Protecting school communities from COVID-19 and other infectious disease outbreaks: the urgent need for healthy schools in Aotearoa New Zealand

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Aotearoa New Zealand's Omicron outbreaks demonstrated that widespread COVID-19 transmission in schools is harmful to both health and education. School should be one of the safest places a child can be. Instead, the events of 2022 showed that New Zealand schools continue to be high-risk settings for infectious disease transmission. High COVID-19 infection rates in school teachers indicate that their occupational safety has been significantly compromised by the lack of protections in schools. This unacceptable situation is preventable in the future, but it requires reorientation away from the current "business-as-usual" approach to a science-led and whānau-centred community response.

In this editorial we review evidence and on-the-ground experience that emerged during 2022, and propose a set of goals and actions to protect students, staff and whānau from the inequitable impacts of COVID-19 and other infectious diseases. As well as protecting health and learning during outbreaks and the winter months, cohesive and effective infection control practices embedded within school communities can avoid a situation where schools act as early amplifiers of a new, severe pandemic disease.

The adverse impacts of COVID-related education policies and guidelines in 2022

In January 2022, Aotearoa New Zealand prepared for the imminent onset of its first Omicron variant outbreak, which meant widespread population exposure to SARS-CoV-2 infection (the virus that causes COVID-19) for the first time. The Government announced that the priority for children was in-person learning.[1] However, schools were unprepared to mitigate the spread of this highly infectious pathogen: New Zealand children were at best partially vaccinated, and key indoor air quality equipment had not been delivered.[2] As the outbreak progressed, further removal of infection control measures, particularly contact tracing, meant that schools were unable to track the progress of local outbreaks and were not resourced to protect their communities.

This approach was strongly criticised by health and disability experts. In April 2022, with high COVID-19 infection rates occurring throughout New Zealand, the Human Rights Commission published an inquiry report stating that the Government response to the spread of Omicron had put the wellbeing of disabled people at risk, and highlighting the lack of support in education settings.[3] The Inquiry's recommendations included a call to ensure access to distance-learning technology if disabled students chose to self-isolate to protect themselves and their whānau from the risks of COVID-19. The Disability Rights Commissioner also called for the Government to protect disabled learners and whānau during high transmission periods by reinstating mandatory mask wearing in schools and providing high-quality masks to students, with exemptions for those unable to wear masks.[4]

These recommendations were not implemented and policies at New Zealand schools continued to emphasise in-person learning; when families opted to keep children at home these absences were recorded as "unjustified". When colder weather arrived and schools in colder areas raised concerns about keeping windows open to ventilate, inconsistent approaches to masking and uneven provision of carbon dioxide (CO_2) monitors and air filters meant that few strategies were available to prevent infection transmission

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in school settings, particularly in schools that had less access to resources.[5,6] Predictably, schools experienced high COVID-19 case numbers.

Although few New Zealand children had experienced COVID-19 at the start of 2022, during the 5 months from February to June 2022 official figures showed that there were 218,206 reported COVID-19 cases in 10–19-year-olds: around one third of the total age group. The more rigorous WellKiwis cohort data showed that 46.4% of 5–19-year-olds tested positive between February and June 2022, and this figure rose to 66.3% by the end of September.[7] Long COVID prevalence was not measured. Consistent with international studies showing that education is a high-risk occupation in the pandemic,[8] data provided to the Government on 27 July 2022 showed that New Zealand school teachers and child carers occupied, respectively, the first and second highest positions in rankings of COVID-19 rates by occupation. By that time, an estimated four in 10 school teachers had tested positive.[9] These results were not made public at the time.

Paradoxically, the policy emphasis on face-to-face learning meant that a number of schools were unable to continue teaching through outbreaks because of high levels of illness among students and staff. A September Cabinet paper stated that "*The impacts of COVID-19 on the education system are significant and ongoing*".[10] Despite the best efforts of educators to mitigate these impacts,[11] at the end of 2022, students entered NCEA exams with fewer credits than in the previous two pandemic years. This reduction in educational attainment has the potential to generate a substantial lifecourse disadvantage for the pandemic generation.

