Element I
Professional Responsibility for Infection Control

Learning Objectives

1. Describe benefits to patients, and health care workers of adhering to scientifically accepted principles and practices of infection control.
2. Describe the professional’s responsibility to adhere to these practices, and the consequences of failing to comply
3. Describe the professional’s responsibility to monitor infection control practices of persons for whom he/she is responsible.
Definitions:

• **Universal precautions (standard precautions):** these are precautions applicable to all patients, including use of barriers, such as gloves, gowns, masks, and/or protective eyewear, and proper disposal of sharps, to prevent skin and mucous membrane exposure to bloodborne pathogens and all other moist and potentially infectious body substances.

• **Standard of Care:** established criteria for the performance of individuals in similar circumstances.

• **OSHA:** Occupational Safety and Health Administration, a branch of the U.S. Department of Labor.
I. Standards of care in infection control

A. Prevention of Bloodborne Diseases:

Evidence suggests that the transmission of human and dental procedures is preventable through the strict adherence to good infection control practices.

**Standard Precautions**: decrease the opportunity for blood exposures among health-care workers and patients, and have become the standard of care in all health care settings since 1985.
I. Standards of care in infection control

B. Other standards of care for infection control include:

1. Practices to prevent spread of airborne diseases. (e.g. tb, measles, chickenpox, smallpox, severe acute respiratory syndrome;

2. Practices, such as hand hygiene, aseptic technique, and use of barrier methods, especially gloves, to prevent spread of most bacterial infections (e.g. staph, and strep) and some viruses (herpes, cold viruses, CMV) in health settings;

3. Appropriate cleaning, disinfection, and sterilization of medical devices and equipment; and

4. Occupational health practices for prevention and control of communicable diseases in health-care workers (e.g. TB skin testing and immunizations against hepatitis B, measles, and rubella).
II. Standards of professional conduct as they apply to infection control

A. Mandated NY State and Federal standard of professional conduct.

1. **New York State:** 1992 legislation formally established accepted infection control practices as standards of professional conduct.

2. NY State Department of Health and NY State Department of Education require that all licensed health care professionals in NY must complete mandatory course work in infection control before 7-1-1994 and every four years for state licensing or registration of non physicians.
II. Standards of professional conduct as they apply to infection control

B. Implications of professional conduct standards

1. All health care professionals bear responsibility to adhere to infection control standards.

2. All health-care professionals have a responsibility to monitor the practices of others to assure safety of all patients and personnel.

3. Consequences of failure to follow accepted standards of infection control include:
   a. subjecting self, coworkers, and/or patients to increased risk of communicable disease.
   b. subjecting oneself to charges of unprofessional conduct.
II. Standards of professional conduct as they apply to infection control

• Consequences of failure-continued
  – 1. Mechanisms for reporting unprofessional conduct: patients, family members or coworkers/employers can file charges to the NY State Department of Health (Office of Health Systems, OHSM)
  – 2. Investigation of the complaint is carried out by the hospital, employer or OHSM
  – 3. Possible outcomes, depending on the severity of misconduct, include:
    • Disciplinary action
    • Revocation of professional license
    • Professional liability: failure to adhere to standard of care can be grounds for
Element II
Transmission and control of infection in health care settings

• Learning objectives
  – Describe how pathogenic organisms may be spread in health care settings
  – Identify the factors which influence the outcome of an exposure
  – List strategies for prevention of transmission of pathogenic organisms
  – Describe how infection control concepts are applied in professional practice.
Transmission and control of infection in health care settings

Definitions

• Pathogen or infectious agent: a microorganism capable of causing disease
• Transmission: any mechanism a pathogen is spread by a source to a host
• Reservoir: any person, animal insect, plant or substance in which an infectious agent normally lives and multiplies, and where it reproduces itself in such a manner it can be transmitted to a host
• Susceptible host: a person or other, lacking effective resistance to particular infectious agent
• Common vehicle: contaminated material, product that serves as an intermediate by which an infectious agent is transported
• Nosocomial infection: any infection which is acquired in a health care setting, manifestation of illness my occur during or after hospital discharge
• Incubation period: time between exposure and onset of disease
• Colonization: presence of infectious agent without causing illness
• Carrier: person who is colonized or infected by agent for extended time, often without symptoms, and may transmit infection to others
I. Transmission of infections

A. “The chain of infection”:

The pattern of spread of infection. This chain requires a pathogen, a source or reservoir, a mode of transmission, a susceptible host, and a port of entry. Many infections are spread from person-to-person including influenza, measles, chickenpox, tb, colds, strep throat, staph, HIV, hepatitis, typhoid, and gastroenteritis, others are environment-to-person such as Legionnaire’s Disease, Anthrax, and fungal infections
I. Transmission of infections

B. Presence of pathogen:

1. Bacteria: examples are staph, strep, E coli, TB.
2. Viruses: examples are influenza, cold viruses, measles, mumps, varicella, smallpox, hepatitis and HIV
3. Fungi: include yeasts (e.g. candida) and molds (e.g. Aspergillus).
4. Parasites: include protozoa, (e.g. malaria, toxoplasmosis, pneumocystis,) worms, and insects, (e.g. lice and scabies)
5. Prions: include Kuru (shivering disease) CJD (mad cow disease) German-Straussler-Scheinker (GSS), fatal familial insomnia (FFI) and atypical dementias (prion dementia w/o spongiform disease.
6. pathogens vary in their illness causing potential, depending on virulence, survival outside the host. Mutations allow microorganisms to become more virulent, to develop resistance to antimicrobial drugs, and to avoid normal host defenses.
I. Transmission of infections

C. Reservoirs include:

1. Animate
   a. people
      - patients and health care workers
      - infected or colonized persons
      - ill persons or asymptomatic carriers
   b. insects or animals

2. Inanimate
   a. Environment, water, food, soil, sinks, medical equipment.
I. Transmission of infections

D. Portals of exit: routes and mechanisms by which pathogens exit the body
   1. Coughing, sneezing, respiratory, oral secretions
   2. draining skin lesions or wounds.
   3. feces
   4. urine
   5. drainage of blood and other body fluids
I. Transmission of infections

