INFECTION PREVENTION
for FAMILY PLANNING
SERVICE PROGRAMS

A PROBLEM-SOLVING REFERENCE MANUAL

authors
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Wendy Cronin
Noel McIntosh
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for FAMILY PLANNING
SERVICE PROGRAMS

A Problem-Solving Reference Manual


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Recognition of the importance of infection prevention in health care facilities led two of the authors (Linda Tietjen and Wendy Cronin), while working in Nepal with the Dooley Foundation/INTERMED, to assist their Nepalese counterparts write a small document, A Manual on Infection Control in Health Facilities. Originally produced in Nepali in 1984 by Ms. Rukmini Charan Shrestha, Chief of the Division of Nursing, members of her staff and consultants from the World Health Organization (WHO), this widely used manual subsequently was revised and published in English by WHO (SEARO Regional Health Papers No 18.) in 1988.

Since then, all three authors have continued to collect additional new information and field test infection prevention practices which are simple, practical and inexpensive to implement and which could form the basis for a new, more comprehensive manual. Along the way it became increasingly obvious that unless these infection prevention practices were incorporated into a uniform set of guidelines, which are universally accepted, then little progress could be made in improving infection prevention in many countries. Therefore, in seeking to make this new manual useful to as wide an audience as possible, the authors and JHPIEGO are deeply indebted to many people and organizations throughout the world who have contributed to it. In particular the authors wish to thank:

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- The more than 50 domestic and international technical experts that reviewed the manual and whose comments were incorporated into the final version at the Infection Prevention Guidelines Review Workshop held in Baltimore in June, 1991. At this meeting representatives from the Johns Hopkins University and more than 12 international organizations critically reviewed the revised manual, resolved many of the technical discrepancies among infection prevention materials currently being distributed by international agencies, and assessed the appropriateness of this manual as an international reference standard.

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JHPIEGO Corporation, March, 1992
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PREFACE

Where 20 years ago the most effective surgical contraceptive methods were male and female sterilization, the list has expanded to include the copper-releasing IUDs, injectables and now Norplant® implants. Additionally, more than ever before, these services are being provided in more remote and non-traditional settings. This expansion of services is key to keeping pace with the increased demand for services.

In the past, the primary focus of infection prevention (IP) in family planning programs was preventing serious postoperative infections when providing surgical contraceptive methods. Although serious postoperative infections still remain a problem in many countries, the emergence of AIDS (and continuing problems with hepatitis B and the more recently identified hepatitis C and D) has shifted the focus of IP dramatically. Attention must now be directed towards minimizing the risk of transmitting these diseases not only to clients but also to service providers and staff, including cleaning and housekeeping personnel. Thus, for the 1990’s and beyond, the goal of IP for family planning service programs must be two-fold: preventing infection and providing protection to both clients and staff.

Major constraints contributing to the lack of improvement in infection-related complications and deaths following surgical contraceptives procedures are:

* A persistent misconception that expensive, high-tech equipment and facilities are required to provide a safe environment to perform surgery.

* A mistaken belief that autoclaving instruments and equipment, regardless of whether or not the items have been properly decontaminated and cleaned, will make them safe.

* A failure to appreciate the importance of simple, inexpensive infection prevention practices such as handwashing and use of protective gloves to reduce the risk of transmitting serious diseases to clients and health care workers.

1 Throughout this manual, when hepatitis B (HBV) is mentioned, hepatitis C (HCV) and Delta hepatitis (HDV) also are referred to as their occurrence is worldwide and their modes of transmission/prevention are similar.
A failure to disseminate practical, accurate and consistent information about specific procedures for infection prevention which takes into account the resource constraints faced by most programs.

This manual addresses these issues. While intended for use in family planning service programs in developing countries, the infection prevention practices and data on which these guidelines are based, are universally applicable. Their primary objective is to enable administrators, clinic managers and health care professionals to develop uniform infection prevention guidelines for use in any type or size of family planning service program, regardless of its location. Moreover, the manual is designed to supply the essential infection prevention information in a simple, easily understandable format so that users can find what they want, when they need it.

