INFECTION PREVENTION PROCESSES

PROCESSING INSTRUMENTS, GLOVES, AND OTHER ITEMS
As shown in Figure 1, decontamination is the first step in processing soiled (contaminated) instruments, gloves, and other reusable items that may have been in contact with blood or other body fluids (American Association of Operating Room Nurses 1990). Soaking contaminated items briefly in 0.5% chlorine solution, for example, rapidly kills HBV and HIV, thereby making instruments and other items safer to be handled during cleaning. Larger surfaces—such as examination tables and other equipment—may be decontaminated by wiping them down with 0.5% chlorine solution. (Guidelines for properly decontaminating items are presented in Textbox 2.)

Figure 1. Processing Surgical Instruments, Gloves, and Other Items

After items have been decontaminated, they should be thoroughly cleaned with water and liquid soap or detergent to physically remove organic material such as blood and body fluids. Dried organic material can trap microorganisms in a residue that protects them against HLD or sterilization. Organic matter also can partially inactivate disinfectants, rendering them less effective (Porter 1987). Guidelines for properly cleaning items are presented in Textbox 1.

After items have been decontaminated and cleaned, they should be final-processed through HLD or sterilization. Although sterilization is generally preferred, it is not necessary for IUD services. This is because mucous membranes are left intact during IUD insertion and removal procedures, and intact mucous membranes are resistant to the
subset of common bacterial endospores that only sterilization (and not HLD) can destroy. Therefore, HLD is a safe, effective, and cost-effective method of final processing for IUD services. Guidelines for properly high-level disinfecting (and sterilizing) items are presented in Textbox 1. Additional information about HLD is provided in the next section.

Textbox 1. General Guidelines for Processing Instruments, Gloves, and Other Items

**Note:** Staff should wear heavy utility gloves while handling soiled instruments and other items during decontamination and cleaning. These gloves should be discarded if torn or damaged, but can otherwise be cleaned, dried, and reused the next day.

**STEP 1: DECONTAMINATION**

- Immediately after use, fully immerse all **instruments** (e.g., tenaculum, speculum, sound) in a plastic container filled with 0.5% chlorine solution or other locally available disinfectant for 10 minutes. (This step helps prevent transmission of HBV and HIV to staff. It should be done before staff are allowed to handle or clean instruments.)
  - If the instruments will not be cleaned (STEP 2) immediately after decontamination, rinse them with water and dry them with a clean towel to minimize possible corrosion.
- Wipe down all **large surfaces** (e.g., procedure table, instrument stand) that could have been contaminated by blood or other body fluids with a 0.5% chlorine solution.
- While still wearing **gloves** (dispose of waste [STEP 4], if appropriate), briefly immerse both gloved hands in the bucket containing the 0.5% chlorine solution and then carefully remove them by turning them inside out.
  - If disposing of gloves, place them in a leak-proof container (with tight-fitting lid) or plastic bag.
  - If reusing surgical gloves, submerge them in the chlorine solution and soak them for 10 minutes.

**Note:** Detailed instructions on making dilute chlorine solutions for decontamination (and HLD) are presented on pages 6 to 8.

**STEP 2: CLEANING AND RINSING**

- After decontaminating **instruments**:
  a. Thoroughly scrub them under the surface of the water with a soft brush (e.g., a toothbrush) and liquid soap or detergent. Pay special attention to teeth, joints, and screws, where organic material may collect.
  b. After cleaning, rinse items well to remove all soap or detergent. (This step is important because some detergents can leave a residue that interferes with the action of chemical disinfectants used for HLD [or sterilization].)
  c. After rinsing, air dry or dry items with a clean towel.
  d. Once items are dried, proceed with HLD (or sterilization).
- Wash **large surfaces** (e.g., procedure table, instrument stand) with soap and water if organic material remains on them after decontamination.

**STEP 3: HLD (Recommended for IUD Services)**

- After decontaminating (instruments and surgical gloves) and cleaning and rinsing **instruments**, high-level disinfect them using one of the following processes:

  **Boil items** for 20 minutes and dry:
  a. Open or take apart items.
  b. Fully immerse items in water in a covered pan and heat.
  c. Bring water to a rolling/bubbling boil, and begin timing.
  d. Boil for 20 minutes.
  e. Remove items using high-level disinfected forceps, and place in a high-level disinfected container.
  f. Allow items to cool and air dry.

Alternatively, **steam items** for 20 minutes and dry.

