East of England Ambulance Service NHS Trust

Incident date: 21 October 2013
Date of Final Report: 23 January 2014
Investigating Manager:
Incident Type: Medication Incident
Incident Level: Level 1 Concise Investigation

Contents

1. Executive Summary

On 21 October 2013 an Ambulance Fleet Assistant was undertaking vehicle checks and identified that a Medical Air cylinder was connected to the Oxygen system on one of the ambulances and based upon the amount of gas left in the cylinder, had been utilised.

This suggested that crews had unwittingly administered Medical Air instead of Oxygen to an unknown number of patients.

A 'stop the line' approach was taken to review all ambulances and one other vehicle was found to be carrying Medical Air four days later.

Patient records have been sourced and reviewed for potential harm and there is no indication that the administration of Medical Air instead of oxygen has had an adverse effect on any patient.

The investigation has identified the following lessons from this incident:

- It is possible to connect F size medical air to an Oxygen circuit and steps should be taken to mitigate this risk.
    - A range of cylinders provided by British Oxygen Company (BOC) including Oxygen and Medical Air are fitted with a standard BS 341 No.3 (Bullnose) fitting which enables maladministration of gas.
- Oxygen and Medical Air should not be stored in the same location (gas locker).
- That training on medical gas identification should be improved.
- Staff should complete a Vehicle Daily Inspection where they check the contents of the ambulance gas locker, to ensure the correct cylinders are in place.
- There was an opportunity to prevent reoccurrence at an early stage, but the actions taken were ineffective. The investigations process was not documented appropriately which together prevented the Trust from taking further steps to prevent this, rather than a sole human barrier control measure.

The Investigating Officer has made the following recommendations:

- That training on medical gas cylinders identification should include medical air.
- That the Medical Air cylinders should be removed from the A&E site and transferred to a more appropriate site and access controlled to the relevant Acute Neonatal Transport Service staff only.
- That the requirement to complete a vehicle daily inspection should be emphasised.

- That the use of F size Medical Air cylinders should be discontinued as soon as BOC make a HX Medical Air cylinder available.
- That the Trust should commence negotiations to procure the HX medical air cylinders when it becomes available in June 2014.
    - The HX cylinder contains more gas and importantly has a Medical Air specific Schraeder valve which prevents incorrect connections. BOC have advised the Trust that HX medical air will be available by the end of June 2014.

2. Main Report

2.1 Concise description of the incident

On 21 October 2013 an Ambulance Fleet Assistant was undertaking vehicle checks and identified that a Medical Air cylinder was connected to the Oxygen system on one of the ambulances and based upon the amount of gas left in the cylinder, had been utilised.

This suggested that crews had unwittingly administered medical air instead of oxygen to an unknown number of patients. Upon review of the incident, it was identified that a similar incident was reported in June 2013, following the finding of two medical air cylinders on-board a Double Staffed Ambulance when the crew were completing their Vehicle Daily Inspection (VDI). This was investigated and the cylinders were removed from service. Control measures were put in place in the form of posters but this has proved insufficient to prevent a re-occurrence.

Since April 2013, each Medical Gas bottle supplied by BOC is bar coded to enable cylinder identification. In relation to the two later DATIX reports, we were able to identify the date the cylinder was delivered to Cambridge Ambulance Station.

Using the available bar code information it is possible to identify the maximum time the cylinder was available and potentially connected to the vehicles medical gas circuit. It has not been possible to identify when the cylinder was loaded into the vehicle. Even when the cylinder was installed in an ambulance it should be noted that the ambulance carried two cylinders so it is impossible to fully determine at which point and to which patients Medical Air was administered. The investigation has therefore looked at all patients who may have received Medical Air.

Gas delivered	Found on vehicle	Gas used (approx.)	Responses in window	Potential patients affected (conveyed)
23/9/13	18/10/13	2/3 cylinder, 830L	121	58
26/9/13	25/10/13	$^1/_2$ cylinder, 622 L	76	47

In relation to these incidents, 105 patients were conveyed in the vehicles and potentially received Medical Air.Within the period, these two vehicles were used on a total of 25 days, and crewed by 32 individual employees.

