Carbon Monoxide

‘The Silent Killer’

Feasibility Study

2009/2010

Andrew Humber

February 2012
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index</td>
<td>2</td>
</tr>
<tr>
<td>Foreword</td>
<td>3</td>
</tr>
<tr>
<td>Summary</td>
<td>4</td>
</tr>
<tr>
<td>Introduction</td>
<td>5</td>
</tr>
<tr>
<td>Recommendations from 2009 Study</td>
<td>5</td>
</tr>
<tr>
<td>Patient Assessment Tools</td>
<td>8</td>
</tr>
<tr>
<td>Supporting Evidence</td>
<td>9</td>
</tr>
<tr>
<td>Case Studies</td>
<td>13</td>
</tr>
<tr>
<td>Limitations</td>
<td>17</td>
</tr>
<tr>
<td>Conclusions</td>
<td>19</td>
</tr>
<tr>
<td>References</td>
<td>19</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>20</td>
</tr>
</tbody>
</table>
The need for ambulance staff to promptly and accurately assess and diagnose patients suffering from exposure to Carbon Monoxide (CO) poisoning is absolutely vital for the benefit and safety of patients and healthcare professionals.

This paper by Andrew Humber of the London Ambulance Service, written following a feasibility study undertaken by him, illustrates the importance of good and credible information to emergency services staff to enable the correct and effective clinical management of patients suffering from exposure to CO.

This paper seeks to raise awareness of the issue and makes a number of recommendations aimed at health care professionals and the other emergency services.

Russ Mansford
Strategic Ambulance Adviser
Department of Health
Summary

Carbon monoxide (CO) is a colourless, odourless and tasteless, yet highly toxic gas produced by the partial oxidation of carbon. Sources include malfunctioning gas appliances, exhaust gases / emissions and burning of other solid fuels. This list is not exhaustive. The Gas Safety Trust Carbon Monoxide Incident report (2010) reported that ‘The number of carbon monoxide incidents associated with domestic natural gas use reported during 2009/10 was 56 involving 115 casualties’. Although this study and results overlap with the gas safety trust statistics, there may not be a direct reflection. The number of incidents and intoxicated patients published in this study may reflect the difficulty with which casualty numbers and incidents are reported and collated both in London and nationally. Whilst this study has reported on a number of different causes of CO injury, individual organisations and support groups report on causes of CO injury specific to them and do not venture outside their remit and report on the other equally devastating causes of CO injury. The national casualty exposure figures have vastly reduced in recent years, whereas the number of recognised CO affected persons monitored in this study has increased in comparison with an earlier feasibility study conducted in London. This raises the question as to whether the national figures are reflective of all CO intoxications or just are specific to individual areas of concern.

A recent estimate from the Department of Health (DH) (September 2011), based on the Hospital Episode Statistics (HES) A&E database, suggests that approximately 4,000 people attend A&E each year diagnosed with carbon monoxide poisoning in England.

In 2009/10, 13 out of 172 units reporting in A&E HES recorded at least 50% of their cases with International Classification of Diseases (ICD 10), amounting to 1,000,000 records (6.5% of the total attendances recorded in A&E HES). Within these Trusts there were 255 attendances where carbon monoxide poisoning was recorded. On the assumption that these Trusts make up a representative sample of the country as a whole, a simple calculation scaling up to the England total would suggest there were about 4,000 attendances in total as a result of carbon monoxide poisoning.

Of the 255 recorded cases just over 40% were brought to A&E by ambulance. This gives an estimate of approximately 1600 cases per year for England arriving by ambulance.

In London a greater number of patients have been identified, treated and referred to the appropriate treatment centres. There has been a 72% increase in identified CO injured patients compared with the 2009 study. In turn there has been an increase in patients receiving definitive treatment for this debilitating injury. (Figure four)

Ambulance crews across the country are entrusted with the responsibility of identifying, treating and transporting CO injured patients but are not routinely equipped with the knowledge or monitoring equipment to aid their patient
assessment and make an informed decision on the correct treatment pathways. CO poisoning is a difficult injury to identify as a great many of the symptoms are prominent features in other diagnoses. This is a good indication for early patient monitoring which is discussed later in this report. There are some areas of good practice such as East Midlands Ambulance Service Trust (EMAS) where the ambulance crews have been given the supporting knowledge and equipment to assess and diagnose CO poisoning. Unfortunately EMAS do not currently collate records for CO incidents or the number of patients seen or treated. Ambulance Services need to recognise that CO poisoning is a serious medical emergency and a potential risk to crews, and consider methods to increase surveillance and diagnosis. Statistics from the London Ambulance Service NHS Trust (LAS) (December 2009 – November 2010 inclusive) state that 251,473 patients were not conveyed to hospital following an ambulance attendance, of these 7554 (0.71%) were coded as “generally unwell” by the attending crew staff. Given the difficulty of making or excluding a diagnosis of CO poisoning, it is conceivable that some of these patients were displaying signs and symptoms of CO poisoning which were not detected or recognised by the attending staff.

