What's New in the Patient Safety World

February 2018

Oxygen Cylinders Back in the News

The UK's National Health Service (NHS 2018) recently issued a warning on incidents related to improper use of oxygen cylinders. Over a three-year period more than 400 incidents involving oxygen cylinders were reported to the National Reporting and Learning System (NRLS). Six patients died, though the NHS could not state with certainty that the deaths were solely the result of the incidents. Incidents involved portable oxygen cylinders of all sizes on trolleys, wheelchairs, resuscitation trolleys and neonatal resuscitaires, and larger cylinders in hospital areas without piped (wall mounted) oxygen.

While in some cases the cylinders were empty and in others the cylinders were faulty, incorrect operation of the cylinders was a frequent problem. In some cases the cylinders were suspected to be empty upon initial investigation, only to be found full on further review.

A significant contributing factor appears to be that there is a difference in initiating oxygen flow between oxygen coming from piped sources vs. cylinders. With piped oxygen systems, oxygen begins flowing as soon as the flowmeter dial is turned. However, with oxygen cylinders several steps are required: (1) remove a plastic cap, (2) turn a valve, and (3) adjust a dial. Often staff apparently just set the flowmeter dial to the desired rate and do not realize that oxygen is not flowing without opening the valve.

NHS noted the following insights from local investigations:

- prioritizing training for staff groups and clinical areas where the risk is high
- reinforcing theoretical training with regular opportunities to practice 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

We don't think the NHS recommendations go far enough. They seem to focus primarily on staff education to prevent the problems. As you know from many of our columns, education and training are relatively weak safety interventions (see our March 27, 2012 Patient Safety Tip of the Week "Action Plan Strength in RCA's" and our Power Point presentation "RCA Strong vs. Weak Responses"). The problem at hand merits a stronger safety intervention. Two of their recommendations were somewhat stronger actions. Regularly practicing use of the oxygen cylinders is stronger than just doing training or

annual inservicing. And placing the laminated guides in areas where the cylinders are being used is a somewhat stronger action.

But the problem is crying out for redesign of the cylinder system. A strong action would be redesigning to push the user do the correct action. Several design issues were found with the cylinders:

- no clear indicator on the valve showing the open and closed positions.
- the plastic cap sometimes hides 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.

Apparently, the valve is required to reduce the risk of fires when the oxygen is not in use. But a redesign would tie opening the valve to show flow on the flowmeter, making the process a one-step rather than two-step process. Redesign would also clearly separate any indicator of flow from the indicator of degree of fullness of the cylinder. We know the green for "full" and red for "empty" are useful when staff need to grab a cylinder during an emergency, but some sort of dual display could indicate something like "cylinder 98% full" and "flow rate is 4 liters/min". The relationship between the cap and the controls should be reassessed. Perhaps there is even a way to use the cap to convey instructions for use.

And, of course, **monitoring** the patient is a critical piece. All such patients should have pulse oximetry and the patient's oxygen saturation should be monitored after the oxygen flow is assumed to be turned on. We'll bet that many of the NHS's events took place during transports and that there was inadequate monitoring of the patients' pulse oximetry during those transports.

In addition to the improper use of the oxygen cylinders, NHS 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.

As far back as our April 8, 2008 Patient Safety Tip of the Week "Oxygen as a Medication" we noted that some studies showed oxygen ran out in as many as 55% of intrahospital transports and thus was born the "**Ticket to Ride**" concept. The latter, of course, is a checklist to be used during transports to remind all about not just ensuring adequate oxygen supply but also about many other important considerations during transports (see list of our prior columns on "Ticket to Ride" below).

In our September 1, 2015 Patient Safety Tip of the Week "Smarter Checklists" we were describing how we would develop a smart checklist for intrahospital transports. In that

we included the following statement: "Conceivably, the amount of oxygen remaining in the oxygen cylinder might be populated in the checklist automatically via Bluetooth or other wireless technology." That is because oxygen runs out in a substantial number of intrahospital transports (not just the transport but also the stay in the area to which the transport occurred, such as radiology). Because manually checking the gauge on the oxygen canister is often a forgotten step before transporting patients, it would be useful to have a technological tool that flags inadequate oxygen supplies.

In our November 2016 What's New in the Patient Safety World column "Oxygen Tank Monitoring" we described use of electronic notification technology to deliver real-time alerts about oxygen cylinder status. But we did have a couple caveats about use of such potential electronic notification technologies. One is that most rely on battery power (or at least battery backup) and batteries may run low (see our February 4, 2014 Patient Safety Tip of the Week "But What If the Battery Runs Low?" for examples of problems that might arise when batteries run low). Another potential problem is that methods of electronic communication (Bluetooth, Wi-Fi, etc.) may not work in all locations. And, most importantly, complacency may become an issue in that staff may presume the oxygen cylinder is full because they have not received a notification that it is not.

We've noted other issues with oxygen cylinders before. In our August 11, 2015 Patient Safety Tip of the Week "New Oxygen Guidelines: Thoracic Society of Australia and NZ" we noted that one of the items we often check on Patient Safety Walk Rounds is the status of oxygen cylinders wherever they may be stored. You'd be surprised how often we find used (empty or partially empty) oxygen cylinders interspersed with full ones. Obviously, that is a serious patient safety vulnerability since one can readily see how in an emergency someone might grab an empty cylinder thinking it is full of oxygen.

In our August 11, 2015 Patient Safety Tip of the Week "New Oxygen Guidelines: Thoracic Society of Australia and NZ" we noted that some hospitals have a **Medical Gas Committee** that oversees all aspects related to oxygen (and other gas) use. Much like your Pharmacy and Therapeutics Committee this should be a multidisciplinary body with expertise from multiple departments (medical staff, nursing, respiratory therapy, central supply, biomedical engineering, etc.).

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), why not this one?

Some of our prior columns on 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"

Some of our prior columns pertaining to oxygen:

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?"

References:

NHS Patient Safety Alert. Risk of death and severe harm from failure to obtain and continue flow from oxygen cylinders. Alert reference number: NHS/PSA/W/2018/001; 9 January 2018
https://improvement.nhs.uk/uploads/documents/Patient_Safety_Alert_-_Failure_to_open_oxygen_cylinders.pdf

Healthcare Consulting
www.patientsafetysolutions.com

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