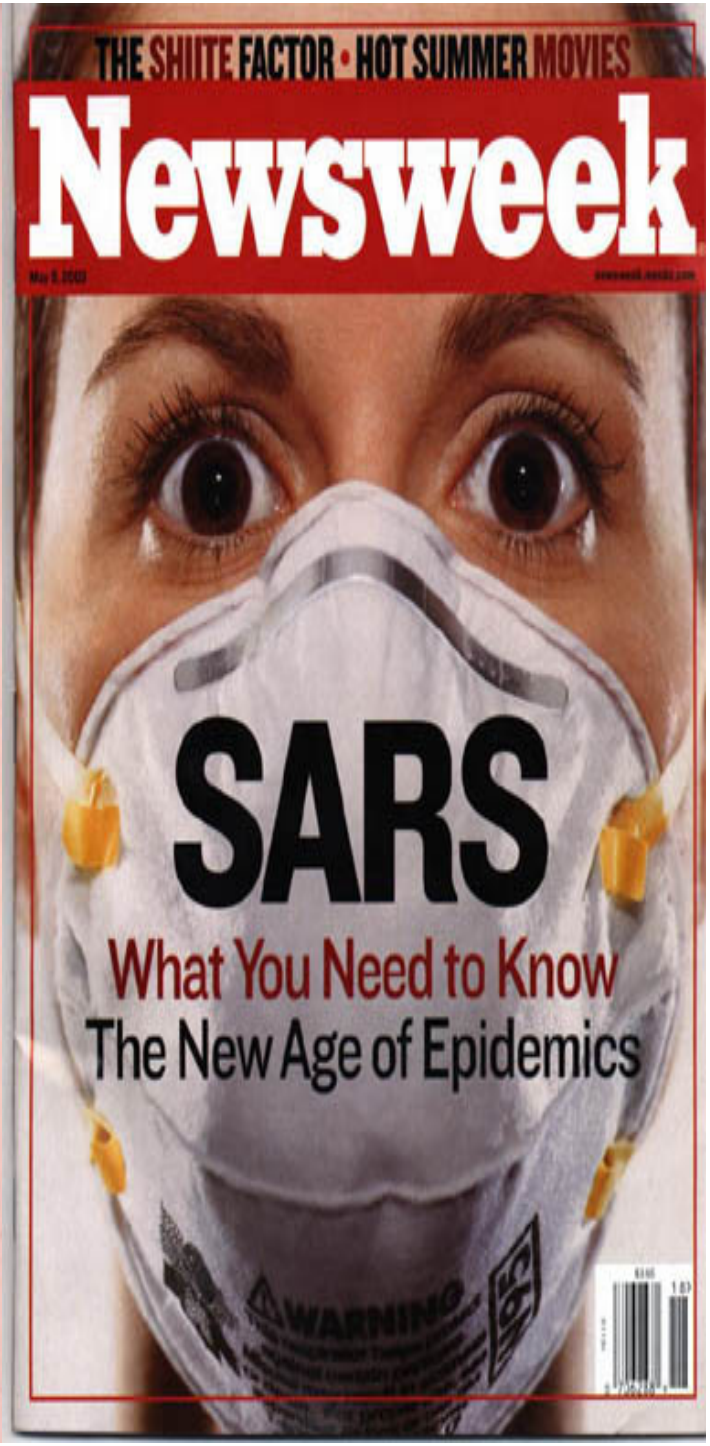

PREVENT DISEASE
CARELESS
SPITTING, COUGHING, SNEEZING,
SPREAD INFLUENZA
and TUBERCULOSIS


THE SHIITE FACTOR • HOT SUMMER MOVIES
Newsweek
SARS
What You Need to Know
The New Age of Epidemics


Flu
FEARS

Aerosol Transmissible Disease Standard (ATD) for Laboratories

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Associate Safety Engineer
San Francisco District Office

Objectives

- Review ATD standard requirements for labs
- Identify the agents covered under the standard
- Discuss some common exposures leading to acquired lab infections
- Provide recommendations for working in the BSC
- Identify high hazard procedures
- Review techniques used to minimize aerosols

Why do we need to comply with the ATD standard?

