United Lincolnshire Hospitals NHS
NHS Trust

Safe Handling of Dry Ice
SOP 18

SOP Title	Safe Handling of Dry Ice
SOP No.	SOP 18
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1. Purpose:

1.1 This standard operating procedure has been written to provide safety information and guidance to research staff working within ULHT in relation to the safe use, handling and temporary storage of dry ice.

1.2 Staff need to be aware that caution must be exercised when using dry ice in order to order to minimise the risks associated with its use.

1.3 HAZARD DESCRIPTION:

1.3.1 Dry ice is the solid form of carbon dioxide (CO2). Dry ice is available for use in the form of pellets, slices or blocks and may be supplied loose or in insulated containers

1.3.2 Dry Ice is very cold (-78.5°C). It sublimes (turns directly from a solid to a gas without passing through the liquid phase) to an asphyxiant gas (CO2) that is heavier than air. It is important to note that a little bit of dry ice will sublime to a large volume of gas and it should therefore be used only in well ventilated areas (BOC, 2014).

1.3.3 Dry Ice must be handled using appropriately insulated gloves. Contact with bare skin can result in severe cold burns or frostbite within a short period of time.

1.3.4 Use of dry ice in poorly ventilated areas can result in the depletion of the oxygen level resulting in asphyxiation. Symptoms may include increased respiration, headaches, nausea, vomiting, loss of mobility, loss of consciousness.

1.3.5 Placing dry ice into a tightly sealed container can produce sufficient gas build up to cause an explosion. This must be avoided.

2. Applies to:

2.1 This SOP applies to all ULHT staff required to handle dry ice as part of their involvement in clinical research.

3. Relevant SOP documentation:

SOP 09 - Training Record
SOP 17 – Safe Operation of -80 Degree Freezer (PHB)

4. Definitions:

ADR – "European Agreement concerning the International Carriage of Dangerous Goods by Road" - governs transnational transport of hazardous materials. Dry ice is not subject to ADR as it is not considered a dangerous good when transported by ground in Europe. However patient specimens transported using dry ice *are* subject to classification, packaging and labelling requirements under ADR.
COSHH – Control of Substances Hazardous to Health
LCRF – Lincolnshire Clinical Research Facility
REC – Research Ethics Committee
SOP – Standard Operating Procedure
ULHT – United Lincolnshire Hospitals NHS Trust
PPE – Personal Protective Equipment

5. Relevant Policies:

ULHT Control of Substances Hazardous to Health (COSHH) Policy and Procedures.

ULHT Health and Safety Risk Assessment Policy

ULHT Health and Safety (First Aid) Policy

The European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR)

Technical Instructions for the Safe Transport of Dangerous Goods by Air from the International Civil Aviation Organisation (ICAO)

The Dangerous Goods Regulations from the International Air Transport Association (IATA)

6. Procedure:

6.1 Dry Ice is increasingly used within the Trust for the purpose of temperature control during the transport of human specimens intended for use in clinical research. The donated samples may be in the form of peripheral blood and related products (e.g. plasma, serum, platelets etc.) and bone marrow. It may also be used for other types of tissue biopsies, for example, breast, skeletal, muscle and liver.

6.2 All samples transported, with or without dry ice, must have been donated by patients for use in active ethically approved clinical research projects, in accordance with the terms of documented consent and study specific REC favourable opinion

6.3 The investigator or delegated person should follow guidelines within the relevant study protocol, where available, for handling dry ice or follow the procedure outlined below.

6.4 Staff should also be aware that the use of dry ice is subject to the COSHH Regulations and should ensure that they are familiar with the COSHH assessment and related safety data sheet, available within the departmental Health and Safety Folder.

6.5 Staff should ensure that they have undertaken the SAFTPAK online training for the safe transport of Division 6.2 Infectious substances, biological specimens, dry ice and related materials, PRIOR to use of dry ice. This is to ensure research specimens transported using dry ice as a refrigerant have been appropriately classified, packaged and labelled in accordance with applicable transport regulations.

