

TB Lab Safety

A Risk Assessment of the TB Lab

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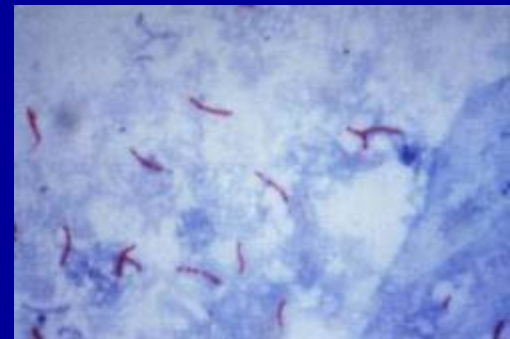
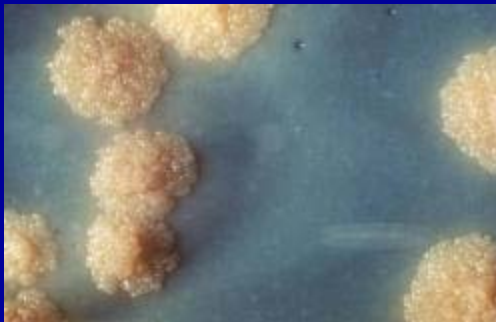
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Disclosures

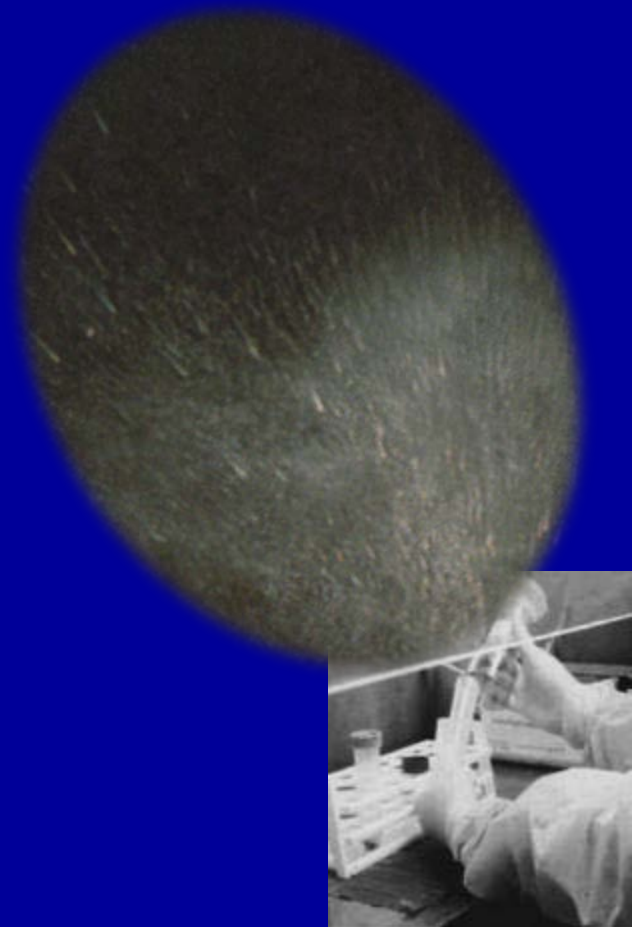
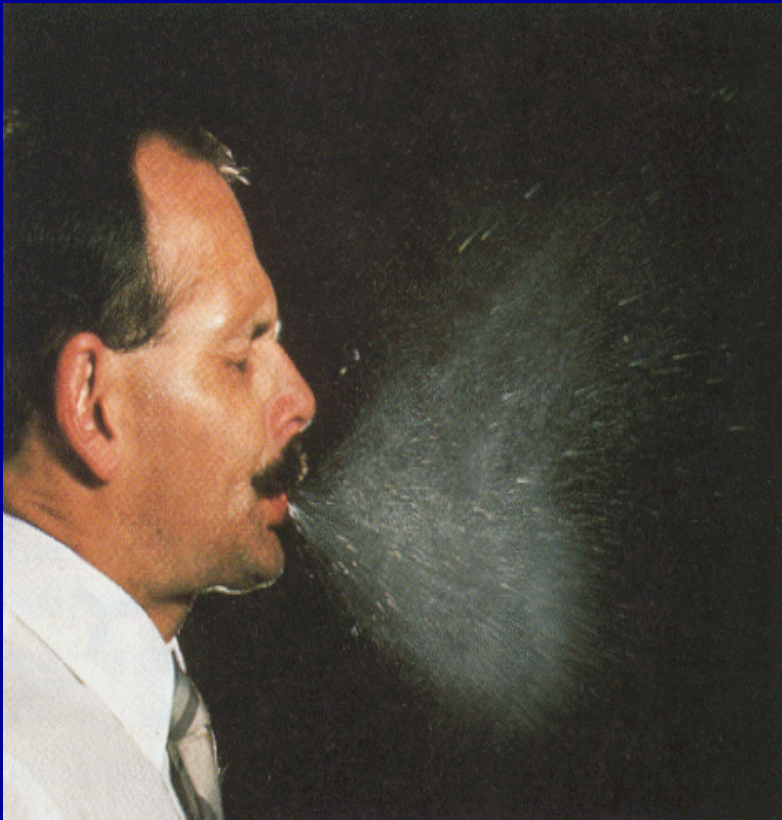
- Received honorarium for Interferon Gamma Release Assay presentation sponsored by Cellectis