- It's the law
- Title 8 CCR Section 5199
- Aerosol Transmissible Diseases
  - Aerosol and droplet hazards
  - Inhalation

- ATD Zoonotic Standard
  5199.1 (a)(1)(A)(7)
  Laboratory operations involving samples, cultures, or other materials potentially containing zoonotic aerosol transmissible pathogens (zoonotic ATPs)

Aerosols & Droplets

- Fine mists of particles of up to 5 µm
- May require up to 1 hour or longer to settle
- Procedures that impart energy to a microbial suspension produce aerosols
- Ubiquitous in laboratory procedures
- Often undetected
- Extremely pervasive, putting all at risk, or exposing staff to hazardous conditions
- Splashes can cause airborne droplets which settle faster
- Aerosols and droplets, contain suspensions of pathogens, may not be seen or smelled, but can be inhaled

Slide by Michael Pentella, PhD (University of Iowa Hygienic Laboratory)

Requirements for Laboratories Section (f)

- Identification of Biosafety Officer
- Risk Assessment in accordance with Section II of BMBL
- Implement feasible engineering and work practice controls in accordance with the risk assessment
- Develop a list of job classification, tasks, and procedures where employee might be exposed
- List of ATP-L that are present in the lab
- Safe handling procedures
- Engineering Controls (biosafety cabinets)
- PPE
- Decontamination of surfaces and equipment
- All incoming materials containing ATPs-L be treated as containing the virulent pathogen
- Inspection of labs and biosafety procedures annually
- Emergency procedures for uncontrolled releases
- Procedures for medical services including (IZ, PPD, Tx)
- Procedure for review of biosafety plan

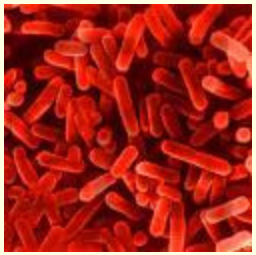
Requirements for Referring Employers

- "Designate a person responsible for the establishment, maintenance, and implementation of infection control procedures" (i.e. isolation, decon, source control, notifications, referral)

Biosafety Officer & Biosafety Manual

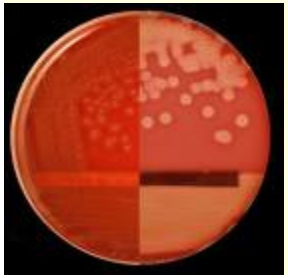
- Biosafety Officer
- Biosafety Manual
- Biosafety Manual & Exposure Control Plan in hospital settings where there is direct patient contact
- Reviewed and revised annually

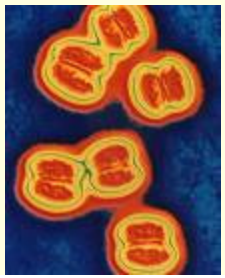
List of Bacterial Agents



See Appendix D

- **All Select Agents!**
- Bordetella pertussis
- Chlamydia pneumoniae
- Chlamydia psittaci
- Chlamydia trachomatis
- Clostridium botulinum
- Corynebacterium diptheriae
- Haemophilus influenzae, type B
- Helicobacter pylori
- Legionella pneumophila
- Neisseria gonorrhoeae
- Neisseria meningitidis
- Salmonella spp.
- Salmonella typhi
- Shigella
- Streptococcus spp. group A
- **Novel or unknown pathogens**
- **Pathogens designated by the safety officer**

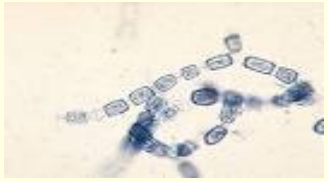


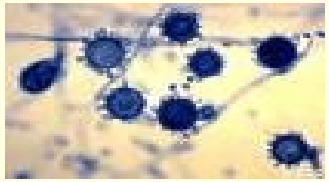


List of Mycobacterium & Fungal Agents

See Appendix D

- **All Select Agents!**
- Blastomyces dermatitidis
- **Coccioides immitis and posadasii**
- Histoplasma capsulatum
- Mycobacterium tuberculosis
- Mycobacteria spp.
- **Novel and unknown pathogens**
- **Pathogens designated by the safety officer**

