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Introduction

With proper maintenance and in conjunction with good laboratory practices, a Biological Safety Cabinet (BSC) can provide effective primary containment for human pathogens. At St. Michael's, BSCs are used for work likely to create a bioaerosol and involving high concentrations or large quantities of infectious or hazardous material.
This SOP will detail the policies and practices in place to work safely and maintain optimum containment in a BSC.

Associated Procedure

Start-up procedure for BSC

- Turn **on** fluorescent light (button on front) and cabinet blower by raising the front sash of the BSC to the designated height. Allow the unit to run for 5 minutes to purge the BSC
- Check the air intake and exhaust grilles for obstructions
- If the cabinet is equipped with an alarm, test the alarm and switch it to the "on" position.
- Confirm inward airflow by holding a tissue at the middle of the edge of the viewing panel and ensuring that it is drawn in
- Disinfect the interior surfaces with a suitable, noncorrosive disinfectant e.g. 70% Ethanol or 10% Virox (Accelerated Hydrogen Peroxide)
- Assemble all materials required for the procedure and load them into the cabinet; do not obstruct the air grills or opening; the working surface may be lined with absorbent paper with plastic backing; segregate "clean" items from "contaminated" items

Work procedure

- Don protective clothing and gloves and insert arms into hood at a 90 degree angle
- Perform operations towards the middle of the cabinet at least 6" from sash
- Avoid movement of materials or excessive movement of hands and arms through the front access opening during use; when you do enter or exit the cabinet, do so from

straight on (90 degree angle); allow the cabinet to establish laminar flow for 10 seconds before resuming work

- Segregate contaminated material towards the rear of the cabinet; do not discard materials in containers outside of the cabinet
- Do **not** work with open flames inside the cabinet
- Before using a vacuum line, ensure that there is fresh concentrated bleach in the collection flask
- **Clean up spills** as soon as they occur. Disinfection should be with 10% Virox solution. **Do not use** bleach as this will damage the work surfaces of the BSC. If necessary, remove and disinfect the grill remember to clean under it
- If the spill was relatively large or contained concentrated infective material then allow the cabinet to sit undisturbed for at least 5 (five) minutes for aerosols to clear before beginning cleanup. While you wait remove and disinfect or dispose appropriately of contaminated personal protective equipment (PPE). Don fresh PPE and proceed with spill cleanup. Remember to allow appropriate contact time for the disinfectant (around 15 minutes).

Upon completion of the work

- Allow the cabinet to run for 5 minutes with no activity
- Close or cover open containers before removing them from the cabinet
- Surface-disinfect objects in contact with contaminated material before removal from the cabinet
- Remove contaminated gloves and dispose of them as appropriate; wash hands
- Don clean gloves and ensure that waste is placed into biohazard bags within the cabinet
- Use 10% Virox disinfect on the interior surfaces of cabinet; periodically remove the grills and interior working surfaces of the BSC and disinfect the area beneath it (including the catch pan)
- Turn off the fluorescent light and cabinet blower by returning sash to designated lower height when appropriate (some cabinets must be left on at all times; if you are unsure, check with your cabinet certifier, safety officer or building maintenance personnel)
- Use of the germicidal UV light as is **not** recommended

Recently new guidelines have been published that show that UV decontamination has serious limitations. In particular;

-the risk of exposure to workers
-the lack of penetration power
-the sharp decline in decontamination associated with an aging lamp
-the mounting evidence that long term (read overnight) UV exposure causes damage to plastic and rubber

Guidelines from the CDC and NIH (*Primary Containment for Biohazards: Selection, Installation and Use of Biological Safety Cabinets, 2nd Ed*) now state that UV lamps are unnecessary, but if installed, lamps should be checked weekly in ensure that the right intensity of UV light is being emitted.

BSC Maintenance and certification

When used for biosafety containment level 2, biological safety cabinet performance must be

tested and certified:

- upon initial installation in the laboratory
- annually thereafter
- when moved from one area to another within the same room, or from one room to another
- whenever maintenance is carried out on internal parts, and whenever filters are changed

Maintenance and certification must be performed by accredited technicians. Please contact the BSO for approved companies.

