ANIMAL SURGERY
(ASEPTIC TECHNIQUE AND DISINFECTANTS)

PERFORMANCE STANDARD: All animal procedures will include appropriate aseptic technique that discourages infection, disease, or contamination, to provide physiologically stable biologic models for research and to support accurate research outcomes.

BACKGROUND / PURPOSE: An important consideration of assuring proper outcomes from surgical procedures includes the incorporation of aseptic technique. According to The Guide:

‘Aseptic technique is used to reduce microbial contamination to the lowest possible practical level …’

‘Aseptic technique includes preparation of the patient, such as hair or feather removal and disinfection of the operative site; preparation of the surgeon, such as provision of appropriate surgical attire, face mask, and sterile surgical gloves; sterilization of instruments, supplies, and implanted materials; and the use of operative techniques to reduce the likelihood of infection.’

‘Surgical outcomes should be continually and thoroughly assessed to ensure that appropriate procedures are followed and timely corrective changes are instituted. Modification of standard techniques may be required (for instance, in aquatic or field surgery), but should not compromise the well-being of the animals. In the event of modification, close assessment of outcomes may have to incorporate criteria other than clinical morbidity and mortality. Such assessments rely on continuing communication among technical staff, investigators, veterinarians, and the IACUC.’

The Duke animal program considers aseptic technique to be an active and continuing process initiated before the proposed activity and continuing until a full recovery and removal of sutures or closure devices. In some cases, such as application of external devices (e.g. ports, catheters, electrode arrays, etc.), while the surgical episode or invasive procedure has been completed, considerations of asepsis must continue through the life of the animal. In other cases, aquatic or field surgery, the concepts of asepsis remain but the implementation of the concepts may differ from a standard in-house surgical activity.

In all cases, the goal of asepsis is destruction, prevention, or removal of bacteria or other infectious agents which could adversely affect animal well-being or healing (and consequently reliable research outcomes). No single procedure, specialized equipment, or germicide can achieve asepsis. Proper asepsis is a consolidation of appropriate disinfection materials,
effective implementation practices, and sufficient protective measures which collectively remove contaminants, kill infectious agents, and prevent re-contamination or infection of the sanitized site.

ROLES:
1. Researchers: Clearly describe surgical procedures in the protocol. Follow the IACUC-approved protocol procedures.
2. DLAR/OAWA veterinary and technical staff: Serve as consultants for training and oversight activities.

PROTECTIVE POSTURES REQUIRED: Depends upon the specific activities and locations, but generally includes surgeon preparation, patient preparation, and space preparation.

DEFINITIONS:

**ASEPSIS (ASEPTIC PROCEDURES):** Activities which limit microbial contamination so that significant infection or suppuration does not occur.

**STERILIZATION:** The process whereby all viable microorganisms are eliminated or destroyed. The criterion of sterilization is the failure of organisms to grow if a growth-supporting medium is supplied.

**DISINFECTION:** The chemical or physical process that involves the destruction of pathogenic organisms. Disinfectants are effective against vegetative forms of organisms, but not necessarily spores.

**POLICY:** Successful procedural outcomes, defined as animals experiencing good welfare and reliable research data, are based upon a mix of personnel, procedures, and practices. This policy describes the acceptable standards which guide surgery in research animals. Several tables outlining appropriate disinfectants are included in this policy as:

- Table 1 (Hard Surface Disinfectants)
- Table 2 (Skin Disinfectants)
- Table 3 (Instrument Sterilants)
- Table 4 (Instrument Disinfectants)
1. **General Surgical Requirements for USDA-Covered Mammalian Species Survival Surgery (or Survival Procedures):** Surgery or other procedures where aseptic technique are a consideration must be conducted in a dedicated facility that contains space for:
   i. Surgical Support,
   ii. Animal Preparation,
   iii. Surgeon's Scrub,
   iv. Operating Room (OR), and
   v. Post-Op Recovery:

   a. **Surgical Support** “The surgical-support area should be designed for washing and sterilizing instruments and for storing instruments and supplies. Autoclaves are commonly placed in this area” ([Guide](#)). The surgical support area does not have to be immediately adjacent to the surgical suite, but there must be such an area available to the surgical laboratory. Sink areas should be clean and free of rust. Instruments should be stored in suitable containers to keep them clean and in good condition. Laboratories must have the capability to sterilize surgical equipment, e.g. access to autoclaves, plasma sterilizers, etc.