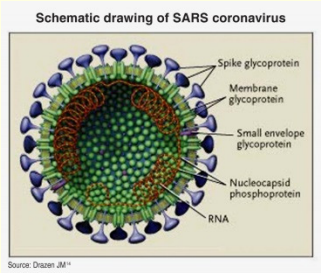




List of Viral Agents

See Appendix D

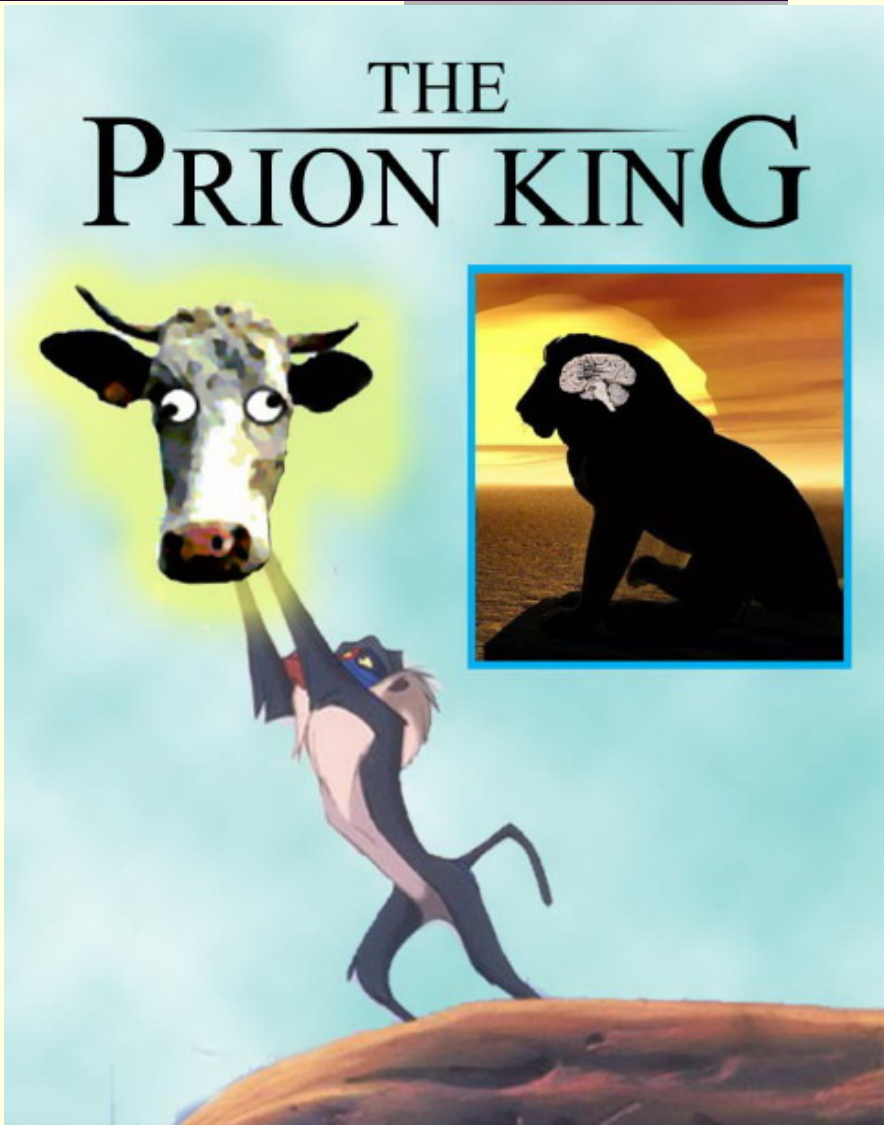
- **All Select Agents!**
- Adenovirus
- Arboviruses
- Arenaviruses
- Chapare Virus
- Cytomegalovirus, human
- Dengue
- Epstein-Barr Virus
- Hantaviruses
- Hepatitis B, C, D
- Herpesvirus simiae (B)
- Influenza, con-contemporary human (H2N2), 1918 strain, H5N1
- Lymphocytic choriomeningitis virus
- Measles
- Mumps
- Parvovirus B19
- Rabies
- Retroviruses
- Rubella
- SARS Co-V
- Venezuelan Encephalitis
- Western Encephalitis
- West Nile
- Yellow Fever
- **Novel or unknown pathogens**
- **Pathogens designated by safety officer**



Other Agents

Appendix D

- **All Select Agents!**
- Mycoplasma
- Prions
- Rickettsia
- **Novel or unknown pathogens**
- **Pathogens designated by the safety officer**



Commonly Acquired Lab Infections

- *Brucella spp.*
- *C. burnetii*
- *C. immitis*
- *C. posadasii*
- *F. Tularensis*
- *M. Tuberculosis*
- *N. meningitidis*
- *R. prowazekii*
- *S. Typhi*

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

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.

Brucellosis
(*B. abortus, canis, maris, melitensis, suis*)

Infectious dose: very low, ~10+ organisms

Symptoms: mild flu like, undulating fever (can be high), aches

Transmission: Can be transmitted by infectious aerosols, consuming unpasteurized dairy products, lab & veterinary occupational exposures

Incubation period: 5-60 days (can be months)

Lab acquisition: generally by transmitted by aerosolization in lab

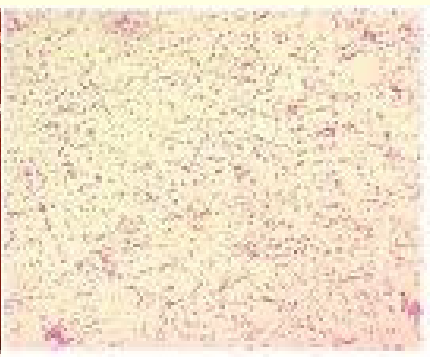
Source specimens: cultures, blood, tissues, placentas, fetuses, urine, and difficult to isolate from food sources (dairy)