These incidents related to the use of Medical Air in an ambulance in error. The cylinder was marked as Medical Air and was connected to the vehicle oxygen system via an oxygen regulator. Historically oxygen cylinders are universally coloured black with a white top, by 2025 these cylinders will be painted white with the name of the name of the gas stencilled on the cylinder. Currently, medical air cylinders are grey with a black and white quartered top; again by 2025 these cylinders will be painted white with the name of the gas stencilled on the cylinder.

Illustration 1 shows that visually these cylinders are very different at present, however when the cupboard is closed, only the contents gauge is visible. If staff check only the volume of gas in the cylinder, there is no need to open the cupboard therefore different cylinders wouldn't be recorded.

Illustration 1.

In each case, the medical air was delivered to Station A where the Neonatal Transport vehicles source their medical gases. The Medical Gas cabinets at Station A are the standard Trust Medical Gas cabinets and are well lit by an overhead gantry and strip lights. Following previous thefts of Entonox, the door labels had been removed to minimise the occurrence of medical gas theft.

BOC were given no specific instruction to place Medical Air cylinders in a specific gas cabinet and the Oxygen and Medical Air would have been side by side.

An F size Medical Air cylinder holds 1280 Litres at 137 Bar. This volume and pressure is consistent with an F size Oxygen cylinder (1360 Litres and 137 Bar). The valve outlet specification of both cylinders conforms to BS 341 No.3 (Bullnose), which means that the valve outlet is fully compliant.

Other gases with BS 341 No.3 (Bullnose) fittings are:

Oxygen (Cylinder sizes: PD; AF; F; G)
Helium (F size)
Oxygen / Carbon Dioxide mixture (Cylinder sizes (F; G; J)
Air (Cylinder sizes: F; G)
Carbon Dioxide / Oxygen (Cylinder sizes: AV; L) 3 mixture strengths.
Carbon Dioxide / Air (Cylinder sizes: AV; L)
Carbon Dioxide / Nitrogen (Cylinder sizes: AV; L)

BOC are part way through a programme which will reduce the numbers of cylinders fitted with the BS 341 No.3 (Bullnose) fitting to minimise errors such as this. Removal of the Bullnose fitting on the Medical Air cylinders is part of this programme.

2.2 Background and context of incident

The East of England Ambulance Trust was created on 1st July 2006 and covers the six counties which make up the East of England - Bedfordshire, Cambridgeshire, Essex, Hertfordshire, Norfolk and Suffolk. The Trust provides a range of services, but is best known for the 999 Emergency Service.

Our diverse area is spread over about 7,500 square miles and contains a mix of rural, coastal and urban areas – from Watford to Wisbech and Cromer to Canvey Island.
Our services are tailored to meet the needs of each community's differing environmental and medical needs.

The Trust employs around 4,000 staff and 1,500 volunteers to deal with 929,134 999 calls every year. In addition the Trust handles more than one million non-emergency patient journeys to and from routine hospital appointments.

The East of England Ambulance Service uses large quantities of Oxygen, routinely uses Entonox, a mixture of Nitrous Oxide and Oxygen and uses limited quantities of Medical Air. Each cylinder is labelled and colour coded, colour coding is shown in BOC medical gas data sheet, Appendix 1.

Medical Air cylinders are only used by the Trust at one location where they are used by the Acute Neonatal Transfer Vehicle (ANTS). In these vehicles there is a requirement to ventilate neonates with an air and oxygen mixture to avoid oxygen induced retinopathy. Retinopathy is a potentially serious loss of vision which may be caused by over oxygenation in babies.

