



Respiratory support for children during the COVID-19 emergency

COVID-19 update 13 May 2020

Who should read this?

Healthcare workers, managers and hospital administration who are providing respiratory support and therapies to children during the COVID-19 pandemic.

Information about protecting yourself against COVID-19

During the COVID-19 pandemic, the Victorian Department of Health and Human Services will regularly update its guidance as new evidence becomes available. To find out general information about COVID-19, visit dhhs.vic.gov.au/health-services-and-general-practitioners-coronavirus-disease-covid-19

What is this document about?

Paediatric epidemiology and clinical presentation during the COVID-19 pandemic are significantly different to what is seen in the adult patient population^{1,2}.

This document outlines advice on using respiratory support therapies and interventions in children with suspected or confirmed SARS-CoV-2. This document **does not** replace evidence-based guidelines which are available for specific paediatric respiratory illnesses including coronavirus disease.

Please ensure respiratory support therapies remain available to children during the pandemic to ensure continued good health outcomes.

What are the key principles for respiratory support in children?

Current epidemiological data in Australia as well as overseas indicate that children requiring respiratory support during the COVID-19 pandemic fall into four categories:

1. Non-COVID disease
2. Non-COVID illness with SARS-CoV-2 co-infection
3. COVID-19 disease
4. SARS-CoV-2 associated multisystem inflammatory disease (unconfirmed)

In the above context, it is imperative that:

- **children continue to receive timely and effective respiratory support.** Outcomes of children needing respiratory support are excellent overall. This must not be compromised by undue changes in practice or restrictions on resources
- **you take appropriate measures** to manage the risk to staff, patients and carers presented by SARS-CoV-2
- **you prioritise COVID-19 testing for patients requiring respiratory support** in order to allow timely downgrading and appropriate use of personal protective equipment (PPE).

What does this mean in practice?

In practice, **all levels of respiratory support, including high-flow oxygen, high-flow nasal prong therapy and non-invasive ventilation (NIV), remain indicated.**

In addition to protecting staff through using PPE³, please identify measures to eliminate, reduction or mitigate for SARS-CoV-2 hazards where available and appropriate. Plan to implement these measures now.

We **do not** recommend early intubation in order to avoid the use of high-flow oxygen or NIV.

In order to prevent unnecessary barriers to care and use of PPE stock, only use PPE (combined airborne and contact precautions) when caring for children with suspected or confirmed SARS-CoV-2 infection (or with other diseases requiring the same level of PPE).

Recommendations for respiratory support in children suspected or confirmed to have COVID-19

Level of respiratory support	Recommendation	Considerations for children suspected or confirmed to have COVID-19
Standard oxygen therapy	<p>Provide as indicated.</p> <p>General hazard controls apply.</p> <p>Droplet and contact precautions apply.</p>	<p>Standard oxygen therapy remains the most widely available means of support in hypoxia with mild to moderate respiratory distress.⁴</p> <p>Exposure to patient exhaled air, droplets or aerosols is considered unlikely at a distance of 1.5 meters.⁵</p> <p>Hazard elimination</p> <ul style="list-style-type: none"> Prevent unnecessary use. <p>Hazard reduction</p> <ul style="list-style-type: none"> Use lowest flow necessary to achieve SpO₂ target. If available, deliver in single room with doors closed. If single room unavailable, deliver in room where air does not circulate to other areas. Place a surgical mask on the patient if tolerated and not at risk of obstructing the airway.^{6,7} <p>Staff protection</p> <p>Staff to wear appropriate PPE (droplet and contact precautions).</p>
High-flow oxygen/air therapy	<p>Provide as indicated.</p> <p>Specific hazard controls apply.</p> <p>Contact and airborne precautions apply.</p>	<p>High-flow oxygen/air therapy is considered aerosol-generating.⁸ Its ease of application makes it liable to overuse with little to no benefit in some patients.</p> <p>Hazard elimination</p> <ul style="list-style-type: none"> Prevent unnecessary use. The indication should be determined by senior medical staff and reviewed within 1-2 hours of initiation. <p>Hazard reduction</p> <ul style="list-style-type: none"> Where available, deliver in negative pressure room.⁹ If negative pressure room unavailable, deliver in single room with doors closed.⁹ If single room unavailable, deliver in room where air does not circulate to other areas if feasible.⁹ Place a surgical mask on the patient if tolerated and not at risk of obstructing the airway.¹⁰ <p>Staff protection</p> <p>Staff to wear appropriate PPE (airborne and contact precautions).</p>