Reference: Control of Communicable Diseases Manual

http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5702a3.htm







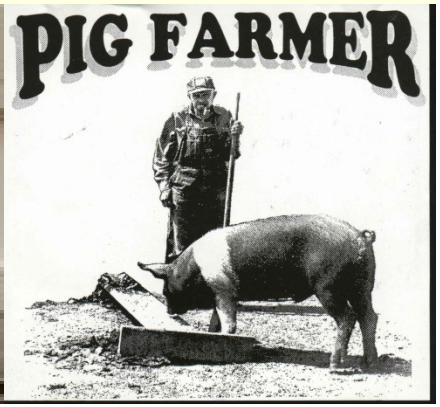
Brucella Disinfection

- Sodium hypochlorite, aldehydes, and phenolics
- Sterilization by autoclaving

Brucella in the clinical laboratory

- Hospital performs gram stain, blood tube inoculation, and basic biochemical tests on the open bench
- Brucella spp. misidentified as Haemophilus
- Specimen run on the multiplex
- Confirmatory genus ID occurs at local LRN lab
- State lab receives a lysate to speciate the specimen as melitensis, abortus, suis



Case Study Brucellosis: 2001 & 2002

Diagnostic Lab 1

- Nov. 2001, New York
- 57 year old female clinical lab worker
- Malaise, vomiting, headache, and fever
- 5 weeks after symptoms gram-variable
- **Infection resulted from clinical sample processed on open bench in BSL-2 lab without proper precautions**

Source: Noviello, S, Gallo R, Kelly, Limberger, RJ, DeAngelis K, Cain L, et al. Laboratory-acquired brucellosis, Emerg Infect Dis, 2004 Oct, Available at http://www.cdc.gov/ncidod/EID/vol10no10/04-0076.htm

Case Study Brucellosis: 2001 & 2002

Diagnostic Lab 2

- Jan. 2002, New York
- 48 year old female laboratory worker
- High fever, chills, drenching sweats, and weight loss
- **Clinical sample from lab worker from (Dx Lab #1) was subcultured in BSC, but biochemical tests done on open bench (catalase)**
- Technician contracted *B. melitensis*

Source: Noviello, S, Gallo R, Kelly, Limberger, RJ, DeAngelis K, Cain L, et al. Laboratory-acquired brucellosis, Emerg Infect Dis, 2004 Oct, Available at http://www.cdc.gov/ncidod/EID/vol10no10/04-0076.htm

Case Report 1: Lab Acquired Brucellosis Indiana

- September 28, 2006
- 47 yr old microbiologist A
- Worked in a clinical laboratory had onset of high fever, sweating, malaise, anorexia, headache, and hip pain. Initially, her symptoms were not severe; she did not seek medical treatment until 3 weeks later
- Microbiologist was hospitalized on October 22nd and recovered fully with treatment
- October 26th, A blood culture isolate from microbiologist A (isolate A) was submitted for identification to a Minnesota clinical laboratory and determined to be *Brucella* spp.; both MDH and IDSH were notified of the finding
- Epidemiologic investigation revealed that, on July 17th, **microbiologist A had subcultured on an open laboratory bench** an unidentified isolate (isolate C) from a referring laboratory. Isolate C was sent to MN clinical laboratory and identified as *Brucella* spp."

Source: MMWR Jan. 18, 2008/57(02); 39-42

Case Report 2: Lab Acquired Brucellosis in Minnesota

- October 25, 2006
- 61 yr old microbiologist B
- Worked at the same Minnesota clinical laboratory that received microbiologist A's isolate, had onset of low-grade fever, fatigue, and night sweats
- She was hospitalized and recovered with treatment
- November 9th, the Minnesota laboratory identified a blood culture isolate from microbiologist B (isolate B) as *Brucella* spp. and notified MDH
- The **subsequent investigation determined that microbiologist B had not handled isolate A from microbiologist A**. However, previously **she had handled on an open bench two unidentified isolates later identified as *Brucella* spp**

Source: MMWR Jan. 18, 2008/57(02); 39-42

Tuberculosis

(*Mycobacterium africanum, bovis, canettii, microti, tuberculosis)*

Infectious dose: 1-10 organisms, no safe level of exposure

Symptoms: coughing, exporating sputum or blood, dyspnea

Transmission: Transmitted by infectious aerosols, can remain communicable for 4 weeks to 6 months post tx, extra pulmonary infections

Incubation period: 2-10 weeks to 1yr, latent TB

Lab acquisition: generally by transmitted by aerosolization, respiratory droplets