Preventing infectious disease transmission in schools

We are now in the fourth year of the pandemic and it is well established that COVID-19 infection is transmitted within school settings and spreads from schools into homes,[12–16] causing widespread impacts in school communities as experienced in New Zealand during 2022. This evidence aligns with pre-pandemic knowledge about other infections where school transmission contributes substantially to disease incidence, including influenza,[17–19] respiratory syncytial virus (RSV)[20] and measles.[21] By July 2022, internal New Zealand agency advice to the Government had acknowledged the link between school term dates and COVID-19 cases.[9]

In common with pre-pandemic childhood infections, COVID-19 case levels in schools do not simply "reflect" community transmission: in-school transmission helps to drive outbreaks. Studies in the US have consistently shown lower case numbers in schools when mask policies are in place.[22–24] In one such study that conducted paired measurements of community and school case rates, COVID-19 rates in staff and students were initially higher than in their local community, but following the introduction of a mask requirement the case rates in schools decreased to become lower than community case rates.[23] This finding illustrates the important role that schools can play in slowing the spread of community outbreaks, particularly now that the effectiveness of good indoor air quality is well understood.[25]

It is essential that school policy is based on robust risk assessment and risk management, taking into account cultural, economic and environmental factors that are relevant to each region and school. The New Zealand Government's school policy during 2022 leaned heavily on a single January 2022 report that stated that schools were not a major driver of COVID-19 transmission when other settings were open and that persisting symptoms in children resolved by 8 to 12 weeks.[26] Unfortunately, some more cautious messages in the body of the report were diluted in accompanying media statements, which reassured the public that COVID-19 was mild in children. These statements did not mention long COVID and other potential longer-term effects of this infection; the health and financial impacts that occur when COVID-19 is brought into a household from the school community; or the occupational risk to school staff.[27] This over-optimistic risk assessment impeded the efforts of health and disability advocates to reduce transmission in schools.

Why school transmission matters: COVID-19 health impacts in children

There is now abundant evidence of short- and longer-term health impacts of COVID-19, indicating the potential for significant population health impacts when children and those closest to them are widely infected and reinfected.

We focus here on health impacts for children, but as noted above, teachers have a high occupational risk of COVID-19 infection and data from the UK show that they also have an elevated risk of developing long COVID.[8] The effect of school transmission

Table 1: Health impacts in children following COVID-19 infection: current state of evidence.

Serious and fatal outcomes
COVID-19 infection has lower hospitalisation and mortality rates in children compared with adults, but when virtually all children are exposed, the population impact on children becomes substantial. US figures show that COVID-19 is now the leading infectious and respiratory cause of death in school-aged children, ahead of many other diseases where vaccines are routinely used.[28]
Development of new health conditions following infection
An estimated 65 million people have long COVID,[30] including children. Research is currently underway in New Zealand to investigate long COVID in children following the Omicron outbreaks of 2022. The underlying mechanisms of long COVID are now better understood, although there is much work to be done.[31] Examples of documented health concerns in children include: Multiple impacts on the brain in childhood ranging from common to rare, including fatigue, cognitive deficits, stroke and new psychiatric conditions[32] with hypometabolism of key areas of the brain seen on functional imaging;[33] Increased risk of cardiorespiratory symptoms and disease, again ranging from common (breathlessness) to rare (cardiac thrombosis); for myocarditis, vaccines show a protective effect relative to disease;[34–36] New-onset diabetes;[37,38] and A large number of other effects; see this major 2023 review[30] and other studies.[39,40]
Evidence of sub-clinical or latent organ damage
Children generally have good functional reserve and may tolerate organ damage with no or minimal symptoms. However, some types of tissue damage during childhood raise concerns about health impacts in later life.[42,43] Clinical research continues to identify biomarkers of tissue damage, including in well children who had mild COVID-19 infection. Child-specific examples include: Studies using specialised lung function tests show persisting abnormalities in lung function after recovery from the initial COVID-19 illness;[43,44] Coagulation biomarker studies show abnormal clotting profiles;[45] Persisting changes in cardiac function were observed in 60% of a cohort of previously healthy children who had had a mild or asymptomatic episode of COVID-19 infection; average follow-up time was 148 ± 68 days;[46] and Viral persistence in tissues is well established in adults, and is now demonstrated in children.[47]
Immune dysregulation
Alterations in immune function following COVID-19 infection are well established and raise the risk of COVID-19 re-infection, susceptibility to other infections and other health impacts. Examples include: Longitudinal studies of immune responses show rapid clearance of SARS-CoV-2 virus in children and a lack of robust memory T-cell responses relative to adults; this pattern of response could explain children's relatively less severe symptoms in the early phase, but it may compromise their ability to resist reinfection;[48] Longer-term (8 months post-infection) immune dysregulation in adults[49] with corresponding child results awaited (but see results below); COVID-19 causes immune cells to switch their gene expression profile from immune to pro-thrombotic (clotting) signatures,[50] consistent with increased risk of thrombosis in children;[51] Impaired gut and respiratory microbiomes have been observed following COVID-19 infection,[52] as another potential mechanism for ongoing health issues; Of particular relevance to New Zealand (where Group A Streptococcus [GAS] infections and rheumatic fever rates are high and inequitable) is evidence that GAS coinfection can contribute to COVID-19 severity;[53] and Additionally, COVID-19 infection is associated with increased risk of GAS infection from 4 to 8 months later.[54]

