

## Patient Safety Tip of the Week

January 31, 2023

### Alert on Oxygen Cylinder Use

We’ve written about problems with oxygen cylinders in several columns (see our What’s New in the Patient Safety World columns for November 2016 “[Oxygen Tank Monitoring](#)” and February 2018 “[Oxygen Cylinders Back in the News](#)”). And, of course, running out of oxygen during patient transports was a major reason that the “Ticket to Ride” checklist was developed (see below for our many columns on the “Ticket to Ride”).

England’s NHS (National Health Service) recently issued a patient safety alert regarding oxygen cylinders ([NHS 2023](#)). NHS saw an increased number of incidents involving oxygen cylinders as there was a surge in demand for oxygen for respiratory-related illnesses. That surge raised issues around oxygen cylinders regarding not only patient safety, but also fire safety and physical safety. It found 120 patient safety incidents related to oxygen cylinders over a 12 month period. These included incidents such as:

- cylinder empty at point of use
- cylinder not switched on
- cylinders inappropriately transported
- cylinders inappropriately secured

Some of these reports described compromised oxygen delivery to the patient, leading to serious deterioration and cardiac or respiratory arrest. In addition, there is a need to conserve oxygen cylinder use to ensure a robust supply chain process.

NHS recommends that hospitals and healthcare facilities undertake a risk assessment, including attention to the following:

- avoiding unnecessary use of cylinder oxygen and excessive flow rates by ensuring oxygen treatment is optimized to recommended target saturation ranges
- ensuring safe use of oxygen cylinders by clinical staff including:
  - safe activation of oxygen flow
  - initial and ongoing checks of flow to patient
  - initial and ongoing checks of amount of oxygen left in the cylinder

- especially during transfer or whilst undergoing diagnostic tests
- fire safety, including:
  - appropriate ventilation (both in physical environments and in ambulances)
  - safe storage of cylinders
- physical safety, including:
  - awareness of manual handling requirements
  - safe transportation of cylinders using appropriate equipment
  - safe storage of cylinders

NHS also notes that priority should be given to escalation/transient areas being used to acutely care for patients (eg corridors, non-inpatient areas such as physiotherapy departments, ambulances outside emergency departments).

NHS had also just released a guidance “[Safe Use of Oxygen Cylinders](#)” that stresses patient safety issues, fire safety, physical safety, and conservation of resources. It begins by reminding us that oxygen treatment should be optimized to target saturation ranges as recommended in BTS Guideline for oxygen use in adults in healthcare and emergency settings ([O'Driscoll 2017](#)). Fixed performance (or "Venturi") masks should be used preferentially to ensure that oxygen saturations remain within the target range. Organizations should ensure that these are available in sufficient quantities. NHS England support patients requiring CPAP or non-invasive ventilation, especially if in an ambulance, to be prioritized for transfer to a clinical area where oxygen via the MGPS (medical gas pipeline systems) is available. If this is not possible, use the lowest flow device available. It stresses ongoing clinical checks, with oxygen saturation checks using appropriate oximeter positioning and probes, and both initial and regular flow checks to ensure oxygen is flowing to the patient.

Regarding **patient safety issues**, it recommends:

- When using an integral valve oxygen cylinder, ensure appropriate activation and flow (it provides several links to resources on this process).
- If using devices to deliver oxygen therapy such as nasal high flow or other forms of non-invasive ventilation in transient parts of the emergency department, escalation areas or ambulances waiting to offload, please note that some devices are reliant on main power and have no battery backup mode when the patient is then transported to another setting.
- It discusses various sizes and types of cylinders and notes care must be taken to ensure the right regulator has been connected to the right medical gas.
- To avoid confusion between cylinders, there should be effective separation of oxygen and other medical gas cylinders, and of the related regulators, in all storage areas.

Because of the current supply issue, the guidance notes it is important the cylinders are used until the cylinder content display is nearing empty, to ensure maximal use. But that also has important patient safety implications. It is therefore essential when using any oxygen cylinder to always check the **cylinder contents display** and **estimate the approximate residual volume according to the prescribed flow rate**. (A generic guide

covering commonly used cylinders can be downloaded and displayed in clinical areas or laminated and tagged to standalone cylinders). Care must be taken that cylinders do not fully empty, and patients no longer receive oxygen. On transfer: ensure patients requiring oxygen are transferred with an oxygen cylinder and that there is sufficient oxygen left to facilitate the transfer and/or the time to undertake diagnostic tests. That is a point we emphasize in our columns on the “Ticket to Ride” checklist. On arrival to ward, ensure patient is attached to oxygen via MGPS (medical gas pipeline systems), eliminating the risk of inadvertent connection to medical air via a flowmeter and oxygen cylinders are returned as soon as possible.