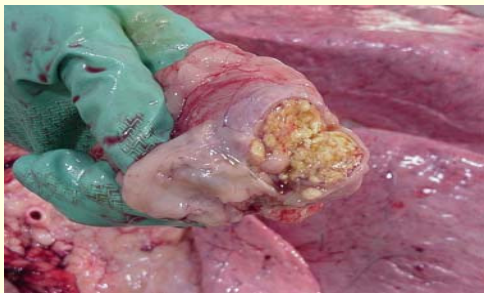
Source specimens: sputum, cultures, BAL, tracheal washes, tissues, unpasteurized milk, infected animal carcasses

Immunization: BCG, questionable efficacy

Reference: Control of Communicable Diseases Manual

Journal of Clinical Microbiology, 07 1997, 1847-1851, Vol 35, No. 7

Sewell, PhD. Clinical Microbiology Newsletter **Volume 28**, **Issue 1**, Pages 1-6 (1 January 2006)



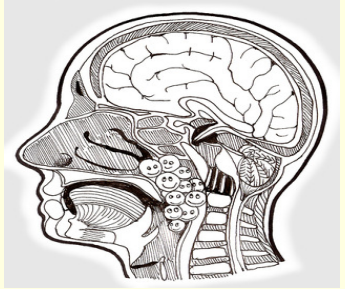
TB Disinfection

Alcohols	Ineffective
Aldehydes	Effective
Chlorine compounds	Ineffective
Sodium hypochlorite	
Phenolics	Effective
Quarternary ammonium	Ineffective
Sterilization by autoclave	Effective

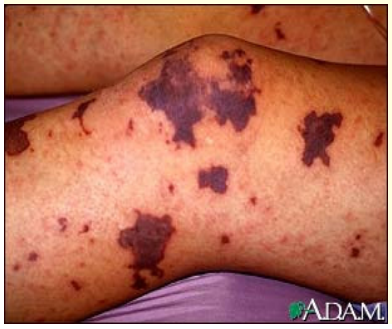
Generation of Droplets & Droplet Nuclei during *M. tuberculosis* (TB) procedures

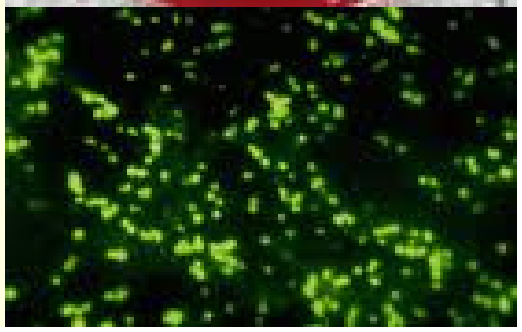
- Pouring liquid cultures and supernatant fluids
- Using fixed-volume automatic pipetters
- Mixing liquid cultures with a pipette
- Preparing specimen and culture smears
- Dropping tubes or flasks containing cultures
- Risk to laboratorians who process specimens in microbiology and histology labs

Neisseria meningitidis (meningococcal disease)



Infectious dose: not available
Symptoms: fever, headaches, rash, stiff neck, light sensitivity
Transmission: direct contact, respiratory droplets, sharing beverages
Incubation period: 2-10 days, commonly 3-4 days
Lab acquisition: droplet, aerosol, mucous membranes
Source specimens: pharyngeal exudates, CSF, blood, saliva
Immunizations: available
Containment: BSL2+
Inactivated by: sodium hypochlorite, aldehydes, phenolics, autoclaving
Reference: MMWR Article Sept. 2005
MMWR Feb. 22, 2002/51(07);141-4
Control of Communicable Diseases Manual





Case Report 1: Lab Acquired Meningitis

- July 15, 2000, Alabama
- 35 year old female microbiologist
- Seen at the hospital emergency with generalized malaise, fever, and diffuse myalgias

- **July 16 patient returned to hospital A, became tachycardic and hypotensive, and died 3 hours later.** Blood cultures were positive for *N. meningitidis* serogroup C

- **Source specimen: Gram's stain from the blood culture of a patient who was subsequently shown to have meningococcal disease. The microbiologist had also subcultured agar plates containing cerebrospinal fluid (CSF) cultures of *N. meningitidis* serogroup C from the same patient**

- Co-workers reported that in the laboratory, **aspiration of materials from blood culture bottles was performed at the open laboratory bench; biosafety cabinets, eye protection, or masks were not used routinely for this procedure.** Results of pulsed-field gel electrophoresis (PFGE)

