Disinfection and Sterilization

William A. Rutala, Ph.D., M.P.H.
University of North Carolina (UNC) Health Care System and UNC at Chapel Hill, NC

- HICPAC Guideline
- Provide overview of disinfection and sterilization principles
- Emerging pathogens and prions
- Current Research
  - *Clostridium difficile*
  - Ophthalmic equipment (applanation tonometers)
  - Infrared coagulation
  - Microfiber mops
  - Computer keyboards
  - QUAT absorption
  - Failure to follow disinfection/sterilization principles and patient exposures
Overview

- Last CDC guideline in 1985
- 274 pages (>130 pages preamble, 21 pages recommendations, glossary of terms, tables/figures, >1000 references)
- Evidence-based guideline
- Cleared by HICPAC February 2003
- Reviewed by OMB
- Publication in December 2006
Efficacy of Disinfection/Sterilization Influencing Factors

Cleaning of the object
Organic and inorganic load present
Type and level of microbial contamination
Concentration of and exposure time to disinfectant/sterilant
Nature of the object
Temperature and relative humidity
Disinfection and Sterilization

EH Spaulding believed that how an object will be disinfected depended on the object’s intended use.

CRITICAL - objects which enter normally sterile tissue or the vascular system or through which blood flows should be **sterile**.

SEMICRITICAL - objects that touch mucous membranes or skin that is not intact require a disinfection process (**high-level disinfection [HLD]**) that kills all microorganisms but high numbers of bacterial spores.

NONCRITICAL - objects that touch only intact skin require **low-level disinfection**.
Processing “Critical” Patient Care Objects

<table>
<thead>
<tr>
<th>Classification:</th>
<th>Critical objects enter normally sterile tissue or vascular system, or through which blood flows.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object:</td>
<td>Sterility.</td>
</tr>
<tr>
<td>Level germicidal action:</td>
<td>Kill all microorganisms, including bacterial spores.</td>
</tr>
<tr>
<td>Examples:</td>
<td>Surgical instruments and devices; cardiac catheters; implants; etc.</td>
</tr>
<tr>
<td>Method:</td>
<td>Steam, ETO, hydrogen peroxide plasma, ozone or chemical sterilization.</td>
</tr>
</tbody>
</table>

Critical Objects

- Surgical instruments
- Cardiac catheters
- Implants
Chemical Sterilization of “Critical Objects”

- Glutaraldehyde (>2.0%)
- Hydrogen peroxide-HP (7.5%)
- Peracetic acid-PA (0.2%)
- HP (1.0%) and PA (0.08%)
- HP (7.5%) and PA (0.23%)
- Glut (1.12%) and Phenol/phenate (1.93%)

Exposure time per manufacturers’ recommendations
### Processing “Semicritical” Patient Care Objects

<table>
<thead>
<tr>
<th>Classification:</th>
<th>Semicritical objects come in contact with mucous membranes or skin that is not intact.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object:</td>
<td>Free of all microorganisms except high numbers of bacterial spores.</td>
</tr>
<tr>
<td>Level germicidal action:</td>
<td>Kills all microorganisms except high numbers of bacterial spores.</td>
</tr>
<tr>
<td>Examples:</td>
<td>Respiratory therapy and anesthesia equipment, GI endoscopes, thermometer, etc.</td>
</tr>
<tr>
<td>Method:</td>
<td>High-level disinfection</td>
</tr>
</tbody>
</table>

### Semicritical Items

- Endoscopes
- Respiratory therapy equipment
- Anesthesia equipment
- Endocavitary probes
- Tonometers
- Diaphragm fitting rings
### High Level Disinfection of “Semicritical Objects”

**Exposure Time > 12 m-30m, 20°C**

<table>
<thead>
<tr>
<th>Germicide</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glutaraldehyde</td>
<td>&gt; 2.0%</td>
</tr>
<tr>
<td>Ortho-phthalaldehyde (12 m)</td>
<td>0.55%</td>
</tr>
<tr>
<td>Hydrogen peroxide*</td>
<td>7.5%</td>
</tr>
<tr>
<td>Hydrogen peroxide and peracetic acid*</td>
<td>1.0%/0.08%</td>
</tr>
<tr>
<td>Hydrogen peroxide and peracetic acid*</td>
<td>7.5%/0.23%</td>
</tr>
<tr>
<td>Hypochlorite (free chlorine)*</td>
<td>650-675 ppm</td>
</tr>
<tr>
<td>Glut and phenol/phenate**</td>
<td>1.21%/1.93%</td>
</tr>
</tbody>
</table>

