The Elimination Strategy for Responding to COVID-19: The New Zealand Experience

Professor Michael Baker, University of Otago, Wellington
Previous experienced with ‘pandemics’
• HIV/AIDS 1987-91 - NEP
• SARS 2003 (minimal impact in NZ)
• Pandemic influenza (H1N1) 2009
• COVID-19 2020
Outline

• Assessing pandemics
• Strategic choices for pandemic response
• Components of elimination strategy
• Impact of COVID-19 elimination strategy
• Key lessons from COVID-19 response
Assessing pandemics

Epidemics (including Outbreaks, Pandemics):
1. Often have a high Impact on population health & social & economic wellbeing
2. Generally increase health Inequalities
3. Show considerable Uncertainty and Unpredictability
4. Often have high Controllability
5. Usually create public Panic and Outrage

Source: M Baker, Five lessons we should have learned from pandemics. Guardian, 7 May 2015
Assessing Pandemics

- Epidemic (more than expected)
- Outbreak (localised) → Pandemic (widespread)
### Assessing Pandemics

<table>
<thead>
<tr>
<th>Pandemic Type</th>
<th>Examples (*PHEIC)</th>
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<tbody>
<tr>
<td><strong>A. Pandemic IDs transmitted between people with short to medium incubation periods</strong></td>
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<tr>
<td>1. ID with well-established pandemic potential</td>
<td>Pandemic influenza 1918, 1957, 2009*</td>
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<tr>
<td>2. Poorly characterised emerging ID with pandemic potential</td>
<td>SARS 2002, MERS-CoV 2012, COVID-19*</td>
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<td>3. Synthetic or weaponised ID with pandemic potential</td>
<td>Synthetic bioterrorist agent, eg smallpox</td>
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<td>5. Exotic ID with pandemic potential in low income countries</td>
<td>Plague in India 1994, Ebola 2014*</td>
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<td><strong>B. Pandemic IDs with predominantly asymptomatic transmission &amp; long incubation</strong></td>
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<tr>
<td>6. ID with high asymptomatic transmission, long latency and pandemic potential</td>
<td>HIV/AIDS 1981, nvCJD 1996</td>
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<tr>
<td>7. Increase in serious antimicrobial resistance</td>
<td>Drug resistant tuberculosis (MDR / XDR / TDR)</td>
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<td><strong>C. Pandemic IDs predominantly transmitted from animals, vectors, food, and water</strong></td>
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<tr>
<td>8. Exotic vector borne &amp; zoonotic ID with moderate to high introduction potential</td>
<td>Arboviral diseases eg, Zika 2016*, Dengue, Chikungunya</td>
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<td>9. Imported food, drink or other product with serious contaminant</td>
<td>Botulism in canned food, Radiological agent in food</td>
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Assessing pandemics

Importance of infections prior to symptoms

Assessing pandemics

Factors influencing response to pandemics, include:

- Health impact – particularly case fatality risk (CFR) & infection fatality risk (IFR)
- Transmissibility of pathogen – $R_0$, $R_{eff}$
- Controllability – effectiveness of interventions
- Certainty of information – science capacity, awareness of options, experience/dogma
- Feasibility of response – public sector capacity to respond, public acceptability & adherence
- Economics – cost of action and inaction, counterfactuals
- Impact on inequalities
Assessing pandemics

Estimated mortality from COVID-19 pandemic:

- Modelled, assuming Ro=2.5, 25% control
- 57% population infected
- Peaks after 5 months – 1650 in ICU
- 28,300 hospitalised (0.6% population)
- 12,700 deaths (0.3% population)
  = mortality of 25 seasonal influenza seasons

Source: Wilson et al, University of Otago 2020
Assessing pandemics

Mortality rates for Māori vs non-Māori in 3 successive influenza pandemics

Strategic Choices for Pandemic Response

- **Control** – Disease rates reduced to an acceptable level
- **Elimination** – Disease or infection incidence reduced to zero in a defined area (country or region), eg poliomyelitis, measles, rubella
- **Eradication** – Infection reduced to zero at a global level, eg smallpox

Source: Dowdle, MMWR Supple. December 1999 / 48 (SU01);23-7
Strategic choices for pandemic response: Light-bulb moments