6.6 The investigator is responsible for ensuring that dry ice is handled in accordance with the study protocol. This duty can be delegated to other appropriately qualified members of the research team as recorded on the project delegation log.

6.7 The investigator or delegated person must only obtain dry ice in the form and quantity in which it is required, in order to avoid risks associated with surplus quantities of dry ice remaining on Trust premises.

6.8 The investigator or delegated person must request dry ice from the appropriate courier company as specified in the study protocol, or instructed by the study sponsor or sponsor representative (i.e. Trial Co-ordinator etc.).

6.9 The investigator or delegated person must inform the person in charge of the affected department, of the date and time that dry ice is expected to be in use within the area to ensure that all relevant personnel are aware of the use of dry ice within the area and its associated risks.

6.10 Staff using dry ice should ensure that there are sufficient personnel close by to summon assistance if there are any concerns. Where staff are working out of normal hours, or in less populated work areas, it is recommended that a buddy system is used.

6.11 The investigator or delegated person must ensure that appropriate personal protective equipment (PPE) is worn when handling dry ice. This includes wearing goggles to protect the eyes (which conform with EN 166 guidance on personal eye protection), cold insulating gloves (which conform

with EN 511 guidance on protective gloves against cold), and a long sleeved lab coat to ensure that the arms are covered. Appropriate PPE has been provided by the LCRF and is available for research staff use. PPE is located in the LCRF offices at LCH; within the LCRF lab at PHB and; at Grantham & District Hospital any dry ice is received, stored and despatched from the path lab, where appropriate PPE is kept. Where staff are unable to locate suitable personal protective equipment – they must immediately inform the Research Governance or relevant LCRF Manager who will ensure that equipment is made available. Staff must not attempt to handle dry ice without appropriate PPE.

6.12 The investigator or delegated person must store dry ice in an insulated container. This will help to reduce the rate of sublimation. Failure to do so will result in the dry ice subliming more quickly. An insulated container will be supplied from the courier company with the dry ice in it.

6.13 If there is too much dry ice and some needs to be decanted to allow the samples to be stored correctly and safely, decant the dry ice into an empty polystyrene container by hand using the insulated gloves, then follow the procedure in paragraph 6.20.

6.14 The investigator or delegated person must not store dry ice in a completely airtight container. The sublimation of dry ice to carbon dioxide gas will cause any airtight container to expand and possibly explode.

6.15 The investigator or delegated person must ensure that there is adequate ventilation where dry ice is stored / in use. Opening all windows and ensuring that dry ice is used within adequately sized rooms (i.e. not within small utility rooms) will assist with this. In poorly ventilated rooms carbon dioxide gas can sink to low areas and replace oxygenated air. This can be dangerous and could cause suffocation if breathed exclusively.

6.16 If at any point when in an area containing dry ice the investigator, delegated person or any other person within the area begins to feel unwell, have rapid breathing or cyanosis they, and all other personnel, must leave the area immediately and seek help. This could be an indication that too much carbon dioxide has been breathed in and not enough oxygen. Staff are reminded of the importance of reporting, via the DATIX system, ALL accidents/incidents and near misses regardless of their severity.

6.17 The investigator or delegated person must ensure that dry ice is not stored in a refrigerator or freezer. Dry ice can cause damage to the thermostat due to the very cold temperature of it. The dry ice will also continue to sublime, albeit at a slower rate, which over a prolonged period of time may lead to a large amount of carbon dioxide building up and escaping when the door is next opened.

6.18 The investigator or delegated person must try to have the dry ice collected by the designated courier company as close to the time that it is needed. Dry ice sublimates at 10% or approx. 2-5kg every 24 hours. The investigator or delegated person must ensure that the courier is aware that the package contains dry ice.

6.19 If at any point the investigator or delegated person sustains a burn or blister as a result of handling dry ice they must follow the first aid measures detailed below and inform either the Research Governance or relevant Clinical Research Facility Manager. An incident form must also be completed.