Agent: *Mycobacterium tuberculosis*

- Infectious dose 1-10 organisms – *No safe level of exposure*
- Risk to laboratorians who process specimens in microbiology and histology labs
- Airborne droplet nuclei can be spread through normal air currents for long periods of time and spread throughout a room or building

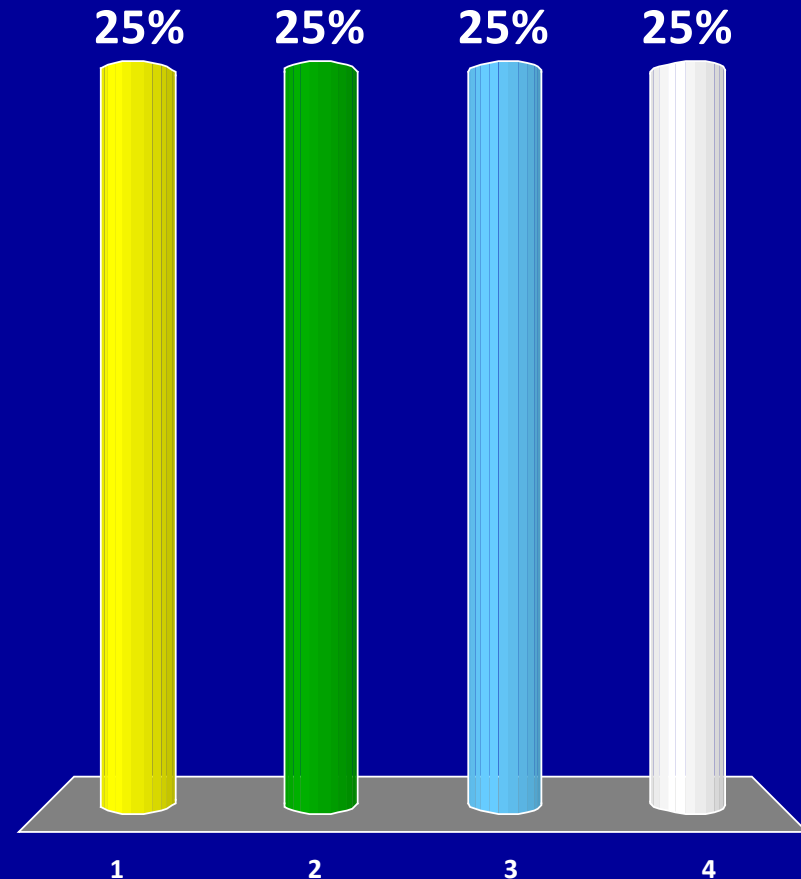


All aerosol producing procedures pose a risk of exposure



What is the risk to laboratorian?

1. 100X greater risk than the general population.
2. 3-5X greater risk than someone working in other parts of the lab.
3. Unknown amount of risk.
4. Both A & B.