**Note:** Detailed instructions on steaming gloves are provided in Textbox 2.
Infection Prevention Processes

Textbox 1. General Guidelines for Processing Instruments, Gloves, and Other Items (continued)

Alternatively, soak items in special chemicals for 20 minutes, rinse, and dry:

a. Fully immerse items in an appropriate high-level disinfectant (i.e., 2% glutaraldehyde or 0.1% chlorine solution), prepared as described.
b. Soak them for 20 minutes.
c. Remove items using new/clean examination or high-level disinfected surgical gloves, and high-level disinfected forceps.
d. Rinse items three times with boiled and filtered (if necessary) water.
e. Place them in a high-level disinfected container and air dry.

Note: Detailed instructions on making dilute chlorine solutions for decontamination (and HLD) are presented on pages 6 to 8.

(Alternate) STEP 3: STERILIZATION (Not Essential for IUD Services if HLD Is Available)

- After decontaminating and cleaning and rinsing instruments, sterilize them by autoclave (121°C [250°F] and 106 kPa [15 lb/in²] for 20 minutes if unwrapped and 30 minutes if wrapped; or by dry-heat (170°C [340°F] for 60 minutes).

Note: Dry-heat sterilization can be used only for metal or glass instruments, not gloves.

STEP 4: WASTE DISPOSAL

- After completing a procedure (e.g., IUD insertion or removal), and while still wearing gloves, dispose of contaminated waste (e.g., gauze, cotton, disposable gloves) in a properly marked leak-proof waste container (with a tight-fitting lid) or plastic bag.

STEP 5: STORAGE

- Use high-level disinfected instruments immediately, or store them for up to 1 week in a high-level disinfected container with a tight-fitting cover. (Sterilized instruments not used immediately should be stored in a dry, sterile container with a tight-fitting cover.)
- Use high-level disinfected gloves immediately or store them for up to 1 week in a dry, high-level disinfected container with a tight-fitting cover (or in the stacked/covered steamer pans, as described in Textbox 2). (Sterilized gloves not used immediately should be stored in a dry, sterile container with a tight-fitting cover.)

More about High-Level Disinfection

Because HLD is a safe, effective, and cost-effective method of final processing for IUD services, additional information is provided below about each of the HLD processes: boiling, steaming, and soaking in special chemicals.

HLD by Boiling and Steaming

For small clinics and those located in remote areas, boiling and steaming are the preferred methods of HLD because they require only inexpensive equipment that is often readily available. There are advantages and disadvantages to both methods.

- An advantage of steaming is that requires less fuel and thus is more cost-effective than boiling for HLD. Only about 1 liter of water is needed to steam gloves or other instruments, whereas 4 to 5 liters are required for boiling.
- For final processing of surgical gloves, steaming has several additional advantages over boiling. It is less destructive to the gloves, and the gloves are less likely to be contaminated while they are drying after steaming because they remain in the closed steamer pan. Moreover, gloves that have been steamed dry in less time (about 4 hours) than those that have been boiled. Because steaming is the most popular method of processing gloves so that they can be safely reused, detailed instructions on steaming gloves are provided in Textbox 2.
- An advantage of boiling is that the pots used can be very large and thus may be more suitable for use with metal instruments. Steaming, on the other hand, may only be
practical for processing small items (e.g., surgical gloves, syringes) because locally available steamers are often small.

- Also, the boiling process requires less attention to ensure that it is being done correctly (Salle 1973; Spaulding 1939). By contrast, for steaming to be effective, the bottom pan must contain enough water to continue boiling throughout the steaming process.

**HLD by Soaking in Special Chemicals**

Aside from boiling and steaming, the only other method of high-level disinfecting instruments, gloves, and other reusable items is by soaking them in special chemicals. Although a number of disinfectants are commercially available in most countries, only four are approved worldwide for use as high-level disinfectants:

- Chlorine—recommended
- Glutaraldehyde—also recommended
- Formaldehyde (formalin)—no longer recommended (potentially cancer-causing)
- Hydrogen peroxide—rarely used (highly corrosive and unstable)

Important information on the proper preparation, use, and storage requirements for chlorine and glutaraldehyde—the two most commonly used and recommended high-level disinfectants—is presented in the next section.

**Textbox 2. How to High-Level Disinfect Surgical Gloves by Steaming**

After gloves have been decontaminated and thoroughly cleaned, they are ready for HLD by steaming.

**STEP 1:** Fold up cuffs of gloves so that they can be put on easily and without contamination after HLD.

**STEP 2:** Place gloves into one of the steamer pans with holes in the bottom. To make removal from the pan after HLD easier, arrange gloves so that cuffs are facing outward, toward the edge of the pan. Five to fifteen pairs can be put in each pan, depending on the diameter of the pan.