6.20 If there is an excess of dry ice the investigator or delegated person is responsible for its disposal. The dry ice should be unwrapped and left at room temperature in a well-ventilated area. The ice in time will sublimate from a solid to a gas. Dry ice must not be placed into a sink. The cold temperature may harm sink disposal and pipes. Care must also be taken to prevent entrance to drains, sewers, basements etc. where accumulation of CO2 could be dangerous.

6.21 The investigator or delegated person should wash their hands after handling dry ice in accordance with the ULHT Hand Hygiene Policy.

6.21 First Aid Measures
First Aid information is outlined within the safety data sheet (available within the health and safety folder and available online at: http://www.boconline.co.uk/en/sheq/safety-data-sheets/index.html
Information below has been taken from the BOC Safety Data Sheet (BOC Industrial Gases UK, 2012 & 2016).

6.21.1 **First Aid Inhalation:**
Attempts to rescue affected persons from confined spaces or where oxygen deficient atmospheres may be present should only be made by those trained in the use of breathing apparatus and confined space entry procedures. The Fire Brigade should be called in all instances where a trapped person requires rescue.

Low concentrations of CO2 cause increased respiration and headache. In high concentrations may cause asphyxiation. Symptoms may include loss of mobility/consciousness. Victim may not be aware of asphyxiation. If a person becomes dizzy, nauseous or loses consciousness while working with dry ice, move them and all personnel in the vicinity to a well-ventilated area immediately. If breathing has stopped, apply artificial respiration. Keep victim warm and rested and seek medical assistance.

6.21.2 **First Aid - Eye Contact:**
In case of frostbite spray or flush with lukewarm water for at least 15 minutes. Do not rub. Apply a sterile dressing. Get medical attention immediately.

6.21.3 **First Aid – Skin Contact:**
In case of frostbite spray with lukewarm water for at least 15 minutes. Do not rub. Apply a sterile dressing. Get medical attention.

6.21.4 **First Aid Ingestion:**
Swallowing must be absolutely avoided, since coldness and developing pressure could be dangerous. Obtain medical attention and take a copy of the Safety Data Sheet, if possible.

7. Responsibilities

7.1 Staff using dry ice should ensure that they are familiar with the relevant safety information within the health and safety folder. The Head of R&I is responsible for ensuring that this information is accessible to staff within the departmental shared folder.

7.2 Staff are responsible for ensuring they have undertaken the relevant training and have provided evidence to the Research Manager of having read and understood this SOP prior to using dry ice.

7.3 Staff are responsible for ensuring that they wear the appropriate personal protective equipment (PPE) provided, namely gloves, eye goggles and lab coat.

8. References:

BOC Industrial Gases UK (2005). Guidelines for the Safe Transportation, Storage, Use and Disposal of Dry Ice Products [online], Available at: http://www.boconline.co.uk/internet.lg.lg.gbr/en/images/dry-ice-bcga-guidelines410_39540.pdf

BOC Industrial Gases UK (2012). Safety Data Sheet, Carbon dioxide, solid (Dry ice) [online], Available at: http://www.boconline.co.uk/internet.lg.lg.gbr/en/images/tg_9390_carbon_dioxide_solid410_55520.pdf [No longer available at 28/02/2018 as superseded by below]

BOC Industrial Gases UK (2016). Safety Data Sheet, Carbon dioxide, solid (Dry ice) [online], Available at: https://www.boconline.co.uk/internet.lg.lg.gbr/en/images/tg-9390-carbon-dioxide-solid-v1.3410_39610.pdf?v=5.0

DryiceInfo.com (2011). SAFE HANDLING OF DRY ICE [online], Available at: http://www.dryiceinfo.com/safe.htm

SAFTPAK (2014). Compliance Training Reference Manual - The Safe Transport of Division 6.2 Infectious Substances, Biological Substances, Dry Ice & Related Materials. *(N.B. Copy Available within LCRF)*

We would like to thank Sheffield Clinical Research Facility for their kind permission in the adoption of some parts of their SOP entitled 'Safe Handling of Dry Ice'.

This SOP will be reviewed every 2 years unless changes to legislation require otherwise

Current versions of all SOPs are located on the LCRF website – users are responsible for ensuring that they are using the most up-to-date version.