Is there a risk to laboratorians?

- Tuberculosis among persons who work with *M. tuberculosis* in the laboratory is 3-5X greater than among those who do not
- Frequency of infection for persons who manipulate *M. tuberculosis* is 100 X greater than for the general population.
 - Reid DP. Incidence of tuberculosis among workers in medical laboratories. Br Med J 1957;2:10-14.

TABLE 1. Most frequently reported laboratory-acquired infections in the United States and Great Britain

Infection	Total no. (%) of cases reported for:			
	U.S. ^a	U.S. and world ^b	Great Britain ^{c,d}	NADC ^e
Brucellosis	274 (9.4)	423 (10.8)	2 (2.1)	18 (52.9)
Q fever	184 (6.3)	278 (7.1)	0	
Typhoid fever	292 (10.0)	256 (6.5)	3 (3.2)	
Hepatitis	126 (4.3)	234 (6.0)	19 (20.0)	
Tularemia	129 (4.4)	225 (5.7)	0	
Tuberculosis	174 (6.0)	176 (4.5)	24 (25.3)	4 (11.8)
Dermatomycosis	84 (2.9)	161 (4.1)	0	2 (5.9)
Venezuelan equine encephalitis	118 (4.1)	141 (3.6)	0	
Typhus	82 (2.8)	124 (3.2)	0	
Psittacosis	70 (2.4)	116 (3.0)	0	4 (11.8)
Coccidioidomycosis	108 (3.7)	93 (2.4)	0	
Streptococcal infections	67 (2.3)	78 (2.0)	3 (3.2)	
Histoplasmosis	81 (2.8)	71 (1.8)	0	
Leptospirosis	43 (1.5)	87 (2.2)	0	3 (8.8)
Salmonellosis	54 (1.9)	48 (1.2)	11 (11.6)	1 (2.9)
Shigellosis	54 (1.9)	58 (1.5)	26 (27.4)	
All reported infections	2,912	3,921	95	34

^a 1969 data adapted from reference 151.

^b 1976 data adapted from reference 110.

^c 1980 to 1989 data adapted from references 51 through 55.

^d Includes possibly attributable and attributable cases.

^e NADC, National Animal Disease Center; 1975 to 1985 data adapted from reference 93.

D. L. Sewell.
1995.
Clinical
Microbiology
Reviews. 8:
389-405.

Reports of conversions

- Kubica described 15 separate incidents in which 80 of 291 (27%) exposed lab staff developed positive TST:
 - 8 involved poor directional airflow
 - 5 associated with BSC failures
 - 1 linked to an autoclave failure
 - 1 due to equipment failure.

Kubica GP. Your Tuberculosis Laboratory: Are You really Safe from Infection ? Clinical Microbiology Newsletter 1990; 12: 85-87.

Recent Findings

- Overall HCW TST conversion 2.3 per 10,000 FTEs in non hospital settings
- TST reactivity claims highest for physician offices 3.7 / 10,000 FTEs
- Medical labs 2.6 / 10,000 FTEs were second

*Shah et.al.Am J Infect Control 2006
34:338-342.*

Under reporting is the rule...

- Lab-acquired infections are under reported
- Kubica estimated that 8-30% of laboratories may experience tuberculin conversions
- Personal observation - 5 conversions in 21 yrs (unpublished).



Risk based on TB Incidence

- Frequency of *M. tuberculosis* positive specimens encountered
- Concentration of organisms in specimens
- Number of specimens handled by an individual worker
- Safety practices in the laboratory

*AFB
Smears*

Concentration

Cultures

Protocol Driven Risk
Assessment

Susceptibility

*Molecular
Testing*

Biochemicals

Risk Assessment starts with the specimen...

