Celebrating 50 years of polio elimination in New Zealand: but inadequate progress in eliminating other vaccine-preventable diseases

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Abstract

New Zealanders can now reflect on and celebrate 50 years of polio elimination in this country. This success was followed by eliminating two other infectious diseases, brucellosis and hydatids, and an imported potential disease vector, the southern saltmarsh mosquito. However, this country has made inadequate progress in eliminating several other vaccine-preventable diseases. These include measles, mumps, and rubella, which are priority candidates for elimination, and potentially Hib disease and rotavirus infection.

To achieve such successes almost certainly requires that the country: (i) builds national leadership for elimination goals; (ii) develops detailed plans; (iii) continues recent successes in enhancing routine vaccination coverage; (iv) introduces rotavirus vaccine into the childhood immunisation schedule; and (v) strengthens surveillance and research (on such questions as the cost-effectiveness of new vaccines, measures to enhance uptake, and effective border controls to reduce the risk of disease importation).

For 50 years now (since 1 April 1962), New Zealand has been free of transmission of wild-type polio virus infection. The end of this disease was particularly sudden with cases declining from 214 notifications in an outbreak in 1961 (with seven deaths) to only five cases in early 1962.\(^1\)

The end coincided with mass immunisation campaigns with the new Sabin (oral) vaccine in 1961 and 1962. The coverage in the vaccination campaign running from April to June 1962 was approximately 95% of the child population up to school leaving age.\(^2\) In the subsequent 50 years there have only been occasional cases of vaccine-associated paralytic poliomyelitis (VAPP), four of which have been laboratory-confirmed.\(^3\) However, there is no longer a vaccination-related risk in New Zealand as in 2002 the national immunisation schedule was changed to replace oral polio vaccine with inactivated polio vaccine (the Salk vaccine).\(^3\)

At a regional level, the Western Pacific Region, of which New Zealand is a part, was declared polio-free in 2000,\(^3\) the consequences of which further lower the risk of disease importation into New Zealand. Even so, health authorities remain appropriately vigilant by maintaining surveillance of acute flaccid paralysis and keeping polio on the notifiable disease schedule of the Health Act.\(^4\)

In this viewpoint article we go beyond the polio success to briefly consider the benefits of disease elimination, the additional vaccine-preventable diseases (VPDs) that could be eliminated in New Zealand, and the actions which are probably needed to achieve such elimination goals.
Disease elimination and eradication internationally

Infectious diseases are one of the few human health threats that have the potential to be entirely eradicated (along with some forms of injury and poisoning where the external cause can be removed from the environment). **Eradication** refers to the cessation of disease transmission at a global level based on the total absence of human cases and the lack or removal of natural reservoirs or other sources of infection. The term **elimination** is generally used to describe the cessation of transmission within a country or region (though “regional eradication” is sometimes also used for the latter). **Disease control** refers to the use of interventions that restrict the circulation of an infectious agent beyond the level that would occur without any such interventions, and unlike the other terms, should be qualified by specifying the level of control achieved.5

Disease eradication offers the huge potential advantage that might arise from no longer having to invest resources in prevention measures, as has been seen with global smallpox eradication and more recently with the globally eradicated cattle disease rinderpest.6 In contrast, elimination and control imply a need for continuing interventions and surveillance, as is still currently the case with polio (i.e., which remains endemic in several countries, albeit at generally declining levels).

Only some diseases are candidates for global eradication or regional or national elimination at the current time. At a technical and biological level, eradication usually requires an effective, practical and affordable intervention; the availability of accurate diagnostic tests that can detect levels of infection that can lead to transmission; and that “humans are essential for the life-cycle of the agent, which has no other vertebrate reservoir and does not amplify in the environment”.7 In addition to biological feasibility, disease eradication requires adequate public health infrastructure, sufficient funding, and sustained political/societal will.8

The International Taskforce on Disease Eradication has repeatedly published (and updated) a list of diseases that they consider are candidates for eradication.9 Their current list of eradicable and potentially eradicable diseases consists of: poliomyelitis, dracunculiasis (Guinea worm disease), measles, mumps, rubella, lymphatic filariasis and taeniasis/cysticercosis (pork tapeworm disease). They also list a number of other diseases, such as hepatitis B, where elimination is conceivable in the future.