on the health of household members is unmeasured in New Zealand's COVID-19 data but community providers are seeing substantial impacts such as reduced work hours for parents needing to stay home and care for tamariki. Māori and Pasifika are more likely to be living in large multi-generational households, with potentially serious impacts when COVID-19 is introduced to the home environment. COVID-19 appears to be similar to a number of other infections, such as RSV, that are introduced into households by school-aged children and can cause serious illness in the youngest and oldest household members.[20,28]

We have previously reviewed the evidence about longer-term impacts of COVID-19 infection in children.[29] Table 1 lists some illustrative examples from the current evidence. The list is not exhaustive as this is now a very large scientific literature.

Next steps for better protection in New Zealand kura/schools: goals and implementation

The COVID-19 pandemic has caused significant loss of education time in New Zealand and beyond,[24] highlighting the importance of protecting health to protect learning.

The duty of care to children and communities

The Crown has a Treaty duty to adopt rational, scientific, equitable policy choices for Māori that sustain Māori wellbeing.[55] Māori have already asked in several ways to be a part of the decision-making around planning and implementing COVID-19 measures and have alerted the Government when it has fallen short.[56] Māori voices need to be safely heard (with respect to anti-racism), followed by actions so that schools are supported to offer healthy spaces for learning. Healthy schools also protect the whānau at home and the wider hapori/community; kura/schools increasingly serve as a focus within communities for meetings and group events, and remain a hub for whānau seeking primary healthcare assistance, including access to pandemic response information and resources.

Instead of devolving key strategic decisions for individual schools with varying access to information and resources, the safety of children in schools should be universal and rights-based, ensuring protection under the Convention (UNCRC) and the Declaration on the Rights of Indigenous peoples (UNDRIP). These international frameworks complement and support upholding the intended constitution of Te Tiriti o Waitangi and the obligations of the articles, providing the active protection of tino rangatiratanga, kotahitanga, ōritetanga and mana.

Ministry of Health Te Tiriti o Waitangi goals include: mana Māori = enabling Māori customary rituals framed in Te Ao Māori, encapsulated within mātauranga Māori and enacted through tikanga Māori; mana tangata = achieving equity in health and disability outcomes for Māori across the lifecourse and contributing to Māori wellness; and mana motuhake = enabling the right for Māori to be Māori and to exercise self-determination over their lives and to live on Māori terms according to Māori philosophies, values and practices including tikanga Māori.

The need for a cohesive public health approach

There is both a need and an opportunity for New Zealand to implement a cohesive approach to protections against COVID-19 and other infections, building on the many synergies in this area.[57] For example, good indoor air quality enables concentration and therefore productive learning as well as protecting against COVID-19 infection and a large array of other respiratory infections.

Similarly, a well-resourced and accessible system for online or hybrid learning may be needed during a large COVID-19 outbreak or during extreme weather events such as the recent North Island flooding. Such a system should also include funding for outreach services to support ongoing access and engagement. Low childhood vaccination levels and the current high probability of a measles outbreak additionally indicate the need for a robust online learning system to support previously unvaccinated contacts during an active measles outbreak, when they may be requested to quarantine from 7 days after first exposure until 14 days after their last exposure.[58]

These protections should be embedded within the school system and within New Zealand's next pandemic plan as they may be needed each year during the winter respiratory season or at short notice during a public health emergency.

