TEXAS A&M INTERNATIONAL UNIVERSITY

BIOLOGICAL SAFETY

April 23, 2002

Introduction

The following information is provided to assist Texas A&M International University (TAMIU) Departments in developing procedures to meet biological safety requirements to protect students, employees, and the environment. This program sets forth recommended minimum requirements that need to be followed to maximize the safety of all workers.

I. Biosafety Principle

The primary principle of biological safety (i.e., biosafety) is containment. The term *containment* refers to a series of safe methods for managing infectious agents in the laboratory. The purpose of containment is to reduce or eliminate human and environmental exposure to potentially harmful agents.

A. Primary and Secondary Containment

There are two levels of biological containment--primary and secondary. Primary containment protects people and the immediate laboratory environment from exposure to infectious agents. Good microbial techniques and safety equipment provide sufficient primary containment. Examples of primary barriers include safety equipment such as biological safety cabinets, enclosed containers, and safety centrifuge cups. Occasionally, when it is impractical to work in biological safety cabinets, personal protective equipment, such as lab coats and gloves may act as the primary barrier between personnel and infectious materials.

Secondary containment protects the environment external to the laboratory from exposure to infectious materials. Good facility design and operational practices provide secondary containment. Examples of secondary barriers include work areas that are separate from public areas, decontamination facilities, handwashing facilities, special ventilation systems, and airlocks.

B. Elements of Containment

Ultimately, the three key elements of biological containment are laboratory practices, safety equipment, and facility design. To ensure minimal exposure, employees must assess the hazards associated with their work and determine how to apply the biosafety principle appropriately.

> ***IMPORTANT:***
> *Employees working with infectious agents or potentially infectious materials must be aware of the hazards associated with their work. These workers must be trained and proficient in biosafety procedures and techniques.*

II. General Biosafety Guidelines

Biohazardous materials require special safety precautions and procedures. Follow these guidelines when working with infectious agents:

A. Personal Hygiene Guidelines:

- ❑ Wash your hands thoroughly, as indicated below:
  - ✓ After working with any biohazard
  - ✓ After removing gloves, laboratory coat, and other contaminated protective clothing
  - ✓ Before eating, drinking, smoking, or applying cosmetics

- ✓ Before leaving the laboratory area
- ❑ Do not touch your face when handling biological material.
- ❑ Never eat, drink, smoke, or apply cosmetics in the work area.

B. Clothing Guidelines:

- ❑ Always wear a wrap-around gown or scrub suit, gloves, and a surgical mask when working with infectious agents or infected animals.
- ❑ Wear gloves *over* gown cuffs.
- ❑ Never wear contact lenses around infectious agents.
- ❑ Do not wear potentially contaminated clothing outside the laboratory area.
- ❑ To remove contaminated clothing, follow these steps:
  1. Remove head covering from the peak.
  2. Untie gown while wearing gloves.
  3. Remove gloves by peeling them from the inside out.
  4. Remove the gown by slipping your finger under the sleeve cuff of the gown.

C. Handling Procedures:

- ❑ Use mechanical pipette devices.
- ❑ Minimize aerosol production.
- ❑ Add disinfectant to water baths for infectious substances.
- ❑ Use trunnion cups with screw caps for centrifuging procedures. Inspect the tubes before use.
- ❑ Use secondary leak-proof containers when transporting samples, cultures, inoculated petri dishes, and other containers of biohazardous materials.

D. Syringes:

Avoid using syringes and needles whenever possible. If a syringe is necessary, minimize your chances of exposure by following these guidelines:

- ❑ Use a needle-locking or disposable needle unit.
- ❑ Take care not to stick yourself with a used needle.
- ❑ Place used syringes into a pan of disinfectant without removing the needles.
- ❑ Do not place used syringes in pan containing pipettes or other glassware that requires sorting.
- ❑ Do not recap used needles.
- ❑ Dispose of needles in an approved sharp container.