E. Modes by which pathogens are transmitted:

1. Contact with an infected person.
   a. direct contact with person or their blood secretions.
   b. indirect contact, handling of contaminated objects in environment
   c. large droplet, close range exposure to droplets
2. Airborne: infections acquired by inhalation of aerosols composed of small infectious particles
3. Common vehicle: contaminated food, water, medication, intravenous fluid or other product which transmits infection to 2 or more persons.
4. Vector-borne: transmission via an insect or animal carrier

F. Portals of Entry: routes and mechanisms by which pathogens are introduced:

1. Entry sites: non-intact skin, mucous membranes, GI, respiratory, etc
2. Mechanisms: via ingestion, inhalation, vascular access, surgical incisions, etc.
I. Transmission of infections

G. Factors which influence the outcome of an exposure:

1. Host susceptibility: Immunity from past infection decreases susceptibility. Impairment of host defenses increases susceptibility. Impairment of defense is mediated by alteration in:
   a. Natural barriers to infection
   b. Immune system
   c. Presence of a foreign body/invasive device

2. Agent factors
   a. Infectivity
   b. Pathogenicity - the ability of an agent to cause disease in a susceptible host
   c. Virulence of the pathogen, invasiveness, ability to cause disease.
   d. Inoculum size: amount of the infectious agent in the exposure
   e. Route of exposure: some routes more likely to cause infection
   f. Duration of exposure

3. Contamination factors
   a. Contamination of environment
   b. Contamination of equipment
II. Prevention strategies
Breaking the “Chain of Transmission”

A. Consider all patients to be potentially infected with a bloodborne pathogen

B. For organisms other than bloodborne pathogens.
   1. Recognize, diagnose, and treat persons with transmissible disease
   2. eliminate or control inanimate reservoirs of pathogenic organisms
II. Prevention strategies
Breaking the “Chain of Transmission”

C. Interrupt routes of transmission:

1. Hand Hygiene is the single most important means of preventing spread of infection.
   a. washing with antimicrobial soap for minimum of 15 seconds, with running water and use of friction.

2. Use of barriers: gloves, masks, goggles

3. Sterilization and disinfection of patient care equipment

4. Isolation or cohorting:
   a. standard precautions synthesize Universal and body substance isolation and apply to all patients receiving care
   b. transmission based isolation precautions:
      1. Contact precautions
      2. Droplet precautions
      3. Airborne precautions
      4. Isolation precaution categories may be combined for multiple route diseases
II. Prevention strategies

Breaking the "Chain of Transmission"

C. Interrupt routes of transmission
   5. Environmental practices
      a. handwashing
      b. ventilation
      c. waste management
      d. linen and laundry management
   6. Engineering controls: safer controls (ex: needleless IV tubing access system)
   7. Work practice controls: modification in techniques (ex: no recapping needles)

D. Protection of the host
   1. Vaccination: personnel: immunity against measles and rubella, recommended against hepatitis B. Influenza vaccine advised
   2. Pre/post exposure prophylaxix: a preventive treatment after exposure to infectious agent
   3. Protect skin from breakdown
   4. Avoid unnecessary use of excessive duration of placement of intravenous lines, bladder, catheters, and other invasive devices

E. Training and education of health care workers
Element III
Use of Engineering and work practice controls to reduce the opportunity for patient and health care worker exposure

• Learning objectives:
  – Define “engineering controls” and “work practice controls”
  – Identify a hierarchy of exposure prevention strategies
  – Describe specific practices and settings which increase the opportunity for exposure of health care workers and patients to infectious material
  – Identify where engineering or work practice controls can be utilized
Element III
Use of Engineering and work practice controls to reduce the opportunity for patient and health care worker exposure

Definitions:
- Engineering controls-use of equipment, devices that remove hazard
- Work practice controls: are alterations in performance of a task in such a manner as to reduce/eliminate likelihood of exposure
- Personal protective equipment: gloves, gowns, masks, goggles
Element III
Use of Engineering and work practice controls to reduce the opportunity for patient and health care worker exposure

1. High risk practices and procedures: circumstances and practices which increase opportunities for exposure to bloodborne and contact pathogens

A. Percutaneous exposures= exposures that occur through the skin
   1. Injury occurs by handling, disassembly, disposal of or reprocessing of needles and sharps
   2. Precedures in which there is opportunity for injury,
      a. Example: blind suturing
      b. Using non dominant hand next to a sharp
Element III
Use of Engineering and work practice controls to reduce the opportunity for patient and health care worker exposure

B. Mucous membrane or non intact skin exposure (exposure through eyes, mouth, nose, cuts, rashes, dermatitis)
   A. direct contact with blood or body fluid
   B. sprays/splashes of blood or body fluid
C. Parenteral exposure: may occur by injection with infectious material
   a. infusion of contaminated blood products
   b. transplantation of contaminated organs or tissue
Element III
Use of Engineering and work practice controls to reduce the opportunity for patient and health care worker exposure

2. Evaluation/surveillance of exposure incidents
   A. Identify who is at risk
      a. Direct care providers/ Patients /family/ visitors
   B. Identify the devices causing exposure
      a. Needles, scalpels, lancets, etc
   C. Devices with higher disease transmission rate
      a. Such as hollow bore needles
   D. Devices with higher injury rate
      a. Recoil effect from butterfly phlebotomy needles
   E. Identify areas or settings where exposures are occurring.
      a. Patient room
      b. Operating room
      c. Treatment room
      d. Physician’s room
   F. Circumstances by which exposures are occurring
      a. Recapping
      b. Transferring body fluid between containers
      c. Failing to properly dispose of used needles
      d. Failure to activate the engineered safety device
Element III
Use of Engineering and work practice controls to reduce the opportunity for patient and health care worker exposure