Source: MMWR February 22, 2002 / 51(07);141-4

Case Report 2: Lab Acquired Meningitis

- December 24, 2000, Michigan
- 52 yr old microbiologist
- Acute onset of sore throat, vomiting, headache, and fever by December 25th, the patient had developed a petechial rash on both legs
- Patient presented to the emergency department of hospital B and died later that day of overwhelming sepsis
- Blood cultures were positive for *N. meningitidis* serogroup C

- **The patient was a micro-biologist in the state public health laboratory and had worked on several *N. meningitidis* serogroup C isolates during the 2 weeks before becoming ill**

- Co-workers reported that the patient **had performed slide agglutination testing and recorded colonial morphology using typical biosafety level 2 (BSL 2) precautions; this did not entail the use of a biosafety cabinet**

Source: MMWR February 22, 2002 / 51(07);141-4

Case Report 3: Lab Acquired Meningitis

- April 27, 2012 in California
- 25 year old male

- Onset of headache, fever, neck pain, and stiffness. Transported to the hospital the next day, looses consciousness in transport, presents in emergency department on April 28th with petechial rash.

- Blood positive by PCR confirming serogroup B infection

- Worked in a research lab with a number of different serogroups performing aerosol generating procedures on the open bench including gram staining, plate spreading, plate scraping, flaming loops, vigorous pipetting of solution, opening discard bin, and disposal of spreader/scraper and plates.

Source: MMWR September 5, 2014/ 63(35);770-772

High Risk *N. meningitidis* Testing Procedures

- Streaking for isolation
- Gram stain preparation
- Serogrouping
- Biochemicals such as rapid fermentation
- Carbohydrate testing
- ONPG
- Creation of a solution for DNA extraction

CCR 5199 f (4)(E) Engineering Controls

- **<u>"Identify and describe the use of engineering controls, including containment equipment, and procedures"</u>**

- Types of engineering controls

  BSC's, centrifuge rotors/cups, specimen transport carriers, pipette tips


NUAIRE

Recommendations for working in the BSC

- Do not block front or rear grilles
- The sash must be adjusted to the appropriate level
- Check and record your airflow gauge reading to verify proper airflows before using the BSC
- The BSC should only contain those items needed to perform the specific function. Upon completion all items should be decontaminated and removed
- Work should be conducted 4-6 inches inside the BSC.
- Minimize traffic flow past the BSC when in use.
- If disruption of the airflow occurs during work, safely secure your work make sure you let it run for at least 15 minutes before you begin to purge the system of settled dust etc.
- Do not use volatile chemicals in recirculating BSCs. Be aware some chemicals may damage the HEPA filtration system. Use a fume hood for volatile chemicals.

What not to do

Photos by Michael Pentella, PhD

What to do

Photo by Michael Pentella, PhD

CCR 5199 f (4)(F) Safe Procedures

- "**<u>Establish safe handling and prohibit practices, such as sniffing in vitro cultures, that my increase employee exposure to infectious agents</u>**"

- Performing high hazard procedures when possible in the hood and inactivating the organism before working on the bench top

- Adherence to proper technique

What are considered high hazard (aerosol generating) procedures?

- Catalase
- Pipetting (vigorous mixing)
- Mixing
- Centrifugation
- Inoculating biochemicals or blood culture bottles
- Vortexing
- Pouring off specimens
- Loading syringes
- Flaming loops
- Open bench subculturing
- Hot loop into broth or media
- Lasers, cell sorters
- Grinding Splashes
- Opening lyophilized cultures
- Entering or opening vessels at non-ambient pressures, fermenters, freezer vials
- Bone saw at autopsy
- Homogenizing
- Sonication
- Flow cytometry

Techniques to minimize aerosols

Dont's

- Use Bunsen burners when you have alternatives
- Pop open the stoppers of blood collection containers.
- Blow out last drop in pipette
- Mix by suction + expulsion
- Open centrifuge immediately after breakage of a specimen
- Operate the cryostat to cut tissue without closing window

Do's

- Discharge liquid down side of container
- Deliver as close as possible to contents
- Use capped tubes when mixing or vortexing
- Use care with needles (gauze pad with alcohol on septum of blood culture bottle)
- Use pipette aids with filters
- Change procedures

Slide by Michael Pentella, PhD (University of Iowa Hygienic Laboratory)

How to minimize aerosols while working with centrifuges

- Transfer liquids with automatic pipette
- Work over absorbent
- Use centrifuge safety cups
- Use sealed rotors
- Use centrifuge in BSC
- Wait until your rotor has stopped spinning

Slide by Michael Pentella, PhD (University of Iowa Hygienic Laboratory)

CCR 5199 f (4)(F) Decon

- **“Establish effective decontamination and disinfection procedures”**

- Decontaminate work surfaces before and after you complete your work
- Decontaminate the BSC before and after working
- Appropriate disinfectant concentration for the appropriate contact time
- Autoclave infectious material daily