Level of respiratory support	Recommendation	Considerations for children suspected or confirmed to have COVID-19
<p>CPAP and BiPAP</p>	<p>Provide as indicated. Specific hazard controls apply. Contact and airborne precautions apply.</p>	<p>CPAP and BiPAP may generate aerosols through interface (mask) leaks or exhaust vents and/or expiratory valves.</p> <p>Hazard elimination</p> <ul style="list-style-type: none"> ▪ Review the strength of the indication, e.g. consider foregoing CPAP if treatment is elective/semi-elective. ▪ Ensure Goals of Care are discussed by a senior medical staff member and agreed for patients with severe life-limiting conditions who are unlikely to gain a benefit from NIV. <p>Hazard reduction</p> <ul style="list-style-type: none"> ▪ Aim for the best-fitting interface (mask) to avoid/minimise leaks. ▪ Use dual-limb (circular flow) ventilator. Apply viral filter to expiratory limb (preferred) or exhaust vent (ventilator will require decontamination). ▪ Avoid single-limb ventilators and vented masks if possible. ▪ Where available, deliver in negative pressure room. ▪ If negative pressure room unavailable, deliver in single room with doors closed. ▪ If single room unavailable, deliver in room where air does not circulate to other areas if feasible.9 <p>NB: The use of non-vented masks is not recommended outside the PICU setting due to increased resistance and risk of suffocation.</p> <p>Staff protection Staff to wear appropriate PPE (airborne and contact precautions).</p>
<p>Mechanical ventilation</p>	<p>Provide as indicated in consultation with PIPER. Specific hazard controls apply. Contact and airborne precautions apply.</p>	<p>Aerosols are generated during intubation, extubation, ETT leaks and ventilator circuit disconnection.</p> <p>Hazard elimination</p> <ul style="list-style-type: none"> ▪ Ensure Goals of Care are discussed and agreed for patients with severe life-limiting conditions who are unlikely to gain a benefit from mechanical ventilation. ▪ Use cuffed ETT whenever possible. ▪ Secure ETT well as well as sedate and muscle-relax the child in order to avoid accidental extubation. ▪ Use in-line suction if available. ▪ Attach a viral filter to the ETT (preferred) or to expiratory limb of ventilator circuit or to exhaust vent (ventilator will require decontamination). Monitor humidification and accumulation of water. ▪ Clamp ETT for any disconnection from circuit unless viral filter remains attached to ETT. <p>Staff protection Staff to wear appropriate PPE (airborne and contact precautions).</p>

