Original Research Paper

Poliovirus in New Zealand 1915-1997

R M Cullen MSc MB ChB BA
W J Walker PhD

R M Cullen is a GP in Auckland.
W J Walker is a senior lecturer, Department of Mathematics, University of Auckland.

Key Points

- There were polio epidemics in 1916, 1921, 1925, 1932, 1937, 1943, 1948-49, 1952-53, 1955-56 and 1961
- These five-yearly epidemics each resulted in an average of 800 cases of paralytic poliomyelitis
- A population-wide mass vaccination campaign with oral vaccine in 1962 resulted in the immunisation of 97 per cent of school children and 80 per cent of the population
- Since 1962 there have been four cases of vaccine-associated paralytic poliomyelitis but no cases of infection in New Zealand from wild virus
- When should polio vaccination cease in New Zealand

ABSTRACT

Between 1916 and 1961 polio epidemics were separated by intervals of five, four, seven, five, six, five, four, four and five years. Each epidemic resulted in an average of 800 cases of paralytic poliomyelitis. In 1962 a massive vaccination campaign using two doses of oral vaccine resulted in the immunisation of 97 per cent of school age children and 80 per cent of the population. Since 1962 there have been four cases of vaccine-associated paralytic poliomyelitis (VAPP) and none from wild virus infection acquired in New Zealand. There have been one, possibly two, imported cases. The incidence of VAPP in New Zealand is one per 1.0 or 1.5 million doses of vaccine.

The annual number of cases of paralytic polio from wild virus infection worldwide is around 5000. These are confined to remote, often war-torn areas. It is time for New Zealand to decide when it will cease polio vaccination. Intermediate options include; making polio vaccination compulsory for visitors from areas where wild virus still circulates, reducing the number of doses included in the immunisation schedule, and moving to inactivated polio vaccine.

INTRODUCTION

Paralytic poliomyelitis was an important illness for an earlier generation of New Zealanders. The causative organism is an enterovirus. This group of RNA viruses also contains the Coxsackie viruses and the echoviruses. They all enter the body through the mouth and replicate in the gastrointestinal tract, including the tonsils

and adenoids. Each is capable of entering the bloodstream and producing a viremia. The polioviruses (there are three types) may proceed to attack the central nervous system.

Standard teaching1 is that the average incubation period is 17 days with a range from three to 35 days. In about 90-95 per cent of individuals the infection is not apparent at all. A minor illness occurs in 4-8 per cent and paralytic poliomyelitis in 1-2 per cent. About 4 per cent of cases of paralytic poliomyelitis result in death. Estimates of the ratio of inapparent infection to paralytic disease range from 100:1 to 800:1.2

In those patients who develop immunity without any signs of infection, antibodies are produced in time to prevent virus entering the bloodstream. The minor infection is thought to be the host's response to the viremia and the replication of virus in the pharynx and gut. It lasts one or two days and is associated with non-specific symptoms such as fever, headache, stomach pain, sore throat and nausea. During this time virus is excreted in the faeces and one important mechanism of viral spread is via contamination of water supplies.

This paper has a number of aims. We present the data set for polio notifications in New Zealand from 1915 and pay tribute to OPV (oral polio vaccine). New Zealand has been well served by this vaccine. The most important question facing GPs now is, when do we stop the routine vaccination of children against polio? In this paper we hope to provide an overview of the issues involved in this decision. The notification data set provides useful information. However, the issue is not one where reasonable people will necessarily agree, even if they agree on the facts.

METHODS

The *Report of the Department of Health for the year ended 31 March 1958* 3 contains an appendix that records the number of cases of paralytic poliomyelitis reported in every year from 1915 to 1956. Annual figures are recorded in the Department's annual reports from 1959 to 1965.

The "Immunisation Handbook"4 provided information for the period from 1965. This was supplemented by a literature search (by hand for the *New Zealand Medical Journal* accompanied by a MEDLINE search). The authors of the "Immunisation Handbook" were each approached, with a draft of the Results section of this paper and asked if any cases since 1965 had been omitted.

The number of births in New Zealand from 1962-1997 was found from editions of the *New Zealand Year Book* and used to calculate a denominator for the incidence of vaccine-associated paralytic poliomyelitis in New Zealand.