Regarding **physical safety issues**, the guidance recommends:

- Medical gas cylinders are only transported using dedicated holders – they should never be placed on the patients’ bed or carried by the patient.
- Only staff trained in the use of manual handling aids move large medical gas cylinders to avoid manual handling injuries
- Staff connecting cylinders to regulators are trained in their use – training resources are available on-line from your medical gas cylinder supplier.
- Cylinders in use are effectively secured to prevent falling (risk of damage and risk of crushing)
- Empty cylinders are returned as soon as possible to the empty medical gas cylinder store to prevent trip hazards and make them available for refilling.
- Cylinders that are ready to be deployed are only stored in designated and signed medical gas cylinder stores with appropriate warning signs.

The NHS guidance discusses **fire safety issues** as well. It recommends:

- Spaces that have been converted or adopted for patient use may have inadequate ventilation, leading to rising oxygen concentration – this should be monitored ensuring that there is adequate ventilation.
- Cylinders that are ready to be deployed should only be stored in designated and signed medical gas cylinder stores with appropriate warning signs.
- The Fire Risk Assessment should be revisited with consideration of:
  - Spaces that have been converted or adopted for patient use may have inappropriate surface finishes and fixtures for the spread of flame
  - Spaces that have been converted or adopted may impede access or egress in the event of an emergency – safe evacuation routes should be maintained.
  - Oxygen use may lead to oxygen saturation of materials increasing likelihood of ignition and fire intensity
  - Portable Oxygen equipment and associated apparatus are at risk of leakage, increasing the risk of fire.
- Patients and public should not smoke, vape or use a lighter in areas where oxygen concentration may be high – this includes close to hospital entrances and ambulances.

Our October 2022 What's New in the Patient Safety World column “[Portable Oxygen and Ambulance Fire](#)” discussed the role of portable oxygen in a fatal ambulance fire. The recent NHS guidance specifically addresses the use of oxygen in ambulances, noting that prolonged use of supplemental oxygen in an enclosed ambulance “saloon” may increase the risk of fire due to raised ambient oxygen concentrations. To minimize this risk the following should be considered:

- Any patient receiving supplemental oxygen should have their oxygen saturations monitored continuously, and oxygen administration titrated to oxygen saturations in accordance with JRCALC guidelines on the administration of oxygen.
- Consider permanently or intermittently opening the roof vent on the ambulance saloon to facilitate equilibration of internal and external ambient oxygen concentrations.

With extended use of supplemental oxygen in the ambulance “saloon” it may be necessary to change onboard cylinders during deployment. Care should be taken to ensure that all valves, regulators and fitments are clean, dry and free from grease or any other contaminant before re-attachment to a cylinder. Following reattachment, valves should be opened slowly into an open supply, i.e. with the flowmeter open, to reduce the risk of fire or explosion from “adiabatic compression” – following instructions for use available for medical gas cylinder supplier. It provides a link to a very interesting discussion about an oxygen cylinder that caught fire whilst being prepared for a patient who was being transferred to another hospital ([Kelly 2014](#)). That fire seemed to arise from within the cylinder and they discuss and the article discusses both the potential fuels within a cylinder plus the “adiabatic” heating of the gases that could lead to combustion.

Don’t forget oxygen cylinders have been projectiles in fatal MRI accidents (see our many columns on MRI safety listed below). We’ve also recommended you carry out simulations or drills with your local police or fire departments. You don’t want any of their personnel entering an MRI suite with an oxygen cylinder.

Our February 2018 What's New in the Patient Safety World column “[Oxygen Cylinders Back in the News](#)” was triggered by a previous NHS safety alert based on over 400 incidents involving oxygen cylinders. We hope you’ll go back to that column for our comments. We criticized that NHS alert because the recommended actions were primarily educational, and we’ve often pointed out that educational interventions are among the least effective interventions. We are pleased to see that the current NHS alert goes well beyond recommendations for educational interventions.

The current “triple-demic” of respiratory illnesses has undoubtedly resulted in potential problems in use, storage, and transport of oxygen cylinders. Now is a good time to review your own vulnerabilities to incidents involving oxygen cylinders. Even if you don’t have a Medical Gas Committee you should at least incorporate assessment of oxygen cylinders into your Patient Safety Walk Rounds (not only assessing cylinders in storage areas but also checking safety issues any time you find an oxygen cylinder with a patient during an intrahospital transport). And for those of you looking for a topic for a FMEA (Failure Mode and Effects Analysis), this is a good topic.