*May cause cosmetic and functional damage; **efficacy not verified*
## Processing “Noncritical” Patient Care Objects

<table>
<thead>
<tr>
<th>Classification:</th>
<th>Noncritical objects will not come in contact with mucous membranes or skin that is not intact.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object:</td>
<td>Can be expected to be contaminated with some microorganisms.</td>
</tr>
<tr>
<td>Level germicidal action:</td>
<td>Kill vegetative bacteria, fungi and lipid viruses.</td>
</tr>
<tr>
<td>Examples:</td>
<td>Bedpans; crutches; bed rails; EKG leads; bedside tables; walls, floors and furniture.</td>
</tr>
<tr>
<td>Method:</td>
<td>Low-level disinfection</td>
</tr>
</tbody>
</table>

## Low-Level Disinfection for “Noncritical” Objects

<table>
<thead>
<tr>
<th>Germicide</th>
<th>Use Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethyl or isopropyl alcohol</td>
<td>70-90%</td>
</tr>
<tr>
<td>Chlorine</td>
<td>100ppm (1:500 dilution)</td>
</tr>
<tr>
<td>Phenolic</td>
<td>UD</td>
</tr>
<tr>
<td>Iodophor</td>
<td>UD</td>
</tr>
<tr>
<td>Quaternary ammonium</td>
<td>UD</td>
</tr>
</tbody>
</table>

UD = Manufacturer's recommended use dilution
Disinfecting Noncritical Patient-Care Items
- Process noncritical patient-care equipment with an EPA-registered disinfectant at the proper use dilution and a contact time of at least 1 min. Category IB
- Ensure that the frequency for disinfecting noncritical patient-care surfaces be done minimally when visibly soiled and on a regular basis. Category IB

Disinfecting Environmental Surfaces in HCF
- Disinfect (or clean) housekeeping surfaces (e.g., floors, tabletops) on a regular basis (e.g., daily, three times per week), when spills occur, and when these surfaces are visibly soiled. Category IB
- Use disinfectant for housekeeping purposes when uncertain if cleaning personnel not able to: distinguish soiled areas containing blood from dirt; or determine when MDROs are likely in the environment. Category IB
Methods in Sterilization

Sterilization

The complete elimination or destruction of all forms of microbial life and is accomplished in healthcare facilities by either physical or chemical processes.
Steam Sterilization

- Advantages
  - Non-toxic
  - Cycle easy to control and monitor
  - Inexpensive
  - Rapidly microbicidal
  - Least affected by organic/inorganic soils
  - Rapid cycle time
  - Penetrates medical packing, device lumens

- Disadvantages
  - Deleterious for heat labile instruments
  - Potential for burns

- Alternatives to ETO-CFC
  ETO-CO₂, ETO-HCFC, 100% ETO
- New Low Temperature Sterilization Technology
  Hydrogen Peroxide Gas Plasma
  Peracetic Acid
  Ozone

Conclusions

- All sterilization processes effective in killing spores
- Cleaning removes salts and proteins and must precede sterilization
- Failure to clean or ensure exposure of microorganisms to sterilant (e.g. connectors) could affect effectiveness of sterilization process
Recommendations
Methods of Sterilization

- Steam is preferred for critical items not damaged by heat
- Follow the operating parameters recommended by the manufacturer
- Use low temperature sterilization technologies for reprocessing critical items damaged by heat
- Use immediately critical items that have been sterilized by peracetic acid immersion process (no long term storage)

Disinfection and Sterilization
New Products and Processes*

- New high-level disinfectants (HLD)
  - Superoxidized water
- New chemical sterilants/HLD
  - 3.4% glutaraldehyde with 26% isopropanol
  - 8.3% hydrogen peroxide with 7.0% peracetic acid
- New sterilization process
  - Ozone

*Limited data in the scientific literature that assesses the antimicrobial activity or material compatibility
Disinfection and Sterilization of Emerging Pathogens

- Hepatitis C virus
- *Clostridium difficile*
- *Cryptosporidium*
- *Helicobacter pylori*
- *E.coli* 0157:H7
- Antibiotic-resistant microbes (MDR-TB, VRE, MRSA)
- SARS Coronavirus, avian influenza, norovirus
- Bioterrorism agents (anthrax, plague, smallpox)
Disinfection and Sterilization of Emerging Pathogens

Standard disinfection and sterilization procedures for patient care equipment are adequate to sterilize or disinfect instruments or devices contaminated with blood and other body fluids from persons infected with emerging pathogens.