The ANTS was setup to support the transport and repatriation of babies between regional neonatal care centres. Initially hosted by the Trusts Accident and Emergency (A&E) team at the Station A, the ANTS team then moved to the nearby Station B. There was no movement in the provision of the British Oxygen Company (BOC) delivery of Medical Air which continued to be delivered to Station A on a one for one basis, where the gasses were stored in mixed lockers. The current Trust holding of medical air relates to just 17 F size cylinders. An F size cylinder is a cylinder containing around 1300 litres of gas depending on the product. it represents the largest cylinder routinely in use by the Trust.

2.3 Terms of reference

- Take immediate steps to identify if any other ambulances were carrying Medical Air in error;
- Identify the time span when the Medical Air could have been in use;
- Review Patient Care Records to determine if any harm had been caused by the potential administration of Medical Air.
- To identify any other instances and establish what actions were taken as a result
- To identify learning to prevent a recurrence.
- To take action that clearly identifies medical air until a long term solution can be completed.

2.4 Investigation Lead and Team

This investigation was led by Head of Operations Analysis.

BOC have been involved and communicated with throughout the investigation process.

2.5 Scope of investigation

This was a level one investigation into the processes which led to the administration of Medical Air instead of Oxygen. Actions taken as a result of the previous incident in June 2013 have also been reviewed for effectiveness.

2.6 Investigation type, process and methods used

The following steps were taken:

- Patient Care records retrieved and reviewed
- Duty Operations Team consulted with for information
- BOC participated in investigation and supplied key information
- Location of Medical Air storage has been reviewed

2.7 Time Line 0f Events

[redacted] Summary

'On performing VDI on vehicle was found to have 2 x cylinders of Medical Air on board rather than Medical Oxygen. One cylinder had run out & was empty, the other cylinder was full'.

Following the investigation of this DATIX, it is clear that significant steps had been taken at Station A to ensure that the contents of each cabinet were readily understood, this included attaching BOC information sheets to the inner face of medical gas cabinet door. The keys to the Medical Gas cabinet are kept in a key safe within the garage area; a further BOC Medical gas identification chart is immediately next to the key safe.

The steps taken were not documented within the DATIX ID .

The manager signing the DATIX off (who has since left the Trust) had no recollection of this DATIX and felt it may have been missed amongst the many low level DATIX reports.

There was no escalation of this incident and it was therefore not considered by the SI panel.

There is anecdotal evidence that a further near-miss occurred around this time where a member of staff with the incorrect gas mounted in a gas cylinder trolley was stopped and challenged, this incident although recalled by two managers was not documented at all.

[redacted]Summary:

‘[redacted] located at , Peterborough.

One of the AFA's made a comment regarding one of the two F size cylinders on this vehicle. ‘’On inspection, I noted that the right hand cylinder was marked as Medical Air and was connected to the vehicle oxygen system via an oxygen regulator”.

Findings from this incident are documented in the body of this report.

As a result of taking immediate action to communicate a requirement to check all DSA’s a further Medical Air cylinder was identified on a DSA and reported in October 2013. This work enabled the Trust to identify the location of its full Medical Gas holding.

[redacted]Summary:

“One of my crews collected back from Station C this morning (25/10/13) and found one of the 'F' Size Medical Air cylinders in the vehicle's O2 cupboard”.

It was in the harness - but was fortunately not connected up to the plumbing. It had a note attached to it (photos attached to Datix).’ (Note states DO NOT USE, MEDICAL AIR).

Findings from this incident are documented in the body of this report.

2.8 Involvement of patient / relatives

The CAD reference numbers of the 105 ambulance journeys were identified and the patient care records were reviewed by the Trust’s Clinical Records department under the direction of the Consultant Paramedic.

This search was only able to identify 62% of the expected Patient Care Records. The Consultant Paramedic reviewed these and identified five patients who were documented as receiving Oxygen but who had low levels of Oxygen Saturation, these were subject to further review and peer review. Following this review no patient harm has been identified. In the interests of transparency, the Trust is contacting the five patients who had low oxygen saturation levels.

2.9 Involvement and support of staff concerned

The investigator of the initial incident in June was interviewed to establish the rationale for the actions undertaken.