   b. **Animal Preparation:** The preparation of the animal must be done in an area adjacent to the operatory (the ‘animal prep’ area) where the animal will be physically prepared to undergo a surgical procedure (e.g. clipping of fur, cleaning of gross debris, intubation, placing intravenous catheters, etc.). Initial monitoring and recording of anesthesia depth and vital signs must begin while the animal is in this area. There must be adequate electrical outlets in the animal prep area in order to power monitoring equipment, a heating source, and lighting as needed. This animal prep area may double as a recovery area after proper cleaning.

   c. **Surgeon Scrub Area:** A specific area “equipped with foot, knee or electric eye surgical sinks” where the surgeon(s) can scrub before performing a surgical procedure must be part of the surgical suite. “To minimize the potential for contamination of the surgical site by aerosols generated during scrubbing, the scrub area should usually be outside the operating room and the animal preparation area.” ([Guide](#)). Adequate space for gowing into sterile surgical garb within or near to the surgeon’s scrub area and the operating room will minimize risks of contamination of sterile status.
d. Operating Room (OR): A dedicated operatory which is appropriately managed to minimize contamination of the patient during pre-, intra-, and post-procedural activities are required. Generally these are core-managed activities, but when justified, a PI-managed space may be IACUC-approved for survival surgery when it is scientifically or technically justified and meets the conditions outlined below:
   vi. The interior surfaces are monolithic and impervious to moisture (non-porous).
   vii. ORs must be sanitized prior to surgical procedures. When not in use, the OR should be maintained clean and clutter-free.
   viii. The OR should not be used for primary storage. If needed, items that are not easily sanitized (e.g. non-surgical equipment, cardboard boxes, general supplies, etc.) should be stored in drawers or cabinets which can be sanitized.
   ix. Positive air pressure should be maintained (relative to the surrounding areas) to prevent airborne contaminants from entering the OR.

e. Post-Operative Recovery: There must be an area available where the animal can safely recover from the effects of anesthesia and surgery. Like the animal prep space, the post-operative recovery area should be appropriately equipped with emergency equipment and supplies, electrical outlets for power supply to warming devices and support equipment, and proper lighting as needed. Ideally, the post-operative recovery should be separate from the animal prep area, but in facilities with limited space, the animal prep area may double as the post-operative recovery space. If the area will be used for both animal prep and recovery, the space should be cleaned between animals. In certain circumstances, animals may recover in their ‘home’ cage or the operatory, based upon veterinary decisions and care requirements.

f. Minimize Contamination: The entire surgical suite must be maintained in such a manner as to reduce risk to the animal patient. Cleanliness is an essential and integral part of the surgical process.

“Inadequate or improper technique may lead to subclinical infections [in animals] that can cause adverse physiologic and behavioral responses affecting surgical success, animal well-being, and research results” (Guide).
2. **Patient Requirements for USDA-Covered Species (e.g. cat, dog, non-human primate, rabbit, guinea pig, and other USDA-covered species) survival surgery:**

   a. **Patient:** How the surgeon or assistants will prepare the animal is described in the protocol. Preparing the animal for surgery is at least a two-step process:

   i. **In the Animal Prep Area (in general):**

      1. Administer analgesics (preemptive analgesia is the institution’s default position), as appropriate or unless exempted in the IACUC-approved protocol.
      2. Administer antibiotics (e.g., preemptive anti-infectives), if described in the IACUC-approved protocol.
      3. Protect the corneas from drying out by applying an ophthalmic ointment.
      4. Remove the hair (e.g. with clippers or depilatory cream) in a wide area around the body site where surgery is to be performed. Close monitoring of the length of time that depilatory creams are applied to animals is encouraged to avoid skin irritation.
      5. Clean hair/fur and any other gross debris from the skin using an appropriate surgical scrub pattern (remove in a concentric pattern moving from the innermost to outermost areas) with a detergent-based surgical scrub (See Table 2: Skin Disinfectants) and alcohol or sterile water as a rinse. This process is completed 3 times.

   ii. **In the Operating Room (in general):**

      1. The anesthetized animal should be properly secured to minimize excessive movement of the animal during the surgery (and to avoid a break in sterility). Secure placement should avoid being excessively tight and thus permit blood flow to extremities.
      2. Disinfect the area with appropriate surgical scrub for as long as the product indicates prior to initiating the surgical procedure.
      3. Alcohol alone is NOT an appropriate disinfectant. Iodophors (e.g. Betadine) or chlorohexidines (e.g. Nolvasan) should be used. See Table 2 (Skin Disinfectants).
      4. Drape the surgical site by placing and securing sterile drapes over the entire animal and the operating room table.
b. **Surgeon and Surgical Assistant(s):** Personnel taking part in the surgery must:

1. Wear clean scrubs, appropriate face mask, head covering, close-toed shoes, shoe covers.
2. Perform a surgical scrub in the surgeon’s scrub area. This includes scrubbing both hands, in between fingers, and both forearms with a designated surgical scrub brush with an antibacterial soap (e.g., chlorhexidine or iodophor) for as long as the product indicates prior to initiating the surgical procedure.
3. Don sterile gown and gloves using appropriate technique.
4. Limit excessive movement (e.g. foot traffic) to avoid contamination of the surgical locations and OR.
5. Rescrub and regown if it is necessary to leave the surgical suite.
6. Non-surgeons (e.g., surgical assistants) must wear appropriate personal protective equipment (PPE)—at least a disposable cover gown, shoe covers, mask, gloves and head cap. Non-surgeons are defined as those individuals that will NOT touch the animal undergoing the surgical procedure, but they may assist the surgeon.

c. **Instruments:** Ensure that all instruments are appropriate for surgery, in particular:

1. All instruments must be cleaned and sterilized prior to use on animals for all surgical procedures. *Alcohol is NOT a sterilant.* Examples of methods of sterilization include steam autoclave, gas (e.g. ethylene oxide), and plasma sterilization. See Table 3. Instrument Sterilants.
2. Cold sterilization (e.g. Cidex) of surgical instruments must strictly follow manufacturer instructions. The CDC lists specific cold sterilants and the necessary conditions (e.g., contact times) to be considered a sterilant or a disinfectant. Rinse instruments free from the cold sterilants with sterile water or sterile saline before putting them in contact with animals. See Table 4. Instrument Disinfectant.
3. The institution’s default is to use only sterile instruments for each animal. Therefore, new autoclaved, gas sterilized, or plasma sterilization packs are required for each animal. However certain exemptions may be IACUC-approved. See Table 3. Sterilized Instruments.
4. Do not use dull or rusted surgical instruments or those not manufactured for surgical use.
5. When sterilizing by autoclave or plasma sterilizer, surgical packs should contain a sterilization indicator, the date of sterilization and expiration date for the pack. Protected storage of sterilized items is required; integrity of sterile packaging must be examined prior to use.
3. General Surgical Requirements for Mice (Mus musculus), Rats (Rattus norvegicus), Avian, Reptile, and Aquatic (cold-blooded) Species: While surgery or other procedures must always be conducted using aseptic concepts, different options exist for these applications of asepsis in these species.