Creutzfeldt Jakob Disease (CJD): Disinfection and Sterilization
Decreasing Order of Resistance of Microorganisms to Disinfectants/Sterilants

<table>
<thead>
<tr>
<th>Organism Type</th>
<th>Resistance Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prions</td>
<td>1</td>
</tr>
<tr>
<td>Spores</td>
<td>2</td>
</tr>
<tr>
<td>Mycobacteria</td>
<td>3</td>
</tr>
<tr>
<td>Non-Enveloped Viruses</td>
<td>4</td>
</tr>
<tr>
<td>Fungi</td>
<td>5</td>
</tr>
<tr>
<td>Bacteria</td>
<td>6</td>
</tr>
<tr>
<td>Enveloped Viruses</td>
<td>7</td>
</tr>
</tbody>
</table>

CJD: potential for secondary spread through contaminated surgical instruments
CJD: Disinfection and Sterilization

Conclusions

- Critical/Semicritical-devices contaminated with high-risk tissue from high risk patients requires special prion reprocessing
  - NaOH and steam sterilization (e.g., 1N NaOH 1h, 121°C 30 m)
  - 134°C for 18m (prevacuum)
  - 132°C for 60m (gravity)

- No low temperature sterilization technology effective*

- Noncritical-four disinfectants (e.g., chlorine, Environ LpH) effective
  (4 log decrease in LD_{50} within 1h)

*VHP reduced infectivity by 4.5 logs (Lancet 2004;364:521)

Inactivation of Prions

Recent Studies

  - Enzymatic cleaner (EC)-no effect
  - Phenolic (Environ LpH), alkaline cleaner (AC), EC+VHP-effective
  - SDS/NaOH, AC, 0.2% PA, 5% SDS-effective (in vitro)
  - Environ LpH-effective
Endoscopes/AERS

Murphy Was an ICP!

Murphy’s Law

“Whatever can go wrong will go wrong”

Corollary

“…in the worst possible way at the worst possible time”
GI ENDOSCOPES AND BRONCHOSCOPIES

- Widely used diagnostic and therapeutic procedure
- Endoscope contamination during use (GI 10^9 in/10^5 out)
- Semicritical items require high-level disinfection minimally
- Inappropriate cleaning and disinfection has lead to cross-transmission
- In the inanimate environment, although the incidence remains very low, endoscopes represent a risk of disease transmission

TRANSMISSION OF INFECTION

- Gastrointestinal endoscopy
  - >300 infections transmitted
  - 70% agents Salmonella sp. and P. aeruginosa
  - Clinical spectrum ranged from colonization to death (~4%)
- Bronchoscopy
  - 90 infections transmitted
  - *M. tuberculosis*, atypical *Mycobacteria*, *P. aeruginosa*

ENDOSCOPE DISINFECTION

- CLEAN-mechanically cleaned with water and enzymatic cleaner
- HLD/STERILIZE-immerscope and perfuse HLD/sterilant through all channels for at least 12 min
- RINSE-scope and channels rinsed with sterile water, filtered water, or tap water followed by alcohol
- DRY-use forced air to dry insertion tube and channels
- STORE-prevent recontamination

Endoscope Safety

- Ensure protocols equivalent to guidelines from professional organizations (APIC, SGNA, ASGE)
  Policies = Practices
- Are the staff who reprocess the endoscope specifically trained in that job?
- Are the staff competency tested at least annually?
- Conduct IC rounds to ensure compliance with policy
Endocavitary Probes

- Probes-Transesophageal echocardiography probes, vaginal/rectal probes used in sonographic scanning
- Probes with contact with mucous membranes are semicritical
- Guideline recommends that a new condom/probe cover should be used to cover the probe for each patient and since covers may fail (1-80%), HLD (semicritical probes) should be performed
Endocavitary Probe Covers

- Sterile transvaginal probe covers had a very high rate of perforations before use (0%, 25%, 65% perforations from three suppliers)
- A very high rate of perforations in used endovaginal probe covers was found after oocyte retrieval use (75% and 81% from two suppliers) but other investigators found a lower rate of perforations after use of condoms (0.9-2.0%)
- Condoms superior to probe covers for ultrasound probe (1.7% condom, 8.3% leakage for probe covers)
Disinfection and Sterilization
New Research