3. Engineering controls which eliminate or isolate the hazard:
   A. Use safer devices whenever possible to prevent sharp injuries:
      a. Passive (i.e., automatic) safety features are preferred
      b. Provide mechanism to safely cover the sharp immediately after use
      c. Integrate safety devices rather than accessory devices
      d. Provide education and training on the use of safer devices
      e. Eliminate the traditional, non-safety alternative
   B. Puncture resistant, durable, leak proof containers for disposal and transport of needles and other sharps.
      a. Containers must be red in color or labeled biohazard
      b. Containers must be removed before overfilled
   C. Splatter shields on medical equipment, biosafety cabinet for lab procedures
Element III
Use of Engineering and work practice controls to reduce the opportunity for patient and health care worker exposure

4. Work practice controls to eliminate or reduce the likelihood of exposure to potentially infectious material
   A. General practices
      1. Wash hands
      2. Avoid unnecessary use of needles and sharps
      3. Use special care in handling and disposal of sharps- do not recap needles or use one handed recapping technique
         -in surgery, dentistry, or emergencies, pass sharps using an area or basin or tray as a “safe zone”
         -only disassemble sharp equipment using forceps or other devices
         -always dispose of sharps you have used
         -watch out for overfilled sharp containers
   4. Modify procedures to avoid injury
   5. Promptly clean blood and body fluid spills
      - wear gloves and use approved disinfectant
      -discard contaminated materials in biohazard container
      -laundry container for contaminated laundry
   6. Do not eat, drink, smoke, apply cosmetics or handle contact lenses in work area
Element III
Use of Engineering and work practice controls to reduce the opportunity for patient and health care worker exposure

5. Prevention and control of airborne pathogens
   A. Circumstances which increase opportunities for exposure include:
      1. Inadequate ventilation
      2. Lack of source control
      3. Failure to institute respiratory precautions for known/suspected TB cases
   B. Unrecognized cases
      1. Failure to consider the diagnosis of TB or other airborne disease, resulting in delayed recognition, isolation, and treatment of cases
      2. Transmission to HCW’S and other patients may follow
   C. Engineering controls for prevention of airborne transmission
      1. Appropriate air exchange (number of complete air replacements per hour)
Element III
Use of Engineering and work practice controls to reduce the opportunity for patient and health care worker exposure

1. Appropriate Air exchange- continued
   a. A minimum of 6 air exchanges per hour are required in rooms housing patients with know or suspected TB or other airborne diseases; high rates of air exchange remove contaminated air more quickly and dilute concentration of airborne organisms with fresh air
   b. Air from these rooms must be exhausted to the outside, or appropriately filtered (HEPA filtration)

2. Negative pressure rooms: special isolation rooms which have air pressure below the corridor air pressure, causing air to flow from the corridor into the room, and limiting flow of contaminated air out into the corridor. Doors to these rooms must be kept closed. Patients with active pulmonary TB should be isolated in negative – pressure rooms.

3. HEPA filters: high efficiency- air filters remove infectious particles

4. Ultraviolet (UV) lights are a supplemental measure for control of airborne pathogens
Element III
Use of Engineering and work practice controls to reduce the opportunity for patient and health care worker exposure

D. Source control
   1. Early Identification
   2. Teach source
   3. possibly infectious patients should be triaged early and isolated
   4. close doors on identified/suspected patients
   5. Perform staff PPD surveillance
   6. Provide patient/family edu

E. Personal Protective Equipment (masks, respirators) see element IV

F. Special considerations
   1. Operating suites must have positive air pressure, therefore
      a. Elective procedures should be postponed until patient is noninfectious
      b. For procedures unable to be postponed-contact your facility’s infections control department
Element III
Use of Engineering and work practice controls to reduce the opportunity for patient and health care worker exposure

F. Special considerations
   2. Procedures associated with aerosol transmission of extrapulmonary TB
   3. Potentially infectious patients must wear a surgical mask during transportation
Element IV
Selection and use of barriers and personal protective equipment

• Learning objectives
  - Describe the circumstances which require the use of barriers and personal protective equipment (PPE) to prevent patient and health care worker (HCW) contact with potentially infectious material
  - Identify specific barriers and PPE for patient and HCW protection
Element IV
Selection and use of barriers and personal protective equipment

• Definitions:
  – Personal Protective Equipment (PPE): specialized clothing or equipment worn by a healthcare worker for protection against a hazard
  – Barrier: an object that separates a person from a hazard

• Types of PPE and barriers and criteria for selection
Element IV
Selection and use of barriers and personal protective equipment

• Types of PPE and barriers and criteria for selection
  A. Gloves:
  1. when to be worn: gloves must be worn for all anticipated hand contact with: blood, body fluids, excretions, mucous membranes, non intact skin. During all invasive procedures and all vascular access procedures, including phlebotomies and IV insertion
  2. Sterile and non sterile gloves:
     a. sterile gloves are required to prevent transmission of infection from HCW to patient in surgery and in other procedures associated with high risk of infection
     b. Non sterile gloves are used to reduce transmission of infection when sterility is not required or where sterile technique does not need sterile gloves
  3. Glove material:
     a. Vinyl or latex gloves are used for most medical, dental, and lab procedures discussed above, double-gloving or puncture resistant liners can be used to decrease risk of percutaneous injury to blood/body fluids
Element IV

Selection and use of barriers and personal protective equipment

3. Glove material
   b. Rubber utility gloves are used for heavy duty housekeeping chores. They may be decontaminated and reused unless they are cracked, peeling or punctured.
   c. Hypoallergenic gloves, glove liners, and powder less gloves are available

B. Cover garb= protective attire to prevent contamination of skin, mucous membranes, work clothes, and undergarments. (Regular work clothes, uniforms, and surgical scrubs are not considered protective attire.)