1. January 2020 - It’s a serious global pandemic

2. February 2020 - It can be contained/eliminated/stopped

3. March 2020 - NZ is not ready, ‘lockdown’ needed

Source: Wu et al. Lancet 31 Jan 2020

Source: Aylward et al, WHO, 28 Feb 2020
### Plan Pandemic Strategy

1. **Exclusion strategy**: Maximum action to exclude disease  
   Eg. Pacific Island countries and territories

2. **Elimination strategy**: Maximum action to exclude disease and eliminate chains of transmission. Eg. Mainland China, Taiwan, New Zealand; also as per SARS

3. **Suppression strategy**: Action increased in stepwise and targeted manner to suppress case numbers and outbreaks. Eg. Most countries in Europe

4. **Mitigation strategy**: Action taken to ‘flatten the curve’ and protect the most vulnerable. Pandemic wave continues, but lower peak. Eg. Sweden at least initially

5. **No substantive strategy**: Largely uncontrolled pandemic wave. Eg. Most low-income states

### Exit path

- Return to carefully managed ‘new normal’ (3 months in Asian countries). Requires persisting quarantine at borders until vaccine and/or antivirals available
- Prolonged control measures until vaccine and/or antivirals available: (12-18+ months) or switch strategies
- Pandemic spreads through population until immunity and/or vaccine and/or antivirals available: (12-18+months)

### Pandemic planning

Assess threat, choose strategy, select interventions* implement ongoing surveillance and evaluation, fine-tune mix of interventions

### Control interventions

1. Border controls to ‘keep it out’;  
2. Case isolation & contact quarantine to ‘stamp it out’;  
3. Improved hygiene and use of masks;  
4. Physical distancing;  
5. Movement restrictions;  
6. Combinations including ‘lock-down’

NB. There are multiple other interventions to mitigate harm, focussed on health services & protecting vulnerable
Strategic choices for pandemic response

- Developed elimination strategy in Feb-March 2020
- Effectively adopted by NZ Gov on 23 March with decision to go into rapid lockdown with ~100 COVID-19 cases, no deaths

Source: Baker, Kvalsøv, ... Wilson, NZ Med J, 3 April 2020
Components of elimination strategy

Intervention logic for pandemic response strategies

**Types of control measures**
- Physical distancing, cough etiquette, masks, hand hygiene, infection control in healthcare settings
- Case isolation and contact quarantine, working from home, school closures, restricting mass gatherings, border controls
- Antiviral treatment for COVID-19 may have a role in reducing the duration of infectivity

**How they work**
- ↓Transmissibility
  - Risk of transmission per contact
- ↓Contact rate
  - Average rate of contact of susceptibles with infected
- ↓Duration
  - of infectivity

**The logic:** Stopping the pandemic means reducing the reproduction number (R) to less than 1. The 3 drivers are **transmission, contact rate, and duration of infectivity.**
Components of elimination strategy

1. Exclusion of cases
   • *Keep it out* – Border Management

2. Case and outbreak management
   • *Stamp it out* – Testing, contact tracing, isolation/quarantine

3. Reducing transmission
   • Reducing transmission per contact – Hygiene measures, Masks
   • Reducing contacts – Physical distancing & travel restrictions

Elimination: Border Management

Arrivals to New Zealand, by day of border crossing, January-June, 2019-20
Elimination: Testing & Contact Tracing

Tests per day for COVID-19

Source: MoH website
Elimination: Physical distancing (lockdown)

**New Zealand COVID-19 Alert Levels Summary**

- The Alert Levels are determined by the Government and specify the public health and social measures to be taken in the fight against COVID-19. Further guidance is available on the Covid19.govt.nz website.
- The measures may be updated based on new scientific knowledge about COVID-19, information about the effectiveness of control measures in New Zealand and overseas, or the application of Alert Levels at different times (e.g. the application may be different depending on if New Zealand is moving down or up Alert Levels).
- Different parts of the country may be at different Alert Levels. We can move up and down Alert Levels.
- Essential services including supermarkets, health services, emergency services, utilities and good transport will continue to operate at any level. Employers in those sectors must continue to meet health and safety obligations.
- Restrictions are cumulative (e.g. at Alert Level 4, all restrictions from Alert Levels 1, 2 and 3 apply). Updated 5 June 2020