- Inactivation of *Clostridium difficile*
- Disinfectants recommended for disinfecting eye examination equipment (e.g., applanation tonometer tips)
- Effectiveness and functional impact of disinfectants on computer keyboards
- Microfiber cloths/mops
- Absorption of QUATS
- Failure to follow disinfection/sterilization principles-patient exposures

*Clostridium difficile*
### Role of the Environment In Transmission

**Hota B, Clin Inf Dis 2004;39:1182**

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Survival</th>
<th>Environmental Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>C. difficile</em></td>
<td>Months (spores)</td>
<td>3+</td>
</tr>
<tr>
<td>VRE</td>
<td>Days to weeks</td>
<td>3+</td>
</tr>
<tr>
<td>MRSA</td>
<td>Days to weeks</td>
<td>2-3+</td>
</tr>
<tr>
<td><em>Acinetobacter</em></td>
<td>33 days</td>
<td>2-3+</td>
</tr>
<tr>
<td><em>P. aeruginosa</em></td>
<td>7 h</td>
<td>1+</td>
</tr>
</tbody>
</table>

### Environmental Contamination

**C. difficile**

- 25% (117/466) of cultures positive (<10 CFU) for *C. difficile*. >90% of sites positive with incontinent patients. Samore et al. Am J Med 1996;100:32.
- 9.3% (85/910) of environmental cultures positive (floors, toilets, toilet seats) for *C. difficile*. Kim et al. J Inf Dis 1981;143:42.
- 29% (62/216) environmental samples were positive for *C. difficile*. 8% (7/88) culture-negative patient, 29% (11/36) positive cultures in rooms occupied by asymptomatic patients and 49% (44/90) in rooms with patients who had CDAD. NEJM 1989;320:204
- 10% (110/1086) environmental samples were positive for *C. difficile* in case-associated areas and 2.5% (14/489) in areas with no known cases. Fekety et al. Am J Med 1981;70:907.
Role of the Environment

*C. difficile*

  - 0-25% environmental sites positive-0% hand cultures positive
  - 26-50% environmental sites positive-8% hand cultures positive
  - >50% environmental sites positive-36% hand cultures positive
- 59% of 35 HCWs were *C. difficile* positive after direct contact with culture-positive patients.
- *C. difficile* incidence data correlated significantly with the prevalence of environmental *C. difficile*. Fawley et al. Epid Infect 2001;126:343.

**FIGURE.** Transmission of infectious agents via animate and inanimate surfaces (modified from reference 25).
Control Measures

*C. difficile*

- Handwashing (soap and water), contact precautions, and meticulous environmental cleaning (disinfect all surfaces) with an EPA-registered disinfectant should be effective in preventing the spread of the organism. McFarland et al. NEJM 1989;320:204.
- In units with high endemic *C. difficile* infection rates or in an outbreak setting, use dilute solutions of 5.25-6.15% sodium hypochlorite (e.g., 1:10 dilution of bleach) for routine disinfection. (Category II)
- For semicritical equipment, glutaraldehyde (20m), OPA (12m) and peracetic acid (12m) reliably kills *C. difficile* spores using normal exposure times

Disinfectants and Antiseptics

*C. difficile* spores at 10 and 20 min, Rutala et al, 2006

- ~4 log$_{10}$ reduction (3 *C. difficile* strains including BI-9)
  - Clorox, 1:10, ~6,000 ppm chlorine (but not 1:50, ~1,200 ppm)
  - Clorox Clean-up, ~1,910 ppm chlorine
  - Tilex, ~25,000 ppm chlorine
  - Steris 20 sterilant, 0.35% peracetic acid
  - Cidex, 2.4% glutaraldehyde
  - Cidex-OPA, 0.55% OPA
  - Wavicide, 2.65% glutaraldehyde
  - Aldahol, 3.4% glutaraldehyde and 26% alcohol
High-Level Disinfection
C. difficile spores

- 2% glutaraldehyde is effective against C. difficile at 20 minutes
- 0.55% ortho-phthalaldehyde is effective against C. difficile at 10 minutes
- Steris 20 is effective against C. difficile at 10 and 20 minutes

