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Integrated Prevention and Control of Seasonal Respiratory Infections in Aotearoa New Zealand next steps for transformative change

Abstract

Public health measures that successfully eliminated the spread of Covid-19 in Aotearoa New Zealand during 2020 also profoundly reduced the normally high seasonal burden of non-Covid infectious diseases. One outcome of this extraordinary year was that life expectancy in New Zealand actually increased during 2020, the first year of this global pandemic. We should not accept or allow a return to previous levels of illness and death during the winter months.

Transformative change will require an integrated approach to infectious disease policy that builds on the knowledge and infrastructure developed

during the first two years of the pandemic response. An effective strategy will include generic elements – notably, science-informed strategic leadership, a Tiriti and equity focus, and an upgraded alert level system. We will also need a specific plan for infectious respiratory diseases, including measures to improve indoor air quality, a national mask strategy, and an enhanced system to deliver vaccinations against seasonal respiratory infections.

Such an approach can have immediate and long-term benefits, protecting New Zealanders from endemic, epidemic and pandemic infections.

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We face a potentially difficult winter in 2022, with multiple infectious disease threats. There is an urgent need for integrated policy and action to prevent and control both Covid-19 and more familiar winter season respiratory infections. In the future, 2020 should be seen as the watershed

year that triggered a transformative improvement in New Zealand's poor track record of infectious disease incidence and inequities.

Keywords Covid-19, pandemic, seasonal, influenza, public health, Aotearoa New Zealand

From March to May 2020, Aotearoa New Zealand's pandemic response was one of the most stringent in the world. Adoption of the elimination strategy successfully ended the initial Covid-19 outbreak (Baker, Wilson and Anglemyer, 2020; Jefferies et al., 2020), but the control measures also caused hardship in communities and populations that were already marginalised (Choi et al., 2021). An unexpected benefit of the strategy was that many other infectious diseases largely disappeared, and life expectancy increased (Islam et al., 2021).

For decades New Zealand has experienced high rates of infectious diseases and their consequences (e.g., rheumatic fever, meningococcal disease, skin infections, bronchiectasis in children) compared with other OECD countries. The distribution of infectious diseases by ethnicity, age and health status or disability has also been highly unequal (Baker et al., 2012; Khieu et al., 2017; Wilson et al., 2012; Oliver et al., 2018). Health inequities have a structural basis and in New Zealand they are strongly patterned by the intergenerational impacts of poverty and colonisation. These structural conditions are able to get 'under the skin' and increase infectious disease risk through multiple pathways, including household crowding, exposure to tobacco smoke, presence of underlying health conditions (comorbidities), and unequal access to healthcare, including immunisations.

The Covid-19 pandemic has once again demonstrated that when structural inequalities are embedded in society they make infectious diseases difficult to prevent and control. For example, the New Zealand government's decision to transition away from Covid-19 elimination during the Delta outbreak in Auckland in 2021 was strongly influenced by a judgement that the outbreak could not be contained because the virus was spreading in

communities that were highly marginalised – for example, people in transitional housing and those with alcohol and drug dependencies (Baker et al., 2021).

New Zealand's vulnerability to infectious disease outbreaks is a concern not only because of the impacts of known pathogens, but also because it indicates a lack of resilience to future epidemics or pandemics that may be more severe than the current one (Boyd, Wilson and Nelson, 2020). On the other hand, New Zealand's effective response to the Covid-19 pandemic and the substantial co-benefits the response delivered for other infectious diseases demonstrate how much can be achieved when government policy is centred on protecting population health (Baker, Wilson and Blakely, 2020).

Before the pandemic, outbreaks of seasonal infectious diseases imposed a costly burden on populations around the world, including in New Zealand (Khieu et al., 2017; Oliver et al., 2018; Paules and Subbarao, 2017; Prasad et al., 2020). We now know how preventable much of that burden is likely to be.

