participating groups in each society. The fate of such groups is intimately bound up with that of the rest of the world—a fact we overlook at our peril. The polio eradication initiative forces a realization and an acknowledgement of our interconnectedness, which in itself may be the most important legacy of the whole endeavour.