**Vaccine-preventable diseases (VPDs) that could potentially be eliminated from New Zealand**

Polio is the only disease to have been eliminated in New Zealand as a result of mass immunisation. The other elimination successes for brucellosis and hydatids, involved a mix of public health and veterinary measures.10 Another elimination success was from environmental control measures i.e., eliminating the imported southern saltmarsh mosquito (a potential mosquito vector for Ross River virus).10

**Measles, mumps and rubella**—Of the diseases identified for global eradication, measles is currently receiving the greatest attention. A recent supplement of the *Journal of Infectious Diseases* was devoted to this question and concluded that measles eradication is biologically feasible so the challenges are logistical, political
Achieving global eradication is the disease control scenario that modelling indicates is the most cost-effective.\textsuperscript{12}

There has been regional elimination of both measles and rubella in the Americas,\textsuperscript{8} with this status persisting even though occasional outbreaks associated with imported cases occur (e.g., in the US in 2011\textsuperscript{13}). Also there were zero cases of measles in eight European countries in 2010,\textsuperscript{14} though recent outbreaks have involved much of Europe.\textsuperscript{15} In New Zealand’s own region (the World Health Organization’s [WHO] Western Pacific Region), measles elimination is a 2012 target.\textsuperscript{16}

WHO defines measles elimination as “the absence of endemic measles transmission in a defined geographical area (e.g., region) for ≥12 months in the presence of a well performing surveillance system.”\textsuperscript{17}

Following the last national epidemic of measles in 1997,\textsuperscript{18} New Zealand had relatively few cases of measles for a decade but then in recent years there have been notable outbreaks. There were 248 notified cases in 2009, 48 in 2010, and 597 in six outbreaks in 2011\textsuperscript{19} and additional outbreaks in early 2012 (e.g., n=69 cases for January to April).\textsuperscript{20} The incidence of measles in New Zealand was the highest reported in the Western Pacific Region of WHO in 2009 (NZ and Vietnam both reported rates of 59.3 cases / million)\textsuperscript{21} and again in 2011 (the NZ rate was 135.7 cases / million).\textsuperscript{22}

The size of these outbreaks in New Zealand probably reflects the inadequate levels of vaccination coverage historically (with older child and youth age cohorts with suboptimal coverage) and suggests that the country will need to do more to achieve elimination status. As noted by the WHO, “Countries with ongoing measles virus transmission in 2012—including China, Malaysia, New Zealand and Singapore—likely will need to supplement routine immunisation with special activities to interrupt measles virus transmission in 2012.”\textsuperscript{22}

**Hib disease**—The progress in some European countries (e.g., zero cases in Greece, Iceland and Malta in the last 2 years of 2005/06 for one data source\textsuperscript{23}), suggests that elimination of *Haemophilus influenzae* type b (Hib disease), may be feasible at the country-level. Furthermore, the herd immunity effect from vaccination appears notable for this disease.\textsuperscript{24} Since New Zealand introduced vaccination against Hib disease, there have been impressive reductions in the disease burden.\textsuperscript{25,19} So potentially only modest further improvements in childhood vaccination coverage in New Zealand might be needed to achieve elimination.

**Rotavirus infection**—This is a VPD where infant vaccination appears to have large herd immunity effects and helps to protect older unvaccinated children and young adults.\textsuperscript{26} This suggests scope for national elimination, though global eradication may not be technically feasible because of zoonotic transmission and animal reservoirs.\textsuperscript{27} In 2009, the WHO recommended inclusion of rotavirus vaccination in all national immunisation programmes.\textsuperscript{28} While there is favourable evidence from a cost-effectiveness study for New Zealand,\textsuperscript{29} rotavirus vaccine has not yet been added to the routine childhood immunisation schedule in this country.

**Other VPDs**—Other VPDs will become candidates for elimination in the future, as new vaccines and other control measures become available. A potential example is varicella (chicken pox). Previous modelling work has suggested that vaccination
against varicella might result in elimination at the country-level (e.g., in Germany\textsuperscript{30}). Furthermore, in the US there has been near elimination of deaths from varicella with the one-dose programme and “with the current two-dose programme, there is potential that these most severe outcomes of a vaccine-preventable disease could be eliminated”.\textsuperscript{31} Nevertheless, the issues around vaccination benefits and costs are very complex. For example, while a study found a combined vaccination policy to be cost-effective (i.e., both varicella and zoster vaccination options),\textsuperscript{32} it concluded that: “Policy makers should be aware of the potential negative benefits in the first 30–50 years after introduction of a childhood varicella vaccine. This can only be partly mitigated by the introduction of a herpes zoster vaccine. They have to decide how they value the potential benefits beyond this time to consider childhood vaccination cost-effective.”\textsuperscript{32}

Given such complexities, aiming for varicella elimination is probably too uncertain and a more appropriate goal for New Zealand may be to focus only on disease burden reduction by adding a suitable vaccine to the childhood immunisation schedule and carefully monitoring experience elsewhere.