a. Surgical Support: A surgical support area does not have to be immediately adjacent to the surgical area. Sink areas should be clean and free of rust. Instruments should be stored in suitable containers to keep them clean and in good condition. Laboratories must have the capability to sterilize surgical equipment, e.g. access to autoclaves, plasma sterilizers, etc.

b. Animal Preparation: The preparation of the animal must be done in an area adjacent to the operatory (the ‘animal prep’ area) where the animal will be physically prepared to undergo a surgical procedure (e.g. clipping of fur, cleaning of gross debris, intubation, placing intravenous catheters, etc.). Initial monitoring and recording of anesthesia depth and vital signs must begin while the animal is in this area. There must be adequate electrical outlets in the animal prep area in order to power monitoring equipment, a heating source, and lighting as needed. This animal prep area may double as a recovery area after proper cleaning.

c. Surgeon Scrub Area: Personal hygiene has the potential for serious adverse consequences in the surgical patient. Certain surgeon preparation is required and other actions are recommended in the best interest of successful patient outcomes.
   i. Required actions include:
      1. Scrubbing of all hand surfaces with a detergent hand soap and water.
      2. Gloves (see approaches below)
      3. A face mask
   ii. Recommended actions include:
      1. Head cover
      2. Surgical gown or dedicated surgical scrubs
d. **Operating Room (OR):** Any laboratory dedicated space which is appropriately managed to minimize contamination from other activities in the room may be used for surgery. Special considerations include:
   i. No other activities may be performed in this dedicated space while surgery is in progress.
   ii. A distance to other laboratory activities sufficient to discourage aerosol contamination of the surgical patient.
   iii. Laminar air flow across the patient and evacuated from the laboratory area is desired to prevent exposure to persons or other laboratory activity.
   iv. Positive air pressure should be maintained (relative to the surrounding areas) to prevent airborne contaminants from contaminating the surgery wounds.
   v. Sufficient space for patient preparation, surgical activities, and patient recovery.
   vi. The animal contact surfaces are monolithic and impervious to moisture (non-porous).
   vii. The space is sanitized prior to surgical procedures.
   viii. The space is uncluttered and free of non-surgical equipment (e.g., cardboard boxes, general supplies, etc.).

e. **Post-Operative Recovery:** There must be an area available where the animal can safely recover from the effects of anesthesia and surgery. Like the animal prep space, the post-operative recovery area should be appropriately equipped with emergency equipment and supplies, electrical outlets for power supply to warming devices and support equipment, and proper lighting as needed. Ideally, the post-operative recovery should be separate from the animal prep area, but in facilities with limited space, the animal prep area may double as the post-operative recovery space. If the area will be used for both animal prep and recovery, the space should be cleaned between animals.

f. **Minimize Contamination:** The entire surgical area must be maintained in such a manner as to reduce risk to the animal patient. Cleanliness is an essential and integral part of the surgical process.

   “Inadequate or improper technique may lead to subclinical infections [in animals] that can cause adverse physiologic and behavioral responses affecting surgical success, animal well-being, and research results” *(Guide)*.
4. **Minimum Requirements for Survival Surgery in Mice (Mus musculus), Rats (Rattus norvegicus), Avian Species, Reptile, and Aquatic (cold-blooded) Species:**

   a. **Patient:** How the surgeon or assistants will prepare the animal is described in the protocol. Preparing these species can be moderately different from USDA-covered species preparation:

   i. **Mammalian / Avian / Reptile:** The utilization of a disinfectant (i.e. iodophor or chlorhexidine detergent) in combination with alcohol is required. Exceptions may be approved by the IACUC on a case-by-case basis, following consultation with a Duke veterinarian.

   ii. **Aquatic / Amphibian Surgery:** The presence of protective substances on the surface of fish and amphibians make the use of removal agents inappropriate. Most detergents and disinfectants for skin pre-operative care are contraindicated for these species. The recommended methodology consists of a sterile saline rinse and gentle patting with sterile gauze prior to making the incision. Exceptions may be approved by the IACUC on a case-by-case basis, following consultation with a Duke veterinarian.

