

Safe administration of intravenous fluids: Avoiding venous air embolism

For clinicians and private and public health service organisations in the acute sector.

What you need to know

- The administration of IV fluids and medicines is one of the most common clinical interventions across healthcare settings and can be a source of air entry into the venous system, potentially leading to clinically significant venous air embolism (VAE).
- Clinically significant VAE is rare, and the severity of the outcome depends on various factors such as the volume and rate of air entry, the patient's position and the final anatomical location of the air embolism. The rate of air entry into an IV line can be faster than anticipated – a lethal dose can be administered in seconds.
- Clinicians caring for patients receiving peripheral or central IV fluids should:
 - Be aware that VAE can cause life-threatening complications.
 - Adhere to safe infusion practices throughout therapy administration and line management to minimise the risk of air entering the bloodstream.

For clinical signs and symptoms of VAE, see: [Clinical signs and symptoms of VAE](#).

For VAE prevention practice points, see: [VAE prevention](#).

Clinical signs and symptoms of VAE

Once in the bloodstream, air can potentially¹:

- Travel to the right side of the heart and obstruct blood flow through the lungs. This can reduce cardiac output and, in severe cases, lead to circulatory collapse.
- Enter the arterial circulation – either by passing through the lungs or crossing intracardiac defects, where it can reduce blood flow to vital organs such as the brain, heart and kidneys, causing end organ ischaemia.

Clinicians should maintain a high level of suspicion for air embolism when a patient develops sudden respiratory, haemodynamic or neurologic deterioration in the presence of a known risk factor (for example, after rapid fluid administration via a pressurised infusion system).¹



Signs and symptoms are variable, non-specific, and depend on the volume and rate of air entrainment. They may include acute dyspnoea, chest tightness, cough, anxiety, tachypnoea, light headedness, altered mental state or speech, wheeze, hypotension, tachycardia and chest pain.^{1,2} Life-threatening VAE should be suspected when a patient develops a sudden sense of impending doom, abrupt loss of consciousness, signs of acute right-sided heart failure, haemodynamic collapse or cardiac arrest.¹ In these circumstances, clinicians should respond in accordance with local escalation protocols and emergency response systems.³

VAE prevention

All IV tubing contains air, and IV fluid bags/containers also hold residual air, with volumes varying depending on the manufacturer. Preventing this air from entering the bloodstream is essential for safe administration of IV fluids and medicines.

Health service organisations should ensure that administration of IV fluids and the management of IV giving sets is undertaken only by clinicians who are considered competent under the organisation's clinical governance framework, with appropriate supervision and regular competency assessment.

Practice points for clinicians

1. Prioritise prevention

- Prime the IV line: Proper technique is essential to ensure the IV line is free from air.⁴⁻⁶ Ensure compliance with local training and competency assessment requirements. For high-level guidance see [Appendix A](#).
- Use in-line air detection devices: Wherever possible, use of infusion pumps with in-line air detection is recommended.⁷
- Stop infusions before they run dry⁶: Once the continuous column of fluid is lost, residual air can enter the line – an effect magnified by pressurisation. This risk is further increased with the use of IV bags that contain larger residual air volumes. In-line air detection devices cannot fully mitigate these risks.
- Stay vigilant and monitor: Monitor IV lines for the presence of air, especially when using gravity fed systems, and respond promptly to infusion pump alarms.⁵
- Use closed-loop communication and effective teamwork: Ensure clear communication when multiple clinicians are involved in priming, connecting or administering IV fluids, particularly in emergency situations.
- Safety focus: Ensure patients, their family and/or carers fully understand why they are not to disconnect or reconnect IV lines unless trained on appropriate techniques and assessed as competent (for example, in the Hospital in the Home setting).⁴

2. Follow proper procedures

- Follow manufacturer instructions: All IV fluid products, giving sets and administration devices should be used in accordance with the manufacturer's instructions for use.⁷
- Only use an IV bag once: IV bags and containers are designed for single use only. Never reconnect (re-spike) an IV bag after initial set up.⁸



- Follow local guidance: Always follow local policies and procedures when caring for patients receiving fluids or medicines intravenously.
- Ensure appropriate training and competency: Before manipulating any IV fluid products, giving sets and administration devices, local training and competency assessment requirements must be met.