E. Work Area:

- ❑ Keep laboratory doors shut when experiments are in progress.
- ❑ Limit access to laboratory areas when experiments involve biohazardous agents.
- ❑ Ensure that warning signs are posted on laboratory doors. These signs should include the universal biohazard symbol and the approved biosafety level for the laboratory.
- ❑ Ensure that vacuum lines have a suitable filter trap.
- ❑ Decontaminate work surfaces daily and after each spill.

- ❑ Decontaminate all potentially contaminated equipment.
- ❑ Transport contaminated materials in leak-proof containers.
- ❑ Keep miscellaneous material (i.e., books, journals, etc.) away from contaminated areas.
- ❑ Completely decontaminate equipment before having maintenance or repair work done.

F. Universal Precautions:

Clinical and diagnostic laboratories often handle specimens without full knowledge of the material's diagnosis; these specimens may contain infectious agents. To minimize exposure, observe universal precautions when handling any biological specimen. Consider all specimens to be infectious and treat these materials as potentially hazardous.

III. CDC and NIH Biosafety Levels

The Centers for Disease Control (CDC) and the National Institute of Health (NIH) have established four biosafety levels consisting of recommended laboratory practices, safety equipment, and facilities for various types of infectious agents. Each biosafety level accounts for the following:

- ❑ Operations to be performed
- ❑ Known and suspected routes of transmission
- ❑ Laboratory function

A. Biosafety Level 1

Biosafety Level 1 precautions are appropriate for facilities that work with defined and characterized strains of viable organisms that do not cause disease in healthy adult humans (e.g., *Bacillus subtilis* and *Naegleria gruberi*). Level 1 precautions rely on standard microbial practices without special primary or secondary barriers. Biosafety Level 1 criteria are suitable for undergraduate and secondary education laboratories.

B. Biosafety Level 2

Biosafety Level 2 precautions are appropriate for facilities that work with a broad range of indigenous moderate-risk agents known to cause human disease (e.g., Hepatitis B virus, salmonellae, and *Toxoplasma* spp.). Level 2 precautions are necessary when working with human blood, body fluids, or tissues where the presence of an infectious agent is unknown. The primary hazards associated with level 2 agents are injection and ingestion.

C. Biosafety Level 3

Biosafety Level 3 precautions apply to facilities that work with indigenous or exotic agents with the potential for aerosol transmission and lethal infection (e.g., *Mycobacterium tuberculosis*). The primary hazards associated with level three agents are autoinoculation, ingestion, and inhalation. Level 3 precautions emphasize primary and secondary barriers. For primary protection, all laboratory

manipulations should be performed in a biological safety cabinet or other enclosed equipment. Secondary protection should include controlled access to the laboratory and a specialized ventilation system.

D. Biosafety Level 4

Biosafety Level 4 precautions are essential for facilities that work with dangerous and exotic agents with a high risk of causing life-threatening disease, the possibility of aerosol transmission, and no known vaccine or therapy (e.g., Marburg or Congo-Crimean viruses). Level 4 agents require complete isolation. Class III biological safety cabinets or full-body air-supplied positive-pressure safety suits are necessary when working with level 4 agents. In addition, isolated facilities, specialized ventilation, and waste management systems are required. There are no Biosafety Level 4 facilities at Tarleton State University.

IMPORTANT:
Currently TAMIU does not own or operate a Biosafety Level 3 or 4 lab. If Level 3 or 4 labs are needed prior consultation regarding purchase, installation and maintenance of safety equipment is needed.