Vaccine introduction has previously been recommended for New Zealand by the Immunisation Technical Forum, by various paediatricians,\textsuperscript{33} and by immunisation experts.\textsuperscript{34} Work indicating favourable cost-effectiveness for varicella vaccination in New Zealand has been done,\textsuperscript{35} though ideally this could benefit from updating.

Potential actions to progress VPD elimination in New Zealand

There are a number of actions that New Zealand could take to progress the elimination of those VPDs listed above:

- **National leadership and planning**—National-level political and health leaders should ideally articulate VPD elimination goals in political manifestos, in strategic documents and in the media. Having detailed plans with defined elimination goals is critical, as was seen for the recent elimination of the southern saltmarsh mosquito.

- **Enhancing routine childhood immunisation coverage**—The current New Zealand Government has made raising routine childhood immunisation coverage one of its health priorities and has been making good progress towards this.\textsuperscript{36, 37} It might be enough to continue on the track of recent improvements in immunisation service delivery (as recently detailed\textsuperscript{37}). But if after a few more years there is not good evidence that measles is about to be eliminated, then other options include: (i) Considering supplementary measles vaccination for older children; (ii) Generating media coverage for a national measles elimination goal (and potentially for selected other VPDs); (iii) Running paid mass media campaigns to promote vaccination uptake. Such media campaigns could address the barrier of “public misconception of seriousness” for measles,\textsuperscript{9} and potentially any public concerns around vaccine safety; (iv) Possibly further incentivising vaccination providers to enhance service delivery.

- **Introducing routine rotavirus vaccination**—While updating a previous cost-effectiveness study\textsuperscript{29} on this oral vaccination for the New Zealand setting
would be optimal, there is probably enough information for prudent policy makers to act now with this introduction. Some of the additional information has been recently cited by Reid and relates to the likely reductions in vaccine price, the prior cost-effectiveness work not considering full benefits to caregivers (aspects of the loss of income for caregivers associated with caring for sick children), and the emerging evidence for improvements in the timeliness of coverage for other scheduled vaccinations when rotavirus vaccination is used. In addition, the previous cost-effectiveness work was considered conservative by its authors and as they stated it didn’t consider potential benefits of herd immunity and benefits for preventing nosocomial transmission. Finally, the potential benefit of reducing the seasonal burden of rotavirus outbreaks on health service functioning (as detailed for the UK), was not accounted for.

**Possible activities at the border**—When measles vaccination coverage for children exceeds 95% in New Zealand, supplementary activities at the border could be considered. That is, all children entering or departing could be required to show documentation of measles vaccination. This need was illustrated by the recent well documented importation of measles cases into Auckland. Nevertheless, such moves need to consider the various limitations identified from previous New Zealand experience with border control activities for infectious disease control in humans.

**Strengthening surveillance capacity**—Comprehensive surveillance is critical to support all stages of disease elimination, from describing the incidence and distribution of disease, identifying individual cases for control measures, monitoring the coverage of interventions such as vaccinations, and finally for confirming successful disease elimination (as is currently illustrated with acute flaccid paralysis for polio in New Zealand and elsewhere). There is considerable potential to improve New Zealand’s infectious disease surveillance system to support elimination and control objectives.

**Research**—To guide decisions around the potential for rotavirus elimination in New Zealand, there needs to be more research on zoonotic and environmental transmission to humans in this country. For example, rotavirus has been detected in surface waters used as drinking water sources in New Zealand.

Action in these areas is compatible with the current government’s interest in improving routine childhood immunisation coverage (as one of six health priorities). They are also generally compatible with the international obligations the country has agreed to for measles elimination. But most importantly, elimination of these additional VPDs would be beneficial for improving child health, reducing health inequalities, and lowering costs for New Zealand’s health care services.

**Competing interests:** Although we do not consider it a competing interest, we note that both of the authors have previously done contract work for the Ministry of Health (MoH) or have been advisors to the MoH on infectious disease epidemiology and control issues.

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