3. Consider patient specific factors

- Paediatric patients (especially neonates and infants) are especially vulnerable to clinically significant VAE, even from small volumes of air. Use paediatric-specific giving sets according to local guidance and use in-line air filters where appropriate.^{9,10}
- Patients requiring pressurised infusions are at an increased risk of VAE. Additional precautions are required, see: Understand the risks with pressurised infusions.

4. Understand the risks with pressurised infusions

There is an increased risk of VAE when administering IV fluids under pressure or external force.¹¹ This includes methods used for:

- rapid fluid administration in emergency situations (for example, pressure cuffs or bags, rapid infusion devices, manual bolus techniques)
- continuous flush systems used for invasive haemodynamic monitoring.

Rationale for increased risk: In these situations, pressure can force residual air within the IV fluid bag or IV giving set tubing into the bloodstream. This risk is increased when using some alternative IV fluids with higher volumes of residual air (for example, alternatives sourced and approved under [Section 19A \(S19A\) of the Therapeutic Goods Act 1989](#)).

Additional considerations for pressurised infusions

- Use of products not intended for pressurised infusions may result in splitting or bursting of the IV fluid bag. When using inflatable pressure cuffs or bags, rapid infuser sets or manual bolus techniques, follow product-specific and local guidance on⁷:
 - Preparation of infusions
 - Appropriate IV fluid product selection.
- When removing air from the IV fluid bag (before pressurisation): Evacuate air via the medication port using a technique that does not allow re-entry of air⁷, while maintaining aseptic technique.¹²

Additional considerations

Incidental air bubbles

While every effort should be made to ensure IV lines are free from air, the presence of very small, incidental air bubbles is generally not clinically significant in most **adult patients**. Clinicians should use their judgement and consider patient-specific factors when deciding whether to proceed and reassure the patient as required, or to take further action to remove incidental air bubbles.

Additional caution is required in **paediatric patients**, particularly neonates and infants (see: [Consider patient-specific factors](#)).

Central venous access devices

Improper insertion, removal or management of central venous access devices (CVADs) also poses a significant risk of air embolism. Adherence to proper procedures, training and competency requirements is essential to prevent air embolism, in line with jurisdictional guidance (for example, the [NSW Agency for Clinical Innovation Central venous access device: Clinical practice guide²](#)).