The need for a practical, science-informed action plan

In New Zealand and elsewhere, highly effective public health and social measures are under-utilised through lack of implementation and evaluation. In the fourth year of the COVID-19 pandemic, this evidence gap has been declared a "pandemic tragedy".[59] The Bulletin of the World Health Organization (WHO) has called for studies to support better implementation of these important protections.[60]

New Zealand is well positioned to contribute to this evidence base by embedding and evaluating best practice models in schools. In the housing sphere, New Zealand researchers have delivered world-leading community trials of healthy housing interventions that provide actionable evidence for policy, including showing that healthy homes help to reduce days off school.[61] Similar principles and approaches can be used to optimise the safety of school communities and protect access to education.

Table 3 (Appendix) lists key goals for infection control and proposes an array of school-based initiatives aimed at protecting staff, students and whānau from the impacts of COVID-19 and other infectious diseases.

Conclusions

Aotearoa New Zealand's policy of "business-as-usual" school-based infection control resulted in serious and inequitable impacts on health and education during 2022. There is an urgent need for New Zealand to reorient its school policy to protect students, staff and whānau in the current era of ongoing new COVID-19 variants. Already in 2023 a school was forced to close shortly after the start of Term 1 because a high proportion of students and staff had COVID-19.[62]

School should be one of the safest places a child can be. Instead, the events of 2022 highlighted that New Zealand schools continue to be high-risk settings for infectious disease transmission. Extremely high infection rates in school staff indicate that their occupational safety has been significantly compromised by the lack of protections in schools.

Even at the milder end of the long COVID spectrum, illness lasting 3 months or more is not trivial in view of the impact it can have on children's social wellbeing and education, or on the ability of teachers and whānau to continue working. Rarer but more serious COVID-19 outcomes can be life changing and life limiting. These impacts are particularly concerning because the ongoing emergence of new variants means that immunity to SARS-CoV-2 is relatively short lived: two or three COVID-19 outbreaks per year, as in 2022, allow very little recovery time from fatigue, immune dysregulation or loss of teaching and learning days.

We have previously proposed an Action Plan for New Zealand schools.[63] In 2023 New Zealand needs to set clear goals and implement them to protect health and education in the current volatile infectious disease environment. Other pathogens including GAS are showing unpredictable patterns of spread in children and there is a high risk of measles and other outbreaks. Widespread infectious disease transmission in

Table 2: Proposed goals for a science-led and whānau-centred approach to infection control in schools (including COVID-19 and other infections).

Proposed goals for a science-led and whānau-centred approach to infection control in schools
1. Air quality in classrooms is excellent at all times; 2. Children, young people and staff are not in school while they are infectious; 3. Additional protection via masks is rapidly available during outbreaks (e.g., periods of high COVID-19 transmission and/or seasonal respiratory infection and/or an emerging influenza pandemic); 4. Schools are resourced to provide high-quality teaching and learning and other support online or in a hybrid model during infectious disease outbreaks; 5. School-based health outcomes and progress on curriculum aspirations are equitable, rights-based and uphold Te Tiriti o Waitangi; 6. School communities are well-informed and are actively participating in programmes to improve health and wellbeing; and 7. There is a high level of situational awareness throughout the school system supported with high-quality surveillance of health and the coverage of key interventions.

schools has the potential to worsen existing high inequities in infectious diseases[64] that have pervasive impacts on low-income families. Cumulatively, if not addressed, the impacts experienced in 2022 and beyond may contribute to a measurable future deterioration in the health of New Zealanders and the sustainability of the education sector. The experience with Omicron variant outbreaks also indicates a concerning gap in New Zealand's pandemic preparedness.[65] Without cohesive and effective infection control practices embedded within school communities, there is a risk that schools may act as early amplifiers of a new, severe pandemic disease.