### ELIMINATION STRATEGY – New Zealand is working together to eliminate COVID-19

<table>
<thead>
<tr>
<th>Alert Level</th>
<th>Risk Assessment</th>
<th>Range of Measures (can be applied locally or nationally)</th>
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<tbody>
<tr>
<td><strong>Level 4 – Lockdown</strong></td>
<td>Likely the disease is not contained</td>
<td>Community transmission might be happening. New clusters may emerge but can be controlled through testing and contact tracing. People instructed to stay at home in their bubble or other for essential personal movement. Safe recreational activity allowed in local area. Travel is severely limited. All gatherings cancelled and all public venues closed. Business is closed except for essential services (e.g. supermarkets, pharmacies, clinics, petrol stations), and education facilities. Rationing of supplies and regulation of facilities possible. Re prioritisation of healthcare services.</td>
</tr>
<tr>
<td><strong>Level 3 – Restrict</strong></td>
<td>High risk the disease is not contained</td>
<td>Community transmission might be happening. New clusters may emerge but can be controlled through testing and contact tracing. People instructed to stay at home in their bubble or other for essential personal movement. Safe recreational activity allowed in local area. Physical distancing of two metres outside home (including public transport, or one metre in controlled environments like schools and workplaces). People must stay within their immediate household bubble, but can expand this to reconnect with close family, friends, or in their care. Support for people is limited. This extended bubble should remain exclusive. Schools (years 1 to 10) and Early Childhood Education centres can stay open, but will have limited capacity. Children should learn at home if possible. People must work from homes unless it is not possible. Business can open premises, but cannot physically interact with customers. Low-risk local recreation activities are allowed. Public venues such as museums, libraries, cinemas, food courts, gyms, pools, playgrounds, markets. Gatherings of up to 10 people are allowed but only for weddings, funerals and tangihanga. Physical distancing and public health measures must be maintained. Healthcare services use virtual, non-contact consultations where possible. Inter-regional travel is tightly limited (e.g. for essential workers, with limited exemptions for others). People at high-risk of severe illness (older people and those with existing medical conditions) are encouraged to stay at home where possible, and take additional precautions when leaving home. They may choose to work.</td>
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<tr>
<td><strong>Level 2 – Reduce</strong></td>
<td>The disease is contained, but the risk of community transmission remains</td>
<td>Household transmission could be occurring. Single or isolated cluster outbreaks. People can reconnect with friends and family, and socialize in groups up to 100, go shopping, or travel domestically, following public health guidance. Keep physical distancing of two metres from people you don’t know, when in public or in retail stores. Keep one metre physical distancing in controlled environments like workplaces, where practicable. No more than 10 people at gatherings, including weddings, birthdays, and funerals and tangihanga. Businesses can open to the public if following public health guidance including physical distancing and record-keeping. Alternative ways of working are encouraged where possible. Hospitality businesses must keep groups of customers apart, seated, and served by a single person. Maximum of 100 people at a time. Sport and recreation activities are allowed, subject to conditions on gatherings, record-keeping, and where practical, physical distancing. Public venues such as museums, libraries, and pools can open if they comply with public health measures and ensure they are at a physical distancing and record-keeping level. Essential services, including cinemas, stadiums, concert venues and cinemas can have more than 100 people at a time, provided that there are no more than 100 in a defined space, and the groups do not mix. Health and disability care services operate as normal as possible. It is safe to send your children to schools, early learning services and tertiary education. There will be appropriate measures in place. People at higher risk of severe illness from COVID-19 (e.g. those with underlying medical conditions, especially if not well-controlled, and seniors) are encouraged to take additional precautions when leaving home. They may work, if they agree with their employer that they can do so safely.</td>
</tr>
<tr>
<td><strong>Level 1 – Prepare</strong></td>
<td>The disease is contained in New Zealand</td>
<td>COVID-19 is uncontrolled overseas. Isolated household transmission could be occurring in New Zealand. Border entry measures to minimize risk of importing COVID-19 cases. Intensive testing for COVID-19. Rapid contact tracing of any positive case. Self-isolation and quarantine required. Schools and workplaces open, and must operate safely. No restrictions on personal movement, but people are encouraged to maintain records of where they have been. No restrictions on gatherings or events. No restrictions on public transport. No restrictions on domestic transport, but people are encouraged to maintain records to enable contact tracing. Stay home if you’re sick, report flu-like symptoms. Wash and dry hands, cough into elbow, don’t touch your face. No restrictions on domestic travel or transport if sick. No restrictions on workplace or services but they are encouraged to maintain records to enable contact tracing</td>
</tr>
</tbody>
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Elimination: Physical distancing (lockdown)

COVID-19: Government Response Stringency Index

The Government Response Stringency Index is a composite measure based on nine response indicators including school closures, workplace closures, and travel bans, rescaled to a value from 0 to 100 (100 = strictest response).