In this article we consider the potential for transformative change as a key legacy of the pandemic. We outline the next steps for applying the knowledge and infrastructure gained from this 'forced experiment' to address the high burden and inequities caused by pandemic, epidemic and endemic respiratory infectious diseases in Aotearoa New Zealand. We propose that the most immediate priority is to develop an action plan to optimise prevention and control of seasonal respiratory infections, beginning in winter 2022.

Learning from the Covid-19 pandemic

New Zealand's initial pandemic response: effects and co-benefits

At the time that Covid-19 case numbers first began to rise, New Zealand's

infrastructure was not adequate for control of widespread community transmission. This capacity problem led to the decision to implement strict border controls and a nationwide lockdown (alert level 4). The public health measures instituted under New Zealand's alert level system not only eliminated Covid-19 transmission (Baker, Wilson and Anglemyer, 2020; Jefferies et al., 2020), but also effectively eliminated or heavily suppressed influenza and other respiratory illnesses, as found across multiple respiratory disease tracking methods. Compared with the years 2015–19, there was a marked reduction in viruses detected in the 2020 post-lockdown period, including a 99.9% reduction in influenza virus and a 98.0% reduction in RSV (respiratory syncytial virus) (Huang et al., 2021). This suppression of infection meant that the annual winter mortality peak was also greatly reduced.

In New Zealand, influenza is typically implicated in around 500 excess winter deaths each year (Khieu et al., 2017; Telfar Barnard et al., 2020). This excess usually ranges from 11% to 21% above non-winter rates, and represents around 4.7% of total mortality. In temperate and cool temperate climates, excess winter mortality seldom falls below 10% (Healy, 2003). In 2020 the winter mortality excess reduced to 225 deaths (~2% excess above non-winter mortality), compared with the average of the 2011–19 period of 1,537 deaths (15%). This marked reduction in morbidity and mortality, across multiple infectious diseases, was also evident in many other jurisdictions (Oh et al., 2021; Ullrich et al., 2021; Zhang, 2021; Australian Bureau of Statistics, 2021).

Implications of these findings

These substantial reductions in respiratory illnesses and deaths were achieved using public health and social measures, also known as non-pharmaceutical measures

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Table 1: Mechanisms of prevention and control of infectious diseases

(Examples in this Table have a strong focus on respiratory transmission because this is the route for Covid-19 infection; it is also the route of most highly transmissible infections spread by human-to-human contact.)

Mechanism	Prevention and control intervention	Policy considerations
Transmissibility Decreasing the risk of transmission when people are in contact	Vaccination, ventilation, filtration, face masks, personal protective equipment (PPE) in high-risk settings, physical distancing, hand hygiene	<ul style="list-style-type: none"> The key advantage of these measures is that they support a high level of normality in daily life, keeping people relatively safe while allowing them to mix with others and stay connected to what they value These measures vary in the degree to which cost or effort is required by the public or by structural entities such as government or businesses Hand hygiene has probably contributed very little to Covid-19 control but may have had a significant impact on other infections; hand hygiene should therefore continue to be promoted, but should not replace respiratory controls such as masks and ventilation
Contact rate Decreasing the risk of susceptible people mixing with infectious people	Vaccination, case isolation and contact quarantine (including staying at home when unwell with any infection), home working, school closures, restricting mass gatherings, border controls, stay-at-home orders (lockdowns)	<ul style="list-style-type: none"> These measures are highly effective at controlling outbreaks but they can also be very disruptive because they keep people apart, causing social as well as physical isolation
Duration of infectivity Reducing the infectious period	Vaccination, antimicrobial treatment, immunomodulatory treatment	<ul style="list-style-type: none"> These measures are extremely important for some infections, particularly those that have a chronic course (e.g., HIV, HCV), but they also have some limitations: in an emerging pandemic there may not be disease-specific prevention or treatment for some time; also, treatment measures are less desirable than prevention measures, and they generally require access to testing and healthcare.

