



Patient Safety Alert

Risk of death and severe harm from failure to obtain and continue flow from oxygen cylinders

9 January 2018

Alert reference number: NHS/PSA/W/2018/001

Warning Alert

Some patients need to be given additional oxygen¹ as part of their treatment. Where there is no access to piped or concentrated oxygen, it is provided in cylinders, the design of which has changed over recent years. Cylinders with integral valves are now in common use and require several steps (typically removing a plastic cap, turning a valve and adjusting a dial) before oxygen starts to flow. To reduce the risk of fire² valves must be closed when cylinders are not in use, and cylinders carried in special holders that can be out of the direct line of sight and hearing of staff caring for the patient.

An unintended consequence of these changes is that staff may believe oxygen is flowing when it is not, and/or may be unable to turn the oxygen flow on in an emergency.

In a recent three-year period, over 400 incidents involving incorrect operation of oxygen cylinder controls were reported to the National Reporting and Learning System (NRLS). Six patients died, although most were already critically ill and may not have survived even if their oxygen supply had been maintained. Five patients had a respiratory and/or a cardiac arrest but were resuscitated, and four became unconscious. Other incident reports described patients experiencing difficulty breathing and low oxygen saturations that required urgent medical attention. Incidents involved portable oxygen cylinders of all sizes on trolleys, wheelchairs, resuscitation trolleys and neonatal resuscitaires, and larger cylinders in hospital areas without piped oxygen.

A typical incident report reads: "Patient arrived on coronary care unit with oxygen saturations of 72%. Oxygen in situ and set to correct rate on the flow dial but unfortunately [the valve] was not opened and the patient was not therefore receiving oxygen. Peri-arrest on arrival, [crash team] calledcondition improvedregistered nurse continued to check cylinder was not running out but failed to notice not turned on as indicator green."

Insights from local investigations include:

- prioritising training for staff groups and clinical areas where the risk is high
- reinforcing theoretical training with regular opportunities to practise operating the cylinder controls
- linking safe operation of cylinder controls with other key safety issues, including fire hazards and how long a full cylinder will last on various flow rates
- placing laminated guides close to the point of use.

NHS Improvement and the Medicines and Healthcare products Regulatory Agency (MHRA) are supporting the distribution of training materials and resources for different manufacturers' designs of oxygen cylinder via the Medication Safety Officer (MSO) and Medical Device Safety Officer (MDSO) networks.³ The MHRA will continue to work with industry partners to improve oxygen cylinder design. The Healthcare Safety Investigation Branch (HSIB) is also currently conducting an investigation into this safety issue.⁴

Actions

Who: All organisations providing NHS funded-care where oxygen cylinders are used, including hospitals, GP practices, ambulance services and mental health units.*

When: To commence immediately and be completed no later than 20 February 2018.

- 1 Identify if oxygen cylinders are used in your organisation, even if only in emergencies
- 2 Bring this alert to the attention of all those with a leadership role in ensuring clinical staff understand how to operate oxygen cylinders safely
- 3 Consider if immediate local action is needed and ensure that an action plan is underway to reduce the risk of incorrect use of oxygen cylinders
- 4 Communicate the key messages in this alert and your local action plan to all relevant medical, nursing, therapy, pharmacy and support staff

*While this alert is directed at improving safe use by clinical staff, home oxygen services may also be able to use these findings to improve training and support for people using oxygen at home and their family/carers.

Sharing resources and examples of work

If there are any resources or examples of work developed in relation to this alert you think would be useful to others, please share them with us by emailing patientsafety.enquiries@nhs.net

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Technical notes

Patient safety incident reporting

We searched the NRLS for incidents occurring between 1 January 2015 and 29 October 2017, reported by 29 October 2017, and containing the keywords [oxygen or O2 or valve] + cylinder (NRLS search reference 3980). All deaths and severe and moderate harm incidents were reviewed and 24 incidents related to failure to operate the oxygen cylinder controls to obtain a flow of oxygen were identified. A coroner notified us of a further death where this may have been a contributory factor. Review of a sample of low and no harm incidents indicated we would have found around 400 further relevant incidents if all incidents with these keywords had been reviewed.

Most staff reporting incidents believed the cylinder was faulty or empty, and only after local investigation was incorrect operation of the cylinder controls (typically failure to open the valve) recognised. Staff appeared to assume the same single step to start piped oxygen flowing (turning the flowmeter dial) also applies to cylinders. They also appeared confused by aspects of the cylinder's design: no clear indicator on the valve showing the open and closed positions, and the plastic cap hiding controls. The green indicator showing a full cylinder appeared to be misinterpreted as an indicator of active flow. When the flow rate dial is operated on cylinders that have previously been used, but not vented before next use, a 'hiss' of flowing oxygen can be heard for a few seconds even with the valve closed. This can reinforce a member of staff's belief that they have turned the flow on. Reinforcement of the need for oxygen to be considered a prescribed medication¹ seemed in some cases to have been misinterpreted as meaning only clinical professionals could check or prepare cylinders for use.

All the identified incidents occurred in hospitals, but similar issues could arise in mental health units, general practices, care homes, ambulances or patients' own homes, particularly when oxygen cylinders are used in an emergency. They could also occur with other medical gas cylinders that have an integral valve.

In addition to the incidents above related to cylinder control operation, we identified incidents suggesting staff found it difficult to estimate how long a cylinder would last, risking smaller cylinders on high flow rates running out in ward-to-ward transfers, and even larger cylinders on slow flow rates while care home residents are on outings or attending outpatient appointments.

References

1. British Thoracic Society - Guideline for oxygen use in healthcare and emergency settings (2017) <https://www.brit-thoracic.org.uk/standards-of-care/guidelines/bts-guideline-for-emergency-oxygen-use-in-adult-patients/> (scroll down page for additional resources relevant to primary care and ambulance services)
2. Royal College of Anaesthetists - Fire safety on intensive care and in theatre (June 2013) <https://www.rcoa.ac.uk/news-and-bulletin/rcoa-news-and-statements/fire-safety-intensive-care-and-theatre>
3. NHS England press release on launch of MSO and MDSO networks (March 2014) <https://www.england.nhs.uk/2014/03/med-devices/>
4. HSIB updates on investigations <https://www.hsib.org.uk/investigations-cases/design-and-safe-use-portable-oxygen-systems>

Stakeholder engagement

- Association of Respiratory Nurse Specialists
- National Patient Safety Response Advisory Panel (for a list of members and organisations represented on the panel, see improvement.nhs.uk/resources/patient-safety-alerts/)

Advice for Central Alerting System officers and risk managers

This alert asks all organisations to adopt a systematic approach to ensuring all their staff using oxygen cylinders can safely operate them. This needs co-ordinated implementation rather than separate action by individual teams or departments. For hospital trusts, if you are unsure who will co-ordinate implementation of this alert, seek advice from any member of your local medical gases committee. They will be able to identify the key individuals needed to lead and co-ordinate implementation. For mental health services, community hospitals, ambulance services and other care settings, resuscitation trainers are likely to be a good initial contact point.