Other aerosol-generating respiratory interventions

Therapy/intervention	Recommendation	Considerations for children suspected or confirmed to have COVID-19
Nebulised adrenaline in croup	<p>Provide when strongly indicated.</p> <p>Specific hazard controls apply.</p> <p>Contact and airborne precautions apply.</p>	<p>Nebulised adrenaline remains the acute treatment of choice for severe croup. It is considered significantly aerosol-generating.¹¹</p> <p>Hazard elimination</p> <ul style="list-style-type: none"> Prevent unnecessary use. The indication should be made by or in consultation with senior medical staff if possible. Do not perform a nasal swab in children with severe croup. Defer until symptoms of airway obstruction have resolved. <p>Hazard reduction</p> <ul style="list-style-type: none"> Where available, deliver in negative pressure room. If negative pressure room unavailable, deliver in single room with doors closed. If single room unavailable, deliver in room where air does not circulate to other areas if feasible.⁹ Place a surgical mask on the patient if tolerated and not at risk of obstructing the airway. <p>Staff protection</p> <p>Staff to wear appropriate PPE (airborne and contact precautions).</p>
Nebulised bronchodilators in acute asthma	<p>Avoid.</p> <p>Hazard controls apply.</p> <p>Contact and airborne precautions apply.</p>	<p>Nebulisers are considered high-risk aerosol-generating procedures.¹¹</p> <p>Hazard elimination</p> <p>Give alternatives to nebulised bronchodilators with appropriate monitoring:</p> <ul style="list-style-type: none"> Metered-dose inhalers (MDI) IV Salbutamol IV Aminophylline <p>Hazard reduction</p> <p>If nebulised bronchodilators cannot not be avoided, apply the same measures for hazard reduction as for nebulised Adrenaline.</p> <p>Staff protection</p> <p>Staff to wear appropriate PPE (airborne and contact precautions).</p>
Nebulised saline	<p>Avoid.</p> <p>Hazard controls apply.</p> <p>Contact and airborne precautions apply.</p>	<p><i>See above.</i></p> <p>Hazard elimination</p> <p>Review the indication and forego this therapy unless essential.</p> <p>Hazard reduction</p> <p>If nebulised saline cannot not be avoided, apply the same measures for hazard reduction as for nebulised Adrenaline.</p> <p>Staff protection</p> <p>Staff to wear appropriate PPE (airborne and contact precautions).</p>

Therapy/intervention	Recommendation	Considerations for children suspected or confirmed to have COVID-19
Procedural sedation with nitrous oxide – continuous flow	<p>Provide if strongly indicated.</p> <p>Note that some alternatives may carry similar risks (e.g. general anaesthesia, parenteral sedation, no sedation). Hazard controls apply. Contact and airborne precautions apply.</p>	<p>The application of continuous flow nitrous oxide creates PEEP and may generate aerosols through interface (mask) leaks and expiratory valves.</p> <p>Hazard elimination</p> <ul style="list-style-type: none"> ▪ Prevent unnecessary use. Review the indication (discuss with seniors). ▪ Ask, ‘Is there an alternative?’ <p>Hazard reduction</p> <ul style="list-style-type: none"> ▪ Use a viral filter on the expiratory limb of the circuit. ▪ Closely monitor bag to avoid over-inflation and high PEEP. ▪ Where available, deliver in negative pressure room. ▪ If negative pressure room unavailable, deliver in single room with doors closed. ▪ If single room unavailable, deliver in room where air does not circulate to other areas if feasible.⁹ <p>Staff protection</p> <p>Staff to wear appropriate PPE (airborne and contact precautions).</p>
Procedural sedation with nitrous oxide - demand flow	<p>Provide as indicated.</p> <p>Note that some alternatives may carry similar risks (e.g. general anaesthesia, parenteral sedation, no sedation). Hazard controls apply. Contact and droplet precautions apply.</p>	<p>Considerations regarding this modality relate to cleaning, filtering, and a potential for aerosolization.¹²</p> <p>Hazard elimination</p> <ul style="list-style-type: none"> ▪ Prevent unnecessary use. Review the indication (discuss with seniors). ▪ Ask, ‘Is there an alternative?’ <p>Hazard reduction</p> <ul style="list-style-type: none"> ▪ Apply viral filter to tubing. ▪ Where available, deliver in single room with doors closed. ▪ If single room unavailable, deliver in room where air does not circulate to other areas if feasible.⁹ <p>Staff protection</p> <p>Staff to wear appropriate PPE (contact and droplet precautions)</p>
Nasopharyngeal swab	<p>1. Perform as indicated.</p> <p>Contact and droplet precautions apply.</p>	<p>1. Taking a nasopharyngeal swab is generally not considered an aerosol-generating procedure (AGP).</p>
	<p>2. Do not perform if signs of upper airway obstruction.</p>	<p>2. Do not perform a nasal swab in children with signs of upper airway obstruction (e.g. croup or suspected foreign body inhalation). Defer until symptoms of airway obstruction have resolved.</p>
Oral or nasal suction	<p>Provide as indicated.</p> <p>Hazard controls apply. Contact and airborne precautions apply.</p>	<p>Oral or nasal suction are considered aerosol-generating procedures.⁸</p> <p>Hazard reduction</p> <ul style="list-style-type: none"> ▪ Where available, care for patient in single room. ▪ If single room unavailable, deliver in room where air does not circulate to other areas.