CCR 5199 f (4)(H & I) PPE

- **“Identify and describe the appropriate PPE to be used to minimize exposure”**

- **“Identify any operations where respiratory protection is required”**








CCR 5199 f (4)(J)

"**Establish emergency procedures for uncontrolled releases with in the laboratory facility and untreated releases outside the laboratory facility" " These procedures shall include effective means for reporting to the local health officer"**

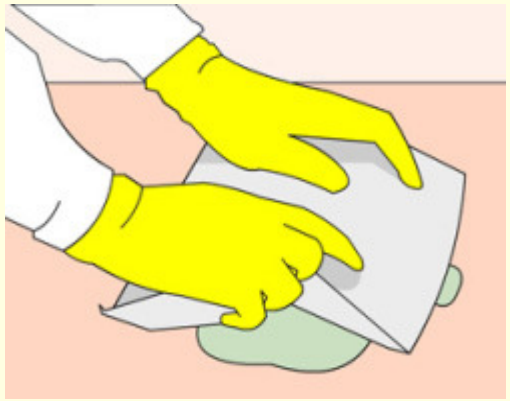
Spill Procedures

- Wear PPE to clean up
- Cover the spill
- Saturate with disinfectant for the appropriate contact time
- Autoclave material
- Disinfect floors and countertops

BSL-3 Major Spill Clean Up

BIOSAFETY LEVEL 3

- Evacuate immediately
- Do not reenter for at least 2-4 hours
- Decontaminate with vaporized hydrogen peroxide, chlorine dioxide, formaldehyde gas or other agent
- Re-enter using appropriate protection



CCR 5199 f (4)(K)

- **“Include medical services from subsection (h)”**

- Immunizations (10 days, declinations)
- Vaccines as recommended by the BMBL 5th Edition
- Examinations
- PPD’s (annually)
- Exposure Incidents
- Treatment
- Emergencies

CCR 5199 f (4)(L)

- **“Include an effective procedures for the communication of hazards and employee training that complies with subsection (i). This shall include training in the employer’s Biosafety Plan and emergency procedures.**

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

CCR 5199 f (4)(M)

- **“Include an effective procedure for obtaining the active involvement of employees in reviewing and updating the Biosafety Plan with respect to the procedures performed by employees in their respective work areas or department on an annual basis”**

- Develop a policy or SOP
- Document your review and revisions

CCR 5199 f (4)(N)

- **Include procedures for the biological safety officer(s) to review plans for the facility design and construction that will affect the control measures for ATPs-L.**

CCR 5199 f (4)(O)

- **“Include procedures for inspection of laboratory facilities, including an audit of biosafety procedures. These inspections shall be performed at least annually. Hazards found during the inspection, and actions taken to correct hazards, shall be recorded.”**

- Develop an inspection procedure or SOP
- Document your inspections including corrective actions

CCR 5199 (g) Respiratory Protection

- Medical Evaluation
- Annual Training
- Fit Testing-Quantitative or Qualitative
- Respiratory Protection Plan

Training

- “Employers shall ensure that all employees with an occupational exposure participate in the training program”
- Training provided at time of initial assignment and annually thereafter
- Updates provided when new engineering devices, work practice controls, or when tasks or procedures are modified

Required Training Elements

- Accessibility to the written standard
- General Explanation of ATD's
- Modes of Transmission
- Exposure Control/Biosafety Plan
- Explanation of appropriate methods of recognizing tasks
- Explanation of mechanisms to reduce ATD's
- Information on selection, decontamination, handling or PPE
- Description of TB surveillance procedures
- Respiratory Protection Training Requirements
- Information on Vaccines
- Exposure incident procedure
- Information on the employers surge plan

Section (j) Recordkeeping

- **(1) Medical Records (A)" The employer shall establish and maintain an accurate medical record for each employee with occupational exposure, in accordance with Section 3204”**

- Record shall include

  -Employee’s name

  -Vaccination status

  -Copy of signed declination forms (exception current seasonal flu)

  -Copy of written opinions from PLHCP

  -Copy of the exposure incident report supplied to PLHCP

  Retention of medical record for employment period plus 30 yrs

  -“Must be supplied to employees upon request to the subject employee, anyone having the written consent of the subject employee, the local health officer, and to the Chief and NIOSH in accordance with Section 3204”