Adenovirus 8
A Common Cause of Epidemic Keratoconjunctivitis
Adenovirus 8

- Adenovirus is extremely hardy when deposited on environmental surfaces and may be recovered from plastic and metal surfaces for more than 30 days.
- Elimination of adenovirus from inanimate surfaces and ophthalmic instruments is essential in preventing outbreaks of epidemic keratoconjunctivitis.
- Unfortunately, no reports that validate CDC recommendations for disinfecting tonometer tips. [CDC. MMWR 1985; 34:533.](#)
CDC, 1985

- Applanation tonometers-Soap and water cleaning and then disinfected by soaking them for 5 to 10 minutes in a solution containing either:
  - 5,000 chlorine (~1:10 household bleach)
  - 3% hydrogen peroxide
  - 70% ethyl alcohol
  - 70% isopropyl alcohol

Disinfectants and Antiseptics
Adeno 8 at 1 and 5 min, Rutala et al. AAC, April 2006

- Ineffective <2 log_{10} reduction
  - Bactoshield (4% CHG)
  - Vesphene (phenolic)
  - 70% isopropyl alcohol
  - 3% hydrogen peroxide
  - TBQ (0.06% QUAT)
  - Novaplus (10% povidone iodine)
  - Soft 'N Sure (0.5% triclosan)
  - Acute-Kare (1% chloroxylenol)
  - Sterilox (218 and 695 ppm chlorine)
  - Dettol (4.8% chloroxylenol)
  - Accel TB (0.5% accelerated hydrogen peroxide)
  - Microcyn (~80 ppm chlorine)
Disinfectants and Antiseptics
Adeno 8 at 1 and 5 min, Rutala et al. AAC, April 2006

- ~4 \( \log_{10} \) reduction
  - Clorox, 1:10, ~6,000 ppm chlorine (but not 1:50)
  - Clorox Clean-up, ~1,910 ppm chlorine
  - Clorox disinfecting spray (65% ethanol, 0.6% Quat)
  - Steris 20 sterilant, 0.35% peracetic acid
  - Ethanol, 70%
  - Lysol disinfecting spray (79.6% ethanol, 0.1% Quat)
  - Cidex, 2.4% glutaraldehyde
  - Cidex-OPA, 0.55% OPA
  - Wavicide, 2.65% glutaraldehyde

CDC Guidelines

- CDC, 1985. Applanation tonometers-soap and water cleaning and then disinfected by soaking them for 5 to 10 minutes in a solution containing either:
  - 5,000 chlorine
  - 3% hydrogen peroxide
  - 70% ethyl alcohol
  - 70% isopropyl alcohol
- CDC, 2006 (In press). Wipe clean tonometer tips and then disinfect them by immersing for 5-10 minutes in either 5000 ppm chlorine or 70% ethyl alcohol. Category II.
- These results emphasize the proper selection of disinfectants for use in disinfecting semicritical items (e.g., applanation tonometers)
Infrared Coagulation (IRC)

- IRC is a widely used method for treating hemorrhoids. The procedure involves applying infrared light to compress and seal hemorrhoid veins.
- The manufacture sells a sterile disposable sheath and states removing and soaking lightguides between procedures is no longer required.
- The manufacture also states that the lightguide is damaged by immersion in a disinfectant (as the lightguide is not sealed at the end and disinfectant gets between the quartz glass and the covering).
Infrared Coagulation (IRC)

- CDC guideline (In press) recommends immersion for reprocessing endocavitary probes with covers because integrity of the cover is compromised.
- Since the lightguide cannot be immersed we investigated an alternative procedure:
  - Wipe the probe for 2 minutes with 1:10 bleach.
  - Wrap in chlorine-soaked laparotomy cloth for 3 minutes.
  - Wipe probe with sterile water and let air dry.

