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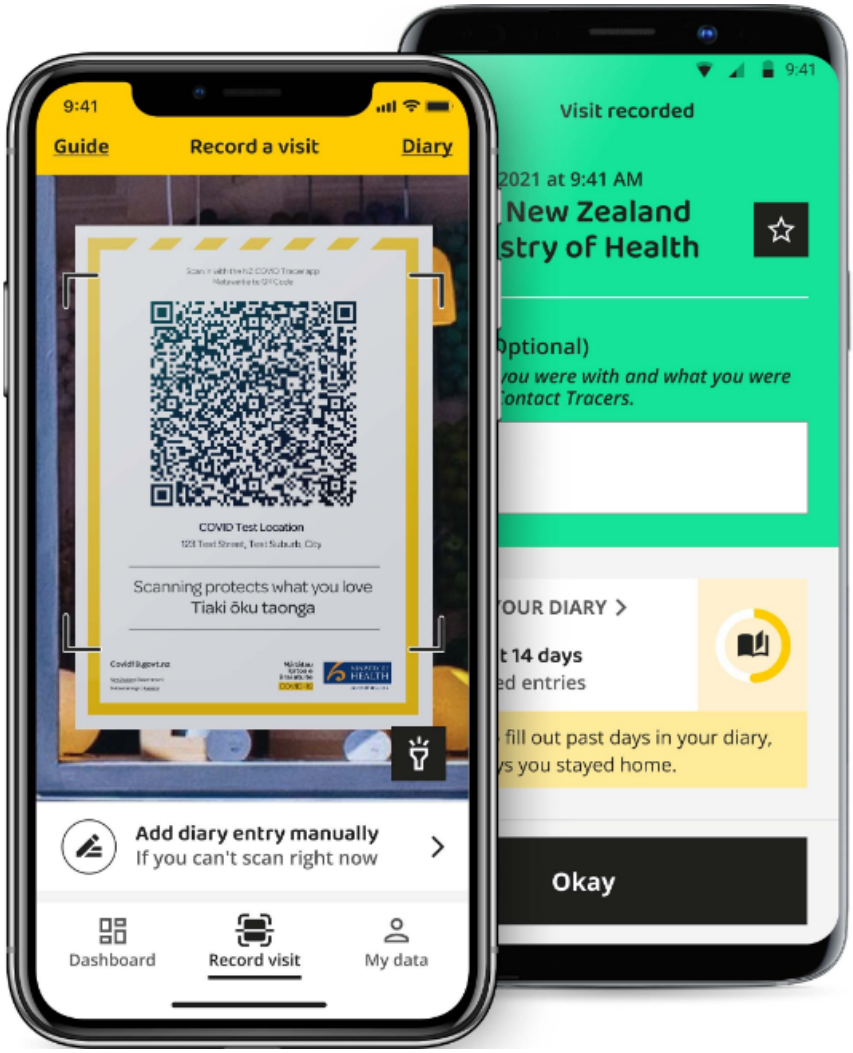

The need for a robust scientific definition for the elimination of COVID-19 from New Zealand

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New Zealand is making good progress towards its elimination goal for COVID-19 at the country-level. In this blog we present the case for a scientific definition of elimination to help guide our national COVID-19 response. The definition must be objectively verifiable, with appropriate levels of testing and surveillance systems in place. It should ideally be refined in collaboration with Australian health authorities, as part of a strategy of opening up our shared borders for easier travel between the two countries.

In common language, the words “elimination” and “eradication” are often used interchangeably, but a distinction is made in the field of infectious disease epidemiology. Eradication is the “permanent reduction to zero of the worldwide incidence of infection caused by a specific agent…” [1]. The global eradication of smallpox was declared in the 1970s, and there are major international efforts to eradicate poliomyelitis.

Definitions of elimination are more variable. The term is often used to describe the “reduction to zero of the incidence of infection caused by a specific agent in a defined geographical area…” [1]. An alternative definition is “the reduction of case transmission to a predetermined very low level” [2]. For example, in 1991 the World Health Organization (WHO) defined the elimination of tuberculosis as a public health problem as reduction of prevalence to a level below one case per million population [2].

Maintaining the elimination of a disease in a country or region requires continued preventive measures. NZ has successfully eliminated poliomyelitis, hydatid disease, and brucellosis [3]. NZ’s polio-free status required a verification process and WHO has an independent monitoring board for this purpose. Measles and rubella elimination also have specific criteria and are scrutinised by a WHO verification commission [4].

The NZ Government has adopted a goal of eliminating COVID-19, although the strategy for achieving this has not been fully described [5]. We appear to be making good progress, with the number of new cases in single digits since 18 April (down to zero new cases on 4 May), while the amount of testing has been steadily increasing. Understanding progress towards elimination would be improved if the Ministry of Health website presented case data in more detail, using categories orientated to the elimination goal (as per this recent blog).

Why do we need a definition of elimination for COVID-19?

There are at least four important reasons for developing a definition for COVID-19 elimination:

1. **To support decisions about lowering the alert level** – The current risk assessment criteria for the COVID-19 alert system state that SARS-CoV-2 transmission within NZ is still occurring for levels 2-4. Moving to alert level 1 would imply that there is relatively high confidence that SARS-CoV-2 transmission has ceased in NZ (though an even higher level of confidence might be required for an elimination definition that would permit a 'trans-Tasman bubble').
2. **To provide a high level of assurance to the NZ public** – Many New Zealanders are understandably concerned about the risk of COVID-19. Reaching a clear elimination goal will help them to make more informed decisions about things they may have otherwise avoided and which are permitted at a particular alert level (eg, attending school, attending workplaces, attending large gatherings). This assurance will be particularly important for people at high risk of severe illness (older people and those with predisposing medical conditions).
3. **To provide a high level of certainty to businesses** – Business operators and investors wishing to assess risks and behave responsibly need high levels of certainty for their planning. This is particularly true for enterprises that involve public venues (eg, food and hospitality) and interacting with the public (eg, retail businesses, hairdressers, physiotherapists).
4. **To provide a high level of assurance to the Australian Government and public** – An agreed elimination definition could pave the way for the gradual opening of NZ borders to two-way movement of people with Australia (ie, when both countries have achieved elimination, a 'trans-Tasman bubble' might become a viable proposition). This process could be a step towards opening NZ to international tourism in the medium to long term. Indeed, similar arguments have been made for the inclusion of certain Pacific Island nations in such a NZ-Australia bubble – given that many Pacific nations have remained free of COVID-19, due to tight border controls and flight restrictions.