Recordkeeping

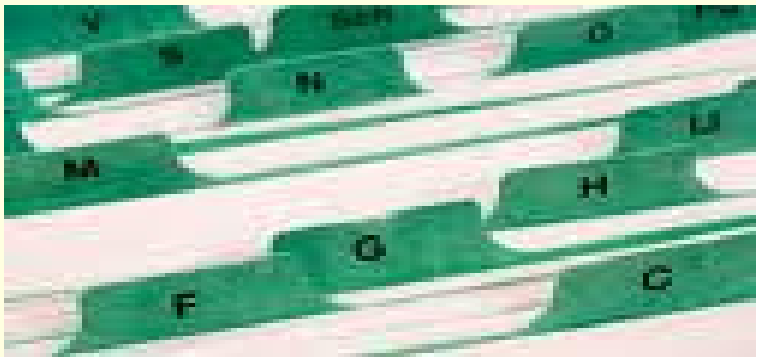
- **<u>Confidentiality "The employer shall ensure that all employee medical records required by this section are:</u>**

  1. Kept confidential

  2. Information should not be disclosed or reported without the employee's express written consent to any person within or outside the workplace except as permitted by this section or as may be required by law.

Recordkeeping

- Training records
  - Date
  - Content or summary of material covered
  - Names and qualifications of person conducting the training
  - Names and job titles of all attendees
  - Record must be retained for **3 years**



Recordkeeping

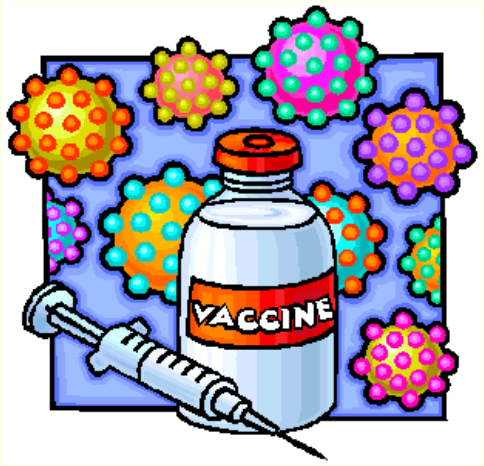
- Plan implementation records
  - Dates of review
  - Person conducting the review
    - Safety officer performs review annually
  - Name and work areas of employees involved and summary of conclusions
  - Record must be retained for **3 years**

Recordkeeping

- Exposure records
  - Date of exposure incident
  - Names of those exposed
  - Disease pathogen
  - Name and job title of person performing the evaluation
  - Identity of any local health officer and/or PLHCP consulted
  - Date of evaluation
  - Date of contact and contact information who other employers who either notified the employer or was notified by the employer

Recordkeeping- Unavailable Vaccines

- Vaccine Unavailability
  - Every 60 days
  - Name of person who determined vaccine was not available
  - Date of contact
  - Record must be retained for **3 years**



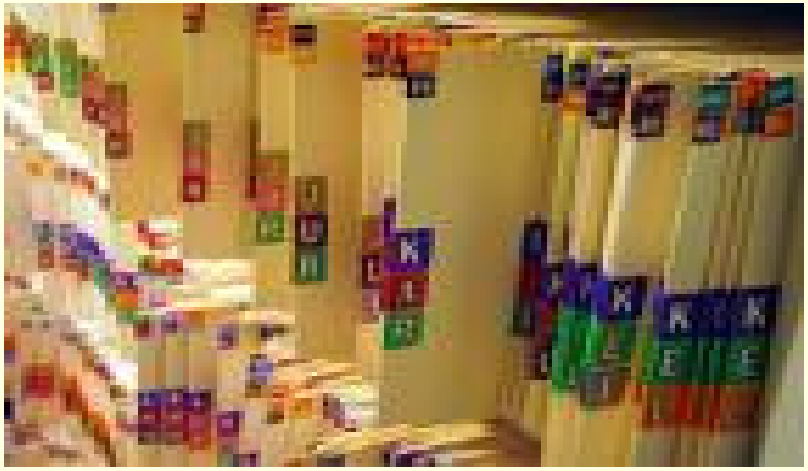
Recordkeeping (facility staff)

- Records of inspection, testing, and maintenance of non-disposable engineering controls including ventilation and other air handling systems, air filtration systems, containment equipment, biological safety cabinets, and waste treatment systems shall be maintained for a minimum of **five years** and shall include”

- Name and affiliation of person performing the test, inspection, or maintenance, date, significant findings, and actions taken

Recordkeeping

- Respiratory Protection Screening
  - Record must be retained for **2 yrs**.
  - Includes initial respirator medical evaluation and any subsequent respiratory clearance records
  - Annual fit test records



Any Questions?

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ATD Standard
http://www.dir.ca.gov/oshsb/atdapprvdtxt.pdf
http://www.dir.ca.gov/Title8/5199.html

Zoonoses Standard
http://www.dir.ca.gov/oshsb/zoonoticsapprvdtxt.pdf