Emergency Spill Procedure within the BSC

- Leave the BSC turned on
- Move slowly but deliberately within and around the cabinet to prevent disruption of air flow
- Remove contaminated gloves and discard within the cabinet. Remove lab coat if it has been contaminated and bag. Contaminated lab coats should be autoclaved before being returned to stores (B2 CC) for laundering
- Don fresh gloves
- Assemble clean up material in the spill kit. Put on a new lab coat and any other PPE you may have been wearing
- Use forceps to pick up any broken glass or sharps and place them in a sharps container **within the BSC**
- Cover the spill with absorbent paper. Allow liquid to be absorbed. Dispose of in a yellow biohazard bag **within the BSC**
- Pour 10% Virox over the area of the spill, beginning at the edge of the spill towards the middle using a gentle flooding action
- If you suspect that infectious material are in the catch tray, pour disinfectant through the grills
- Allow for a contact time of 30 minutes
- Absorb the liquid and dispose of in a yellow biohazard bag, **within the BSC**
- Decontaminate the outside of the bag before removing from the BSC
- Items that cannot be disposed must be wiped down thoroughly with an appropriate disinfectant inside the cabinet
- Wipe the inside of the cabinet with a disinfectant and let the BSC run for 10 minutes before resuming your work

Emergency BSC Failure

In case of BSC failure follow the following procedures:

- Immediately stop all work and close all containers within the hood
- Close the sash and wait for 30 minutes for aerosols to settle
- Remove your lab coat, gloves or any other personal protective equipment.
- After 30 minutes, disinfect the exterior of all items in the hood before removing from the BSC
- Inform your supervisor, the RBSO and if appropriate, your RCEF Coordinator about the

incident

- In case of the loss of containment, please report the incident to the hospital's tracking system

Definitions

Biological Safety Cabinet (BSC)

A BSC is an enclosed, ventilated laboratory workspace for safely working with materials contaminated with (or potentially contaminated with) pathogens or where there is the possibility of producing bio-aerosols. All exhaust air is HEPA-filtered as it exits the biosafety cabinet, removing harmful bacteria and viruses. Several different types of BSCs exist, differentiated by the degree of biocontainment required. At the LKSKI, all BSCs are type A2, defined as: A BSC that has a minimum inflow air velocity of 100 ft/min. The filtered makeup air is divided equally over the work surface at about two to six inches above the work surface. Exhaust is drawn at the bottom of the cabinet where it rises to the top. At the top of the cabinet, 70% of the air re-circulates through the supply HEPA filter, the other 30% of air exhausted through the exhaust HEPA filter. This is due to the relative sizes of the two filters, and dampers typically allow the adjustment of this ratio. This type is not safe for work with hazardous chemicals except when ducted, usually with a "thimble" or canopy hood to avoid disturbing internal air flow.

HEPA filter

High-Efficiency Particulate Air or HEPA is a type of air filter which can remove up to 99.7% of airborne contaminates of 0.3um, the size of particle most difficult to filter. They are typically composed of a mat of randomly arranged fibres, these fibres typically being composed of fiberglass and particles stick to the filter by one of the following mechanisms:

1. *Interception*, where particles following a line of flow in the air stream come within one radius of a fibre and adhere to it.
2. *Impaction*, where larger particles are unable to avoid fibres by following the curving contours of the air stream and are forced to embed in one of them directly; this effect increases with diminishing fibre separation and higher air flow velocity.
3. *Diffusion*, an enhancing mechanism that is a result of the collision with gas molecules by the smallest particles, especially those below 0.1 µm in diameter, which are thereby impeded and delayed in their path through the filter; this behaviour is similar to Brownian motion and raises the probability that a particle will be stopped by either of the two mechanisms above; it becomes dominant at lower air flow velocities

It should be noted that HEPA filters do not filter out gasses or odours and thus are of no use when handling volatile chemicals.

References

Public Health Agency of Canada (PHAC), Canadian Biosafety Standards and Guidelines, 1st Edition, 2014

Canadian Food Inspection Agency (CFIA) Veterinary Standards for Animal Facilities

National Sanitation Foundation (NSF) Standard No. 49-2002 for the design, manufacture and testing of BSCs (NSF-49)

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