- Collect specimens into sealed, leak proof containers
- Transport in sealed plastic bag
- Examine outer surface for leakage
- Disinfect external surfaces before handling

Evaluate Protocols to determine when generation of droplets occurs

- Droplet generators
 - Pouring liquid cultures and supernatant fluids
 - Using fixed-volume automatic pipettors
 - Mixing liquid cultures with a pipette
 - Preparing specimen and culture smears
 - Dropping tubes or flasks containing cultures

Also consider unexpected events and outside the TB lab



- Spilling suspensions of bacilli
- Breaking tubes during centrifugation
- Preparing frozen sections
- Cutting or sawing through tissue specimens that have not been fixed
- Homogenizing tissues for primary culture



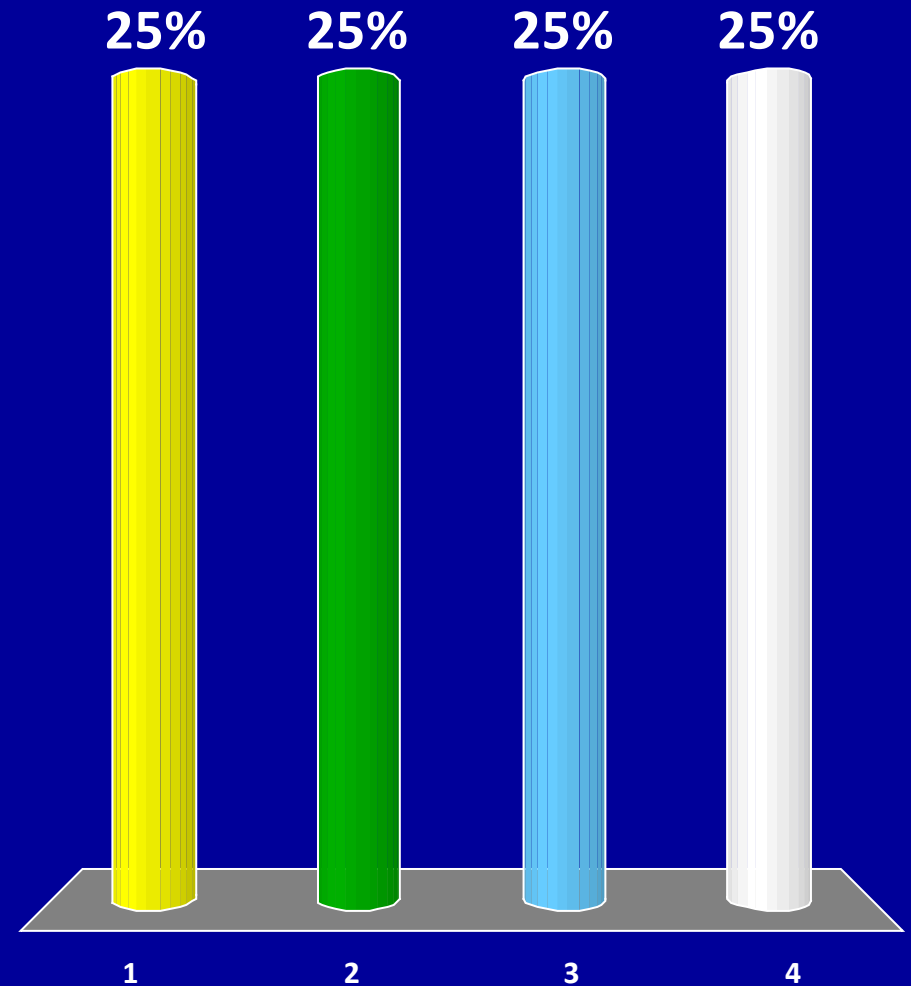
Risk Assessment: evaluate how exposure is prevented

- During the risk assessment, consider prevention methods employed:
 - Safe work practices
 - Use of containment equipment
 - Specially-designed laboratory facilities



What category of disinfectant is used in the TB lab?