   iii. **In the Animal Prep Area (in general):**
   1. Administer analgesics (preemptive analgesia is the institution’s default position), as appropriate or unless exempted in the IACUC-approved protocol.
   2. Administer antibiotics (e.g. preemptive anti-infectives), when approved by the IACUC.
   3. Protect the corneas from drying out by applying an ophthalmic ointment.
   4. Remove the hair (e.g. with clippers or depilatory cream) in a wide area around the body site where surgery is to be performed. Close monitoring of the length of time that depilatory creams are applied to animals is encouraged to avoid skin irritation.
   5. Clean hair/fur and any other gross debris from the skin using an appropriate surgical scrub pattern (remove in a concentric pattern moving from the innermost to outermost areas) with a detergent-based surgical scrub (See Table 2: Skin Disinfectants) and alcohol or sterile water as a rinse. This process is completed 3 times.

   iv. **In the Operating Room (in general):**
   1. The anesthetized animal should be properly secured to minimize excessive movement of the animal during the surgery (and to avoid a break in sterility). Secure placement should avoid being excessively tight and thus permit blood flow to extremities.
   2. Disinfect the area with appropriate surgical scrub for as long as the
product indicates prior to initiating the surgical procedure.

3. Alcohol alone is NOT an appropriate disinfectant. Iodophors (e.g. Betadine) or chlorohexidines (e.g. Nolvasan) should be used. See Table 2 (Skin Disinfectants).

4. Draping as appropriate:
   a. Drape the surgical site by placing and securing sterile drapes over the entire animal and the operating room table.
   b. Drape the surgical site by placing and securing sterile drapes over the entire animal and the operating room table. While standard surgical draping may be used for these small patients, the Duke IACUC has approved the use of adhesive plastic food wrap (e.g. Press-n-Seal or similar) for surgical drape material in mouse, rat, and avian surgeries. Pulled from a clean roll, applied across the surgical field, and surrounding area, ‘Press-n-Seal’ protects the patient from unwanted operative site contamination. The incision can be made directly through the plastic wrap, through the skin, and into the deeper tissues.

**NOTE:** The IACUC will consider any other process or material that provides a clean area that protects the surgical site from contamination.

v. **Surgical procedure methodology:** The IACUC recognizes two different forms of surgical procedure methodology for non-USDA species:

1. **Full Sterile Instrumentation:**
   a. Mask & sterile surgical gloves: Using sterile surgical gloves allows you to touch all areas of the sterile surgical field and surgical instruments with your gloved hands.
   b. Sterile instruments and supplies are used in a standard aseptic surgery. See Table 3 (Instrument Sterilants) and Table 4 (Instrument Disinfectants) for specific options.
   c. Surgical instruments may be re-used for multiple animals on the same day, if the tips of the instruments are placed in a glass or ceramic bead sterilizer between procedures, provided they are maintained clean and disinfected between animals. See Table 3 (Instrument Sterilants) and Table 4 (Instrument Disinfectants) for specific options. See 2.3.ii below.

Note: New sterile gloves are necessary for this methodology.
2. Enhanced Clean Instrumentation using a ‘Tips-Only’ Methodology: This technique is useful when working alone and manipulation of non-sterile objects (e.g., anesthesia machines, microscopes, lighting) is required.
   a. Start the procedure with an autoclaved (or cold sterilized) pack of instruments.
   b. Mask & gloves (clean): Surgeons are restricted to use the sterile working ends of the instruments for manipulating tissues.
   c. The gloved hand must never touch the working end of the instruments, the suture, suture needle, or any part of the surgical field.
   d. Even though a ‘tips-only’ methodology is employed, other materials and supplies that touch the surgical site must be sterile. See Table 3 (Instrument Sterilants) and Table 4 (Instrument Disinfectants) for specific options.
   e. Surgical instruments may be re-used for multiple animals on the same day, if the tips of the instruments are placed in a glass or ceramic bead sterilizer between procedures, provided they are maintained clean and disinfected between animals on the same day. See Table 3 (Instrument Sterilants) and Table 4 (Instrument Disinfectants) for specific options. See 2.3.ii below.
5. **SPECIAL NOTES REGARDING ASEPSIS AND SURGERY:**