Infrared Coagulation Testing
(Rutala, Gergen, Weber, 2006)

<table>
<thead>
<tr>
<th>Test Organism</th>
<th>Inoculum</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mycobacterium terrae</td>
<td>~1.6 x 10^7</td>
<td>100</td>
</tr>
<tr>
<td>Enterococcus</td>
<td>~9.3 x 10^5</td>
<td>100</td>
</tr>
<tr>
<td>P. aeruginosa</td>
<td>~8.3 x 10^6</td>
<td>100</td>
</tr>
</tbody>
</table>
Microfiber Cleaning

- Pad contains fibers (polyester and polyamide) that provide a cleaning surface 40 times greater than conventional string mops
- Proposed advantages: reduce chemical use and disposal (disinfectant solution not changed after every third room, clean microfiber per room [washing lifetime 500-1000]); light (~5 lb less than string mop) and ergonomic; reduce cleaning times.
- Does the microfiber provide the same or better removal of microorganisms on surfaces?
Effectiveness of Microfiber Mop

- Test conditions with a EPA-registered disinfectant: compared routine mop and bucket; microfiber mop and bucket; microfiber mop and system bucket. Twenty-four replicates per condition.
- Conducted RODAC sampling before and after floor disinfection (5 samples per room)
- New disinfectant solution for each test condition
- Dry time varied from 2 (routine mop and bucket)-8 (microfiber mop and bucket) minutes
Effectiveness of Microfiber Mop  
(Rutala et al, 2006)

<table>
<thead>
<tr>
<th>Disinfectant-method</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disinfectant-regular mop</td>
<td>95%</td>
</tr>
<tr>
<td>Disinfectant-Microfiber system</td>
<td>95%</td>
</tr>
<tr>
<td>Disinfectant-Microfiber mop and regular mop bucket</td>
<td>88%</td>
</tr>
<tr>
<td>Detergent-regular mop</td>
<td>68%</td>
</tr>
</tbody>
</table>

Disinfection of Computer Keyboards  
Computer Keyboards, ICHE April 2006

- Increased use of computers in patient areas has led to contamination of keyboards as reservoirs of pathogens
- Study performed to
  - Examine the efficacy of different disinfectants on the computer keyboard
  - Determine if there were cosmetic (key lettering removed) or functional changes after 300 wipes
Disinfection of Computer Keyboards

- All tested products were effective (>95%) in removing and/or inactivating the test pathogens (MRSA, P. aeruginosa). No functional/cosmetic damage after 300 wipes.

- Disinfectants included: 3 quaternary ammonium compounds, 70% isopropyl alcohol, phenolic, chlorine (80ppm)

- At present, recommend that keyboards be disinfected daily (for 5 sec) and when visibly soiled
Reduction in the Release of QUATS

- Issue: Do wipers (cotton, cellulose, nonwoven spunlace) consume/bind QUAT and release less QUAT when disinfecting patient rooms
- Method: Fluid samples were collected from the wipers and tested at predetermined points to detect QUAT available from the wiper for surface disinfection
Reduction in the Release of QUATS

- Results
  - Nonwoven spunlace wipers released an average 90% of the original chemical concentration at 8h
  - Cellulose-based wiper was 21% of the original concentration at 8h
  - Cotton wiper was 5% of the original concentration at 6h
- Conclusions
  - Select wiping material that is compatible with disinfectants
  - Select wiping material and disinfectant that release an effective concentration of the disinfectant to the surface
  - Nothing until verified (unique to these QUATS; what affect does reduced concentration have on removal/inactivation of microbes from a surface)
Failure to Follow Disinfection and Sterilization Principles

What Do You Do?

Scenario:

Hospital A discovered that for the past 3 days all surgical instruments were exposed to steam sterilization at 132°C for 0 minutes rather than the intended 4 minutes. A central processing technician turned the timer to 0 minutes in error.

What do you do?

- Follow the 14 steps at website disinfectionandsterilization.org (confirm failure, embargo improperly D/S items, investigate the cause, etc)
- The steps provide a general outline, but each event is unique and you must be flexible and adaptable
- Communication among key stakeholders is very important
- Ethical to notify patients if there is a risk-should be upfront and factual
- Train staff and access processes/practices to minimize recurrence
- These are stressful events (patients and staff) but the goal is to assess failure and protect patients rather than assessing blame
Disinfection and Sterilization

- HICPAC Guideline
- Provide overview of disinfection and sterilization principles
- Emerging pathogens and prions
- Current Research
  - *Clostridium difficile*
  - Ophthalmic equipment (applanation tonometers)
  - Infrared coagulation
  - Microfiber mops
  - Computer keyboards
  - QUAT absorption
  - Failure to follow disinfection/sterilization principles and patient exposures

Thank you
References

- Rutala WA, Weber DJ, HICPAC. CDC guideline for disinfection and sterilization in healthcare facilities. MMWR. In press.
- Rutala WA. APIC guideline for selection and use of disinfectants. Am J Infect Control 1996;24:313
References