The feasibility study of 2009 produced statistics for London alone. It was decided to expand the study to three other urban sites where the same vehicles and staff with the same training Hazardous Area Response Team (HART) would be using the same identified equipment. There has been a prolonged delay in the publication of this study; this is attributed to operational demand pressures, resources, continued editing with current statistics and awaiting LAS approval.

Introduction

The 2009 feasibility study suggested that the LAS may not be as proficient in identifying CO intoxicated patients as other outside agencies had previously thought. It has been difficult in gaining data from any other ambulance service in regard to CO incidents, as many do not register CO as an individual cause of injury within their clinical coding categories. We have seen within the previous report and again within this study that ambulance crews are still being exposed needlessly and without adequate protection.

Recommendations from the 2009 feasibility study.

The 2009 study made several recommendations based upon the data collected, whilst many of the recommendations have been applauded and the rationale agreed with, it appears that there has been little if not no movement on all of these points.

- CO monitors for crew safety: The LAS initially took the lead with crew protection. A group was formed and it was asked to investigate and source a
personal CO alarm that could be trialled by the personnel employed on Rapid Response Units (RRUs) to quantify the threat that CO exposure poses to ambulance crew health and safety. The LAS bought four Drager CO badges which were issued to individual personnel working on the RRUs; this equates to approximately 3% of the work force on RRU deployment. A proportion of the personal alarms were returned or not used by the selected staff due to the on / off alarm sounding every minute which was found to be distracting to the staff when driving and assessing patients. This could have been avoided if the purchaser had sought advice from people who were familiar with the equipment. During the trial period, the LAS attended 1 046 819 calls with RRU’s attending 289 347, (28%) of these. Only 3% of the RRU staff who attended these calls were supported by a personal CO alarm if they had not already returned the device issued to them. Due to the limited data and limitations of the trial and in the absence of a detailed report on the use of CO alarms, the potential danger to staff from CO cannot be established.

- **CO monitors to aid patient diagnosis:** The East Midlands Ambulance Service NHS Trust enabled a large number of their Lifepak 15 defibrillators to monitor for CO. Unfortunately this dynamic lead has not been followed by most other ambulance services. Reasons given for the non-activation of this feature on the monitors in the LAS include the associated cost of the finger probe and leads and a lack of drive for increased monitoring and definitive diagnosis of CO. Dr John Stephenson, Clinical Director, NHS East Midlands and now Ambulance Medical Advisor, National Ambulance Resilience Unit, Department of Health Emergency Preparedness Resilience and Response Branch stated “I was keen to introduce CO monitoring into the ambulance service for two reasons. Firstly to be able to assess which patients exposed to smoke in house fires required further treatment and assessment, therefore potentially decreasing hospital attendances and secondly the facility to detect elevated CO levels in patients when you are not looking for it. I was aware of a few cases when we were later advised of the cause of illness being CO poisoning and we had been unable to detect the problem meaning that staff had been exposed in the house and potentially also affected”. Dr. Stephenson also stated “CO monitoring became available in an affordable package when we introduced the Lifepak 15 in 2009 and since then there have been many occasions when we have been aware that CO may be an issue and been able to arrange appropriate care and advice”

- **Improved training and awareness for all health care providers / professionals:** There have been several significant awareness campaigns launched nationally, one of which was from the Chief Medical Officer and the Chief Nursing Officer published in November 2010\(^\text{(i)}\). Good areas of positive communication have been noted, such as West Midlands Ambulance Service
Trust publicising CO incidents both to ambulance staff and the local community via press releases.