RESULTS

Table 1 records the notified cases of paralytic poliomyelits in New Zealand from 1915 to 1965. These data are presented graphically as Figure 1. There was a polio epidemic in 1916. Subsequent epidemics were separated by intervals of five, four, seven, five, six, five, four, four and five

TABLE: CASES OF PARALYTIC POLIOMYELITIS NOTIFIED IN NEW ZEALAND 1915 - 1965

Year	Number	Year	Number	Year	Number
1915	10	1932	150	1949	355
1916	1018	1933	45	1950	70
1917	54	1934	14	1951	26
1918	6	1935	8	1952	894

1919	11	1936	87	1953	406
1920	76	1937	816	1954	43
1921	267	1938	22	1955	703
1922	98	1939	50	1956	897
1923	17	1940	23	1957	63
1924	73	1941	4	1958	57
1925	1159	1942	31	1959	16
1926	22	1943	179	1960	4
1927	29	1944	45	1961	214
1928	47	1945	16	1962	5
1929	55	1946	113	1963	0
1930	12	1947	135	1964	0
1931	25	1948	964	1965	0

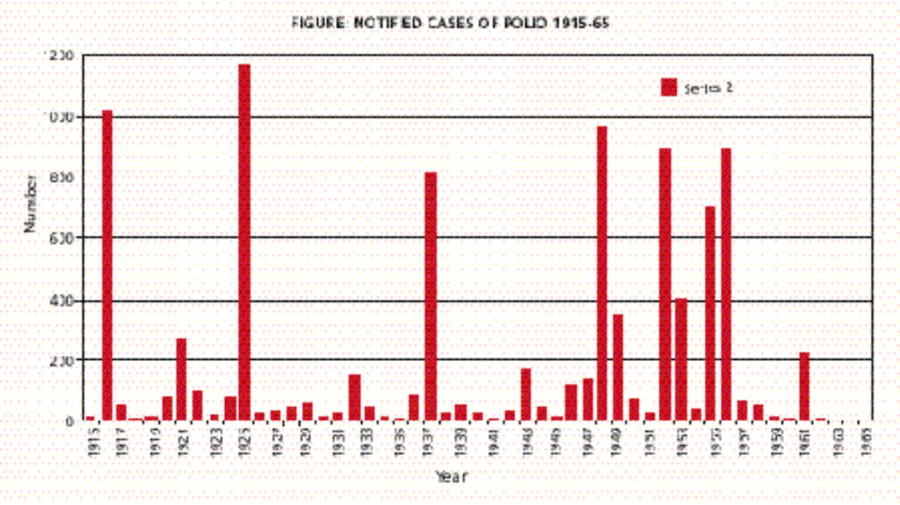
years.

Only four cases of polio have been reported in New Zealand since 1962. One of these cases has been published as a case of vaccine-associated paralytic poliomyelitis (VAPP).5 The patient was a 35-year-old unimmunised male who had been in contact with (including changing the nappies of) a three-month-old baby. The baby had been immunised three weeks before the man became ill. There seems to be a consensus that all four cases were VAPP (O Mansoor, Ministry of Health, personal communication). A possible case of VAPP in 1998 has been reported but the diagnosis was not confirmed at the time of writing.6

There was a case of imported polio in 1976. A three-month-old baby became ill in Tonga shortly before coming here. A reported imported case in 19907 may well have been Guillain-Barré syndrome. No polio virus was isolated.

In the 35 years from 1963 to 1997 just over 2,000,000 children were born in New Zealand. If it is allowed that there have been four cases of VAPP in that period and, if it is assumed that the average number of doses of polio vaccine given to each child is somewhere between two and three, then the incidence of VAPP in New Zealand is one case for every 1.0 to 1.5 million doses of vaccine given.

DISCUSSION



Wild poliovirus has been eliminated from New Zealand. Notwithstanding the observation of Samuel Johnson that "of all men the medical man is most likely to confuse subsequence with consequence" this achievement can be credited to mass vaccination.

The Salk vaccine, an inactivated polio vaccine (IPV) was introduced to New Zealand in 1956. According to the Department of Health (1959 annual report) by the end of 1958 over 80 per cent of school children aged from five-16 had received two injections. Vaccination was offered to children aged six months to four years and to young adults until age 21, but the department expressed itself disappointed (1959

report) by the response in these "not at school" age groups. In its report for the year ended 31 March 1961 the department stated that 81 per cent of those aged 0-16 years had received one injection, 78 per cent had received two injections, and 71 per cent had three injections.