1. Types of cover garb:
   a. **Gowns** (with sleeves) are worn:
      - In surgery and obstetrics,
      - When splashing, spraying, spattering of blood/body fluids is anticipated, or
      - When blood/body fluid contamination of arms is anticipated.
   b. **Aprons** (no sleeves) may be worn for lesser degrees of exposure.
   c. **Laboratory coats** are worn in laboratory setting.
Element IV
Selection and use of barriers and personal protective equipment

• 2. Permeability characteristics:
  a. **Impervious** = fluids will not pass through
  b. **Fluid resistant** = fluids will not readily pass through
  c. **Permeable** = easily penetrated by fluids

3. **Choice of gown or apron** depends on the level of blood or body fluid exposure anticipated. **Fluid resistant** gowns are suitable for most situations; extra fluid resistant sleeves can be worn over a gown, and/or an impervious apron can be worn under a gown, to improve protection against soak-through during prolonged or high-blood-loss surgical procedures. **Impervious gowns** may be preferable for procedures with the highest risk of blood exposure. Impervious gowns may be less comfortable since the material does not breathe well.
Element IV
Selection and use of barriers and personal protective equipment

• C. Masks
  1. Types of masks
    a. Surgical Mask: purpose is to protect the patient by preventing discharge of contaminated nasal and oral secretions from the wearer during a procedure, and thereby reduce risk of wound infection.
    b. Masks to protect the wearer:
      - Protect wearer’s nose/mouth from exposure to splattered or splashed blood or body fluids. Standard surgical masks are appropriate for this purpose.
      - Masks to protect wearer from inhalation of airborne aerosolized infectious particles (e.g., TB, influenza, and measles).

Masks for protection against organisms spread via the airborne route such as TB, Chickenpox, and include N95 respirators, also called Particulate Respirators, and HEPA filter respirators in disposable and reusable types. N95 respirators must filter out particles as small as 1 micron in size with at least 95% efficiency, and allow no more than 10% leakage of air around the mask. HEPA filters provide the highest level of filtering ability (0.3 micron size with 99.7% efficiency). Powered air-purifying against TB. N95 respirators, HEPA respirators and PAPRs are accepted by OSHA for protection of the wearer against airborne organisms.
Element IV
Selection and use of barriers and personal protective equipment

2. Characteristics of masks:
   a. **Filtration** characteristics of the material: surgical masks may effectively block discharge of large droplets into the air, but the material is not an effective filter to prevent inhalation of very small, aerosolized particles characteristic of TB and airborne viral diseases. N95 and HEPA respirators provide increased levels of filtration. A wet mask is no longer effective.
   
   b. **Face seal:** a tight seal around the edges of a particulate respirator is essential to its effectiveness. If loose fitting, contaminated air is drawn in around the edges of the mask with each inhalation, instead of the air being drawn through the filter. Acceptable protection requires that face-seal leakage be no more than 10%. See *Respirator Fit-testing and Training* (section III.A.3)
Element IV
Selection and use of barriers and personal protective equipment

D. **Field shields** protect eyes, nose, and mouth from exposure to blood or body fluids via splash, splatter, of spray. Protection against airborne pathogens requires the addition of an appropriate mask.

E. **Eye protection (goggles, safety glasses, of face shield)** should be worn during all major surgical procedures and whenever splashes/ sprays of blood of body fluid may be generated. **Ordinary glasses are not acceptable** unless a solid side shield is added to the eyewear.

F. **Shoe covers, leg covers, boots, and head covers** are appropriate attire whenever heavy exposure to blood/body fluids is anticipated, usually in surgery. Most such situations involve surgical procedures in which caps or hoods are already required for sterility. Shoe/ leg and head covers should be removed or discarded before leaving the room.

G. Other barriers, such as wound dressings, reduce the risk of exposure to blood/body fluids.
Element IV
Selection and use of barriers and personal protective equipment

A. Selection of PPE/barriers based on anticipated exposure of HCW.
   1. Contact with minimal bleeding or drainage: use gloves plus gown or apron.
   2. The possibility of blood/body fluid splashes, sprays, splatters exists: use gloves, fluid resistant gown, mask, and eye protection or faceshield (for example: in surgery, obstetrics, and dentistry).
   3. Contact with large volume bleeding or drainage (likely to soak through): use the above, (Select vinyl or nitrile gloves) with fluid resistant gown, and add shoe covers, leg covers, and/or boots; consider impervious gown.
   4. Large droplet vs. airborne (aerosol) pathogen: a faceshield, or surgical mask plus eye protection, will protect against inoculation of large droplets or splatter into mouth, nose, and eyes. Optimal protection against airborne disease (e.g., TB) requires a particulate respirator.
Element IV
Selection and use of barriers and personal protective equipment

II. Choice of PPD and barriers is based on reasonably anticipated exposure of the HCW and on the need for patient protection:

B. Selection of PPE/Barriers based on need for patient protection:

1. Select sterile barriers and PPE for invasive procedures
2. Select surgical masks for prevention of droplet contamination of patient’s wounds. Most particulate respirators will also prevent droplet contamination from HCW to patient.
3. HCW’s with skin lesions or nail infections must wear dressings and/or gloves to protect patients from exposure to HCW’s blood/body fluid
Element IV
Selection and use of barriers and personal protective equipment

III. Proper and effective use of PPE and barriers
   A. Proper fit
      1. Gloves: to small may tear, too large are clumsy.
      2. Gowns: should cover skin and clothes
      3. Mask: must fit snugly around mouth and nose, with metal band molded across bridge of nose, and straps or ties in place. When wearing a N95 particulate respirator mask, a fit check should be done after applying the mask and before going in the room.

Note: Respirator Fit testing and training: HCW’s who care for patients with know or suspected infectious TB are evaluated for ability to wear a particulate respirator (N95 mask or HEPA mask), fit –tested with the designated mask, and educated regarding TB transmission and precautions. Successful fit testing requires that face-seal leakage be no more than 10%. HCW’s who have not been fit-tested and trained for the appropriate respirator do not enter rooms being used for TB isolation. Powered air-purifying particulate respirators (PAPR’s) are an alternative for respiratory protection of persons who have not or cannot be fit-tested successfully with an N95 mask but proper training for its use must occur.
Element IV
Selection and use of barriers and personal protective equipment

B. Integrity of barrier: check for holes, tears, and damage before use.
   1. Inspect gloves for tears or holes before use. Replace gloves as soon as practical if damaged during use. Gloves need to be changed between patients and during care of the same patient if going from a dirty to clean task (e.g. from performing perineal care to checking an IV site).
   2. Masks should be replaced if damaged or wet.