- **Direct referral pathway for CO poisoned patients:** This has been a difficult task as currently hyperbaric units are private entities and do not sit within the NHS system. The lack of an A&E type receiving department is also a consideration and many are in relatively isolated locations. Although this does cause concern, it has been possible for the LAS to transport CO intoxicated patients to the Whipps Cross hospital A&E department where they are met by the specialised staff from the hyperbaric unit and assessed further. This pathway has reduced the exposure to treatment time dramatically and the direct referral time is well below the recommended exposure to treatment time of six hours \(^{(ii)}\). Following the implementation of pre-hospital monitoring of CO, hyperbaric oxygen therapy (HBOT) within six hours of removal from scene has increased from 44.7% to 70.3%. During this same period, mean time spent in hospital has fallen from 41.7rs to 21.7hrs and complete resolution has increased from 62% to 72%. (Carbon monoxide audit the effect of HART on outcome in those treated with hyperbaric oxygen; 2011) HBOT is commented upon in the Chief Medical Officers CO bulletin; ‘HBOT is also thought to be of use for extensive exposure to CO and neurological damage is suspected, its use should be on a case by case basis’. Whipps Cross hospital hyperbaric unit is fairly unique that it is co-located with a large Emergency Department. This can be set out as a standard which would be an ideal, but unfortunately this is not reflected around the three other study sites.

- **Updated software within Ambulance control call taking system:** As all Ambulance Service Trusts use a range of different software from external agencies and companies which may not be based within the United Kingdom, it has proved very difficult to gain access to those responsible to affect change. It has already been stated that it is a difficult task to identify CO poisoning in the field, so to identify CO over the phone may prove more than a difficult task especially if it is a singular patient with non-specific symptoms.

- **A greater sharing of information between interested agencies:** As with the previous study, it has proved difficult gaining information from other national bodies and Ambulance Service Trusts. There seems to be a reluctance to release data or a willingness to concede that the data is not collected.

- **A National agency to collate CO incidents:** Although the idea of a sole agency collating CO incidents is thought by many departments and independent bodies to be ideal, this as of yet has not happened and seems unlikely to happen whilst a general sharing of information does not occur. An
agency to take the lead in this area (which will have to be designated centrally) may well help to identify the true incidence and impact of CO poisoning.

- **Legal requirement for all CO incidents to be reported:** This has been supported by all of the interested parties, but unfortunately no further progress has been made. Until this recommendation is actioned by the Government the situation will remain and the statistics will not reflect the true number of CO victims from any source.

- **Rigid health surveillance for CO affected staff (all blue light responders):** Until all blue light services understand the potential dangers and long-term effects of CO can have on the individual, the status quo will remain and staff will potentially suffer the effects without relief or responsibility of the employer. It has been identified by the Fire services nationally that there is a risk to fire fighters inhaling this toxic gas during active fire fighting, raking over post fire and use of petrol driven rescue tools (Case study two). Despite this, there appears to be unwillingness for fire personnel to be monitored after the event by equipped ambulance service responders.

**Patient Assessment Tools**

Four sites were selected for the feasibility study. The demographics, community mix and social economic status were considered so that the target areas would be similar. The West Midlands, the North East, Yorkshire and London were the sites where the equipment was circulated. Each site was given a Masimo RAD-57 and four ToxCO exhaled air monitors. (iii) (iv) (v) (vi)

The project leads and other personnel were given a familiarisation and education package which included the signs, symptoms and incident history taking that forms the majority of the diagnosis, which is then supported by the chosen equipment. They were asked to cascade training to the other personnel who were using the equipment for the length of the project. The vehicles in which the equipment was placed was not specified; it was the experience and knowledge of the site leads which depicted the vehicles chosen. (Each HART unit deploys the vehicles dependent upon staffing levels and local Standard Operating Procedures (SOPs)). It was specified however, that one item of equipment was to be used on the rapid response units (RRU) assessing all patients as part of the normal generic patient observations.
Figure one (Incident type)

Figure one illustrates the diverse type of CO related incidents and the percentage of patients that have been monitored at these incidents during the study period. The “other” category include persons using charcoal for heating, faulty domestic cookers and persons exposed to CO and complaining of symptoms some time later where the source was unable to be identified.
Figure Two (Patient Exposure)

Figure two displays the percentage of the patients who were through monitoring to have a 5% higher level of SpCO (Carboxyhemoglobin saturation) than what would have been expected. Considerations were taken in to account whether patients had recently smoked a cigarette or were confirmed as persons who had smoked over a long term period as this type of patient would be expected to display a residual level of CO. Figure two suggests that although more patients were monitored at the scene of a fire that had smoke inhalation, (as displayed in figure one) it was the CO exposure in the domestic setting that created a bigger risk to health within the CO intoxication remit.
Figure three (Number of CO incidents attended by HART units in the four Trusts)