References

1. Air embolism. In: *UpToDate* [Internet]. Waltham (MA): UpToDate Inc.; c2026 [Accessed 2026]. Available from: <https://www.uptodate.com/contents/air-embolism>
2. NSW Agency for Clinical Innovation. Central venous access devices (CVAD): clinical practice guide [Internet]. Sydney: Agency for Clinical Innovation; 2021 Oct [Accessed 2026]. Available from: https://aci.health.nsw.gov.au/_data/assets/pdf_file/0010/239626/ACI-CVAD-clinical-practice-guide.pdf
3. Australian Commission on Safety and Quality in Health Care. National Consensus Statement: Essential elements for recognising and responding to acute physiological deterioration (3rd ed.). Sydney: ACSQHC; 2021. Available from: <https://www.safetyandquality.gov.au/resources/national-consensus-statement-essential-elements-recognising-and-responding-acute-physiological-deterioration-third-edition>
4. B. Nickel *et al.*, "Infusion therapy standards of practice, 9th edition," *J. Infus. Nurs.*, vol. 47, no. 1S Suppl 1, pp. S1–S285, 2024.
5. McCarthy CJ, Behraves S, Naidu SG, Oklu R. Air embolism: practical tips for prevention and treatment. *J Clin Med* [Internet]. 2016 Oct 31;5(11):93 [Accessed 2026]. Available from: <https://pmc.ncbi.nlm.nih.gov/articles/PMC5126790>
6. European Network for Infusion Therapy Standards (EUNETIPS). *Standards for infusion therapy* [Internet]. 4th ed. London: Royal College of Nursing; 2016 [Accessed 2026]. Available from: https://www.eunetips.eu/pdf/Standards_for_infusion_therapy.pdf
7. Clinical Excellence Commission. *Information for clinicians: Risk of air embolism when administering intravenous (IV) fluids without in-line air detection* [Internet]. Sydney: Clinical Excellence Commission; 2024 Aug. Available from: https://www.cec.health.nsw.gov.au/_data/assets/pdf_file/0008/956357/Information-for-clinicians-Risk-of-air-embolism-when-administering-intravenous-IV-fluids-without-in-line-air-detection.pdf
8. Pant D, Narani KK, Sood J. Significant air embolism: a possibility even with collapsible intravenous fluid containers when used with rapid infuser system. *Indian J Anaesth.* 2010 Jan–Feb;54(1):49–51. doi:10.4103/0019-5049.60498.
9. Zhou Q, Lee SK. Vascular air embolism in neonates: a literature review. *Am J Perinatol.* 2025;42(14):1819–1824. doi:10.1055/a-2508-2733.
10. Royal Children's Hospital Melbourne. Filters for venous access lines in select group of cardiac patients [Internet]. Melbourne: Royal Children's Hospital; [Accessed 2026]. Available from: https://www.rch.org.au/rchcpg/hospital_clinical_guideline_index/Filters_for_venous_access_lines_in_select_group_of_cardiac_patients
11. Santucci J, Mullaguri N, Battineni A, Guddeti RR, Newey CR. Paradoxical and retrograde air embolism from pressurized peripheral bolus. *Case Rep Neurol Med.* 2021;2021:1063264. doi:10.1155/2021/1063264.
12. Australian Commission on Safety and Quality in Health Care. Principles of aseptic technique: information for healthcare workers [Internet]. Sydney: ACSQHC; n.d. Available from: <https://www.safetyandquality.gov.au/publications-and-resources/resource-library/principles-aseptic-technique-information-healthcare-workers>
13. Tasmanian Health Service. Safe administration of intravenous fluids: preventing air embolism [Protocol; internal document]. Document ID: P25/26. Hobart (TAS): Tasmanian Health Service; 2025. Available from csi@health.tas.gov.au

Appendix A: Priming of IV lines

Priming of IV lines should be undertaken by clinicians who meet local training and competency requirements, in accordance with organisational policies and procedures.

Careful preparation and priming techniques are essential to prevent air from entering the patient's bloodstream. This involves allowing enough time to ensure the giving set tubing is free from air – even in emergency situations.

General recommendations to support safe preparation and priming of IV lines, and reduce the risk of VAE, are described below:

Preparation¹³ ([applying the principles of aseptic technique¹²](#))

- Check the giving set tubing and the IV fluid bag for any cracks and other abnormalities.
- Assess the residual air volume in the IV fluid bag.
- Hang the IV fluid bag vertically, avoiding displacement of air into the IV line.
- Ensure the roller clamp on the giving set tubing is closed.
- Remove the protective caps from the giving set spike and the IV fluid bag port, taking care to maintain aseptic technique and not touch the spike.
- Insert the spike into the port using a twisting motion.

Priming the giving set line¹³

- Squeeze the drip chamber on the giving set until it is approximately half full of fluid.
- Slowly open the roller clamp on the giving set tubing to allow fluid to flow through.
- Turn any injection ports or connectors upside down while flushing to help clear trapped air bubbles. Gently flicking these parts of the giving set may help dislodge air bubbles.
- Once the fluid reaches the end of the giving set tubing and all air has been expelled, close the roller clamp securely.

To enable vertical hanging of IV fluid bags, health service organisations should ensure the availability of appropriate equipment/devices (for example, height adjustable IV poles or infusion stands) in all clinical areas, including for intra and inter hospital patient transport.

For more information

Please visit: safetyandquality.gov.au/ivfluids

© Australian Commission on Safety and Quality in Health Care 2026