New Zealand's approach to infection control in schools should be reorientated to be science led and whānau centred, based on a set of clearly articulated and well-understood goals (Table 2). The emphasis should be on supporting whānau-centred agency that upholds Te Tiriti articles as a means of delivering equity. These activities can be seen as placing a korowai/cloak of protection around school environments and communities.

COMPETING INTERESTS
Nil.

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Appendix: goals and implementation.

Table 3: Goals for infection control in New Zealand schools and potential projects to support effective implementation.

Goals	Implementation	Comments
Air quality in class-rooms is excellent at all times	Roll out community trials of what works in the New Zealand setting, enabling the education system to monitor and sustain good indoor air quality while maintaining thermal comfort in different building types, seasons and climate areas. Establish policies. Other jurisdictions (e.g., France) have legislation to ensure appropriate ventilation standards in schools;[66] New Zealand could liaise with policy and implementation counterparts to adapt for the New Zealand context. Carry out an evaluation targeting insights into barriers and enablers for schools and teachers implementing policies and guidelines for air quality (and other mitigations including infection control and masking) effectively, consistently and equitably. Develop a public health-led tailored education package for schools around ventilation and how it works, aimed at a wide audience including whānau, students and providers who go into schools (e.g., public health nurses, community organisations, Hauora Māori providers) so that they can also become advocates. Develop a plan that includes short- to medium-term measures (e.g., portable air filtration units) that transition over time to a sustainable future of longer-term, structural changes to deliver a high standard of indoor air quality.	Optimising ventilation was shown to achieve a substantial reduction in COVID-19 cases in school settings in Italy.[67] Portable air filtration units are shown to reduce airborne SARS-CoV-2 virus.[68] A high standard of air quality protects against a large number of infectious diseases and air pollution, enables cognitive function and better learning, and reduces allergy symptoms.[69] Several research projects are currently in progress in New Zealand. School and system conditions can mean that well-intentioned practitioners cannot realise the health and inclusive curriculum goals they aspire to and the barriers to implementation are not well understood.
Children, young people and staff are not in school while they are infectious	Identify effective and acceptable protocols for schools, such as test-to-return (identifying when they are no longer infectious after isolation), test-to-stay (identifying whether close contacts of a case are infectious), and/or routine testing (to identify persons who are infectious but have no symptoms). Develop a risk-assessment system and identify specific supports that may be needed to achieve this goal, especially for children whose wellbeing is compromised when they are not in school. These assessments and support would overlap strongly with initiatives to protect children's wellbeing during the summer break (which is a much longer time away from school than any infectious disease quarantine period). Conduct trials of rapid point-of-care tests that can detect an array of other respiratory viruses as well as SARS-CoV-2.	Modelling of test-to-return options by Covid Modelling Aotearoa shows that current advice not to test is likely resulting in a high number of people with COVID-19 returning to public settings while still infectious.[70] Siblings need to be included in outbreak control planning to prevent seeding of infections into other school years and other schools. For this goal to work, negative impacts of absence must be addressed, e.g., with absence of sanctions and provision of financial and other support to students and teachers.

