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1. OBJECTIVE

This SOP provides information on the selection and use of protective gloves to protect the hands from injury in the research laboratories of Department of Medicine.

2. SCOPE

This SOP is applicable to all staff and students working in the research laboratories as well as to the external parties (such as visitors, contractors, cleaners, etc.) working in or visiting the laboratories of Department of Medicine.

3. RESPONSIBILITY

3.1 Principal investigators (PI) should ensure that all staff and students shall identify hand injury hazards arising from work in their areas; assess the risk and ensure that the most suitable precautions are taken to minimise the risk of hand injury. The PIs are responsible for providing proper hand protection for their lab workers.

3.2 Staff and Students are responsible for properly wearing required hand protection and to inform their PI when worn or damaged items needs to be replaced.

4. WHEN TO USE GLOVES

It should be noted that gloves are a control measure of last resort and should always be used in conjunction with other measures. This is because:

- Gloves only protect the wearer and they do not remove or reduce the risk to others.
- Gloves used incorrectly, or badly maintained, may leave the wearer unprotected.
- Gloves themselves can cause skin problems.
- Gloves can interfere with the wearer’s sense of touch.
- The extent of protection depends on a good fit.
- Some types of gloves are inconvenient and interfere with the way people work.

There are four principle factors to consider when deciding whether gloves are required and when selecting the glove that would be more suitable for the task.

- Type of hazard (Example: mechanical, thermal, biological or chemical)
- Type of task being undertaken
- Profile of user (Example: size and fit, state of health)
- Workplace conditions (Example: ergonomics, temperature, humidity, hot or cold)

All of these factors should be considered together in the risk assessment, and not in isolation, as their interaction may determine the suitability of the glove.

5. HAZARD IDENTIFICATION

- Contact with or absorption of harmful chemicals, human or animal's tissue or body fluids, microorganisms (such as bacteria, viruses, fungi, etc.) and/or their toxins, and radioactive materials.
- Exposure to temperature extremes associated with heated/cold surfaces, processes or products. Examples: Hot plate, storing lab specimens at -80^{o}C, handling cryogenic materials, etc.
- Contact with sharp objects or surfaces that could result in severe cuts or lacerations, penetration by sharp objects, such as needles, broken glass, and puncture wounds inflicted by animal bites.
- Potential contact with live electrical systems operating at greater than 50 Volts AC (alternating current).

6. TASKS AND WORKPLACE CONDITIONS

Whilst the hazard will usually be the key factor determining the choice of glove material, the task and the environment in which it is performed may influence the choice of the material and the style of glove.

6.1 Temperature: Temperature can affect comfort. Prolonged exposure to sweat inside a glove can provoke rashes or dermatitis. Gloves may need to be changed frequently and hands dried before donning a fresh pair or a cotton liner used inside the glove to absorb the sweat.

6.2 Grip and wet work: The amount of grip a glove provides is influenced by the material it is manufactured from and its surface texture. A textured surface provides a more secure grip in dry or wet conditions. Generally natural latex has better grip qualities than nitrile, or other artificial rubber gloves. Long cuffs and a good wet-grip are particularly important for wet or oily work.

6.3 Repetitive movements: A task that involves repetitive movements requires a glove with good flexibility and elasticity. A good quality nitrile or neoprene glove should meet most requirements.

6.4 Dexterity: The thicker the glove material the greater the resistance to chemicals, mechanical damage and thermal stress. However thick gloves can impair grip and dexterity and can themselves compromise safety. Thinner gloves generally do not offer a high degree of protection against physical hazards and may reduce chemical resistance.

6.5 Cuff length: The cuff of a standard disposable glove protects only a small area of the wrist. Longer cuffed gloves are essential if you have to ensure protection of the wrist and lower arm during handling of highly irritant chemicals, high grade pathogens or dealing with large volumes of liquid which may spill or splash over the top of a standard length glove.

6.6 Physical resistance: Resistance to physical damage such as abrasion, puncture, snagging, tearing and cuts will be dependent upon both the nature of the glove material(s) used and its thickness. Single use disposable gloves do not offer a high degree of protection against physical hazards. Thicker re-usable or specialised gloves may be required.

7. DISPOSABLE VERSUS RE-USEABLE GLOVES

Disposable gloves are only intended for small splash / incidental contact with a limited range of hazardous substances, whilst reusable gloves may be more suitable for direct exposure to a hazard. The risk assessment should consider these aspects before selecting the best glove for the given task.

7.1 Disposable Gloves
Disposable gloves allow the user to retain good touch sensitivity and dexterity, however may consequentially have relatively poor chemical and mechanical resistance; tearing or puncturing easily if snagged. They are only intended to protect against incidental rather than intentional contact with chemicals and are unsuitable for some highly hazardous chemicals.

7.2 Re-usable Gloves
Re-usable gloves offer greater protection than disposable gloves against abrasion and other physical hazards. They are less likely to tear in use and will resist chemical attack for longer. However, they generally reduce dexterity and touch sensitivity. They can still be damaged or penetrated by many chemicals and they need to be looked after to prolong their useful life. Reusable gloves usually have a longer cuff length than standard disposable gloves made of the same material, and so may offer better protection against liquid slopping over the top of the glove. The longer cuff also allows protective clothing, ie: overalls or laboratory coat sleeves, to overlap the glove cuff.