C. Disposable vs. reusable barriers and PPE:
   1. Disposable items should not be reused.
   2. Reusable items must be properly cleaned and reprocessed before reuse.
   3. Surgical masks are replaced after each use, and discarded promptly between patients. Particulate respirators (N95 and HEPA respirators) are often used for longer periods of time, but must be replaced if damaged, soiled, or wet.
   4. All PPE, whether disposable or reusable, must be removed before leaving the patient room or work area, and hands must be sanitized.
Element IV
Selection and use of barriers and personal protective equipment

D. Potential for cross-contamination if PPE is not changed between patients.
   1. Gloves, gowns, aprons, and surgical masks must be changed between patient contacts. Never wear the same gloves, gowns, etc.
   2. Hands must be sanitized after gloves are removed. Gloves do not completely prevent penetration of bacteria and viruses, and the moist environment inside a glove can promote growth of bacteria on the skin.

E. Under-and over utilization of barriers and PPE:
   1. Under-utilization places HCW’s and patients at unnecessary risk.
   2. Over-utilization wastes resources, may intimidate patients, and may interfere with patient care.

F. The proper sequence for putting on and removing PPE is as follows:
   Http://www.cdc.gov/handhygiene/download/hand_hygiene_supplement.ppt
Element IV
Selection and use of barriers and personal protective equipment

IV. Dentist and dental hygienists:
see (CDC)
Element V
Principles and practices for cleaning, disinfection, and sterilization

• Learning Objectives:
  – Recognize the importance of the correct application of reprocessing methods of assuring the safety and integrity of patient care equipment.
  – Identify the individual’s professional responsibility for maintaining a safe patient care environment.
  – Recognize strategies for effective pre-cleaning, chemical disinfection, and sterilization of instruments and devices.
Element V
Principles and practices for cleaning, disinfection, and sterilization

• Definitions:
  – Cleaning: the removal of all foreign material from objects.
  – Contamination: the presence of microorganisms on inanimate objects or in substances.
  – Decontamination: the process of removing disease-producing microorganisms and rendering the object safe for handling.
  – Disinfection: a process that results in the elimination of many or all pathogenic microorganisms on inanimate objects, with the exception of bacterial endospores.
  – High-level disinfection: kills bacteria, Mycobacteria (TB), most fungi, and most viruses. Does not kill resistant bacterial spores.
  – Intermediate-level disinfection: kills bacteria, some fungi, some viruses. Will not kill bacterial spores and is less active against some gram-negative rods (e.g. Pseudomonas) and Mycobacteria.
  – Sterilization: A process that completely eliminates all forms of microbial life.
Element V
Principles and practices for cleaning, disinfection, and sterilization

I. General Information:
   A. Cleaning, disinfection, and sterilization play an important role in prevention of infections related to exogenous introduction of microorganisms.
   B. The major risk from breaks in infection control practice is to patients.
      1. Infections may occur at any body size when medical supplies or equipment are contaminated.
      2. The infection potential is greatest when invasive procedures are performed.
   C. Additional risk exists for personnel who may become colonized/infected during processing of equipment.
   D. Every health care setting should establish policies for the disposal and/or reprocessing of supplies, to include:
      1. Procedure for reprocessing reusable equipment or supplies appropriate for each type of material and its intended use in pt care.
      2. Workflow patterns from soiled/contaminated to clean/sterile areas.
      3. Procedure for receiving and storing clean/sterile supplies and to provided for rotation to avoid outdating of supplies.
      4. Procedures for recall of products from commercial suppliers and from in-house preparation.
Element V
Principles and practices for cleaning, disinfection, and sterilization

• I. General Information
E. Every health care setting should develop monitoring systems, to include:
  1. Monitoring of the sterilization process with results recorded in a permanent log or record.
  2. recall of items if monitors indicate sterilization is not complete.
  3. Criteria for sterility assurance
     -shelf life-the length of time the item is considered sterile
     - Event-related sterility-sterility of a package depends on the packaging material used, the number of times it is handled and the conditions of storage
  4. the healthcare professional is responsible for checking supplies based on shelf life or event-related sterility.
Element V
Principles and practices for cleaning, disinfection, and sterilization

II. Evidence of disease transmission by contaminated equipment is well documented
A. Examples:
   1. Vascular access devices (IV cannulas, arterial pressure monitors, cardiac and vascular prostheses, A-V shunts for hemodialysis) contamination of devices at time of insertion, or subsequent contamination, may result in blood stream infection, site of entry infection, or remote infection.
   2. Genito-urinary tract devices: contaminated urinary drainage systems or cystoscopes can cause nosocomial urinary tract infection and subsequent blood stream infection.
   3. Respiratory tract devices: contaminated fluid nebulizers, ventilators, or bronchoscopes may cause nosocomial pneumonia.
Element V
Principles and practices for cleaning, disinfection, and sterilization

II. Evidence of disease transmission by contaminated equipment is well documented:

B. Factors that have contributed to contamination in reported cases include:

1. Inadequate cleaning. Examples: Inadequately cleaned commodes contributing to transmission of clostridium difficile colitis; inadequate clean up of blood spills contributing to transmission of hepatitis B.

2. Inadequate disinfection/sterilization processes. Example: inadequately sterilized instruments increasing post operative wound infection rates.

3. Contamination of disinfectant or rinse solution. Example: Pseudomonas-contaminated disinfectant causing contamination of bronchoscopes; C. difficile-contaminated endoscopes.

4. Reuse of disposable equipment. Example. Reuse of disposable platforms on glucometers linked with transmission of Hepatitis B.

5. Failure to reprocess or dispose of equipment between patients. Example: transmission of S. aureus, hepatitis B and numerous other pathogens.
Element V
Principles and practices for cleaning, disinfection, and sterilization

III. Points in reprocessing or handling where breaks in infection control practices can compromise the integrity of equipment or devices.

A. General Principles of Cleaning:

1. Soil protects microbes from contact with lethal agents and may directly inactivate these agents.

2. Physical cleaning eliminates large numbers of organisms associated with gross soil.

3. Sound cleaning practices, in addition to their aesthetic benefits, reduce the microbial load on environmental surfaces.