Goals	Implementation	Comments
Additional protection via masking is rapidly available during serious outbreaks (e.g., periods of high COVID-19 transmission and/or seasonal respiratory infection and/or an emerging influenza pandemic)	Conduct a trial and survey of high-quality child-sized respirator masks in school settings to identify enablers and barriers to mask use and test mitigation strategies, along the lines of the randomised clinical trial by Science et al.[71] Conduct a qualitative study to develop best practice guidelines for enabling access to communication when staff and students are masked, including technological and behavioural strategies (e.g., microphones and amplifiers), slower speech patterns, reduced background noise, clear face masks, written or electronic text (including live captions) and non-verbal communication (e.g., using gestures or hand signals).	The WHO advises mask-wearing for children over the age of 5 years, emphasising that "*the best interest, health and well-being of the child should be prioritized*".[72] A 2019 randomised clinical trial of a paediatric N95 mask in children aged 7–14 that measured safety, fit and comfort reported that the mask was "*well fitting, comfortable and safe for use in children at rest and on mild exertion*".[73] The trial of mask-wearing by Science et al. reported that masks were well accepted by the children, and that there was less hand-to-face contact among the children wearing masks, compared with the control goup of children not wearing masks.[71]
Schools are resourced to provide high-quality teaching, learning and other support online or in a hybrid model during infectious disease outbreaks	Conduct trials, particularly in schools in low-income areas, to identify effective and equitable strategies for resourcing online or hybrid education during a major outbreak or other public health emergency. Leverage educational networks and develop case studies that support improved quality of online learning delivery in support of goals for learners' inclusion, health and educational progress, and the wellbeing of learners and teachers. Develop a policy design project using collaboration between educators and infectious disease modellers to develop a decision framework about when it is appropriate to move to online or hybrid learning as a circuit-breaker during active outbreaks.	There is a digital divide: national infrastructure for internet access is inadequate and not every learner has access to an appropriate device for learning. Waiting until schools are compelled to close because of high levels of sickness is disruptive to both education and population health. A move to online or hybrid learning should be a planned action with a smooth transition and resources in place to protect health and learning.
School-based health outcomes and progress on curriculum aspirations are equitable, rights-based and uphold Te Tiriti o Waitangi	Identify the impact of long COVID, fatigue and pre-existing/new health conditions on school attendance and learning; communicate solutions that are proposed by students and their families. Ensure that there is formal monitoring and reporting of inequities in the school system (see below). Enable iwi and hapū interventions: for example, Ngāti Toa has welcomed a settlement with the Ministry of Education that will see it buy the land of 40 public schools in the Wellington region, negotiated under the Ngāti Toa Rangatira Claims Settlement Act 2014. Their active role in the community pandemic response along with other iwi, including supporting other mātāwaka iwi responding to the COVID-19 pandemic in the region, has further demonstrated pro-equity solutions that all iwi exhibited within their regions, that afforded and augmented opportunities to improve Crown and Māori relationship.	Impacts of the COVID-19 pandemic have been highly inequitable.[56,74] As part of Crown and Māori relationships to support obligations of Te Tiriti o Waitangi articles, Te Puni Kōkiri developed the COVID-19 Whānau Recovery Fund and is continuing to support hapū, iwi, Hauora Māori providers and organisations to facilitate a Māori-led response and recovery from COVID-19.

Goals	Implementation	Comments
School communities are well informed and are actively participating in programmes to improve health and wellbeing	Use a Citizen Science approach – develop projects with active participation by children and staff, including teaching and non-teaching staff and families. Develop a network of Kaupapa Māori research and researchers in school communities, especially Kura Kaupapa Māori, where tamariki and whānau can take on researcher roles, so that lived experience defines and leads outcomes. Develop systems for school leaders, including school boards, to access and respond to relevant data for decision making. Provide guidance and capability building for school leaders to strengthen their leadership capabilities for dealing with challenges associated with establishing and sustaining initiatives targeting these health goals. Develop and deliver learning resources for staff, students and whānau about infection control and healthy schools.	Previous campaigns about handwashing and sun safety have carried health promotion messaging beyond school settings and into communities. Initiatives developed or put in place can be embedded as contexts for young people learning the knowledge, understandings, skills, values and capabilities set out in the curriculum.
There is a high level of situational awareness throughout the school system	Establish schools as sentinel surveillance sites for monitoring incidence of infectious diseases, particularly COVID-19, respiratory syncytial virus (RSV), influenza and Group A streptococcal infection (GAS). Direct all schools to collect a set of key reporting requirements, with a subset of schools providing intensified surveillance for a range of infectious diseases, combined with collection of other in-depth measurements. Develop a system to measure and report a range of key health and learning indicators, e.g., the prevalence and impact of long COVID, inequities in health and education, days lost to education through infectious diseases and many more, where possible, linking this information into national data collections. Link school data to existing population cohorts, e.g., Growing Up in New Zealand and WellKiwis, for better understanding of household-level factors. Develop a surveillance hub to manage the surveillance and reporting functions in collaboration with other key agencies, or contract one of them to do it. Develop communication systems to ensure that school communities are always well informed about infectious disease outbreaks and are empowered to take preventive action.	A high standard of information is required for multiple purposes, including: Rapid awareness and response to community outbreaks and/or emergence of a new pandemic disease. Developing evidence-informed policy relating to schools. Evaluating the success of trials and programmes.