(Müller, Razum and Jahn, 2021). Unlike vaccines, these measures are not specific to any one infection, hence their wide-ranging effects. We need to consider how to achieve similar reductions in morbidity and mortality every winter from now on.

The Covid-19 pandemic should also change our thinking around control of influenza. Aotearoa New Zealand's pandemic plan (which remains the same as pre-Covid) (Ministry of Health, 2017) was founded on an assumption that influenza could not be stopped, although it could potentially be delayed with the use of border management strategies, and the pandemic peak flattened with mitigation measures. However, the initial national alert level 4 lockdown in 2020 eliminated transmission of a nationwide Covid outbreak with a basic reproduction number (R0) much higher (around 2–3) than influenza (R0 of 1.2–1.8 in eight southern hemisphere countries for the 2009 H1N1 pandemic influenza) (Opatowski et al., 2011). We can be reasonably confident of eliminating influenza transmission with similar control measures in future, should we need to (i.e., in the event of a severe influenza winter season or pandemic). However, the hardship caused by lockdowns

and other movement restrictions indicates a need to develop better ways of preventing community transmission of infections during the winter months.

The current policy gap

Aotearoa New Zealand's alert level system was a highly effective policy, enabling decision makers to coordinate control measures and escalate or de-escalate them in response to the level of risk. While the system had several flaws, it was an effective tool for communication and pandemic control, particularly in the early phases of the pandemic response.

In early December 2021, the alert level system was replaced by the Covid-19 Protection Framework, also known as the traffic light system (New Zealand Government, 2021). Despite being presented as a 'protection framework', the scope of this tool is largely restricted to providing a vaccine mandate for indoor social environments (including hospitality venues, gyms, and personal grooming services such as hairdressers). This system also incentivises the population to be vaccinated. It offers very little non-vaccine (public health and social measures-based) protection, and because of its strong focus

on Covid-19 vaccination status it has little potential to protect the public from other infectious disease threats. Because of its highly specific focus on Covid-19 vaccine mandates for public settings, this policy is in many ways the opposite of the integrated approach that is needed.

We need a national strategy for prevention and control of respiratory infectious diseases that can address existing disease burden and inequities and prepare the country for future threats. Without urgent action, the winter of 2022 may be a difficult one; once border restrictions are loosened, we may face multiple infectious disease threats, including new Covid-19 variants, and waning immunity from Covid vaccines occurring simultaneously with the return of other infectious diseases (such as influenza and meningococcal disease). We could also see a new pandemic emerging at any time.

We have previously proposed a series of upgrades to the alert level system that would enhance its ongoing value for infectious diseases prevention and control (Kvalsvig, Wilson et al., 2021). Introduction of a next-generation alert level system would provide the policy basis for an integrated approach and would itself have

an integrating function. This option is discussed further in a later section.

In the next sections we describe the intervention logic of infectious diseases control measures, and outline the implications for new approaches that build on lessons learned and novel infrastructure developed during the pandemic.

Intervention logic: how infectious disease control measures work

Many different control measures are used to prevent or contain infectious disease outbreaks, but ultimately all of them rely on just three mechanisms of action. These three mechanisms can be applied in combination to reduce the reproduction number of an outbreak to below 1 (Kvalsvig and Baker, 2021). As a result of this shared intervention logic there are many synergies in infectious diseases control, such that most control measures can prevent transmission of a variety of pathogens. This synergy is the explanation for the unprecedented decrease in non-Covid infections experienced in New Zealand over the past two years, and is the basis for the integrated approach proposed in this article. The three main mechanisms are summarised in Table 1.

The legacy value of pandemic infrastructure: integrating the prevention and control of Covid-19 and other infectious disease threats

New Zealand's Covid-19 pandemic response has been supported by the development of a wide variety of infection control infrastructure, including managed isolation and quarantine (MIQ) facilities for border control; genome sequencing and waste water testing to inform outbreak control; QR code scanning to support quarantine of contacts; vastly increased capacity of the contact tracing system; and large-scale vaccination infrastructure, aimed at immunising the entire eligible population in a short time frame. This infrastructure presents an opportunity to address other infectious disease threats in synergy with ongoing Covid-19 control.

