



Biosafety Challenges in a Multi-tenanted Animal High Containment Laboratory

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Overview of Challenges Faced

- Physical
 - Pressure regime
 - Caging system
- Occupational Health Program
 - Fear of the unknown
 - Vaccination program
 - Post exposure medical attention
 - Immuno-compromised individuals
- Material Management
 - Mixed waste (eg: animal carcasses inoculated with radioactive probes)
- Animal Movement
 - Imaging facility not within the boundary of high containment laboratory
- Others
 - IP issues when more than 1 commercial entity present
 - Biorisk communication with community within vicinity (scientific and laymen)

Overview of BRC's ABSL3

- Gazetted as Protected Place
- Surrounded by Specific Pathogen Free (SPF) facility
- 5 rooms served by a common corridor.
- Directional controlled entry and exit:
 - Entry Airlock – Common Corridor – Individual Room – Shower Cluster
- Entry Airlock doubles up as fumigation chamber at times of ¹*Special Operation*
- Additional support system:
 - Dedicated 2 way autoclaves
 - Building Automation System (BAS) control room offsite
 - Liquid waste treatment plant room
 - Dedicated ventilation system (Air Handling Units and Exhaust Fans)
- Facility is designed to enable compartmentalization for decontamination to take place without affecting adjacent room(s).

Physical Challenges: Pressure Regime

Ventilation and Pressure Regime:

- SPF's requirement: Keep things out
- ABSL3 requirement: Keep things in

Challenge: Prevent SPF's positive pressure to enter ABSL3 pressurizing the high containment during ABSL3 ventilation failures.

Does tying over ABSL3 ventilation failure to SPF ventilation cut-off solve the problem?

Physical Challenges: Animal Housing

Caging choices in BRC

1. Flexi-filmed Isolators

- flexible PVC canopy
- gloved oval sleeve (changeable)
- transfer port with hinged doors
- HEPA filtered supply and exhaust ventilation system provides complete bio-security with negative or positive pressure operation



2. Individually Caging System (with built-in containment)

- Hepa filter on the exhaust valve provides double filtration for the contaminated air in addition to the pre-filter.
- Twin clamps on the sides to evenly and securely distribute the closing pressure on the airtight seal to ensure biocontainment
- Hermetic ventilated cage and working at a highly consistent negative pressure and it is able to maintain the pressure mode when disconnected from the ventilating rack.

Physical Challenges: Animal Housing

Caging choices in BRC

1. Isolators

Real-life considerations and limitations

- Reduced cage number per floor space utilization
- Loss of dexterity
- Difficulty in carrying out delicate procedure
- Contact time (minimum 5-10 minutes) for disinfectant every time transfer port is opened at the “dirty” side.
- Risk of PVC canopy tear (especially at the welded sleeves)
- Ergonomic challenges due to wide range of users height
- Wear and tear of PVC
- Compatibility of PVC with decontamination agent adopted by facility.



Physical Challenges: Animal Housing

2. Individually Caging System (with built-in containment)



Real-life considerations and limitations

- Animal may suffocate in about 15 minutes (estimated) due to static pressure built up by the HEPA filter when cage is removed from rack system.
- Is the facility support (autoclaving, cage changing) able to cater to the drastic cage number increase with this system?
- Cages are airtight
 - Direct autoclaving will damage these cages.
 - Increased handling steps increase the risk of animal escape, spillage, exposures and labour time.

Any solution?

Physical Challenges: Animal Housings



OR



Considerations:

- Cost
- Experimental size
- Amount of manpower dedicated for the facility operation
- Capability of support system such as autoclaving, fumigation (if applicable)
- Workflow of the facility
- Material flow
- Holding space for waste, cages pending autoclaving

OHP Challenges: Fear of Unknown

- Words of fear started to spread over a cup of coffee when news of the facility is going hot.

Considerations:

- Education level of staff
- What platform is best to address this fear?
- Who is/are best person(s) to address this fear?
- Experience sharing

OHP Challenges : Vaccination Program

- It is a policy in BRC that someone who is identified to work in high containment lab to undergo mandatory medical assessment. If advised by the Occupational Health Specialist, vaccination will be given.
- **Considerations:**
- With 5 rooms, in reality, there may be 5 different agents present at any one time. With this worst case, one may be advised to be vaccinated with 5 different agents. Will this be acceptable?
- Is this practice an overkill?
- Will the cons outweigh the pros?
- Experience sharing

OHP Challenges : Post Exposure Medical Response

- It is established that if anyone is suspected to have exposed to any agents while working in ABSL3, the individual will be sent to nearest hospital by ambulance.
- **Considerations:**
 - The individual will definite not appearing to be requiring A&E attention
 - What if the person sits among other patients in A&E for hours?
 - Will this increase the risk of immediate community noting that most agents required BSL3 containments are air-borne?
 - Experience sharing

OHP Challenges : Immuno-compromised individuals

- In BRC, there is a policy to restrict individuals who are known to be immuno-compromised from working in high containment facility.
 - Pregnant ladies
 - Those undergoing chemo or radio-therapy
- **Considerations:**
 - AIDS patients
 - Those undergoing short term steroid therapy
 - Experience sharing

Material Management Challenges: Mixed Waste

- Mixed waste is referring to Waste which cannot be classified strictly into any specific category. Example is animal carcasses which had been inoculated with radioisotopes.
 - ^{111}In with a half-life of 2.8047 days
 - $^{99\text{m}}\text{Tc}$ with a half-life of 6 hours
 - ^{123}I with a half-life of 13.22 hours
- **Considerations:**
 - To treat the carcass as biohazard and autoclave it?
 - To hold for 10 half lives of radioisotopes (rule of thumb from CRPNS)?
 - Experience sharing

ANIMAL MOVEMENT CHALLENGES: Transfer live animals out of ABSL3 boundary

- Cross-disciplinary researches calls for more sophisticated imaging equipments to support experimental designs.
- No high containment laboratory in Singapore is equipped nor specialized to provide bio-imaging.
- **Considerations:**
 - To allow infected animals out of high containment?
 - To duplicate the imaging equipments in high containment?
 - Cost
 - Space
 - Waste handling
 - Experience sharing

OTHER CHALLENGES: Biorisk Communication

- There is a standing responsibility on the operator to communicate the risk present to the local community brought about by the activities, material, or operation of the facility.
- **Considerations:**
 - Is it wise to publicize the high risk activity to the following communities:
 - Scientific communities within Biopolis
 - Residential communities around Biopolis
 - Will the information attracts the attention of animal activists, parties who may harbour ill-intention such as terrorists?
 - Are these worries / concerns overboard in a peaceful country like Singapore?
 - Experience sharing

Conclusion & Recommendation

- Good understanding of workplace; both strength as well as weakness in the aspects such as operation, location, engineering design, manpower, management support etc.
- Risk assessment
- Professional Associations to act as a platform for field players to exchange learning experience
- Establish network to learn from each other. There is always more than 1 way to solve a problem.

THANK YOU