Therapy/intervention	Recommendation	Considerations for children suspected or confirmed to have COVID-19
<p>Care of a tracheostomy</p>	<p>Provide as indicated. Hazard controls apply. Contact and airborne precautions apply.</p>	<p>Tracheostomy care, particularly in a child, involves a range of procedures that may lead to generation of, and exposure to, aerosols – for example:</p> <ul style="list-style-type: none"> ▪ open suction (in-line suction is not available via tracheostomy) ▪ tracheostomy changes ▪ changes of connections such as heat-moisture exchanger (HME). <p>Hazard reduction</p> <ul style="list-style-type: none"> ▪ Ensure tracheostomy care occurs as indicated. ▪ If available and tolerated, replace HME with HME with viral filter (HME-F), carefully observing for any increase in airway resistance.¹³ Change HME-F once a day. ▪ Where available, care for the patient in negative pressure room. ▪ If negative pressure room unavailable, care for patient in single room. ▪ If single room unavailable, deliver in room where air does not circulate to other areas. <p>Staff protection</p> <p>Staff to wear appropriate PPE (airborne and contact precautions).</p>
<p>Bag-valve-mask (BVM) ventilation</p>	<p>Provide as indicated. Hazard controls apply. Contact and airborne precautions apply.</p>	<p>Delay in effective ventilation is potentially harmful to children as the primary cause of deterioration is more likely to be respiratory than cardiac. Timely and effective bag-valve-mask ventilation therefore remains imperative in children.</p> <p>However, balancing the benefit of early resuscitation and the potential harm to staff and the wider community is challenging. Hazard elimination and reduction are of paramount importance.</p> <p>Hazard elimination</p> <ul style="list-style-type: none"> ▪ Ensure Goals of Care are discussed and agreed for patients with severe life-limiting conditions who are unlikely to benefit from life-support in case of severe deterioration. ▪ Ensure a plan is communicated to both medical and nursing staff for any at-risk paediatric in-patient (e.g. seizures, febrile neutropenia, eating disorder, etc.) directing: <ol style="list-style-type: none"> 1. Early escalation of clinical concerns (e.g. to senior medical and senior nursing staff) 2. Actions in the case of deterioration.

Therapy/intervention	Recommendation	Considerations for children suspected or confirmed to have COVID-19
Bag-valve-mask (BVM) ventilation (continued)		<p>Hazard reduction</p> <ul style="list-style-type: none"> ▪ BVM devices must be fitted with a viral filter. Resuscitation trolleys must be equipped with viral filters now and staff trained in assembling BVM+viral filter. ▪ Whenever possible, BVM ventilation should be performed by two persons with one person applying a two-hand technique to the mask in order to achieve an optimal seal and avoid/minimise air leak from the mask. <p>Staff protection</p> <ul style="list-style-type: none"> ▪ Staff to wear appropriate PPE (airborne and contact precautions) ▪ If not already in appropriate PPE when BVM is required: <ol style="list-style-type: none"> 1. Staff should apply oxygen via Hudson mask to the patient. 2. Don the appropriate PPE. 3. Proceed to perform BVM ventilation.