**STEP 3:** Repeat this process until up to three steamer pans have been filled with gloves. Stack the filled steamer pans on top of the bottom pan, which contains water for boiling. A second (empty) pan without holes should be placed on the counter next to the heat source (see STEP 9).

**STEP 4:** Place the lid on the top pan and bring water to a full rolling boil. (When water only simmers, very little steam is formed and the temperature may not get high enough to kill microorganisms.)

**STEP 5:** Reduce heat so that water continues to boil at a rolling boil. (When water boils too violently, it evaporates quickly and wastes fuel.)

**Remember:** Be sure there is sufficient water in the bottom pan for the entire 20 minutes of steaming.

**STEP 6:** When steam begins to come out between the pans, start the timer, or note the time on the clock and record it in the HLD log.

**STEP 7:** Steam gloves for 20 minutes.
Textbox 2. How to High-Level Disinfect Surgical Gloves by Steaming (continued)

STEP 8: Remove the top steamer pan and place the lid on the top pan remaining in the stack. Gently shake excess water from the gloves in the pan just removed.

STEP 9: Place the pan containing gloves on the second (empty) pan (see STEP 3). Repeat until all pans containing gloves are restacked on this empty pan. (This step allows the gloves to cool and dry without becoming contaminated.)

Remember: Do not place pans containing gloves directly on a table top, counter, or other surface as gloves will be contaminated.

STEP 10: Allow gloves to air dry in the steamer pans (4 to 6 hours) before using them.\(^a\)

STEP 11: Using a high-level disinfected forceps, transfer the dry gloves to a dry, high-level disinfected container\(^b\) with a tight-fitting lid. Store for up to 1 week. (Gloves also can be stored in the stacked and covered steamer pans.)

\(^a\) Alternatively, allow gloves to cool for 5 to 10 minutes before wearing “wet.” Gloves should be used within 30 minutes, if possible. After this time, the fingers of the gloves stick together and the gloves are hard to put on despite being damp. Gloves that are removed from the steamer pan(s) to be worn “wet” but which are not used during the clinic session should be reprocessed before using.

\(^b\) To prepare a high-level disinfected container, boil (if small) or fill a plastic container with 0.5% chlorine solution and soak for 20 minutes. (The chlorine solution can then be transferred to another container and reused.) Rinse the cover and inside thoroughly with boiled water and allow to air dry.

ADDITIONAL INFORMATION ON CHEMICALS USED IN INFECTION PREVENTION PROCESSES

This section contains guidance on the following topics:
- Making dilute chlorine solutions for decontamination and HLD
- Choosing appropriate chemicals for HLD
- Storing chemicals and processing chemical containers
- Preparing and using chemical disinfectants

Making Dilute Chlorine Solutions for Decontamination and HLD

The WHO recommends 0.5% chlorine solution for decontaminating instruments before cleaning or when potable water is not available for making the solution (WHO 1989). For HLD, a 0.1% solution is satisfactory, provided boiled water is used for dilution.

Table 1 describes how to make 0.5% and 0.1% chlorine solutions using commercially available liquid bleach products. The general formula for making a dilute solution from a commercial preparation of any concentration is shown in Textbox 3.

The approximate amounts (in grams) needed to make 0.5% and 0.1% chlorine-releasing solutions from several commercially available compounds (dry powders) are listed in Table 2. The formula for making a dilute solution from a powder of any percent available chlorine is listed in Textbox 4.
### Table 1. Preparing Dilute Chlorine Solution from Liquid Bleach (Sodium Hypochlorite Solution) for Decontamination and HLD

<table>
<thead>
<tr>
<th>TYPE OR BRAND OF BLEACH (BY COUNTRY)</th>
<th>CHLORINE % AVAILABLE</th>
<th>PARTS WATER TO 1 PART BLEACH&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5%</td>
<td>0.1%&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>8 °chlorum</td>
<td>2.4%</td>
<td>4</td>
</tr>
<tr>
<td>JIK (Kenya), Robin Bleach (Nepal)</td>
<td>3.5%</td>
<td>6</td>
</tr>
<tr>
<td>12 °chlorum</td>
<td>3.6%</td>
<td>6</td>
</tr>
<tr>
<td>Household bleach (USA, Indonesia), ACE (Turkey), Eau de Javal (France) (15 °chlorum')</td>
<td>5%</td>
<td>9</td>
</tr>
<tr>
<td>Blanquedor, Cloro (Mexico)</td>
<td>6%</td>
<td>11</td>
</tr>
<tr>
<td>Lavandina (Bolivia)</td>
<td>8%</td>
<td>15</td>
</tr>
<tr>
<td>Chloros (UK)</td>
<td>10%</td>
<td>19</td>
</tr>
<tr>
<td>Chloros (UK), Extrait de Javel (France) (48 °chlorum”)</td>
<td>15%</td>
<td>29</td>
</tr>
</tbody>
</table>

<sup>a</sup> Read as one part (e.g., cup or glass) concentrated bleach to x parts water (e.g., JIK [0.5% solution]—mix 1 cup bleach with 6 cups water for a total of 7 cups).