The Duty Operational Management Team were invited to contribute. All of the identified clinicians were contacted and invited to contribute to the investigation and asked to identify any patient episode where they had noted that the patient did not respond to Oxygen therapy.

2.10 Notable practice

The Trust responded to the report with a 'Stop the Line' with an action that required every ambulance to be checked over the course of a weekend. This was carried out swiftly and was successful in locating a further cylinder and so preventing any further potential harm.

2.11 Detection of incident

The DATIX was raised as a consequence of an Ambulance Fleet Assistant checking a vehicle, identifying the incorrect cylinder and ensuring it was reported through DATIX.

2.12 Care and service delivery problems

Care Delivery Problem:

Incorrect medical gas was administered to up to 105 patients in the place of oxygen. There was therefore a care delivery problem in terms of unknowingly withholding Oxygen Therapy, which was the clinicians' intended treatment.

Service Delivery Problem:

Inadequate controls around specialist medical gas management have led to the connection of Medical Air instead of Oxygen within the ambulance on three known occasions.

2.13 Contributory Factors

- Completion of a thorough Vehicle Daily Inspection at any point of between the incorrect connection of Medical Air to the ambulance and the identification of the error would have resulted in more timely identification of the mistake and prevented exposing patients to potential harm. Whilst staff confirmed they had completed VDIs, no evidence could be found and if a VDI had been undertaken, the Medical Air would have been identified and removed.
- Oxygen and Medical Air cylinders were stored side by side in the same locker resulting in a lack of preventive measure for confusing the two.
- Medical Air cylinders were stored on a site away from the location of the specialist vehicles which use this gas. The staff at the storage location had received no training in relation to Medical Air, as they do not utilise it.
- In-effective action of earlier incident in June 2013 to ensure medical air was clearly identified and separated within the medical gas store.

- The design of medical air and oxygen cylinders.
- The Medical Air cylinder design enables the cylinder to be connected to the ambulance Oxygen circuit.

2.14 Root Cause Analysis

There is no single root cause. This incident occurred as all existing barriers, as identified in the contributing factors failed together.

2.15 Lessons learnt.

- It is possible to connect F size medical air to an Oxygen circuit and steps should be taken to mitigate this risk.
    - A range of cylinders provided by BOC including Oxygen and Medical Air are fitted with a standard BS 341 No.3 (Bullnose) fitting which enables maladministration of gas.
- Oxygen and Medical Air should not be stored in the same location (gas locker).
- Lack of appropriate action.
- That training on medical gas identification should be improved.
    - It should be noted that this is the **only** Ambulance Trust location in the country that receives a supply of Medical air from BOC, a major gas supplier.
- Staff should complete a Vehicle Daily Inspection where they must check the cylinders to ensure it is oxygen (including the contents gauge) in the ambulance gas locker.
- There was an opportunity to prevent reoccurrence at an early stage, but the actions taken were ineffective and the investigations process was not documented appropriately which together prevented the Trust from considering further measures to ensure that it would not occur.

2.16 Recommendations

- That training on medical gas cylinder identification should include medical air.
- That the Medical Air cylinders should be transferred to the Paddocks and access controlled to the relevant ANTS staff only.
- That the requirement to complete a Vehicle Daily Inspection should be emphasised.
- That the use of F size Medical Air cylinder should be discontinued as soon as BOC make a HX Medical Air cylinder available.
    - The HX cylinder contains more gas and importantly has a Medical Air specific Schraeder valve which prevents incorrect connections. BOC have advised the Trust that HX medical air will be available by the end of June 2014.
- That the Trust should commence negotiations to procure the HX medical air cylinders when it becomes available in June 2014.

- All managers are reminded of their responsibilities in relation to DATIX investigations and that on-going support and performance monitoring is embedded.

2.17 Arrangements for shared learning

A copy of this Report will be circulated to all General Managers in the Trust and shared with BOC who have been fully involved in this investigation throughout, where appropriate.