NZ = 96.3
Aust = 75.9

Note: This index simply records the number and strictness of government policies, and should not be interpreted as 'scoring' the appropriateness or effectiveness of a country's response.
OurWorldInData.org/coronavirus • CC BY
Impact of Elimination Strategy

Simulated and actual daily numbers of new local and imported cases (confirmed and probable). Effective reproduction number ($R_{eff}$)

- Prior to lockdown: $R_{eff} = 1.8$ (best-fit to case data)
- Level 4 $R_{eff} = 0.35$ (best-fit)
- Level 3 $R_{eff} = 0.95$ (assumed)
- Level 2 $R_{eff} = 1.7$ (assumed)

Source: Rachelle Binny, Shaun Hendy et al, University of Auckland
Impact of Elimination Strategy

Source: Baker, Wilson, Anglemyer. NEJM e56 DOI: 202010.1056/NEJMc2025203
Impact of Elimination Strategy
Death rate from COVID-19, OECD countries

Source: Wilson et al, PHE Blog, 22 July 2020
Impact of Elimination Strategy
Other deaths during lockdown
Incidental benefits: Reduced weekly deaths in lockdown (548 fewer deaths to June 2020 than in 2019, RR = 0.94; 95%CI: 0.92 to 0.97)

Source: Wilson et al, PHE Blog, July 2020
Economic impacts
Preliminary weekly electronic payroll jobs estimates for NZ & Australia

Source: Blakely et al MJA preprint July 2020
Components of elimination strategy
Resurgence planning & management

• New extended cluster detected in Auckland 11 August
• Now 177 cases with same genome lineage
• Rapid response including:
  • High levels of testing & contact tracing
  • Alert levels 3 (Auck), 2 (Rest of NZ)
  • Mass masking on public transport
Key lessons from COVID-19 elimination in NZ

Effective Science + Good Political Leadership
Key lessons from COVID-19 elimination in NZ

Scientific questions

1. **Circumstances when elimination optimal** – compared with alternatives eg, control/mitigation/suppression using health & economic metrics

2. **Defining elimination**
   - Absence of detected cases for a defined period eg, 28 days*
   - Presence of a high performing surveillance system
   - Defined exclusions eg, cases identified at borders and placed in effective isolation/quarantine

*Usually specified according to statistical likelihood, eg 95% probability of elimination. Distinct from active cases.

Key lessons from COVID-19 elimination in NZ

Scientific questions (continued)

3. **Disease reporting conventions** – WHO reporting distinguishing community cases from those in managed isolation & quarantine

4. **Optimal use of key technologies** - eg
   - Surveillance systems
   - Genomics, waste water testing
   - Border quarantine/isolation
   - Digital tools to support contact tracing eg Google/Apple system, Bluetooth (eg, CovidCard), telecoms data
   - Face masks/covering
   - Alert level system (use of ‘stay at home’ / lockdown)
Key lessons from COVID-19 elimination in NZ

5. Application of elimination approach to other IDs

Pandemic diseases
• Disease X, Pandemic influenza?

Eradicated diseases
• Smallpox, Rinderpest

Global eradication underway
• Poliomyelitis (polio), Dracunculiasis, Yaws

Regional elimination established or underway
• Hookworm, Lymphatic filariasis, Onchocerciasis, African, trypanosomiasis, Malaria
• Measles, Rubella
• Syphilis, Rabies, BSE and nvCJD,

Other diseases where elimination proposed
• HIV, Hepatitis C, Hepatitis B, TB
Key lessons from COVID-19 elimination in NZ

Institutional lessons

1. Elimination of COVID-19 benefits health & economy compared with alternatives

2. Effective risk assessment & strategic decision making is important in public health crises

3. Consider equity and partnerships with affected communities

4. Need to strengthen public health infrastructure for this and future crises

5. Need to strengthen and reform global health agencies like WHO
Key lessons from COVID-19 elimination in NZ

Opportunity for broad ‘reset’ and increased focus on managing major global health threats
Acknowledgements

- COVID-19 Research Collaborative
- Based at the University of Otago, multiple collaborations
- Director: Michael Baker, Lead Researchers: Amanda Kvalsvig, Nick Wilson
- Goal: To support an effective and equitable pandemic response
- Researchers from Universities (x3), CRI, Community group

- Funding from HRC, philanthropic organisations, Universities
Follow-up

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