1. Don't Know.
2. High level.
3. Intermediate Level.
4. Whatever is provided by housekeeping.



Safe Work Practices - Disinfection

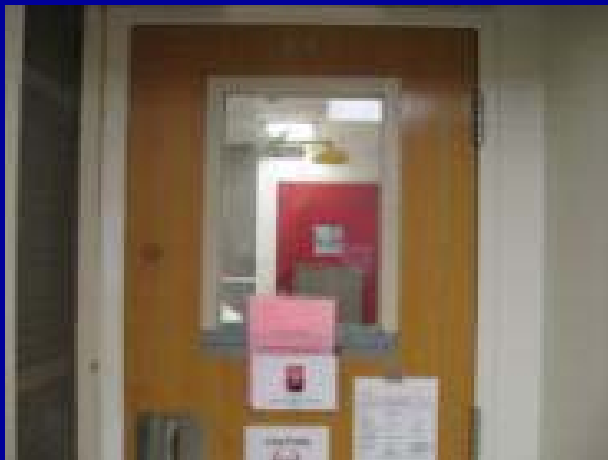
- Is an intermediate level disinfectant used?
 - phenolics, iodophors, chlorine or 70%-100% alcohols
- Are all surfaces disinfected daily?
- Is work performed over a disinfectant soaked gauze pad or paper towel in the BSC?

Safe Work Practices - Training

- How well are workers trained for the tasks?
- Do workers meet a level of competency before being allowed to work?
- Training should include:
 - Use of safety equipment,
 - Decontamination procedures,
 - Spill clean-up,
 - Use of autoclave,
 - Waste disposal.

Safe Work Practices - Design

- Is there a written biosafety manual?
- Is the door to the TB lab kept closed during specimen processing?
- Is a biosafety sign posted on the door?
- Is all work performed in a BSC?



Safe Work Practices – Employee Health

- Do new employees receive TST in a “two step” process or a IGRA?
- Is there a respiratory protection program?



Safe Work Practices – Host factors placing staff at increased risk

- Do personnel understand the increased risk from:
 - Known immunosuppression?
 - Chronic asthma, emphysema or severe respiratory conditions?
 - Use of medications known to reduce dexterity or reaction time?
 - Pregnancy?

Safe Work Practices – Waste Management

- Is all waste autoclaved prior to transporting from the laboratory?
 - The autoclave should have proper QC and maintenance performed as scheduled.
 - If an autoclave is not available, all waste from the mycobacteriology laboratory must be securely contained in leak-proof containers. Waste should be packaged so that the outside of the container can be disinfected before it leaves the laboratory.

Containment Equipment - BSC

- Is all work performed within the BSC?
- Is the BSC certified at least annually?
 - Who certifies the certifier?
- Are personnel trained on
 - Working within the BSC?
 - Movements that could disturb the air flow?
 - Storage of items in the BSC?

Containment Equipment – PPE

Are personnel provided:

- Solid front disposable gown with snug (knit) cuffs?
- Gloves long enough to overlap the sleeves of the gown?
- Remove all outer protective clothing when leaving the BSL-3 laboratory and place the clothing into bags for autoclaving.