Figure three shows the incidents in the individual ambulance services. As previously mentioned, the figures for London are greater than the other Trusts. Whilst this might reflect that other sites had a reduced number of incidents, it could also reflect incidents were unreported to the respective Trust or that the HART units were not assigned due to a number of factors. Unfortunately it has not been possible to collate the number of incidents where CO has been a factor which other agencies were aware of but, the statutory ambulance service had no knowledge, or of how or if the patients were transported and where or if they had received treatment.
Figure Four shows the comparison between patients identified in London during the two studies. The difference in the figures can possibly be explained by the impact of education and awareness packages supplied to the respective departments in the LAS by London HART. The peaks in June and July were attributed to industrial incidents where a number of work personnel had become affected by CO during their working day. Other than that the seasonal trend is as expected. These are incidents that HART have attended; from the results of the 2009 study the LAS produced an incident code for CO and from this, information from the LAS Management Information Department states that the LAS attended during the time span of this project 271 patients where CO was attributed as the cause of injury, from this number HART attended twelve of these calls. The other calls that HART attended had been mis-coded by the receiving ambulance crews and therefore were not captured by the information sweep. PRF codes used by the receiving ambulance crew for confirmed CO intoxicated patients include difficulty in breathing, chest pain, poisoning and generally unwell. This needs to be addressed in the education / information drop to all ambulance stations and drawn to the attention of the personnel during the PRF review / feedback sessions which all staff undertake. The issue of coding errors should also be considered, how many diagnosed patients are being mis-coded and therefore do not figure within the data gained? Considering Figure four, if HART had attended all the calls which the LAS codes indicated, the graph would have been even more dramatic than shown, although there was a 72% increase of confirmed CO affected patients in London monitored by HART from the previous study. (This figure does not include the incidents attended by the LAS where HART were not involved)
**CO Case review**

The case studies in the report will demonstrate areas of good practice from the initial call taking to diagnosis, treatment and then transportation to definitive effective treatment centres. Case studies will also illustrate areas where improvement in CO recognition, diagnosis and treatment not only in the pre-hospital setting is needed. Mis-diagnosis or failure to identify CO symptoms in one case led to further exposure, a delay in the correct treatment and placed an ambulance crew at risk. The case studies used have occurred since the previous study and are being used to emphasise the varied problems encountered in the pre-hospital field.

**Undiagnosed CO poisoning**

An ambulance was called a 24yr male who had fainted at work. The male was in an enclosed area using petrol powered concrete cutting equipment; other powered tools similar to this were also being used. The patient had been unconscious and was complaining of dizziness on the crew arrival. All observations were in normal parameters apart from him being tachycardic for no obvious reason. The ambulance crew took the patient to hospital and diagnosed a fainting episode. Approximately two hours later the ambulance service received a call back to the industrial site as several members of staff were feeling unwell with nausea, vomiting and dizziness although none had lost consciousness. Eleven further patients were identified with SpCO of between 13 and 26%; all were transported to hospital and treated for the effects of CO poisoning. The first crew on scene noted that it was a hot environment and were aware of the power tools being used but did not think of the possible CO implication. If CO had been detected in the first patient or the crew were alerted through a personal CO alarm then the other persons involved would not have been further exposed.

- **Recommendation:** Patient CO monitoring on all front line Ambulance Service vehicles
CO risks caused by Blue light responders

A 999 call was placed to an Ambulance Service and Fire and Rescue Service stating four persons had been trapped in a broken down lift for over two hours. As there was no way of releasing the entrapped persons or lowering the lift, the fire personnel on scene decided to cut an escape hole in the roof of the lift. In doing so they used a petrol driven tool; this produced a CO enhanced environment of up to fifty-one parts per million (PPM) in a confined space, (As monitored by HART personnel once on scene and safety measures put in place to protect all staff from CO injury). Neither the fire or ambulance staff were protected against the toxic inhalant during this elongated process before monitoring; therefore approximately ten staff were unnecessarily exposed. While it is the responsibility of all staff to maintain their own health and safety and those who may be affected by their actions, the overall responsibility is of the Ambulance and Fire Officers on scene to be aware of the dangers and potential dangers to which their personnel are and maybe exposed to and to, and put into place work restraints to protect the staff on scene.

- **Recommendation:** Education of all Blue light responders on the potential dangers of CO in all environments.