Summary of recommendations

Level of respiratory support	Recommendations	
	SARS-CoV-2 infection not suspected – Standard practice	SARS-CoV-2 infection suspected or confirmed
Standard oxygen therapy	Provide as indicated Precautions as required	Provide as indicated General hazard controls Droplet and contact precautions
High-flow oxygen/air therapy	Provide as indicated Precautions as required	Provide as indicated Specific hazard controls Contact and airborne precautions
CPAP and BiPAP	Provide as indicated Precautions as required	Provide as indicated Specific hazard controls Contact and airborne precautions
Mechanical ventilation	Provide as indicated. Consult with PIPER. Precautions as required	Provide as indicated in consultation with PIPER. Specific hazard controls Contact and airborne precautions
Nebulised adrenaline in croup	Provide as indicated Precautions as required	Provide when strongly indicated Specific hazard controls Contact and airborne precautions
Nebulised bronchodilators in acute asthma	Provide as indicated Precautions as required	Avoid If delivering: Specific hazard controls Contact and airborne precautions
Nebulised saline	Provide as indicated Precautions as required	Avoid If delivering: Specific hazard controls Contact and airborne precautions
Procedural sedation with Nitrous oxide – continuous flow	Provide as indicated Precautions as required	Provide if strongly indicated. If delivering: Specific hazard controls Contact and airborne precautions
Procedural sedation with Nitrous oxide – demand flow	Provide as indicated Precautions as required	Provide as indicated Specific hazard controls Droplet and contact precautions
Nasopharyngeal swab	Provide as indicated Precautions as required	1. Perform as indicated 2. Do not perform if signs of upper airway obstruction
Oral or nasal suction	Provide as indicated Precautions as required	Provide as indicated General hazard controls Contact and airborne precautions
Care of a tracheostomy	Provide as indicated Precautions as required	Provide as indicated General hazard controls Contact and airborne precautions
Bag-valve-mask (BVM) ventilation	Provide as indicated Precautions as required	Provide as indicated Specific hazard controls Contact and airborne precautions

Additional information related to Victorian data for children

Non-COVID disease

As of 30 April 2020, there have been no confirmed COVID-positive paediatric cases requiring respiratory support in Victoria.¹⁴

Based on current clinical testing criteria, most children presenting for respiratory support are **considered suspected COVID-19 cases until proven otherwise**. The number of these patients is expected to increase significantly during the winter months.

Non-COVID illness with SARS-CoV-2 co-infection

Co-infection in the presence of other viral or bacterial respiratory disease has been reported overseas¹⁵ but the incidence is unknown. Similarly, the prevalence of asymptomatic SARS-CoV-2 carriage and therefore the prevalence among non-respiratory presentations (e.g. in trauma or status epilepticus) is not known.^{16,17} To date, symptom- and epidemiology-based testing in Victoria indicates only a very low level of SARS-CoV-2 community transmission. This suggests a very low probability of encountering the virus in this patient group at this time.

COVID-19 disease

Coronavirus disease, including critical illness and death, does occur in children but to date has been rare compared with the adult population.²

SARS-CoV-2 associated multisystem inflammatory system (unconfirmed)

Recently, concerns have been raised overseas about the possibility of SARS-CoV-2 causing a severe multi-system inflammatory syndrome in some children but information is limited at this stage.¹⁸

Where can I find out more information?

For Victorian updates: dhhs.vic.gov.au/novelcoronavirus

For national updates: health.gov.au/news/latest-information-about-novel-coronavirus