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measures that work by decreasing contact (e.g., school closures). The policy aim should be to prioritise transmission prevention measures that work unobtrusively in the background to protect population health while enabling normal activities to continue. By applying vaccine-based immunity in combination with innovative surveillance and outbreak control options, effective population-based infection control can be experienced quite differently 'on the ground' with minimal use of movement restrictions and lockdowns.

Another policy design consideration is about who is expected to bear the cost or effort of implementing the various measures. This difference is not necessarily a characteristic of the control measures themselves, but reflects how they are implemented.

For example, mask wearing can be implemented in an individualised way that requires members of the public to buy and wear masks, to ensure they always have a mask with them, and to manage any associated difficulties, such as communication barriers for people who need to see faces to access communication. Alternatively, mask wearing can be promoted as a public good, with masks freely available in public settings where they are required, and a government-level

action plan for communication support to ensure that masks do not further disable those who use them. A systemic approach to support for mask wearing is essential to ensure that outbreak control measures do not widen existing inequities (Rimar et al., 2021).

Aotearoa New Zealand needs a dedicated public health agency that has the ability to coordinate threat responses across government departments and other relevant agencies, with the aim of preventing infectious diseases and reducing inequalities at the core of its role. The Pae Ora (Healthy Futures) Bill is currently before Parliament. It proposes a public health agency, potentially located within the Ministry of Health. Such an agency may be well placed to develop an effective and wide-ranging pandemic plan that is dynamic and therefore not fixed on one particular infectious pathogen, thus avoiding a reactionary approach as evidenced with the Covid-19 response in New Zealand (Kvalsvig and Baker, 2021). By contrast, Taiwan is a leading example of pandemic preparedness, as, following the SARS pandemic in 2003, a dedicated Centers of Disease Control was established which was able to lead the later Covid-19 response in 2020 onwards with immediate effect (Summers et al., 2020). This capacity meant that there was border screening implemented almost immediately, extensive resources were available for both digital and manual approaches to contact tracing, and existing protocols for isolation of both cases and suspected cases were able to be enacted relatively quickly. In non-pandemic times, this agency would address endemic infections and build and maintain the infectious diseases workforce and expertise.

Next steps for an integrated approach to winter infectious diseases

Here we propose ways of minimising the impact of winter infectious diseases. Some of these are generic measures that improve capacity to respond to all infectious diseases. Others are specific to those infectious diseases with respiratory transmission. Some of these measures follow from our recent descriptions of how to respond to Covid-19, which include science-informed strategic leadership;

a Tiriti (Treaty of Waitangi) and equity focus (Baker et al., 2021); use of the precautionary principle (Kvalsvig, Russell et al., 2021); and the need to create legacy benefits for our healthcare and public health systems (Kvalsvig, Wilson et al., 2021).

Elements focused on all infectious diseases
Science-informed strategic leadership

Infectious diseases with an exceptionally high impact, such as Covid-19 and rheumatic fever, may require disease-specific action to mitigate their effects. But this approach is inefficient and there are too many infectious diseases of public health significance to address each of them separately. Instead, an integrated approach is needed.

Before the pandemic there was high annual morbidity and mortality from infections caused by influenza, enteroviruses, rhinoviruses, respiratory syncytial virus (RSV) and others, including bacterial pneumonias and less common but potentially life-threatening infections such as pneumococcal and meningococcal septicaemia. The increase in seasonal respiratory infectious diseases seen each winter caused preventable illness and deaths, and placed a significant burden on the healthcare system, causing reduced capacity to address non-infectious disease presentations. Even mild respiratory outbreaks can result in reduced productivity due to time off work and school, and cause social disruption to individuals and whānau. We can expect these infections to return during 2022, perhaps with unpredictable epidemiology that differs from patterns seen in previous years.