**NOTE 1:** The DLAR has performed testing on ‘Press-n-Seal’ and confirmed that plastic wrap from a recently purchased roll does not contain bacteria that can be grown on common laboratory media. This does not mean the product is sterile, but does mean it is sufficiently clean for this specific application, and it is IACUC-approved.

**NOTE 2:** Surgeons should wash and dry their hands AFTER scrubbing the surgical site and BEFORE aseptically donning surgical gloves.

**NOTE 3:** For non-survival (terminal) surgery, when animals are anesthetized for period less than 6 hours, aseptic technique is encouraged, but not required. Disinfectants are recommended for personnel safety, but not for animal protection. For procedures lasting longer than 6 hours, the stipulations described in this policy are in effect.

**NOTE 4:** Deviations from approved surgical procedures necessitated by emergency conditions must be immediately reported to the DLAR/DLC veterinary staff and to the IACUC.

**NOTE 5:** Alcohol is neither a sterilant nor a high-level disinfectant. Alcohol has been used historically for disinfection in a variety of species and situations. In certain cases, alcohol may actually achieve the desired outcome, but this is highly variable and inconsistent, since it depends on duration of contact time, agents being killed, contamination present on the skin surface, and organism life stage (vegetative organisms are killed more quickly than spores). According to the Association for Professionals in Infection Control and Epidemiology, “ethyl alcohol and isopropyl alcohol are not effective in sterilizing instruments because they lack sporicidal activity and cannot penetrate protein-rich materials and cannot kill hydrophilic viruses.”
REFERENCES:

- Suckow MA, Stevens KA, and Wilson RP. The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents. Academic Press, 2012
- http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2587003/
**TABLE 1**  
RECOMMENDED HARD SURFACE DISINFECTANTS

Note: Recommended hard surface disinfectants for table tops, equipment. Always follow manufacturer's instructions for dilution and expiration periods.

<table>
<thead>
<tr>
<th>AGENT</th>
<th>EXAMPLES</th>
<th>COMMENTS</th>
</tr>
</thead>
</table>
| Alcohols            | 70% ethyl alcohol                             | Contact time required is 15 minutes.  
                      | 85% isopropyl alcohol                        | Contaminated surfaces take longer to disinfect.  
                      |                                                | Remove gross contamination before using.  
                      |                                                | Inexpensive.                                  |
| Quaternary Ammonium| Roccal®, Quatricide®                          | Rapidly inactivated by organic matter.  
                      |                                                | Compounds may support growth of gram negative bacteria.                 |
| Chlorine            | Sodium hypochlorite (Clorox ®, 10% solution)  | Corrosive.  
                      | Chlorine dioxide (Clidox®, Alcide®, MB-10®) | Presence of organic matter reduces activity. Chlorine dioxide must be fresh; kills vegetative organisms within 3 minutes of contact. |
| Glutaraldehydes     | Glutaraldehydes (Cidex®, Cetylcide®, Cide Wipes®) | Rapidly disinfects surfaces.                                              |
| Phenolics           | Lysol®, TBQ®                                  | Less affected by organic material than other disinfectants.               |
| Chlorhexidine       | Nolvasan®, Hibiclens®                         | Presence of blood does not interfere with activity.  
                      |                                                | Rapidly bactericidal and persistent. Effective against many viruses.    |
| Hydrogen peroxide/peracetic acid/acetic acid | Spor Klenz | Contact time 10 minutes.                                              |

*The use of common brand names as examples does not indicate a product endorsement.*
TABLE 2
SKIN DISINFECTANTS

Note: Alternating disinfectants is more effective than using a single agent. For example, an iodophor scrub can be alternated three times with 70% alcohol, followed by a final soaking with a disinfectant solution. Alcohol, by itself, is not an adequate skin disinfectant. The evaporation of alcohol can induce hypothermia in small animals.