<sup>b</sup> Use boiled water when preparing a 0.1% chlorine solution for HLD because tap water contains microscopic organic matter that inactivates chlorine.

<sup>c</sup> In some countries, the concentration of sodium hypochlorite is expressed in chlorometric degrees (°chlorum); one °chlorum is approximately equivalent to 0.3% available chlorine.

---

### Textbox 3. Formula for Making Dilute Chlorine Solution from Concentrated Solution

Check concentration (% concentrate) of the chlorine product you are using. Determine total parts water needed using Table 1 or the formula below.

\[
\text{Total Parts (TP) Water} = \left(\frac{\% \text{ Concentrate}}{\% \text{ Dilute}}\right) - 1
\]

Mix 1 part concentrated bleach with the total parts water required.

**Example:** Make a dilute solution (0.5%) from 5% concentrated solution.

**STEP 1:** Calculate TP water: \[
\frac{5.0\%}{0.5\%} - 1 = 10 - 1 = 9
\]

**STEP 2:** Take 1 part concentrated solution and add to 9 parts water.

---

<sup>2</sup> Adapted from: WHO 1989.
Table 2. Preparing Dilute Chlorine Solution from Dry Powder

<table>
<thead>
<tr>
<th>AVAILABLE CHLORINE REQUIRED</th>
<th>0.5%</th>
<th>0.1%*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium hypochlorite</td>
<td>7.1 g/L</td>
<td>1.4 g/L</td>
</tr>
<tr>
<td>(70% available chlorine)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium hypochlorite</td>
<td>14.2 g/L</td>
<td>2.8 g/L</td>
</tr>
<tr>
<td>(35% available chlorine)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NaDCC (60% available chlorine)</td>
<td>8.3 g/L</td>
<td>1.5 g/L</td>
</tr>
<tr>
<td>Chloramine tablets (1 g of available chlorine per tablet)</td>
<td>20 g/L (20 tablets/liter)&lt;sup&gt;g&lt;/sup&gt;</td>
<td>4 g/L (4 tablets/liter)&lt;sup&gt;g&lt;/sup&gt;</td>
</tr>
<tr>
<td>NaDCC-based tablets (1.5 g of available chlorine per tablet)</td>
<td>4 tablets/liter</td>
<td>1 tablet/liter</td>
</tr>
</tbody>
</table>

<sup>a</sup> Use boiled water when preparing a 0.1% chlorine solution for HLD because tap water contains microscopic organic matter that inactivates chlorine.

<sup>b</sup> For dry powders, read x grams per liter (example: Calcium hypochlorite—7.1 grams mixed with 1 liter water).

<sup>c</sup> Sodium dichloroisocyanurate

<sup>d</sup> Chloramine releases chlorine at a slower rate than does hypochlorite. Before using the solution, be sure the tablet is completely dissolved.

Textbox 4. Formula for Making Dilute Chlorine Solution from Dry Powder

Check concentration (% concentrate) of the powder you are using. Determine grams bleach needed using Table 2 or the formula below.

\[
\text{Grams/Liter} = \frac{\% \text{ Dilute}}{\% \text{ Concentrate}} \times 1000
\]

Mix measured amount of bleach powder with 1 liter of water.

**Example**: Make a dilute chlorine-releasing solution (0.5%) from a concentrated powder (35%).

**STEP 1**: Calculate grams/liter:

\[
\frac{0.5\%}{35\%} \times 1000 = 14.2 \text{ g/L}
\]

**STEP 2**: Add 14.2 grams (14 g) to 1 liter of water.

Choosing Appropriate Chemicals for HLD

The two most commonly used chemicals approved for use as high-level disinfectants are chlorine (0.1%) and glutaraldehyde (2%). The major advantages and disadvantages of these chemicals are presented in Table 3. Note that although alcohols and iodophors are disinfectants, they are no longer classified as high-level disinfectants. They should be used only when chlorine (0.1%) and glutaraldehyde (2%) are not available or appropriate.