The first step in applying the principles and practice of Covid-19 control to other infections is to establish as closely as possible the true effect of the lockdown on non-Covid-19 infections. This step requires methodological care to account for changes in reporting and diagnosis of infectious diseases arising from health services disruption. Research should also consider how to adapt Covid pandemic measures for other situations. For example, border controls are unlikely to be used for seasonal outbreaks, but further research and modelling can establish the value of

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using lockdowns in an influenza pandemic in a similar way to Covid-19.

Infectious diseases have a high impact via acute or long-term health effects, mortality, health service burden, or time lost from work and education due to illness or caregiver responsibilities. It is important that policy evaluation takes both direct and indirect impacts into account – for example, estimating the full public health impact of vaccine programmes, not just the healthcare costs of acute infection.

A Tiriti and equity focus

Given the importance of infectious diseases prevention to Māori, it is vital that policy around winter infectious diseases upholds te Tiriti in all aspects. This means ensuring that Māori have a leading role in prioritisation, design and implementation. Likewise, Pasifika populations experience high and inequitable impacts from these infections and Pasifika leadership is needed to ensure equitable processes and outcomes. Māori-led responses have been highly effective during the Covid-19 pandemic and there is considerable depth of Māori expertise across a wide range of

policy areas relevant to outbreak control (McLeod et al., 2020; Pihama and Lipsham, 2020; McMeeking, Leahy and Savage, 2020).

Poverty and racism are powerful drivers of the infectious disease burden in Aotearoa. Addressing these 'upstream' factors is far more efficient than most other prevention and treatment approaches because their impact is seen in such a wide range of outcomes. Examples of this type of support that have been highlighted by the Covid-19 pandemic include the need for healthy homes, schools and workplaces, food security and sovereignty, and equitable and culturally safe access to vaccination and other types of healthcare (Choi et al., 2021) When communities are connected to these resources they are far more likely to be resilient to infectious disease threats.

An upgraded alert level system

We need to strengthen New Zealand's pandemic strategy with a next-generation alert level system (Kvalsvig, Wilson et al., 2021) that is not focused on a single infection, although it should reflect the importance of Covid infection as a public health threat. Instead this system should be flexible enough to provide protection against a range of pathogens, including currently unknown emerging infectious diseases. It should be designed as legacy infrastructure, incorporating measures that will have a lasting impact on population health, such as optimising air quality. As previously mentioned, disruptive measures such as lockdowns that reduce contact between people should be reserved for situations where the threat to population health is high. At all other times, measures that allow contact while preventing transmission should be built into everyday life as enduring protection against endemic, epidemic and pandemic infections.

Elements focused on respiratory infectious diseases

A specific respiratory infectious disease control plan

Many control measures have the potential to provide effective protection against a range of seasonal respiratory infections: for example, masks and indoor ventilation; high influenza vaccination uptake; and a culture of staying at home when unwell

that is supported by paid sick leave so that all workers can stay at home when they or their whānau might be infectious. But a coherent policy for winter infections will need to include systematic organisation at structural levels to ensure that prioritisation, policy design and implementation are effective and equitable.

Designing policy for transformative change requires innovative and ambitious policy goals. In future we will know that this approach has been successful if there is epidemiological evidence that 2020 was a watershed year, when the longstanding trend of rising infectious diseases incidence and inequities was finally and permanently reversed.

Policy implementation needs to be similarly ambitious and to avoid business-as-usual approaches. Innovative policy should include the following measures.

Measures to improve indoor air quality

It is now clear that airborne transmission (inhalation of aerosolised particles) is the major route of infection with Covid-19 (Greenhalgh et al., 2021) and this evidence is generating reassessment of the potential to prevent many other infectious diseases by improving ventilation of indoor spaces. Importantly, this protection provides highly effective protection from infections where no vaccine is available, or when population immunity is suboptimal – for example, if Covid-19 variants demonstrate vaccine escape.