<table>
<thead>
<tr>
<th>AGENT</th>
<th>EXAMPLES *</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cholorhexidine</td>
<td>Nolvasan®, Hibiclen®</td>
<td>Presence of blood does not interfere with activity. Rapidly bactericidal and persistent. Effective against many viruses. Excellent for use on skin.</td>
</tr>
</tbody>
</table>

*The use of common brand names as examples does not indicate a product endorsement.

TABLE 3
RECOMMENDED INSTRUMENT STERILANTS

Note: Always follow manufacturer’s instructions for dilution, exposure times and expiration periods.

<table>
<thead>
<tr>
<th>AGENT</th>
<th>EXAMPLES *</th>
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</tr>
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<tbody>
<tr>
<td>Steam sterilization (moist heat)</td>
<td>Autoclave</td>
<td>Effectiveness dependent upon temperature, pressure and time (e.g., 121°C for 15 min. vs 131°C for 3 min).</td>
</tr>
<tr>
<td>Dry Heat</td>
<td>Hot Bead Sterilizer</td>
<td>Fast. Instruments must be cooled before contacting tissue. Only tips of instruments are sterilized with hot beads.</td>
</tr>
<tr>
<td></td>
<td>Dry Chamber</td>
<td></td>
</tr>
<tr>
<td>Gas sterilization</td>
<td>Ethylene Oxide</td>
<td>Requires 30% or greater relative humidity for effectiveness against spores. Gas is irritating to tissue; all materials require safe airing time.</td>
</tr>
<tr>
<td>Chlorine</td>
<td>Chlorine Dioxide</td>
<td>Corrosive to instruments. Instruments must be rinsed with sterile saline or sterile water before use.</td>
</tr>
<tr>
<td>Glutaraldehydes</td>
<td>Glutaraldehyde (Cidex®, Cetylci®de®, Metricide®)</td>
<td>Several hours required for sterilization. Corrosive and irritating. Instruments must be rinsed with sterile saline or sterile water before use.</td>
</tr>
<tr>
<td>Hydrogen peroxide- acetic acid</td>
<td>Actril®, Spor-Klenz®</td>
<td>Several hours required for sterilization. Corrosive and irritating. Instruments must be rinsed with sterile saline or sterile water before use.</td>
</tr>
</tbody>
</table>

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**TABLE 4**

**RECOMMENDED INSTRUMENT DISINFECTANTS**

Note: Always follow manufacturer's instructions for dilution, exposure times and expiration periods.

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</tr>
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<tbody>
<tr>
<td>Alcohols</td>
<td>70% ethyl alcohol  85% isopropyl alcohol</td>
<td>Contact time required is 15 minutes. Contaminated surfaces take longer to disinfect. Remove gross contamination before using. Inexpensive. NOTE: Requires specific IACUC approval for use.</td>
</tr>
<tr>
<td>Chlorine</td>
<td>Sodium hypochlorite (Clorox ® 10% solution) Chlorine dioxide (Clidox®),</td>
<td>Corrosive. Presence of organic matter reduces activity. Chlorine dioxide must be fresh. Kills vegetative organisms within 3 min. Corrosive to instruments. Instruments must be rinsed with sterile saline or sterile water before use.</td>
</tr>
<tr>
<td>Chlorhexidine</td>
<td>Nolvasan®, Hibiclens®</td>
<td>Presence of blood does not interfere with activity. Rapidly bactericidal and persistent. Effective against many viruses. Instruments must be rinsed with sterile saline or sterile water before use.</td>
</tr>
</tbody>
</table>

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