Crew staff safety

An ambulance was called to a private residential house to a 57yr male that had collapsed; on arrival they were given the history that the patient had entered a room to find his son on the floor for an unknown reason, he then in turn felt unwell himself and fainted. The initial assessment by the ambulance crew stated that food poisoning could be the cause as both patients were vomiting. Once the patients had been assessed at the hospital, CO was shown to be the cause. Further ambulance resources, HART and the police were sent to the address where two other brothers were found to be suffering from CO intoxication. All four patients were assessed at the local A&E department and then transferred for hyperbaric treatment. The original ambulance crew were on scene in excess of thirty minutes within the property and therefore were at risk from the exposure to CO. If they had the opportunity to have a CO warning device or have a type of patient CO monitoring equipment it would have served several purposes. First it would have warned the crew that they were or had been in a CO enriched environment and secondly, the patients would have received the correct treatment / referral pathway. Thirdly, the other residents in the property would also have been assessed and treated and not left on scene and been intoxicated further.

- **Recommendation:** CO alarms to be fitted to all oxygen / first response bags
Direct referral to a hyperbaric unit

At 0921hrs an Ambulance Service received a 999 call to a 26yr female who had fainted, her mother had also fainted previously in the residential property. An ambulance, RRU, Ambulance Officer and HART were dispatched to scene. On arrival a further two patients were identified, making four in total and they were all standing by the front door of the property as requested by the respective Ambulance Control. All of the patients were displaying the classic symptoms of CO intoxication. On the arrival of the HART unit all patients were monitored and found to have CO levels (SpCO) of 26 to 28%. A telephone call was made to a hyperbaric unit, all the patients were accepted by the unit and transportation was arranged. The patients arrived at the hospital at 1123hrs where upon they were received in the A&E department, assessed by the hyperbaric team and then taken to the hyperbaric unit for treatment. The first treatment started at 1340hrs. The patients received three treatments and were discharged after twenty-three hours fifty minutes after a complete resolution of all of the symptoms. Going straight to the correct receiving treatment centre and not necessarily the nearest A&E department prevented a delay in definitive treatment, further transportation, a prolonged hospital stay in either hospital and all the associated costs surrounding this type of care. As previously stated, it is unfortunate although this was a confirmed CO incident, the coding placed on the ambulance PRF was incorrect and would not feature in any statistics on CO incidents if an audit was conducted by the ambulance service or outside agency.

The following page indicates encouraging statistics that have been gained since the partnership between London HART and the Whipps Cross hyperbaric unit and shows the benefit both to the patient and also to the receiving hospital in terms of reduced CO intoxication duration and inpatient time.

- **Recommendation:** A research study conducted into the benefits of early detection, referral and definitive treatment pathways of CO injured patients.
Hazardous Area Response Teams Improve Outcome with Hyperbaric Oxygen in Carbon Monoxide poisoning

We looked at cases of CO poisoning treated at London Hyperbaric Medicine before and after HART started to see whether there was an improvement in outcome.

Results:

Table1: Important outcome measures in CO poisoning treated with HBO before and after the start of HART

<table>
<thead>
<tr>
<th></th>
<th>Before HART</th>
<th>After HART</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean pH</td>
<td>7.391</td>
<td>7.392</td>
</tr>
<tr>
<td>Mean BE</td>
<td>-2.4</td>
<td>-1.7</td>
</tr>
<tr>
<td>Mean No of HBO sessions within 24hrs</td>
<td>1.87</td>
<td>2.08</td>
</tr>
<tr>
<td>Proportion of cases receiving HBO within 6 hrs</td>
<td>44.7%</td>
<td>70.3%</td>
</tr>
<tr>
<td>Mean time from removal from source to hospital discharge</td>
<td>41.7hrs</td>
<td>21.7hrs</td>
</tr>
<tr>
<td>Proportion of cases which achieved complete resolution of symptoms</td>
<td>62%</td>
<td>72%</td>
</tr>
</tbody>
</table>

pH=-log$_{10}$ H$^+$ion concentration, BE=Base excess, HART=Hazardous Area Response Teams, HBO=Hyperbaric Oxygen, CO=Carbon Monoxide

Conclusions from Table one

3 HBO treatments within 24hrs, beginning within 6 hrs of removal, are industry standards.
Judged by loss of consciousness, the cases were sicker before HART started and are sicker compared to DOH figures.