**Some of our prior columns on potential harmful effects of oxygen and other oxygen issues:**

April 8, 2008 “[Oxygen as a Medication](#)”  
January 27, 2009 “[Oxygen Therapy: Everything You Wanted to Know and More!](#)”  
April 2009 “[Nursing Companion to the BTS Oxygen Therapy Guidelines](#)”  
October 6, 2009 “[Oxygen Safety: More Lessons from the UK](#)”  
July 2010 “[Cochrane Review: Oxygen in MI](#)”  
December 6, 2011 “[Why You Need to Beware of Oxygen Therapy](#)”  
February 2012 “[More Evidence of Harm from Oxygen](#)”  
March 2014 “[Another Strike Against Hyperoxia](#)”  
June 17, 2014 “[SO2S Confirms Routine O2 of No Benefit in Stroke](#)”  
December 2014 “[Oxygen Should Be AVOIDed](#)”  
August 11, 2015 “[New Oxygen Guidelines: Thoracic Society of Australia and NZ](#)”  
November 2016 “[Oxygen Tank Monitoring](#)”  
November 2016 “[More on Safer Use of Oxygen](#)”  
October 2017 “[End of the Oxygen in MI and Stroke Debate?](#)”  
February 2018 “[Oxygen Cylinders Back in the News](#)”  
June 2018 “[Too Much Oxygen](#)”  
July 2021 “[Unique Way to Rapidly Identify Oxygen Flow](#)”  
October 2022 “[Portable Oxygen and Ambulance Fire](#)”  
January 2023 “[Oxygen During Surgery](#)”

**Some of our prior columns on intrahospital transports and the “Ticket to Ride” concept:**

- April 8, 2008 “[Oxygen as a Medication](#)”
- November 18, 2008 “[Ticket to Ride: Checklist, Form, or Decision Scorecard?](#)”
- August 11, 2009 “[The Radiology Suite...Again!](#)”
- March 13, 2012 “[Medical Emergency Team Calls to Radiology](#)”
- August 25, 2015 “[Checklist for Intrahospital Transport](#)”
- September 1, 2015 “[Smarter Checklists](#)”
- November 2016 “[Oxygen Tank Monitoring](#)”
- February 2018 “[Oxygen Cylinders Back in the News](#)”
- May 22, 2018 “[Hazardous Intrahospital Transport](#)”
- October 30, 2018 “[Interhospital Transfers](#)”
- March 31, 2020 “[Intrahospital Transport Issues in Children](#)”
- June 23, 2020 “[Telemetry Incidents](#)”
- July 14, 2020 “[A Thesis on Intrahospital Transports](#)”
- August 4, 2020 “[Intravenous Issues](#)”
- February 2021 “[Risk from Intrahospital Transfer: Healthcare-Associated Infection](#)”
- May 25, 2021 “[Yes, Radiologists Have Handoffs, Too](#)”
- July 2021 “[Unique Way to Rapidly Identify Oxygen Flow](#)”

- April 2022 [“Safety Issues in Interhospital Transports”](#)

**Some of our prior columns on patient safety issues related to MRI:**

- February 19, 2008 [“MRI Safety”](#)
- March 17, 2009 [“More on MRI Safety”](#)
- October 2008 [“Preventing Infection in MRI”](#)
- March 2009 [“Risk of Burns during MRI Scans from Transdermal Drug Patches”](#)
- January 25, 2011 [“Procedural Sedation in Children”](#)
- February 1, 2011 [“MRI Safety Audit”](#)
- October 25, 2011 [“Renewed Focus on MRI Safety”](#)
- August 2012 [“Newest MRI Hazard: Ingested Magnets”](#)
- October 22, 2013 [“How Safe Is Your Radiology Suite?”](#)
- October 21, 2014 [“The Fire Department and Your Hospital”](#)
- August 25, 2015 [“Checklist for Intrahospital Transport”](#)
- August 2016 [“Guideline Update for Pediatric Sedation”](#)
- October 2016 [“MRI Safety: There’s an App for That!”](#)
- January 17, 2017 [“Pediatric MRI Safety”](#)
- August 8, 2017 [“Sedation for Pediatric MRI Rising”](#)
- March 2018 [“MRI Death a Reminder of Dangers”](#)
- March 2018 [“Cardiac Devices Safe During MRI But Spinners!?”](#)
- November 2018 [“OMG! Not My iPhone!”](#)
- April 2, 2019 [“Unexpected Events During MRI”](#)
- September 2019 [“New MRI Hazard: Magnetic Eyelashes”](#)
- October 15, 2019 [“Lots More on MRI Safety”](#)
- November 5, 2019 [“A Near-Fatal MRI Incident”](#)
- November 2019 [“ECRI Institute’s Top 10 Health Technology Hazards for 2020”](#)
- January 7, 2020 [“Even More Concerns About MRI Safety”](#)
- March 2020 [“Airway Emergencies in the MRI Suite”](#)
- October 2020 [“New Warnings on Implants and MRI”](#)
- January 2021 [“New MRI Risk: Face Masks”](#)
- June 1, 2021 [“Stronger Magnets, More MRI Safety Concerns”](#)
- November 2021 [“Yet Another Risk During MRI”](#)
- January 2022 [“MRI Safety Issues”](#)
- July 26, 2022 [“More Risks in the Radiology Suite”](#)

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NHS England. Safe Use of Oxygen Cylinders. NHS England 2023; 5 January 2023, Version 1

<https://www.england.nhs.uk/wp-content/uploads/2023/01/Official-sensitive-Oxygen-Cylinder-Comms-FINAL-v2.pdf>

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