The outbreak in 1961 (214 cases, seven deaths, most occurring from April to June) and a review of the overseas experience of the Sabin vaccine, the first oral polio vaccine (OPV), led to the introduction of OPV in August 1961. Initially this was only for the vaccination of children up to 12 months of age. Between April and July 1962 approximately 97 per cent of all 780,000 children up to school leaving age received two doses of OPV. Later in the year the entire New Zealand population was offered two doses of the vaccine, and the department estimated that 80 per cent of the total population received two doses of the oral vaccine.8

The Table and Figure attest to the dramatic effect of this population-wide initiative. Similar successes have been achieved elsewhere and, although the WHO aim of global eradication may not be achieved by the year 2000, very few cases of polio occur worldwide now. In each of 1996 and 1997 about 5000 cases of polio were reported. These were confined to some areas of India and Africa.

At some time in the next decade or two the globe will be declared free of wild polio. The only stocks of the virus will be wild virus in laboratories, attenuated virus in vaccine, and some circulating vaccine virus that has been excreted by children post-vaccination. At this time the last areas of the world will stop vaccinating. When should New Zealand stop?

Some of the issues involved have been discussed by Baker and Eberhart-Phillips7 in their discussion paper, which argued for a shift to IPV. They stated the question baldly as "is it acceptable to expose our population to the risk of vaccine-associated paralytic polio in order to protect against a disease which is now unlikely to be encountered?"

From a general practice perspective, that of the individual patient, there is a small risk of vaccine-associated paralytic poliomyelitis associated with use of OPV. This is in the order of one case per 700,000 first doses.4,7 The risk for second and subsequent doses is significantly less than this. We have calculated the incidence of VAPP in New Zealand to be one case per 1.0-1.5 million doses of vaccine given.

The risk of a particular New Zealand child (the one whose mother is about to ask, "does my child need this vaccine?") contracting paralytic polio is difficult to quantify. There are a number of probabilities that need to be multiplied together. The first of these is the chance that someone from one of the areas where polio persists will visit New Zealand and excrete the virus here. Given that these areas are small and tend to be poor, isolated, and torn by civil war, that probability is small.

If such a person does arrive in New Zealand, it is necessary to calculate the probability that he or she will transmit the virus to someone who is not immune, who in turn will transmit it to someone who is not immune, and so on until this particular child is infected. Clearly, the chain of transmission is probably longer (and the risk of infection smaller) for rural children.

If this child is infected there is a small chance, perhaps one in 50, perhaps as low as one in 1000, that she or he will develop paralytic poliomyelitis.

From a public health perspective the issue looks a little different. If a case is introduced to New Zealand, a high level of immunity in the community (for polio, more than 80 per cent of individuals immune) functions to prevent an outbreak or

limit its size. If vaccination of children were to cease, a pool of susceptibles could build up. If one child became infected the disease could spread rapidly through schools and social groups.

From this perspective the first priority must be to prevent a "polio excretor" arriving in New Zealand. An obvious way of doing this is to require travellers who are from, or have visited, India or Africa to provide evidence of polio vaccination.

The inter-epidemic periods observed in the pre-vaccine era (an average of five years) suggests it takes a long period for the pool of susceptibles to build up. If polio vaccination in New Zealand were stopped tomorrow, the virus could be eradicated from the planet before the pool had developed.

The approach recommended by Baker and Eberhart-Phillips, of switching from OPV to IPV, at least for some doses, would reduce the risk of vaccine-associated paralytic poliomyelitis. Other options to reduce the risk of VAPP include moving polio from a "recommended" to an "optional" vaccine and reducing the number of doses of polio vaccine included in the immunisation schedule. New Zealand should be clear about why polio vaccination is still necessary in this country – if it is – as there would be no VAPP at all if there were no polio vaccination.

In this paper we have tried to summarise the relevant facts that will inform a decision to cease polio vaccination in this country. They do not dictate a policy. However, polio vaccination will end in New Zealand; the question is when.

Address for correspondence: Dr R M Cullen, Avondale Family Health Centre, PO Box 19-253, Avondale, Auckland 7.

References

1. Menkes JH. *Textbook of Child Neurology* (5th edition). Baltimore, Williams and Wilkins, 1995.

2. Rudolph AM (ed). *Pediatrics* (18th edition).. Norwalk, Conn. Appleton and Lange, 1987.

3. Department of Health. *Report of the Department of Health for the year ended 31 March 1958*. Wellington. Government Print.

4. Bourke J, Roy CW. Immunisation Handbook. Paralytic poliomyelitis. *NZ Med J* 1992; 105: 36-7

5. A possible case of vaccine associated paralytic poliomyelitis. *New Zealand Public Health Report*.1998; 8(5): 61.

6. Baker C, Eberhart-Phillips J. Polio vaccine: should New Zealand make the change? *NZ Med J* 1997; 100: 340-2.

7. Department of Health. *Report of the Department of Health for the year ended 31 March 1963*. Wellington. Government Print.