E. Biosafety Summary

Safety Level	Agent Characteristics	Safety Practices	Primary Barriers	Secondary Barriers
1	Not known to cause disease in healthy adults.	Standard Microbial Practices	None	Open bench top sink required.
2	Associated with human disease.	Level 1 precautions plus: - Limited access - Biohazard warning signs - Biosafety manual defining needed waste decontamination or medical surveillance policies	- Class I or II Biological safety cabinet or other physical containment devices: - Laboratory coat - Gloves - Face protection as needed	Level 1 precautions plus: - Autoclave available
3	Indigenous or exotic agent with the potential for aerosol transmission. Known to cause disease with serious or lethal consequences.	Level 2 precautions plus: - Controlled access - Decontamination of all waste - Decontamination of laboratory clothing before laundering - Baseline serum collected and stored	- Class I or II Biological safety cabinet or other physical containment - Protective clothing - Gloves - Respiratory protection as needed	Level 2 precautions plus: - Physical separation from access corridors - Self-closing, double door access - Exhausted air not re-circulated - Negative airflow into laboratory
4	Dangerous/exotic agents which pose high risk of life-threatening disease and aerosol transmitted infection. Related agents with unknown risk of transmission.	Level 3 precautions plus: - Clothing change before entering - Shower upon exit - All material decontaminated upon exit from facility	- All procedures conducted in Class III biological safety cabinets or in Class I or II safety cabinets with full-body, air supplied, positive pressure personnel suits.	Level 3 precautions plus: - Separate building or isolated zone - Dedicated supply/exhaust, vacuum, and decontamination system - Other requirements, as necessary

F. Animal Biosafety

Four biosafety levels are also described for infectious disease work with laboratory animals. Safety practices, equipment, and facilities are designated by Animal Biosafety Levels 1, 2, 3, and 4.

Refer to the TAMIU Animal Care and Use Guidelines for more information regarding the use of hazardous materials with laboratory research animals.

IMPORTANT:
A copy of the CDC/NIH criteria for laboratory and animal biosafety levels is available from the Physical Plant Department.

IV. Recombinant DNA Research

TAMIU is obligated to ensure that all recombinant DNA (rDNA) work conducted by its faculty and staff conforms to Federal rDNA guidelines. This task falls jointly to the TAMU's Institutional Biosafety Committee (TAMU's IBC) and the Biological Safety Officer (BSO). TAMU's IBC reviews all protocols involving rDNA, rules on the appropriateness of proposed containment procedures, and sets suitable biosafety levels. The BSO inspects individual laboratories and verifies that practices and facilities meet the requisite biosafety level assigned by TAMU's IBC.

The Federal rDNA guidelines define rDNA as "...molecules which are constructed outside of living cells by joining natural or synthetic DNA segments to DNA molecules that can replicate in a living cell." The Federal definition also includes the replicated progeny of these molecules as well as cells, plants, and animals that harbor such molecules. Transgenic plants and animals also come under the guidelines, even if the transgenic DNA was not cloned prior to introduction.

Investigators who possess rDNA in any form must file a rDNA protocol with TAMU's IBC. Refer to the TAMIU's Policies and Procedures for Research Involving Recombinant DNA for more information.

V. Disinfection and Sterilization

Biological safety depends on proper cleanup and removal of potentially harmful agents. Disinfection and sterilization are two ways to help ensure biological safety in the laboratory.

- **Disinfection:**
  Reduction of the number of pathogenic organisms by the direct application of physical or chemical agents.
- **Sterilization:**
  Total destruction of all living organisms.

The following sections discuss guidelines and procedures for biological disinfection and sterilization.

A. General Guidelines

Choosing the best method for disinfection and sterilization is very important. The proper method depends on the following:

- ❑ Target organisms to be removed
- ❑ Characteristics of the area to be cleaned

Once you have chosen the proper method for disinfection or sterilization, follow these guidelines to ensure laboratory safety:

- ❑ Frequently disinfect all floors, cabinet tops, and equipment where biohazardous materials are used.
- ❑ Use autoclavable or disposable materials whenever possible. Keep reusable and disposable items separate.
- ❑ Minimize the amount of materials and equipment present when working with infectious agents.
- ❑ Sterilize or properly store all biohazardous materials at the end of each day.
- ❑ Remember that some materials may interfere with chemical disinfectants-use higher concentrations or longer contact time.
- ❑ Use indicators with autoclave loads to ensure sterilization.
- ❑ Clearly mark all containers for biological materials (e.g.*, BIOHAZARDOUS - TO BE AUTOCLAVED).*

Use the following table to aid in the selection of disinfectants:

B. Types of Disinfectant

Disinfectant	Uses
Alcohols	Ethyl or isopropyl alcohol at 70-80% concentration is a good general purpose disinfectant; not effective against bacterial spores.
Phenols	Effective against vegetative bacteria, fungi, and viruses containing lipids, unpleasant odor.
Formaldehyde	Concentration of 5-8% formalin is a good disinfectant against vegetative bacteria, spores, and viruses; known carcinogen; irritating odor.
Quaternary Ammonium Compounds	Cationic detergents are strongly surface active; extremely effective against lipoviruses; ineffective against bacterial spores; may be neutralized by anionic detergents (i.e., soaps).
Chlorine	Low concentrations (50-500 ppm) are active against vegetative bacteria and most viruses; higher concentrations (2,500 ppm) are required for bacterial spores; corrosive to metal surfaces; must be prepared fresh; laundry bleach (5.25% chlorine) may be diluted and used as a disinfectant.
Iodine	Recommended for general use; effective against vegetative bacteria and viruses; less effective against bacterial spores; Wescodyne diluted 1 to 10 is a popular disinfectant for washing hands.

C. Sterilization Methods

The most common method for sterilization of laboratory materials is through the use of a Steam Autoclave.

SAFE and EFFECTIVE USE of the STEAM AUTOCLAVE

A steam autoclave may be used to sterilize media, glassware, waste, instruments, etc. To accomplish the desired end goal and to protect the user and the environment from hazardous materials, the autoclave must be used correctly. Additionally, wastes must be managed in compliance with state and local regulations.

For the autoclave process to be effective in achieving sterilization, sufficient temperature, time and direct steam contact are essential. Air must be completely removed from the sterilizer chamber and from the materials to allow steam penetration so that the material being autoclaved will be at treatment temperature for sufficient time to achieve kill. Factors that affect air removal include type and quantity of material to be autoclaved, packaging, load density and configuration, and container type, size, and shape.

1. General Procedures

- ❑ All potentially infectious materials must be autoclaved before being washed and stored or disposed.
- ❑ Personnel who use an autoclave must be trained to understand proper packaging, loading, labeling, and operation procedures.
- ❑ Biohazardous materials must be labeled as such and must be sterilized by the end of each work day, or must be secured appropriately. Do not leave biohazardous materials in an autoclave overnight in anticipation of autoclaving the next day.
- ❑ Do not autoclave materials that also contain toxic or volatile chemical or radiological agents.

2. Packaging

- ❑ Use bags or other containers labeled “Biohazard” for items that contain or may be contaminated with potentially infectious agents.
- ❑ Use plain, unmarked containers for items that are not hazardous.
- ❑ Do not double bag waste or tightly seal containers as this will impede steam penetration.
- ❑ Do not put sharp objects such as broken glassware into an autoclave bag.
- ❑ Open, shallow metal pans are more effective in conducting heat and allowing air removal than tall, plastic tubs.
- ❑ Vessels with liquid should not be plugged or tightly capped.
- ❑ It is advisable to add some water to bags of solid wastes (the water will vaporize into steam that will drive out residual air once sterilization temperature has been reached inside the bag).
- ❑ When using an autoclave bag with a ‘Biohazard’ symbol on it, place a strip of tape that produces the word “autoclaved” across the symbol. This must be done for any autoclave bag that has a Biohazard symbol.

3. Loading

- ❑ Place containers of liquid, bags of agar plates, or other items that may boil over or leak inside a secondary pan in the autoclave.

- ❑ Never place autoclave bags or glassware in direct contact with the bottom of the autoclave.
- ❑ Do not overload the autoclave; leave sufficient room for thorough steam circulation.
- ❑ Make sure the plug screen in the bottom of the autoclave is clean.
- ❑ Do not mix loads of liquids with solids.