4. Manufacturer’s recommendations for operation of cleaning equipment and use of cleaning supplies must be followed carefully.
Element V
Principles and practices for cleaning, disinfection, and sterilization

III. Points in reprocessing or handling where breaks in infection control practices can compromise the integrity of equipment or devices.

B. Handling and cleaning contaminated items, e.g.:

1. Pre-soaking instruments vs. immediate transport to a central reprocessing area. Pre-soaking in detergent disinfectant solution is preferred when delays in reprocessing are unavoidable.

2. Thoroughness of internal and external physical cleaning is vital to the process. Adequate disinfection cannot be achieved without first completing thorough cleaning and rinsing of the item, since organic debris and residual detergent may inactivate the disinfectant. More complex equipment creates opportunities for breaks in this process.

C. Choice of reprocessing method should be based on the:

1. Intended use of the equipment or device,
2. desired level of antimicrobial activity and
3. manufacturer’s recommendations for reprocessing.
Element V
Principles and practices for cleaning, disinfection, and sterilization

III. Points in reprocessing or handling where breaks in infection control practices can compromise the integrity of equipment or devices.

D. Reprocessing and Re-use.
    1. Definitions
       a. single use disposable-single use device that is intended to be used on one patient during a single procedure.
       b. opened unused single-use device- a disposable single use device whose sterility has been breached or compromised or whose sterile package was opened but which has not been used on a patient
       c. reprocessing-includes all operations performed to render a contaminated reusable reusable or single use device patient ready. Steps may include cleaning, testing, repackaging, disinfection and sterilization.
       d. re-sterilization- repeated application of a terminal process designed to remove or destroy all viable forms of microbial life, including bacterial spores.
       e. reuse: repeated use of multiple uses of any medical device, including devices intended for reuse or single use with reprocessing
Element V
Principles and practices for cleaning, disinfection, and sterilization

III. Points in reprocessing or handling where breaks in infection control practices can compromise the integrity of equipment or devices.

f. Disposable devices: Medical devices that are required to be sterile and are supplied by the manufacturers as for single use only. A wide range of items used for diagnosis and treatment are marketed as disposable devices such as syringes to cardiac pacemakers.

g. Endotoxin: a high molecular weight complex associated with the outer membrane of gram negative bacteria. Endotoxins are pyrogenic and increase capillary permeability regardless of the species of bacteria.

h. Original equipment manufacturers (OEM) the company that originally manufactures a device prior to its first use

i. outsourcing: the process in healthcare facilities of contracting reprocessing activities to a company that specializes in re-sterilization

j. pyrogen: a fever producing substance

k. reposable: recommended practices for endoscopy and minimally invasive surgery from the association of perioperative registered nurses (AORN) defines a reposable device as an instrument with a combination of reusable and disposable components

l. Reusable devices: intended to be used and reprocessed many times
Table 1: Equipment Reprocessing Guidelines

<table>
<thead>
<tr>
<th>Risk of Infection</th>
<th>Usage of Medical Device</th>
<th>Examples of Medical Devices</th>
<th>Procedure to Use Before Each Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical</td>
<td>Enters normally sterile tissue or vascular system</td>
<td>-surgical instruments, cardiac catheters; implants; pertinent components of heart-lung oxygenators, blood component of hemodialyzers; laparoscopes; arthroscopes; bronchoscopes</td>
<td>Sterilize</td>
</tr>
<tr>
<td>Semi-Critical</td>
<td>contacts intact muscous membranes, does not ordinarily penetrate body surface</td>
<td>non-invasive flexible and rigid fiberoptic endoscopes, endotracheal tubes; anesthesia breathing circuits; cystoscopes</td>
<td>sterilize if feasible or at least high level disinfection</td>
</tr>
<tr>
<td>Non-Critical</td>
<td>does not ordinarily touch the patient or touches only intact skin</td>
<td>crutches; bed boards; blood pressure cuffs</td>
<td>intermediate to low level disinfection</td>
</tr>
</tbody>
</table>

Note: The CDC recommends that scopes be sterilized, if feasible, and if sterilization is not feasible, high level disinfection should be utilized. There is currently no data to prove that sterilization of scopes reduces the risk of infection as compared to proper cleaning and high level disinfection. However, since there is also no data to prove that proper cleaning and high level disinfection eliminates the potential for cross-contamination, sterilization following cleaning is the preferred method.
Element V

IV. Effectiveness of the disinfection process is dependent on three factors:
- Selection and use of disinfecting products
- Monitoring activity of disinfectants, and
- Post-disinfection handling and storage of the equipment or device

A. General principles regarding use of any chemical disinfectant include:
1. Read the label for activity and use instructions
2. All items must be thoroughly cleaned before disinfecting.
3. All items must be thoroughly rinsed and dried after disinfecting. Care must be taken not to recontaminate the items.
4. Only surfaces in direct contact with the solution will be disinfected (instruments must be opened, disassembled, and completely submerged to avoid diluting the solution to inactive levels.
5. Items should be dry before submerging to avoid diluting the solution to inactive levels.
6. Disinfectants are designed for inanimate objects and are damaging to the skin. Gloves should always be worn to protect the hands. Goggles may be advisable to protect eyes from splashes. Generally, the more effective against microbes, the more toxic to humans.
7. Disinfectants should be used in well-ventilated rooms.
V. Sterilization

A. Types of sterilization methods

1. Heat
   a. Steam
      
      Steam continues to be the method of choice for sterilization of heat-all moisture-stable items. The CDC Guideline for Handwashing and Hospital Environmental Control states that steam sterilization should be used unless the object to be sterilized will be damaged by high pressure or moisture or is otherwise inappropriate for steam sterilization.

      Flash sterilization is the process of sterilizing items that are needed for immediate use. This process also requires the use of saturated steam. This process destroys most vegetative bacteria and viruses if the bioburden is low and no or little matter is evident. Flash sterilization should not be used as a routine sterilization process because of minimal time, temperature and per requirements; the lack of biological indicators appropriate for rapid sterilization; the absence of protective packaging, and the possibility of contamination during transport. Implantable items should not be flash sterilized.

   b. Dry Heat
      
      This process has been used for the sterilization of glass, instruments of glass, instruments and other items that cannot be sterilized by steam sterilization. However, it is considered a less efficient process that moist heat. Furthermore, the parameters for dry heat are difficult to determine and the process is quite lengthy.

