PUBLIC HEALTH COMMUNICATION CENTRE AOTEAROA

# Improving ventilation in schools: a key protection against Covid-19 outbreaks and an enduring legacy for healthier learning

9 September 2021

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**As much of the country moves down Alert Levels, children are returning to in-person learning with little or no protection against the potential spread of Covid-19 infection in schools. It is therefore critical that ventilation is improved in schools; it is often as easy as opening windows, but ultimately new standards and improved resourcing are required. Ventilation is a valuable protection that**

**works well in combination with other pandemic control measures such as vaccination and mask use, with additional benefits for improving children's learning and concentration.**

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The Covid-19 pandemic continues to evolve, with an increasing focus on the impact it is having on child health and wellbeing. Countries across the world are reporting Covid-19 outbreaks with high proportions of child cases,[1 2] leading to large numbers of child hospitalisations, including ICU admissions,[3] and severe capacity issues in paediatric services.[4] There are also growing concerns about long-term effects of Covid-19 illness on children, including impacts on the developing brain.[5 6]

The significant increase in child cases worldwide, compared with earlier in the pandemic, is probably the result of several factors. These include the higher infectiousness and severity of new variants (notably the Delta variant);[7] the higher proportion of children still unvaccinated compared with adults; government policies mandating a return to in-person learning in several countries with high community transmission; and greater numbers of children being tested for Covid-19 compared with earlier outbreaks.

It now appears to be the turn of Aotearoa New Zealand's young people to bear the brunt of Covid-19 outbreaks: 326/868 (38%) of the cases to date in the current Delta variant outbreak are aged 0-19 years, with 13 schools caught up in the outbreak and thousands of

secondary school students identified as close contacts.

But as cautious optimism develops about the outbreak coming under control and as children in regions outside Auckland return to school, there is still no substantive provision for prevention/reduction of Covid-19 transmission in schools at Alert Levels 1 and 2. The recent decision to approve vaccination of children aged 12-15 years is a welcome development, but it will be some months before a significant proportion of this age group is fully vaccinated, and vaccine trial data for primary-age children is still awaited. As a result, children in Aotearoa will be mixing in large numbers while still almost completely susceptible to Covid-19 infection.

## Ventilation as a key pandemic and epidemic control measure

The science on airborne transmission of the Covid-19 pandemic virus is now largely settled, as evidenced in a recent major review. The virus can remain suspended in the air for long periods before being inhaled into the airways, triggering new infections. This is why super-spreading events typically occur in settings where people are crowded into indoor spaces with poor ventilation. Viral spread is enhanced when people spend a long time in such spaces, and especially when they are speaking, singing, or exercising enough to be breathing hard. All of these conditions are present in school settings in New Zealand.

We recently considered the practical implications of airborne transmission and its prevention via improved ventilation in the home (for those self-isolating), in managed isolation and quarantine (MIQ) facilities, and in workplaces. Effective Covid-19 outbreak control and prevention of future outbreaks requires a similar approach in schools. Indeed, many common respiratory infections are spread in school settings and brought back into the home, including respiratory syncytial virus (RSV) infection that returned to New Zealand during 2021 after being almost eliminated by the Covid-19 response in 2020.

There is some preliminary evidence that improving ventilation through dilution (i.e., opening windows and doors) may be associated with a similar-sized reduction in Covid-19 incidence in schools as masking within schools,[8 9] but the greatest reductions in Covid-19 incidence are seen when mitigation measures are combined. The approach of layering up mitigations to reduce transmission in schools is recommended by major health agencies such as the ECDC and CDC.[10 11] Ventilation plays an important role here and has the advantage that many changes can be implemented immediately, although flexibility will be required initially while indoor environments in New Zealand schools are brought up to acceptable standards.