8. COMMONLY AVAILABLE GLOVE MATERIALS

8.1 Natural Rubber: A naturally produced rubber (commonly called latex) that is highly elastic and flexible. This type of material resists bases, acids, alcohols and diluted water solutions of most types of chemicals, especially when it is thick (18 mils or more). Latex (natural rubber) exam gloves and thin latex gloves do not provide chemical protection. Latex allergies limit widespread use.

8.2 Neoprene: A synthetic rubber developed as an oil-resistant substitute for natural rubber. Provides moderate abrasion resistance but good tensile strength and heat resistance. Compatible with many acids, caustics and oils.

8.3 Nitrile: Synthetic acrylonitrile-butadiene rubber. Excellent general duty glove. Provides protection from a wide variety of solvents, oils, petroleum products and some corrosives. Excellent resistance to cuts, snags, punctures and abrasions.

8.4 PVC: Polyvinyl chloride (PVC) or vinyl is a plastic material. Provides excellent abrasion resistance and protection from most fats, acids, and petroleum hydrocarbons.

8.5 Viton: A specialty fluoroelastomer which is the most chemical resistant of all rubbers. Exceptional resistance to chlorinated and aromatic solvents. Good resistance to cuts and abrasions.

8.6 PVA: Polyvinyl Alcohol, PVA is a plastic material. Highly impermeable to gases. Excellent protection from aromatic and chlorinated solvents. Cannot be used in water or water-based solutions.

8.7 Butyl: Butyl rubber provides superior resistance to highly corrosive acids and is excellent against ketones and esters. It should not be worn with halogenated compounds.

8.8 Flexible Laminates (Silver Shield): Resists a wide variety of toxic and hazardous chemicals. Provides the highest level of overall chemical resistance.

More information on “glove chart” and “glove type and chemical use” can be found at @NUS Laboratory Chemical Safety Manual (NUS/OSHE/M/02).

9. SELECTION OF GLOVES

- It is essential to select gloves suitable for the potential hazards. In some cases, there may be more than one hazard. For example, it may be necessary to select a chemical resistant glove that also provides enhanced tear-resistance. In some cases, it may be necessary to layer different combinations of gloves to achieve the needed protection.
- Select gloves of an appropriate style (length, cuff/no cuff, etc.).
- A good fit is necessary to provide the most protection, dexterity, and comfort. Don’t use gloves that are too big or too small.
- Review and adhere to the manufacturer’s use and maintenance instructions.
- Review the Safety Data Sheet (SDS) of the chemical(s) of concern. Consider whether the chemical of concern is relatively toxic or non-toxic and whether it is efficiently or poorly absorbed through the skin. Know the signs and symptoms of exposure. These factors will all impact selection of the proper glove.

10. USE OF GLOVES

- Store gloves in a clean, well-ventilated area with low light intensity and free from exposure to ozone, high relative humidity, and/or contaminants that may degrade the gloves over time.
- Before use, inspect gloves (even new ones) for physical damage such as tears or pinholes, which indicate that physical or chemical degradation has occurred. Latex gloves are extremely sensitive to storage conditions (e.g. high temperatures and sunlight).
- Never wear possibly contaminated gloves outside of the laboratory or to handle telephones, door handles, computer keyboards, etc.
- Some gloves, especially lightweight disposables, may be flammable: keep hands well away from flames or other high temperature heat sources.
- Disposable gloves must be discarded once removed. Do not retain for future use.
- Always wash hands with soap and water after removing gloves.

- Dispose of contaminated gloves properly.
- Non-disposable/reusable gloves must be washed and dried, as needed, and then inspected for tears and holes prior to reuse.
- Remove gloves before touching personal items, such as phones, computers, pens and one's skin.
- If for any reason a glove fails, and chemicals come into contact with skin, consider it an exposure and seek medical attention.

11. REMOVAL OF GLOVES

Gloves should be removed avoiding skin contact with the exterior of the glove and possible contamination. Disposable gloves should be removed as follows:

- Grasp the exterior of one glove with your other gloved hand.
- Carefully pull the glove off your hand, turning it inside-out. The contamination is now on the inside.
- Ball the glove up and hold in your other gloved hand.
- Slide your ungloved finger into the opening of the other glove. Avoid touching the exterior.
- Carefully pull the glove off your hand, turning it inside out again. All contamination is contained.
- Discard appropriately.

12. INCIDENT REPORTING

Accidents resulting in injuries must be reported to the PI and/or laboratory safety lead immediately after first aid is applied.

Seek medical attention when necessary at the University Health Centre or proceed to the Accident & Emergency units of National University Hospital after office hours.

All incidents or accidents have to be notified to OSHE within 24 hours via the online Accident and Incident Management System (AIMS) at https://inetapps.nus.edu.sg/osh/portal/eServices/ehs360_aims.html.

13. REFERENCES

- NUS Laboratory Chemical Safety Manual (NUS/OSHE/M/02)
- NUS Laboratory Biorisk Management Manual (NUS/OSHE/M/01)
- NUS General Laboratory Safety Manual (NUS/OSHE/M/06)

14. REVISION HISTORY

Date Revised	Version No.	Author	Summary of Revisions
16-07-2021	002	Adeline Chow	1) Update of approver (HOD): Prof Anantharaman Vathsala