2. Gas
   a. ETO is a colorless gas that is highly reactive with other chemicals. The ETO cycle involves preconditioning and humidification, gas introduction, exposure, evaluation and air washes. The process, excluding aeration time, is approximately 2 to 3 hours. ETO penetrates materials and, therefore, mechanical aeration is needed to remove the toxic ETO residue.

   b. Formaldehyde can be used as a disinfectant (liquid form) or a sterilant (gas form). It is primarily used for decontamination of biological safety cabinets, high-efficiency particulate filter units.

   c. Peroxide gas plasma:
      
      - new low-temperature sterilization method
      - Utilizes hydrogen peroxide in vapor phase and low-temperature gas plasma

   d. Peracetic acid gas plasma: process (Plazlyte) cleared for use on selected instruments without small lumens.
      
      - can form a toxic salt when sterilization materials interact with copper, brass or zinc

   e. Vapor-phase hydrogen peroxide: uses a deep vacuum to pull 30% liquid hydrogen peroxide from a disposable cartridge through a heated vaporizer.

3. Chemical Sterilants:
   - Glutaraldehyde
   - Hydrogen peroxide
   - Peracetic acid
   - Peracetic acid with hydrogen peroxide

4. Other Methods:
   a. Chlorine dioxide
   b. Filtration
   c. Ozone
# Table 2: Summary of Chemical Sterilants Used Primarily as High-Level Disinfectants

<table>
<thead>
<tr>
<th>AGENT</th>
<th>ADVANTAGES</th>
<th>DISADVANTAGES</th>
<th>CLEARED BY FDA?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glutaraldehyde (≥2.0%)</td>
<td>Good compatibility</td>
<td>Respiratory irritant; can coagulate blood and fix tissues to surfaces</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Fairly inexpensive</td>
<td>Activation required</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slow mycobacterial activity</td>
<td></td>
</tr>
<tr>
<td>Hydrogen peroxide (7.5%)</td>
<td>No activation required</td>
<td>Compatibility concern with brass, copper, zinc and nickel-silver plating</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>May facilitate removal of organisms and organic material</td>
<td>Can cause serious eye damage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No specific disposal necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Compatible with metals, plastics, and elastomers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No odor</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Does not coagulate blood or fix tissues to surfaces</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inactivates Cryptosporidium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peracetic acid (0.2%)</td>
<td>Broad spectrum</td>
<td>Can corrode copper, brass, bronze, plain steel and galvanized iron</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Rapid activity</td>
<td>Unstable when diluted</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Environment-friendly by-products</td>
<td>Can cause serious eye and skin damage</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Agent</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Cleared by FDA?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peracetic acid with hydrogen peroxide (0.8%, 1%)</td>
<td>No activation</td>
<td>Some concerns about compatibility with lead, brass, copper, and zinc (both cosmetic and functional)</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Mild Odor</td>
<td>Limited clinical use</td>
<td></td>
</tr>
</tbody>
</table>
B. **Sterilization monitoring systems** are meant to assure that equipment and devices labeled sterile are in fact sterile. Such systems take one of two forms: product control or process control.

1. **Product control** = sterility testing; use of biological indicators (i.e. spore samples placed in sterilizer to document sterilization)
2. **Product control** = assessing the sterilization process; e.g.:
   a. Mechanical indicators (time/temperature charts & pressure gauges);
   b. Chemical indicators of temperature/humidity.

C. **Post-sterilization handling and storage procedures are important to prevent contamination:**

1. **Provide sterile storage** in procedure areas (closed cabinets, wrappers) to avoid:
   a. Contamination from patient secretions or body fluids
   b. Hand contamination by employees obtaining extra supplies, and
   c. Contamination from supplies being returned to stock after use.

2. **Store packages to prevent disruption of package integrity:**
   a. Covered storage to prevent moisture damage,
   b. Keep storage off the floor, and
   c. Protect from insects and other pests.

3. Rotate stock to avoid use of outdated supplies.
4. Designate separate area for mixing of medications or solutions.
5. **Refrigerate products according to manufacturer’s requirements.**
6. **Appropriate storage conditions for sterile packs include:**
   - limited access to storage area and/or closed cabinets,
   - clean supplies should be stored separately from sterile supplies,
   - area must be clean, dry, dust free, lint free,
   - temperature 18-22 C (65 – 72 F),
   - relative humidity 35-50%
7. **Check package integrity:**
   - is the package free of tears, dampness, excessive dust, and gross soil?
   - Is there a chemical indicator on the outside of the package?
   - Has the expiration date been reached or passed?
   - If heat-sealed, has the seal been maintained?
III. Recognizing potential sources of cross-contamination in the health care environment

A. Identification of surfaces or equipment requiring between-patient cleaning:
   1. All items having contact with mucous membranes must be cleaned and disinfected between patient uses. *Example:* reusable thermometers.
   2. Items having contact with intact skin, such as blood pressure cuffs and stethoscopes, need periodic cleaning.
   3. Any environmental surface, equipment, or device contaminated with blood or body fluids should be cleaned and disinfected immediately.

B. Identification of practices which contribute to touch contamination and the potential for cross-contamination:
   1. Clean and dirty work areas should be separated to reduce cross-contamination of supplies.
   2. Environmental (e.g., commodes contaminated with feces may be a vehicle for spread of *C. difficile* between patients).
   3. Gloves must be removed and hands washed after touching contaminated surfaces or equipment (e.g., urinary collection devices, bedpans, dressings).