## Ventilation in New Zealand schools

New Zealand’s cold, damp, indoor environments were a major public health concern long before this pandemic. Much of the public health focus on indoor environments for children has been on homes, where children spend the largest proportion of their time. But for school-aged children the second-largest proportion of their time is spent in educational settings where poor-quality indoor environments can have a substantial adverse impact on their health and learning.[12 13]

Ventilation rates in New Zealand schools are inadequate, with a typical Wellington primary school classroom only meeting the building code ventilation standard 38% of the school day – an average ventilation rate of 6.6 litres per second (compared to an acceptable air quality guideline of 8 litres per second).[14] An Auckland based study reported three out of six

classrooms had very poor ventilation, with carbon dioxide ($CO_2$) levels above 1000 parts per million for 50% of the school day.[15]

In 2017 the Ministry of Education published detailed guidelines that identified minimum performance requirements for indoor air quality and thermal comfort in schools. However, these guidelines were prospective (only applying to new buildings and upgrades) rather than retrospective (aiming to improve the indoor environment in all schools).

## Indoor air quality in schools: immediate action and pandemic legacy

Some ventilation improvements will require structural alterations to school buildings and these measures will take time to implement. But there are plenty of strategies that schools can use right away, especially as the Southern Hemisphere spring advances.

**To do immediately:**

- Increase natural ventilation: bring as much outdoor air in as possible by opening windows to get across-room air-flow, and turn heaters on if needed to maintain comfort.
- Use child-safe fans to increase effectiveness of open windows by safely securing fans to blow potentially contaminated air out and pull in outdoor air.
- Move activities, classes, and breaks outdoors when circumstances allow.
- Use $CO_2$ monitors in classrooms to indicate when to take action e.g., opening windows, or briefly vacating the classroom to air it. The use of these monitors in classrooms could potentially be built into science lessons for appropriately aged children. As an example, the UK Government has pledged provision of 300,000 $CO_2$ monitors to improve ventilation in schools.[16]
- Use portable air cleaners (high-efficiency particulate air [HEPA] filtration units) for settings were natural ventilation isn't feasible and in high-risk areas such as sick bays.
- Prioritise all the above for schools in Auckland, and then other cities at increased risk of Covid-19 outbreaks (i.e., those with international airports, seaports and MIQ facilities).
- Consider appropriate measures for other school-related settings where ventilation is important for children, e.g., extracurricular activities and school buses.
- Communicate key messages about ventilation and Covid-19 to children in an age-appropriate way. Leadership from the Ministry of Education would include the creation of practical guidance and resources for teachers to minimise their already high burden of responsibility for multiple facets of children's wellbeing.

**To do over the next six months:**

- Revise the 2017 indoor air guidelines for schools with updated information about preventing airborne transmission of infection.
- Implement universal standards for indoor air quality in all New Zealand classrooms (both for existing and new builds; and with a system for surveillance that these standards are being met).
- Provide resourcing and support for schools to upgrade air quality. Such support should include a fuel supplement for increased heating to ensure thermal comfort in classrooms where windows are regularly opened.

## Integrating ventilation with other pandemic control measures

One unifying framework for infection prevention and control (IPC) is the hierarchy of controls. After elimination, the next priorities are engineering and administrative controls to improve ventilation and separate infected people, followed by use of personal protective equipment (PPE). These strategies are most effective when combined to prevent and control the Covid-19 pandemic virus and other respiratory pathogens. In schools such measures include mask-wearing, cohorting, sick leave entitlements for staff and parents, staying home when unwell, and vaccinating staff and eligible students.

Applying multiple control measures allows for variations in feasibility of individual measures across the school environment. For example, some school children may not be able to wear masks due to health or developmental reasons. Improving classroom ventilation is protective for these children, as well as for other children and staff.

## Conclusions

The ideal time to optimise ventilation in schools would have been during 2018 and 2019 following the publication of detailed guidelines by the Ministry of Education; however, the next best time is now. There is pressure to ‘reconnect’ New Zealand with the rest of the world and loosening border protections during 2022 may greatly increase the risk of new Covid-19 outbreaks.

The current lack of control measures to prevent transmission of Covid-19 in school settings increases the risk that future outbreaks will continue to generate large numbers of child cases and children in quarantine and unable to attend school, as in the current Auckland outbreak. The risk is particularly high while most of New Zealand’s children are unvaccinated.

Optimising ventilation in schools has multiple co-benefits aside from Covid-19 prevention, including prevention of other respiratory infections that circulate in schools and improving children’s learning and concentration. Better air quality in schools should be a lasting legacy of the pandemic and may have a vital role in keeping children safe during future pandemics and outbreaks.

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Public Health Expert Briefing (ISSN 2816-1203)

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