Worldwide and in Aotearoa there are increasing calls for a profound change in indoor air quality as an enduring action to improve public health (Kvalsvig, Bennett et al., 2021). This change would be similar to the massive effort to build waste water infrastructure in London during the 19th century that achieved a significant and permanent reduction in the risk of outbreaks of enteric diseases such as cholera.

An Aotearoa New Zealand face mask strategy

Mask wearing is a highly effective prevention measure for respiratory infections (including Covid-19) (Howard et al., 2021). Policy support from governments combined with cultural acceptance of face masks led to a high uptake of mask wearing in Asian

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jurisdictions from very early in the pandemic (Summers et al., 2020; Cowling et al., 2020), followed by adoption of mass masking in regions across the world that did not have a previous history of using masks for respiratory infections. New Zealand has been something of an outlier in this respect, providing delayed and often equivocal recommendations about mask wearing in public. New Zealand has not benefited as much as it could from mask wearing as protection against Covid-19 and a range of respiratory pathogens.

A face mask strategy is now needed to establish and normalise mask wearing during the winter months and at other times when community transmission risk is high. Policy settings for effective population mask use include development and dissemination of clear guidelines,

direct provision of masks to ensure equitable access, communication support as mentioned above, and evidence-informed quality standards for masks used in public to complement existing standards for medical masking (Rimar et al., 2021; Kvalsvig, Wilson et al., 2020). Mask mandates have a high impact on population uptake and can act as a 'behavioural anchor' to support adherence to other public health and social measures (Karaivanos et al., 2021). As with vaccine uptake, there is evidence that people are more likely to wear a mask when provided with information about how this behaviour protects others, compared with information about protecting themselves (Bokemper, 2021).

Vaccination for enhanced protection from winter respiratory infections

Vaccines are available for two major respiratory pathogens, influenza and Covid-19; vaccines for a third major infection, RSV, are currently in development. In future, New Zealanders could be offered a combined vaccine against a range of winter respiratory infections. Because respiratory infection risk is highest in the youngest and oldest age bands, a whānau-centred approach to vaccination has much to offer. For example, routine vaccination of children against influenza in the United Kingdom has proven to be a highly effective public health strategy because children readily acquire and transmit this infection, including to older members of the family or household (Paules and Subbarao, 2017; Kassianos et al., 2020). This approach needs urgent consideration in Aotearoa New Zealand, given the high and inequitable burden of influenza in this country.

Conclusions

Until recently, policymakers and the public have appeared to accept the heavy winter burden of infectious diseases and the structural mechanisms of health inequities as being too difficult and impractical to address. New Zealand's pandemic experience has also shown that control measures to reduce transmission of Covid-19 infection have been effective against a range of infectious diseases that impose a high mortality, morbidity

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and equity burden on population health. The forced experiment of the pandemic response in New Zealand indicates a need to change our thinking about the preventability of much of this burden.

Population health and wellbeing gains from an active approach to harm minimisation extend beyond avoiding acute illness and mortality to include prevention of a range of post-infectious consequences, support for health services, and reduction of indirect effects such as time lost from education and work. This approach would have a substantial and

positive impact on health inequities, with particular benefit for Maori and Pasifika populations.

Although a full lockdown is a high-impact outbreak control strategy that should be reserved for severe public health threats, our proposed approach is to integrate other elements of the Covid-19 response into everyday life to prevent transmission while enabling everyday life to continue. For example, a concerted effort to optimise indoor air quality could have a transformative effect on population health and wellbeing similar to the effect

of provision of clean water in European cities during the 19th century.

Aotearoa needs an integrated approach to outbreak control that can protect the population from multiple infectious diseases. This need is now urgent because of the challenges presented by the changing infectious disease landscape we are likely to see during winter 2022. This integrated approach and the long-term benefits it will deliver for our populations should be a long-term legacy of the Covid-19 pandemic.

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