4. Operating Parameters

- ❑ The parameters for the sterilization cycle will depend upon the amount and type of material. Usually 121 C° at 15 psi for a minimum of 30 minutes is recommended. However, the temperature and cycle time should be determined using a worst case load and using a biological indicator as verification that sterilization was achieved (e.g., ampoule of *B. stearothermophilus* spores placed in the middle of the full load). A biological indicator should be used frequently enough (e.g., once per month) to ensure that the sterilization parameters are effective in treating biohazardous waste.
- ❑ Make sure chart paper or printer paper is in place to document the cycle parameters for the load. If a recording system is not available, it is critical to verify that sterilization parameters were achieved by another means such as spore strips, an autoclave thermometer, etc.
- ❑ The exact operating procedure for each model of autoclave will differ. The user should develop an SOP to describe proper steps to operate the autoclave.

5. Removing Sterilized Items

- ❑ Open the sterilizer door no more than 0.5 inch; wait 10 minutes before unloading items.
- ❑ Wear heat resistant gloves to unload items.
- ❑ Be very careful of liquids, molten agar, etc. to avoid getting splashed with scalding liquid. Do not agitate containers of super-heated liquid or remove caps before unloading.
- ❑ Unload hot items onto a cart for transport.
- ❑ Take bags of autoclaved disposable waste to the dumpster.

NOTE:
If a faulty condition exists (e.g., sterilizer did not finish the cycle, or water leaks out when the door is unlocked), contact a service technician.

6. Recordkeeping

- ❑ Document the treatment of each load of biohazardous waste in a log which lists: the date of treatment; the amount of waste treated; the method or conditions of treatment; and the printed name and initials of the person performing the treatment. Keep charts or printout strips with the logbook as documentation of the autoclave operation.
- ❑ Document the date and results of each verification test using biological indicators.

7. Non-Sterilization Procedures

For procedures where an autoclave treatment is used for purposes other than acquiring sterilization, the time and temperature parameters will vary as needed to accomplish the intended goal of the user.

8. Repairs / Maintenance

When maintenance work or repairs are needed, the user must provide a safe work environment for the service technician. Remove all items from the sterilizer chamber, clean any spills or leaks inside the chamber, remove untreated biohazardous materials from the vicinity, etc.

VI. Biological Safety Cabinets

A biological safety cabinet is a primary barrier against biohazardous or infectious agents. Although biological safety cabinets surround the immediate workspace involving an agent, they do not provide complete containment (i.e., aerosols can escape). Therefore, careful work practices are essential when working with agents that require a biological safety cabinet.

NOTE:
A biological safety cabinet is often referred to by other names such as: biohood, tissue culture hood, or biological fume hood.

All biological safety cabinets contain at least one High Efficiency Particulate Air (HEPA) filter. These cabinets operate with a laminar air flow (i.e., the air flows with uniform velocity, in one direction, along parallel flow lines.).

Biological safety cabinets must be inspected and certified:
- ❑ When newly installed
- ❑ After filter or motor replacement
- ❑ After being moved
- ❑ Annually

The following sections discuss safety procedures and guidelines for working with various types of biological safety cabinets.

A. Types of Cabinets

The following table outlines various types of biological safety cabinets:

Type of Cabinet	Operation and Use
Class I	Only exhaust air is filtered. The user and environment are protected but the experiment is not. Operator's hands and arms may be exposed to hazardous materials inside the cabinet. This cabinet may be used with low to moderate-risk biological agents.
Class II	Vertical laminar air flow with filtered supply and exhaust air. The user, product, and

	environment are protected.
Type A	Recirculates 70% of the air inside the cabinet. Do not use with flammable, radioactive, carcinogenic, or high-risk biological agents.
Type B1	Recirculates 30% of the air inside the cabinet and exhausts the rest to the outside. May be used with low to moderate-risk agents and small amounts of chemical carcinogens or volatiles.
Type B2	Offers total exhaust with no recirculation.
Type B3	Same as Class II Type A, but vented to the outside of the building.
Class III or Glovebox	Gas-tight and maintained under negative air pressure. Used to work with highly infectious, carcinogenic, or hazardous materials. All operations are conducted through rubber gloves attached to entry portals.