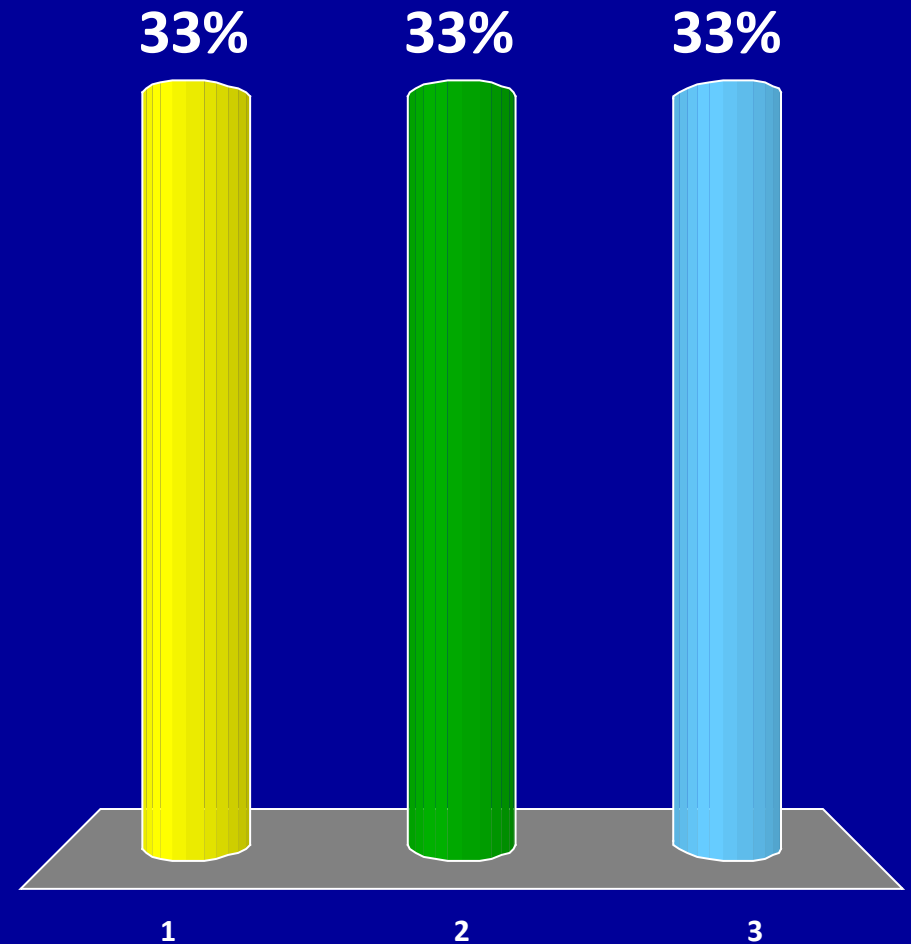


Containment Equipment – Respiratory Protection

- Since no BSC is 100% effective, personnel must use respirators:
- Respirators provide greater protection
 - Filters are more efficient
 - Can be fit-tested
 - Can be fit-checked by the user to ensure a tight seal to the face
- Respiratory protection program requires: SOP, training, storage, inspection, medical review, program evaluation.

What to do for the fashion conscious who won't wear an N95?

1. Find them another lab to work in?
2. Allow them to make an N95 out of T shirts?
3. Purchase the Sling Couture Fashion Face Mask?





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Containment Equipment - Centrifugation

- Are all centrifuge tubes sealed tightly, disinfected, and placed in safety cups in the BSC?
 - After centrifugation open safety cups in BSC