Number of HBO within 24hrs is only very slightly better (1.8 vs 2.0 sessions)

Time from removal to HBO is better with Hart (44% vs 70%)

Average time spent in hospital is considerably better with Hart (41 vs 21 hrs)

Complete resolution after HBO is better with Hart (62% vs 72%)

The demographics of Table one

95 Cases (2007 to 2010)

27 HART Referrals

44 Male

51 Female

Mean Age 38 (7 to 81yrs)

5 Pregnancies

13 Suicides

83 Acute/single exposures

12 Chronic/Multiple exposures

Limitations

The London Ambulance Service participated in the previous project of 2009; it was decided to involve other Ambulance Service Trusts in the 2010 study to ascertain whether the data gained was specific to London or would be reflected in other UK locations. Three other ambulance services were identified after consultation meetings were held with a number of interested parties and the sponsor within the Department of Health. North West, West Midlands and Yorkshire Ambulance Service NHS Trusts were chosen. Within each Trust a study lead was selected and a communication network was formed with project information and references being sent to each. Training dates were set for each of the Trust leads who were then expected to cascade training to the other members of the HART unit. Due to
operational needs, sickness and pre-planned training a number of training dates had to be rescheduled in the three new sites. North West Ambulance Service Trust received the training on the live date which delayed the project within this Trust. Furthermore, it became apparent two months into the study that some members of staff had not received full training in the equipment and were unable to complete the required documentation when attending a suspected CO incident, presumably due to the training not being cascaded.

During the study year it became apparent that the attendance at CO incidents and the return of the research documentation from the three Trusts was at best, hit and miss. CO incidents had been reported in the catchment areas by the Heath Protection Agency (HPA) which had not been reported to the study or attended by the HART units. The non-reporting of the incidents cannot be explained by lack of supporting documentation as this was freely available to all staff in those units. Consultation with the study leads suggests that the HART units may not have attended all CO incidents due to a number of outside factors including HART not informed or activated by the ambulance control, the ambulance service employees not aware of the CO monitoring capability and the distance to scene was deemed too far to justify a delay in patient transportation to treatment centre, with some journeys being in excess of ninety minutes.

The study lead for the Yorkshire Ambulance Service HART decided to change the way their staff reported incidents and the format of the forms. As a result, the study could not use the documents and results supplied after the first three months as essential information with regards to smokers and non smokers was removed from the replacement document and there was no way of regaining the missing data.

These examples illustrate the differences between Trusts in the completed documentation in comparison the forms completed by London HART. Unfortunately this has may have a big impact on the information collected and makes interpretation of the data more difficult. The figures suggest that London has a greater incidence of CO related injury than the other regions, but this may simply be the consequence of differences between Trusts in completing the documentation.

There were areas of good practise amongst the Trusts, West Midlands Ambulance Service NHS Trust used the CO incidents they attended to publicise the dangers of CO in the local newspapers and the involvement of the Trust communications department increased the awareness in the region they cover. Links were also formed with CO awareness groups, which have proved a positive move as this also involves the local community.

With the problems faced in this study at a National level, it is proposed that this type of study will be undertaken from October 2013 for a calendar year. This will allow for
all included Trusts to bring into effect the reporting and communication mechanisms that have been missing which affected the data obtained during this study.

**Conclusions from this report**

The study of 2009 showed that ‘on many occasions ambulance personnel had been exposed to unidentified incidents of elevated CO concentration’, this still remains the case, although ambulance crew staff are becoming more aware of CO and how to identify a CO intoxicated patient or a potential CO incidents. This increase awareness is due to a number of factors.

- Information dissemination to all LAS staff
- Articles in LAS publications
- A willingness of the HART personnel in London to educate personnel on site at incidents.
- A greater understanding within all areas of operational staff ranging from the Emergency Operations Centre (EOC), the Officers, crews to the potential danger of CO.

As stated previously in this report, there was an increase of 72% of detected CO poisoned patients in comparison with the previous report of 2009. This is a mammoth step forward for the ambulance services as a whole and can only be beneficial for the public for who we strive to help.

**References**


iii. [http://www.masimo.co.uk/pdf/rad-57/LAB5525A.pdf](http://www.masimo.co.uk/pdf/rad-57/LAB5525A.pdf)


Acknowledgements

The author recognises the commitment to the project by the staff and management of all four Hazardous Area Response Team (HART) sites used in this study, the time and technical assistance of the Clinical Audit and Research Department (CARU) and the LAS Medical Directorate. The financial support and encouragement of LAS HART management team, and the Emergency Preparedness Department of the Department of Health (DH).
Intentionally left blank