For international updates: who.int/westernpacific/emergencies/novel-coronavirus

WHO resources: who.int/health-topics/coronavirus

References

1. Lu X, Zhang L, Du H, et al. SARS-CoV-2 Infection in Children. *N Engl J Med*. 2020;382(17):1663-1665.
2. Cdc Covid- Response Team. Coronavirus Disease 2019 in Children - United States, February 12-April 2, 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(14):422-426.
3. Victoria State Government. Department of Health and Human Services Victoria | Coronavirus COVID-19 Guide to conventional use of personal protective equipment PPE. 2020; www.dhhs.vic.gov.au/coronavirus-covid-19-daily-update. Accessed 20 April 20 2020.
4. Luo J, Duke T, Chisti MJ, Kepreotes E, Kalinowski V, Li J. Efficacy of High-Flow Nasal Cannula vs Standard Oxygen Therapy or Nasal Continuous Positive Airway Pressure in Children with Respiratory Distress: A Meta-Analysis. *J Pediatr*. 2019;215:199-208 e198.
5. Hui DS, Chan MT, Chow B. Aerosol dispersion during various respiratory therapies: a risk assessment model of nosocomial infection to health care workers. *Hong Kong Med J*. 2014;20 Suppl 4:9-13.
6. Leung NHL, D.K.W.; Shiu, E.Y.C. Respiratory virus shedding in exhaled breath and efficacy of face masks. *Nature Medicine*. 2020; doi.org/10.1038/s41591-020-0843-2.
7. Hui DS, Chow BK, Chu L, et al. Exhaled air dispersion during coughing with and without wearing a surgical or N95 mask. *PLoS One*. 2012;7(12):e50845.
8. Australian Government Department of Health. Guidance of the use of personal protective equipment (PPE) in hospitals during the COVID-19 outbreak. 2020; www.health.gov.au/sites/default/files/documents/2020/04/interim-recommendations-

for-the-use-of-personal-protective-equipment-ppe-during-hospital-care-of-people-with-coronavirus-disease-2019-covid-19.pdf. Accessed 26 April 2020.

9. Australian Government Department of Health Communicable Diseases Network Australia. Coronavirus Disease 2019 (COVID-19) CDNA National Guidelines for Public Health Units. 2020; [www1.health.gov.au/internet/main/publishing.nsf/Content/7A8654A8CB144F5FCA2584F8001F91E2/\\$File/interim-COVID-19-SoNG-v2.7.pdf](http://www1.health.gov.au/internet/main/publishing.nsf/Content/7A8654A8CB144F5FCA2584F8001F91E2/$File/interim-COVID-19-SoNG-v2.7.pdf). Accessed April 26, 2020.
10. Leonard S, Atwood CW, Jr., Walsh BK, et al. Preliminary Findings of Control of Dispersion of Aerosols and Droplets during High Velocity Nasal Insufflation Therapy Using a Simple Surgical Mask: Implications for High Flow Nasal Cannula. *Chest*. 2020;10.1016/j.chest.2020.03.043.
11. O'Callaghan C, Barry PW. The science of nebulised drug delivery. *Thorax*. 1997;52 Suppl 2:S31-44.
12. The Royal Australian and New Zealand College of Obstetricians and Gynaecologists. RANZCOG - COVID-19: Protection of midwives and doctors in the birth unit. 2020; ranzocg.edu.au/news/covid-19-protection-of-midwives-and-doctors-in-th. Accessed 30 April 2020.
13. Lawes EG. Hidden hazards and dangers associated with the use of HME/filters in breathing circuits. Their effect on toxic metabolite production, pulse oximetry and airway resistance. *Br J Anaesth*. 2003;91(2):249-264.
14. Victoria State Government. Department of Health and Human Services Victoria | Coronavirus COVID-19 daily update. 2020; www.dhhs.vic.gov.au/coronavirus-covid-19-daily-update. Accessed 1 May 2020.
15. Kim D, Quinn, J, Pinsky, B, Shah, N.H., Brown, I. Rates of Co-infection Between SARS-CoV-2 and Other Respiratory Pathogens. *JAMA*. 2020;10.3201/eid2608.201016.
16. Luo Y, Trevathan, E, Qian, Zhengmin. Asymptomatic SARS-CoV-2 Infection in Household Contacts of a Healthcare Provider, Wuhan, China. *Emerg Infect Dis*. 2020;doi.org/10.3201/eid2608.200282.
17. Lai C, Liu, YH, Wang, CY. Asymptomatic carrier state, acute respiratory disease, and pneumonia due to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2): Facts and myths. *J Microbiol Immunol Infect*. 2020;10.1016/j.jmii.2020.02.012.
18. Paediatric Intensive Care Society (PICS UK). PICS Statement: Increased number of reported cases of novel presentation of multi-system inflammatory disease. 2020; picsociety.uk/wp-content/uploads/2020/04/PICS-statement-re-novel-KD-C19-presentation-v2-27042020.pdf. Accessed 1 May 2020.