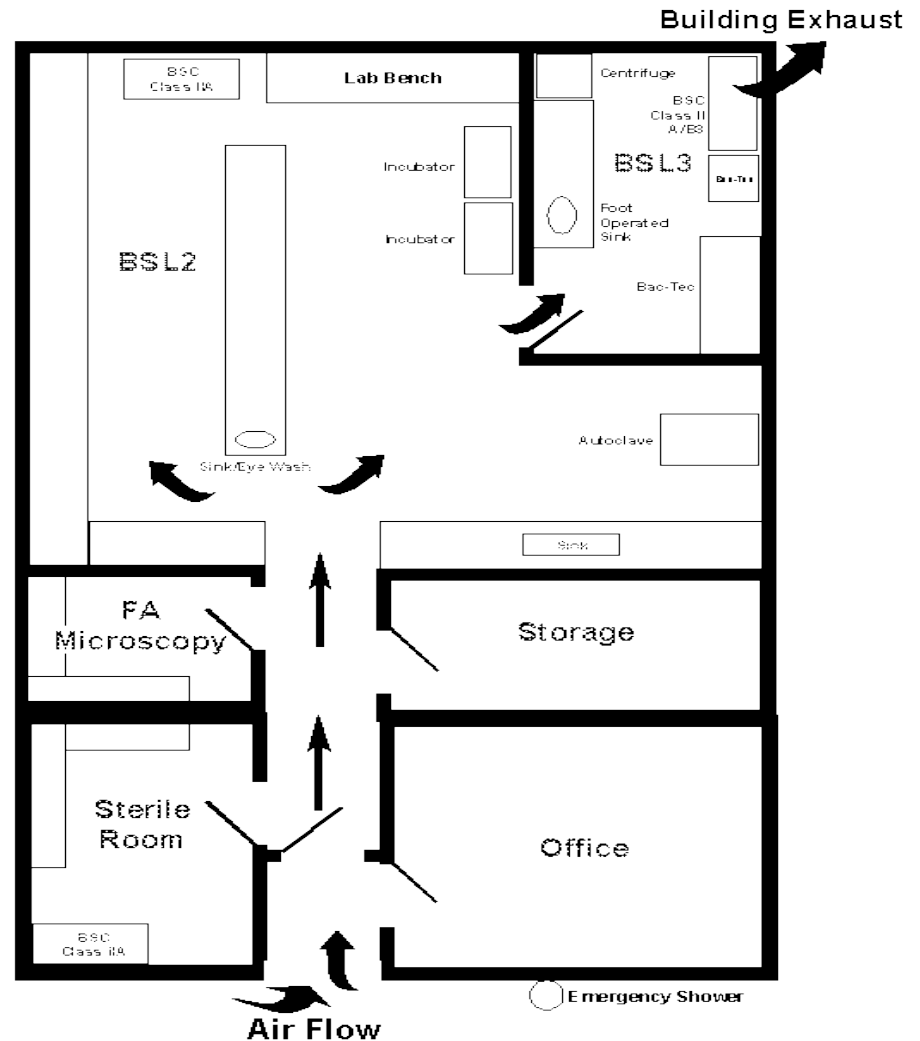


Risk Assessment looks at the Laboratory Facilities

- BSL2
 - Staining specimen smear for AFB No cult
 - Inoculating cultures from specimens (use BSL3 practices)
- BSL3
 - Smears from cultures
 - Manipulating grown cultures of TB

Laboratory Facilities

- BSL3 lab facility
- Access through 2 doors with an air space between
- Single pass ventilation system, exhausting all room air to the outside



Laboratory Facilities – BSL3

- 6-12 air changes per hour (removes 99% of the airborne particulate matter)
- Airflow should be from “clean” to “less clean” areas
 - Create negative pressure into which flow is desired relative to adjacent areas.
- The lab should be kept under negative pressure at all times regardless of BSC power



Laboratory Facilities – BSL3

- Interior surface of walls, floors and ceiling sealed and utility penetrations
- Bench tops resistant to acids, alkalis, organic solvents, and moderate heat
- Foot-operated hand washing
- Automatic door closures
- Autoclave



Is there a written Spill Clean Up Procedure?

- If minimal aerosols are produced:
 - Cover the spill
 - Saturate with disinfectant
 - Leave room for at least 2 hours to permit air handling system to evacuate aerosols
 - Wear PPE to reenter
 - Autoclave material
 - Disinfect floors and countertops

Spill Clean Up Procedures

- If major aerosols are produced:
 - Evacuate immediately
 - Do not reenter for at least 4 hours
 - Decontaminate with formaldehyde gas or other agent
 - Reenter using appropriate protection

What is the Infectious Agent Post Exposure Management Plan?

Laboratory Occupational Health Protocol

- Reporting of exposure events and illnesses
- Responding to potential exposure events
- Responding to respiratory illness in laboratory workers post exposure
- Initiation of laboratory testing



Beyond the Risk Assessment

- Audit the program
 - Self audits, internal & external audits
- Follow up on accidents and incidents
- Revise the program accordingly



Collaborate with Occupational Health and Safety Program

- General laboratory safety training and familiarity with safety guidelines, universal precautions, training and experience are required to conduct work in the laboratory.
- At a minimum, occupational health program includes:
 - Offering of two step TST based on expected work areas such as mycobacteriology lab
 - Ongoing evaluation if in the respirator program, based on expected work area

Safety Orientation and Annual Competency Include...

- Proper and Safe Handling Practices
- Use of the BSC
- Biohazardous waste handling
- Use of autoclave
- Disease symptoms
- Post exposure management
- Reporting exposures and illnesses



BSL COMPETENCIES OPEN FOR COMMENT

SILENCE = AGREEMENT

YOUR INPUT IS NEEDED. Go to:
<http://www.surveymonkey.com/s/bslcompetencies>

Questions?

Contact Kajari Shah,
kajari.shah@aphl.org

Biosafety competencies for laboratorians working in BSL-2, BSL-3, and BSL-4 laboratories now available for comment. The draft was created by representatives from federal, state, private and academic laboratory settings.
Submit input by June 15, 2010!



What you don't want to see in your TB lab...