---

<sup>3</sup> Adapted from: WHO 1989.
Table 3. Advantages and Disadvantages of Commonly Used Chemicals Approved for Use in HLD

<table>
<thead>
<tr>
<th>DISINFECTANT</th>
<th>ADVANTAGES</th>
<th>DISADVANTAGES AND OTHER CONSIDERATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorine solutions (0.1%)</td>
<td>● Fast-acting&lt;br&gt;● Very effective against HBV and HIV&lt;br&gt;● Inexpensive&lt;br&gt;● Readily available</td>
<td>● Concentrated chlorine solutions (≥ 0.5%) can discolor and corrode metals. However: Stainless steel instruments can be soaked safely in a 0.1% chlorine solution (using a plastic container) for up to 20 minutes. Discoloration is a problem only when calcium (not sodium) hypochlorite powders are used. (Wiping instruments with vinegar, which is weakly acidic, will quickly remove the discoloration.) Also, corrosion will not be a problem if items are rinsed with boiled water and dried promptly. Because chlorine solutions break down rapidly and can lose their effectiveness, fresh solutions should be made at least daily or more often if the solution is visibly cloudy.</td>
</tr>
<tr>
<td>Glutaraldehyde (2%)</td>
<td>● Can be used for HLD and sterilization</td>
<td>● Although less irritating than formaldehyde, glutaraldehyde should be used in well-ventilated areas following recommended precautions. Because glutaraldehyde leaves a residue, instruments must be rinsed thoroughly with boiled water three times after HLD to remove any residue and prevent skin irritation.</td>
</tr>
</tbody>
</table>

Storing Chemicals and Processing Chemical Containers

- Disinfectants should be stored in a cool, dark area. Never store chemicals in direct sunlight or in excessive heat (e.g., upper shelves in a tin-roofed building).
- Glass containers used for toxic substances (e.g., glutaraldehyde, formaldehyde) may be washed with soap and water, rinsed, dried, and reused. Alternatively, they should be thoroughly rinsed with water (at least three times) and disposed of by burying.
- Plastic containers used for toxic substances should be thoroughly rinsed (at least two times) with water, punctured (so that they can not be used to carry water or other liquids), and disposed of by burning or burial.

Preparing and Using Chemical Disinfectants

Information on preparing and using high-level disinfectants and disinfectants is provided in Table 4.
Table 4. Preparing and Using Chemical Disinfectants

<table>
<thead>
<tr>
<th>CHEMICALS FOR STERILIZATION AND/OR HIGH-LEVEL DISINFECTION</th>
<th>Disinfectant (common solution or brand)</th>
<th>Effective Concentration</th>
<th>How to Dilute</th>
<th>Skin Irritant</th>
<th>Eye Irritant</th>
<th>Respiratory Irritant</th>
<th>Corrosive</th>
<th>Leaves Residue</th>
<th>Time Needed for HLD</th>
<th>Time Needed for Sterilization</th>
<th>Activated Shelf Life*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorine</td>
<td>0.1%</td>
<td>Dilution procedures vary&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Yes (with prolonged contact)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Yes</td>
<td>Yes</td>
<td>20 minutes</td>
<td>Do not use</td>
<td>Change every 14 days, sooner if cloudy.</td>
</tr>
<tr>
<td>Glutaraldehyde (Cidex7)</td>
<td>Varies (2–4%)</td>
<td>Add activator</td>
<td>Yes (vapors)</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>20 minutes at 25°C&lt;sup&gt;c&lt;/sup&gt;</td>
<td>10 hours for Cidex</td>
<td>Change every 14–28 days, sooner if cloudy.</td>
</tr>
</tbody>
</table>

CHEMICALS FOR DISINFECTION (Note: alcohols and iodophors are not high-level disinfectants.)

| Alcohol (ethyl or isopropyl)                             | 60–90%                                 | Use full strength       | Yes (can dry skin) | Yes         | No          | No                  | No        | Do not use     | Do not use          | If container (bottle) kept closed, use until empty. |
| Iodophors (10% povidone-iodine [PVI])                    | Approximately 2.5%                    | 1 part 10% PVI to 3 parts water | No              | Yes         | No          | Yes                  | Yes       | Do not use     | Do not use          | If container (bottle) kept closed, use until empty. |

<sup>a</sup> All chemical disinfectants are heat- and light-sensitive and should be stored away from direct sunlight and in a cool place (< 40°C).

<sup>b</sup> See Tables 1 and 2 for instructions on preparing chlorine solutions.

<sup>c</sup> Corrosive with prolonged (> 20 minutes) contact at concentrations > 0.5% if not rinsed immediately with boiled water.

<sup>d</sup> Different commercial preparations of Cidex and other glutaraldehydes are effective at lower temperatures (20°C) and for longer activated shelf life. Always check manufacturers’ instructions.

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<sup>4</sup> Adapted from: Rutala 1996.
Infection Prevention Processes

REFERENCES