What might a definition of COVID-19 elimination look like?

There is currently no accepted international definition of COVID-19 elimination, and a number of options would be possible. The most clear-cut approach would be to require zero transmission within a country or region.

Although Australia would appear to have the potential to achieve elimination, it has not yet adopted such a goal. Nevertheless, a report from Australia's leading research universities ("The Group of Eight") produced a preliminary definition of elimination: "In practice this would mean no new SARS-CoV-2 cases linked to community transmission or unknown sources of infection over two incubation periods since the time of the last known community acquired case, provided a highly sensitive early detection, case and contact tracing and management surveillance system is in place" [6].

A definition for elimination of COVID-19 could include three components:

- the absence of newly diagnosed SARS-CoV-2 virus infections, within the country (New Zealand) for a specified period (eg, 28 days since the onset date of the last known infection);

- the presence of a high-performing, carefully targeted, national surveillance system that was testing an average of at least a specified number of people per 1000 population per day (ie, a specified minimum number of tests per day) throughout this period, with good geographic and demographic coverage;
- allowing exemptions for cases of SARS-CoV-2 infection among incoming travellers detected at the border and held in supervised isolation/quarantine facilities until full recovery.

All components of this suggested definition require careful scrutiny.

Duration of absences from new infections: The duration could be estimated from modelling for some relatively high level of certainty, eg, 99% or even higher. But until these values are carefully determined, it would be prudent to assume at least 28 days (two times the maximum incubation period), with testing levels of over 2 per 1000 population (ie, 10,000 tests per day in NZ). The reference date could be for the onset of symptoms in the most recent case. Asymptomatic cases found to be positive on testing would need careful evaluation to determine a proxy date.

This definition would imply that if a border control failure occurred and any transmission in NZ resulted, the country's elimination status would be revoked. But the elimination status could then be regained after a period of time and on-going surveillance activities according to the definition above.

Level of surveillance: A recent Australian study [7] suggested that timely detection and management of community transmission of COVID-19 is feasible. This modelling study concluded that "testing for infection in primary care patients presenting with cough and fever is an efficient, effective and feasible strategy for the detection and elimination of transmission chains". For example, when testing 9000 people per week (per million population), the authors estimated that no cases of COVID-19 would be missed in some circumstances. But this testing level is higher than current levels in NZ (ie, the 7-day rolling average for NZ is around 4,200 tests per day, as reported on 3 May 2020 [8], which is around 6000 people per week per million population).

Exemptions that could be allowed: Global eradication of SARS-CoV-2 is a distant and uncertain possibility. Nor may it be necessary, depending on the future scenarios that may emerge with development of antiviral drugs and vaccines. Consequently, NZ will continue to receive potentially infected people arriving at our borders. If such travellers are effectively quarantined, they should not affect our elimination status.

There is a question as to whether or not other events, that might generate cases, would necessarily remove elimination status. An example would be asymptomatic or even symptomatic airline crews or airport staff (or sea crews and seaport staff) testing positive to SARS-CoV-2. If such staff were rapidly isolated and there was no evidence of ongoing transmission, such events might not necessarily remove elimination status. This is an area where phylodynamic evidence might be useful in determining the origins of any detected virus.

Wider exemptions could potentially be considered, as is allowed for elimination definitions such as for measles [4]. However, given the relatively high infectiousness of SARS-CoV-2, and the near total susceptibility of the NZ population, such exceptions would be problematic until there are other containment measures available, notably vaccines.

Other precautions that should be in place: A COVID-19 elimination definition might also need to include other requirements, in addition to a high-performing surveillance system:

- Documented border management criteria: There could be added criteria and performance measures specified for managing points of entry.
- Documented contact management criteria: There could be added criteria and performance measures specified for contact tracing. There is still a need to improve NZ's capabilities eg, use of digital technologies to enhance the speed and effectiveness of contact tracing.
- Documented surveillance criteria: There could also be more detailed requirements for COVID-19 surveillance, including passive and active surveillance and possibly environmental surveillance (see this recent blog).

An additional condition for elimination, and certainly eradication, is that humans are the only host of any significance, ie, there are no important animal or environmental reservoirs of infection. While a number of animals appear capable of being infected with SARS-CoV-2, none are considered important routes of transmission [9]. But this issue could be reviewed at regular intervals.

What process should NZ use for developing an elimination definition?

NZ health authorities need to formulate an elimination definition as part of a wider elimination strategy. Given the 'all of government' response to COVID-19, such a definition would require high-level Government agreement.

Since the benefits of an elimination definition extend to the international level, it would be important to consider a process that included other countries with which NZ might plan to extend travel links. An obvious starting point would be to consult with Australian health authorities about the benefits of a shared elimination definition. In the longer term, this discussion could potentially extend to other countries that are on similar containment paths. Involvement of the WHO could also be considered. For example, an elimination definition could be recommended by a joint panel of NZ and Australian scientists, and this might lead to a process mandated by WHO for verification of elimination.

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