Liquid Nitrogen
Learning lessons the hard way

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From: "XXX" <xxxx@imperial.ac.uk>
Date: 27 October 2011 11:45:22 GMT+01:00
To: "YYY" <yyyyy@imperial.ac.uk>

Subject: body found in lab at ANHS hospital

YYY,

ANO has just called me to say that a body has been found in a lab in our area at ANHS hospital, the deceased is a member of the hospital staff, a technician, and the lab is being treated as a crime scene.

I will get in touch with the principal investigator and offer assistance if needed

Regards

XXX
• This is still a crime scene
• I represent only Imperial College
Outline

• The incident
• Lessons learnt
Background

Imperial College London
- Top 10 globally ranked University
- Science only (teaching and research)
- 5-10% of the UK’s capacity for BSL3 laboratories
- Medical School

Terminology
- ‘Hospital or Trust’ = National Health Service (NHS) Hospital Trust
- ‘College’ = Imperial College London
Yellow = College space
Pink = Hospital space
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Pink = Hospital space
Initial findings

Victim was removing small amount of LN for snap freezing of biopsy tissue

No formal agreement allowing entry by Hospital staff into this room

Lone working/out of hours

Was wearing PPE (not sure precisely what)
Room was ventilated (>25ACH) albeit high level extract with low level supply

There was a visual indicator of ventilation performance
but....
Room ventilation was switched off
Plant room
Gas detection
Sensor and alarm were battery operated and no repeater outside of the room
Action by regulator

Room sealed (by the police)
Direction to leave undisturbed issued
Prohibition Notice served
Improvement Notice served
So what then?

- Immediate re-training for staff involved
- Immediate training and ‘PR’ for Trust staff
- Re-assess the College’s use of liquid nitrogen
- Review policy and Codes of Practice
Review of ‘policy’

Key questions:

• O₂ sensors - type, location and repeaters
• Warning systems for ventilation performance
• Risk assessment methodologies (calculations used)
• Lone working procedures
• Critical plant identification
• Plus usage, substitution, etc etc
Code of Practice
Liquid nitrogen - storage, use and transportation within College premises
What really did happen?
## TABLE I:
Effects and symptoms at differing breathable O2 levels (Source: BOC - Cryogenic Gas Risks)

<table>
<thead>
<tr>
<th>O₂ content (% vol)</th>
<th>Effects and symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-14%</td>
<td>Physical and intellectual performance diminishes without the person being aware.</td>
</tr>
<tr>
<td>8-11%</td>
<td>Possibility of fainting without prior warning.</td>
</tr>
<tr>
<td>6-8%</td>
<td>Fainting within a few minutes - resuscitation possible if carried out immediately.</td>
</tr>
<tr>
<td>0-6%</td>
<td>Fainting almost immediate, death ensues, brain damage even if resuscitated.</td>
</tr>
</tbody>
</table>
**GRAPH 9:**
Theoretical calculation for comparison (source: BCGA GN11 Reduced Oxygen Atmospheres).

**Assumptions:**
1 air change per hour in room.
Gas release rate = 185m³/hour

\[
C_t = 0.21 + \left( \frac{0.21n - 0.21}{L + n} \right) \left[ \frac{1}{V_T} \right] \left[ 1 - e^{-\frac{1}{m}} \right]
\]

(see footnote below)
So what happened?

Does it matter?
Would this have happened if...

- He had not been working alone?
- He was not using ‘borrowed’ space and equipment?
- The ventilation was on?
- He had checked that the ventilation was on?
- He had paid attention to the O₂ alarm
How could this have been prevented?

Control lone working

• Know what people are doing
• And what to do in the event of problems
How could this have been prevented?

Formal site partner arrangement

• Covering the use of shared space and equipment
• Plant rooms and labs
How could this have been prevented?

Critical plant

• Do you know where this all is?
• Who has access to the controls?
• And what about shared sites?
How could this have been prevented?

Control access to hazardous areas

• Think about specific rooms in shared spaces
• Think about the culture at the shared site
How could this have been prevented?

Training

- Use of liquid nitrogen
- Ventilation monitoring
- Gas alarms
- Lone working
Any questions?