# How to use your risk assessment to select a biosafety cabinet



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## Deciding which biological safety cabinet (BSC) works best for your lab based on your overall risk assessment

Conducting a risk assessment is recommended before performing experiments that may expose workers to hazardous materials [1-3]. However, you may be wondering what is a risk assessment, and how do I conduct one appropriate for my biological materials work? This article summarises information about conducting a risk assessment, mitigating risks, and selecting a biosafety cabinet based on your risk assessment.

## What is a risk assessment?

A risk assessment is a process that evaluates the likelihood (chance/probability) and consequence (severity) of exposure to hazards [3]. Risk assessments are best completed by a team of individuals who understand all aspects of the hazards, staff capabilities, and facility and equipment features [1, 3].

Several health agencies provide information on how to conduct a risk assessment [1, 3].

The steps vary by organisation but generally seek to:

1. Assess the hazards associated with specific agents and with specific laboratory procedures
2. Determine and implement control measures
3. Provide ongoing review of the remaining risks and effectiveness of control measures [1-3]

## Procedural risk factors

Features of the microbe(s) can impact the consequence and the likelihood of an exposure or release [1-3]. Once the biological materials have been characterised, then the materials handling can be assessed. Laboratory procedures that include generation of aerosols, use of sharps, animal handling, untrained or poorly trained staff, and facility or equipment deficiencies may increase the likelihood of exposure. Laboratory work that includes genetic modification of agents and/or use of large quantities or high concentrations of agents may increase the severity of exposure or release [1-3].

The overall risk is then calculated by plotting the likelihood and consequence of exposure [3]. Whether this level of risk is acceptable, or if there is need for risk reduction, will be subjective and requires consideration by individuals with knowledge of the hazards and the organisation's leadership [1-3].

## How Can I Reduce or Eliminate Identified Risks?

After the risks are evaluated, you can determine ways to eliminate the hazard or minimise the likelihood and/or consequence of an exposure. Risk assessments and mitigation strategies must be specific to individual organisations and should not simply be transferred from one institution to another. The process of risk mitigation involves application of control measures represented in the 'Hierarchy of Controls' [4].

This hierarchy contains five levels of controlling exposure to hazards listed from most to least effective [4]:

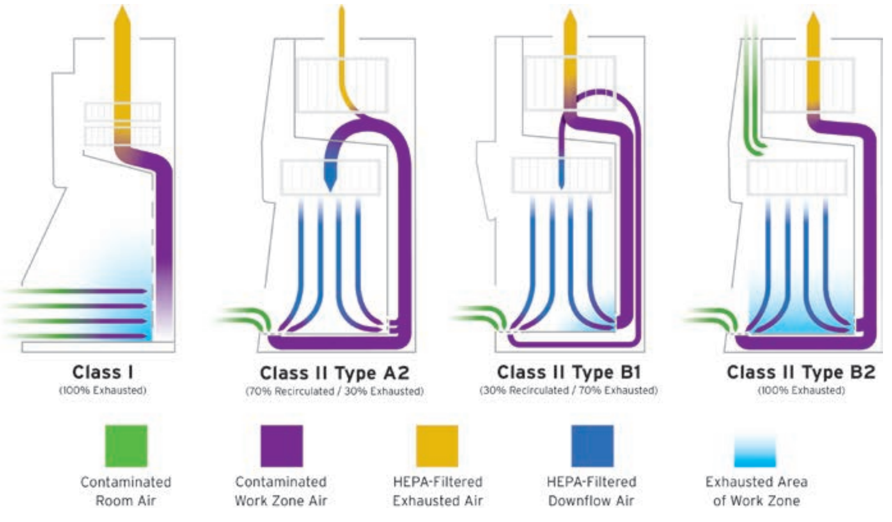
1. **Elimination** removes the hazard from the work entirely [4].
2. **Substitution** replaces the hazard with a less hazardous alternative [4].
3. **Engineering Controls** physically modify equipment, facilities, and/or processes to separate personnel from the hazard [4].
4. **Administrative Controls** change the way the work is done [4].
5. **Personal Protective Equipment (PPE)** physically protects the individual by covering possible routes of exposure [4].

Commonly, a combination of controls from levels 3-5 is selected that collectively reduces the risk of exposure or release to an acceptable level [1]. For instance, when working with biological materials in a biosafety cabinet (engineering control), you may follow your research-specific SOPs (administrative control), and wear gloves and a lab coat (PPE).

These three control measures all depend on the effort of the individuals using them [4]. Engineering controls, like BSCs, require routine maintenance, cleaning, certification, and proper operational technique to ensure user protection. Administrative controls, such as personnel training and work procedures, require individuals to create and follow them appropriately. Furthermore, PPE must fit the individual and be worn correctly to be considered protective. There is no single 'catch-all' for risk mitigation that can eliminate all risk, other than abstaining from hazardous work entirely. Finally, risk assessments are meant to be cyclical and evaluate the effectiveness of the employed control measures in reducing risk [1, 3].

## How does my risk assessment fit into biosafety cabinet selection?

When considering the use of engineering controls, specifically biosafety cabinets, it is important to understand the different classes and types of BSCs, how they differ, and what limitations they may have based on the proposed work to be performed.




There are three classes of BSCs that offer varying levels and types of protection [1, 5, 6]. Class I cabinets protect personnel and the environment but do not provide HEPA-filtered air to the work zone for the product's protection [1, 5, 6]. If your risk assessment identifies a need to protect the product from external contaminants, you may need to select a Class II or Class III biological safety cabinet.

Class II BSCs provide personnel, environment, and product protection by utilising an additional HEPA filter to provide clean air to the work zone to safeguard the product from cross- contamination. There are five types of Class II BSCs which differ in the percentage of air that is recirculated versus exhausted, how they are connected to the building's exhaust system, and whether they can accommodate work with hazardous or volatile chemicals [1, 5, 6]. Your risk assessment should identify which of these features are needed or whether a higher level of protection is needed.

Class III BSCs provide the highest level of personnel and environmental protection [1]. They also provide product protection and are typically used for highly hazardous work involving potentially infectious aerosols [1, 5]. There are additional logistical considerations for using a Class III BSC above and beyond those for Class I and Class II BSCs.

BSC class selection is reliant on the types of protection needed for the work. For example, Class II BSCs can be used at BSL-1 through BSL-4 [1, 6]. However, at BSL-4, the use of Class II BSCs requires additional PPE and work in a specially designed laboratory [1].

## BSC manufacturer considerations and overall conclusions

Although it may be tempting to ask your BSC manufacturer to select your BSC, this approach is likely to fail to meet your organisation's needs. The manufacturer does not understand all the factors that went into your risk assessment, proposed future work, and the risk tolerance of your organisation. The manufacturer can help with the selection of a model and relevant features that will complement your risk mitigation strategies after your risk assessment is completed.

Conducting a risk assessment for work with biological materials is the critical first step in evaluating laboratory activities and their risks to health and safety. A multi-layered approach of control measures based on NIOSH's hierarchy of controls should be selected where engineering controls (including BSCs) may be identified as one part of an overall risk reduction strategy.

## References

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## About the author

Julianne L. Baron is the President of Science and Safety Consulting. She has a background in infectious diseases, biosafety, and public health and consults on laboratory safety and design, pandemic preparedness, and scientific communication.

Science and Safety Consulting provides biosafety and biorisk guidance and training to facilitate safe and secure biological research and to prepare organisations for infectious diseases and pandemics. Science and Safety Consulting also facilitates successful scientific communication for technical and non-technical audiences.

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