B. Using Biological Safety Cabinets

Follow these guidelines for using biological safety cabinets properly:

1. Preparation:

- ❑ Leave safety cabinets on at all times. Otherwise, turn the blower on and purge the air for at least five minutes before beginning work.
- ❑ Never turn off the blower of a biological safety cabinet that is vented to the outside.
- ❑ Turn off the UV light if it is on. Never work in a unit with the UV light illuminated. (UV light will damage your eyes.)
- ❑ Do not depend on the UV germicidal lamp to provide a sterile work surface; wipe down the surface with a disinfectant (70% alcohol is usually suitable).
- ❑ Place everything needed for your procedure inside the cabinet prior to beginning work. Remove unnecessary items; excessive material may disrupt the air flow. Arrange the equipment in logical order.
- ❑ Provide a container for wastes inside the cabinet. (Remember, nothing should pass through the air barrier until the entire procedure is complete.)
- ❑ Never place any items on the air-intake grilles.
- ❑ Place a disinfectant-soaked towel on the work surface to contain any splatters or spills that occur.
- ❑ Keep the laboratory door shut and post signs stating "CABINET IN USE" on all the doors. Restrict activities that will disturb the cabinet's airflow, such as entry, egress, and walking traffic.

2. Cabinet Use:

- ❑ Always wear lab coats and gloves
- ❑ Conduct work at least 4” from the glass view panel. The middle third of work surface is the ideal area to be used.
- ❑ Limit arm movement and avoid motions that could disturb airflow.
- ❑ If a burner is necessary, use the Touch-O-Matic type with a pilot light. Since flames cause air turbulence, place burners to the rear of the workspace. Most procedures should not require use of a flame when combined with good aseptic techniques and proper cabinet use.
- ❑ Place a disinfectant-soaked towel on the work surface to contain any splatters or small spills that may occur during the procedure.

- ❑ Never use flammable solvents in a biological safety cabinet unless it is a total-exhaust cabinet (e.g., Class II B2).
- ❑ Control all tissues, needle packages and other small loose paper or plastic products which may be caught in the air stream and pulled to the motor or HEPA filter.

3. Experiment Completion:

- ❑ Enclose or decontaminate all equipment that has been in direct contact with the infectious agent.
- ❑ Cover all waste containers.
- ❑ To purge airborne contaminants from the work area, allow the cabinet to operate for five minutes with no activity inside the cabinet.
- ❑ Remove all equipment from the cabinet.
- ❑ Decontaminate interior work surfaces. If desired, the UV light may be turned on.

IMPORTANT:
Biological safety cabinets are not a substitute for good laboratory practices. Because aerosols can escape, take precautions to minimize aerosol production and to protect yourself from contamination.

VII. Clean Benches

A clean bench has horizontal laminar air flow. The HEPA-filtered air flows across the work surface towards the operator, providing protection for the product, but no protection for the user. Because clean benches offer no protection, use a clean bench only to prepare sterile media. Do not use clean benches when working with pathogenic organisms, biological materials, chemicals, or radioactive materials.

VIII. Importing and Shipping Biological Materials

The Public Health Service provides Foreign Quarantine regulations for importing etiologic agents and human disease vectors. Other regulations for packaging, labeling, and shipping, are administered jointly by the Public Health Service and the Department of Transportation. The U.S. Department of Agriculture regulates the importation and shipment of animal pathogens. It prohibits the importation, possession, and use of certain animal disease agents that pose a serious threat to domestic livestock and poultry.

IX. Biological Spill Response

The exact procedure for responding to a biological spill depends on the material, amount, and location of the spill.

In general, follow these steps immediately after a biological spill occurs:

1. Warn others.
2. Leave the room; close the door.

3. Remove contaminated garments.
4. Wash your hands.
5. Notify your supervisor.

Follow these steps to clean up a biological spill:
1. Wait for any aerosols to settle.
2. Put on protective clothing, as appropriate.
3. Apply disinfectant to the contaminated area.
4. Cover the area with paper towels to absorb the disinfectant.
5. Wipe up the towels and mop the floor.
6. Autoclave all contaminated wastes.