V. Appropriate levels of knowledge of disinfection/sterilization methods and agents are based on the area of professional practice and scope of responsibility

A. Knowledge expectations of health professionals who practice in organizations where the responsibility for handling, cleaning and reprocessing equipment or devices is designated to another department should include:
   1. Basic concepts and principles of cleaning, disinfection, and sterilization described above.
   2. Appropriate application of safe practices for handling devices and equipment in the specific area of professional practice (e.g., ophthalmology, dentistry)

B. Knowledge expectations of individuals who have primary or supervisory responsibilities for equipment or device reprocessing should include:
   1. Core concepts and principles of cleaning, disinfection, and sterilization described above.
   2. Detailed information on the following:
      a. Properties and uses of chemical disinfectants
      b. Methods for achieving sterilization
      c. Sterilization equipment and packaging devices
      methods for monitoring sterilization processes and current recommendations for monitoring frequency

Additional references for persons responsible for Sterilization/Disinfection procedures:
Guidelines for infection control in dental health-care settings-2003
http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5217al.htm

Guidelines for environmental infection control in health-care facilities-2003
http://www.cdc.govncidod/dhqp/glenvironinfection.htm
Element VI
PREVENTION AND CONTROL OF INFECTIOUS AND COMMUNICABLE DISEASES IN HEALTH-CARE WORKERS

Learning Objective
• List occupational health strategies for protecting health-care workers (HCW’s) and patients;
• List non-specific disease findings which should prompt evaluation of HCW’s;
• Identify occupational health strategies for preventing HIV, hepatitis B (HBV), hepatitis C (HCV) and tuberculosis (TB) in health-care workers;
• Identify resources for evaluation of HCW’s infected with HIV, HBV, and/or HCV

Definitions
• Infectious disease: a clinically manifest disease resulting from infection.
• Communicable Disease: an illness due to a specific infectious agent which is acquired through transmission of that agent from an infected person, animal, or inanimate reservoir to a susceptible host.
• Occupational health strategies: as applied to infection control, a set of activities intended to assess, prevent, and control infections and communicable diseases in HCW’s.

I. Overview of occupational health strategies for infection control

A. Goals of occupational health strategies:
• Prevent disease transmission from HCW’s to patients and staff
• Protect susceptible HCW’s from infectious or communicable diseases.

B. Strategies to assess HCWs for disease risks:
1. Pre-employment: review of overall health and immunization status, TB testing (PPD) before employment (2-step if no documentation of negative PPD within past year), chest x-ray and medical assessment for PPD positive employees, administration of necessary vaccinations (i.e. rubella, rubeola, varicella, and tetanus/diphtheria).
   Periodic (annual) health assessments: review of overall health status and assessment for possible communicable disease exposure, PPD skin test for negative employees, medical assessment and screening for signs/symptoms of TB activation (i.e. fever, chills, night sweats, fatigue, anorexia, and cough) for PPD positive employees.
2. Immunization/screening programs are targeted at several diseases:
   a. Tuberculosis (TB): at least annual tuberculin skin testing (PPD) is required; more often for high-risk positions.
   b. Hepatitis B (HBV): HBV vaccination is highly recommended; must be offered at no charge to all HCWs whose work involves risk of exposure to blood/body fluids.
   c. Rubeola (measles): documentation of immunity (2 doses of vaccine or a history of illness) is required of all HCW born in 1957 or later.
Element VI

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      c. Rubeola (measles): documentation of immunity (2 doses of vaccine or a history of illness) is required of all HCW born in 1957 or later.
      d. Rubella (german measles) documentation of immunity (1 dose of vaccine or a positive serologic test) is required of all HCWs
      e. Mumps: screening for history of illness (and/or a blood test to confirm immunity or susceptibility) is often performed; vaccination is recommended for susceptible HCWs.
      f. Varicella (chickenpox): screening for history of illness (and/or a blood test to confirm immunity or susceptibility) is often done; vaccination is highly recommended for susceptible HCWs.
      g. Influenza: annual influenza vaccination is highly recommended for all HCWs; vaccination is required to be offered to all employees in long term care facilities, home care, adult day care programs etc.
      h. Pneumovax: vaccination is required to be offered to all employees in long term care facilities, home care, adult day care programs etc.; it is highly recommended for anyone at risk as identified in ACIP guidelines.

Some of the above screenings and immunizations are required by NY State or Federal mandates; others are highly recommended. Immunity to rubeola and rubella are required by the NY State Department of Health. Offering hepatitis B vaccine at no charge is required by the US Department of Labor (OSHA) Periodic TB screening (PPD) is required by both the NY State Department of Health and OSHA.
Element VI

2. Evaluation of acute or incubating illnesses in HCWs:
   a. HCWs exhibiting any of these symptoms should be promptly evaluated for fitness to work (i.e., risk of transmitting to patients, staff, visitors):
      • Fever, chills
      • Cough, sputum production
      • Sore throat
      • Exanthema (rash), vesicles
      • Skin lesions, weeping dermatitis
      • Draining wounds, sores
      • Diarrhea or vomiting
      • Eye infection or drainage

   b. Post-exposure evaluation: susceptible HCWs who have been exposed to the following diseases should also be evaluated:
      • Tuberculosis
      • Varicella (chickenpox or herpes zoster, shingles)
      • Rubeola
      • Rubella
      • Pertussis (whooping cough)
      • Mumps
      • Meningococcal infection (close contact)
      • Scabies
      • Parvovirus B19 (fifth disease)
      • Example: if a HCW is exposed to a personal family member or patient with active TB, the HCW must be evaluated for symptoms of active TB and tested for TB infection (PPD skin test). If infection is present, a chest x-ray is performed and treatment is begun.

   c. Management of ill or exposed HCWs with acute or incubating communicable disease. Goal is to prevent potential transmission to susceptible patients and staff
      1) Limit contact with susceptible patients and staff. Example: temporary job re-assignment.
      2) Furlough from work until HCW is no longer infectious or risk of contracting infection (post-exposure) has passed.
         • Example: a susceptible (non-immune) HCW who has been exposed to chickenpox is usually furloughed from work beginning the 10th day through the 21st day after exposure (the incubation period for chickenpox).
      3) Treatment as needed. Examples:
         • HCW with active pulmonary tuberculosis is treated with multiple anti-tuberculosis drugs, and may return to work after symptoms have resolved and sputum smears show clearing of TB.