NOTE:
Spill cleanup must be appropriate for the hazards involved. If spill is large and cleanup assistance is needed contact University Police Department at 2911

If a spill occurs inside a biological safety cabinet, follow these steps:
1. Decontaminate materials while the cabinet is operating to prevent contaminants from escaping.
2. Spray or wipe all affected equipment with an appropriate disinfectant. (Wear gloves while doing this.)
3. If the spill is large, flood the work surface with disinfectant and allow it to stand for 10 to 15 minutes before removing it.

X. Biological Waste Disposal

The Texas Department of Health (TDH) and the Texas Natural Resource Conservation Commission (TNRCC) regulate the disposal of biohazardous waste. Waste that contains infectious materials and waste that may be harmful to humans, animals, plants, or the environment is considered biohazardous.

Refer to TAMIU's Management and Disposal of Biological Waste Program for further assistance.

XI. Bloodborne Pathogens

Bloodborne pathogens are biological agents that cause human disease. Examples of bloodborne diseases include the following:
- ❑ Hepatitis
- ❑ Syphilis
- ❑ Malaria
- ❑ Human Immunodeficiency Virus (HIV)

Two significant and deadly bloodborne diseases are hepatitis B virus (HBV) and HIV. These pathogens may be present in the following:

- ❑ Human blood
- ❑ Body fluids, such as saliva, semen, vaginal secretions, phlegm, and other body fluids visibly contaminated with blood
- ❑ Unfixed human tissues or organs other than intact skin
- ❑ HIV or HBV cultures
- ❑ Blood, organs, or other tissues from experimental animals infected with HIV or HBV.

Bloodborne pathogens may enter the body and infect you through a variety of means, including the following:

- ❑ Accidental injury with a sharp object contaminated with infectious material.
- ❑ Open cuts, nicks, and skin abrasions that come into contact with infectious materials. Other potential sites of transmission include acne sores and the mucous membranes of the mouth, nose, or eyes.
- ❑ Unprotected sexual activity with someone who is infected with the disease.
- ❑ Indirect transmission, such as touching a contaminated object and then transferring the pathogen to the mouth, eyes, nose, or open skin.

Texas Department of Health regulates issues concerning bloodborne pathogens. Refer to TAMIU's Bloodborne Pathogen Exposure Control Plan for more information.

REFERENCE MATERIAL

Biological Safety Guidelines – TSU Safety Manual
TAMU's Guidelines for the Safe Use of Class II Biological Safety Cabinets
TAMU's Safe and Effective Use of the Steam Autoclave
Biosafety in Microbiological and Biomedical Laboratories – US Dept. of Health and Human Services
TSU Requirements and Procedures for Research with Human Pathogens
TSU Requirements and Procedures for Research Involving Recombinant DNA
TAMIU Management and Disposal of Biological Waste
MSDS for Infectious Agents
Laboratory Biosafety Guidelines
CDC/NIH Primary Containment for Biohazards: Selection, Installation and Use of Biological Safety Cabinets
NIH Recombinant DNA Guidelines (1997)
Importation Permits for Etiologic Agents
Interstate Shipment of Etiologic Agents (42 CFR Part 72)
Introduction of Regulated Articles (APHIS)
TAMIU Bloodborne Pathogen Exposure Control Plan
Hanta Virus Information
Laboratory Management of Agents Associated with Hantavirus Pulmonary Syndrome: Interim Biosafety Guidelines
Texas Health and Safety Code Regulations

REFERENCES for Safe and Effective Use of the Steam Autoclave:

Title 25, Texas Administrative Code, Chapter 1, Sections 131-137
Title 30, Texas Administrative Code, Chapter 330, Sections 1001-1010
Management of Medical Waste, City of College Station – Sanitation Department
Management and Disposal of Biological Waste at Texas A&M University
Infectious and Medical Waste Management, Peter Reinhardt and Judith Gordon
The Foundations of Laboratory Safety, Stephen R. Rayburn
Laboratory Safety Principles and Practices, Diane Fleming, John Richardson, Jerry Tulis, and Donald Vesley, editors
Biohazards Management Handbook, Daniel Liberman and Judith Gordon, editors
Stanford University Biosafety Manual
Massachusetts Institute of Technology Biosafety Manual