The material in the manual is divided into three parts. In the first part, FUNDAMENTALS OF INFECTION PREVENTION, the basic principles and practices of modern infection prevention are briefly described. In addition, data supporting their use, relative importance and applicability in situations where resources and manpower are limited is documented. In the second part, INFECTION PREVENTION GUIDELINES, the essential components of preventing infection and disease transmission are outlined for each surgical contraceptive method currently provided worldwide. The emphasis in this section is on the use of infection prevention practices that are practical and easy-to-do. They are designed to minimize costs and the need for expensive technology and/or fragile equipment while at the same time assuring a high quality of safety (i.e., they incorporate use of readily available agents and appropriate technology). The third section, APPENDICES, is the "how to" section. Each appendix provides detailed instructions on how to prepare and/or use the recommended procedures as well as information regarding the advantages and disadvantages of each in given circumstances.
INTRODUCTION TO INFECTION PREVENTION

BACKGROUND

The material in this section provides essential information about the spread of infection and its prevention in family planning and health care facilities. Included are:

- definitions of key infection prevention terms to be used throughout the manual, and
- brief discussions of the disease transmission cycle and the purpose of infection prevention.

The primary objective of this section is to assist service providers and clinic managers in understanding the basic principles of preventing infection and disease transmission.

DEFINITIONS

Microorganisms are the causative agents of infection. They include bacteria, viruses, fungi and parasites. For infection prevention purposes, bacteria can be further divided into three categories: vegetative (staphylococcus), mycobacteria (tuberculosis), and endospores (gangrene and tetanus), which are the most difficult to kill due to their protective coating.

Infection prevention often relies on placing barriers between the host and microorganisms. Protective barriers are physical, mechanical or chemical processes which help prevent the spread of infectious microorganisms from client to client, clinic staff to client, or vice versa due to lack of infection prevention practices or from contaminated instruments or equipment.

The terms asepsis, antisepsis, decontamination, disinfection and sterilization often are confusing. For the purposes of these guidelines, the following definitions will be used:
Introduction

- **Asepsis** or **aseptic technique** are general terms used in health care settings to describe the combination of efforts made to prevent entry of microorganisms into any area of the body where they are likely to cause infection. The goal of asepsis is to reduce or eliminate the number of microorganisms on both animate (living) surfaces (skin and tissue) and inanimate objects (surgical instruments) to a safe level.

- **Antisepsis** is the prevention of infection by killing or inhibiting the growth of microorganisms on skin and other body tissues.

- **Decontamination** is the process that makes inanimate (non-living) objects safer to be handled by staff, especially cleaning personnel, before cleaning. Such objects include large surfaces (e.g., pelvic examination or operating tables) and surgical instruments and gloves contaminated with blood or body fluids during or following surgical procedures.

- **Cleaning** is the process that physically removes all visible blood, body fluids or any other foreign material such as dust or soil from skin or inanimate objects.

- **Disinfection** is the process that eliminates most, but not all, disease-causing microorganisms from inanimate objects. **High-level disinfection** (HLD), through boiling or the use of chemicals, eliminates all microorganisms except some bacterial endospores.

- **Sterilization** is the process that eliminates **all** microorganisms (bacteria, viruses, fungi and parasites), including bacterial endospores from inanimate objects.

**WHICH PROCESS TO USE**

As summarized in **Table 1-1**, **decontamination** is the first step in processing contaminated (soiled) surgical instruments, reusable gloves and other items. For example, brief soaking of contaminated items in 0.5% chlorine solution, or other locally available and approved disinfectant, rapidly kills hepatitis B and AIDS viruses; thereby making the instruments safer to be handled during cleaning (**Comm Disease Bulletin**, 1990 and **AORN**, 1990). Larger surfaces, such as examination and operating tables, laboratory bench tops and other equipment,
which may have come in contact with blood or other body fluids, also should be decontaminated. Wiping them down with a suitable disinfectant (e.g., 0.5% chlorine or 1-2% phenol) is a practical, inexpensive way to decontaminate these items.

Once the surgical instruments and other items have been decontaminated, they need to be further processed by cleaning and then either sterilization or high-level disinfection. As outlined in Table 1-1, which method (i.e., sterilization or high-level disinfection) is used depends on whether the instruments will touch only intact mucous membranes/broken skin or come in contact with the blood stream, tissue deep beneath the skin or tissue which normally is sterile.

**When is Sterilization Absolutely Essential? When Can High-level Disinfection (HLD) be an Acceptable Alternative?**

Most authorities recommend that instruments and other items used for surgical contraceptive procedures such as voluntary sterilization (minilaparotomy or vasectomy) or Norplant insertion and removal, should be sterile. Some guidelines, however, are more flexible and state that when sterilization equipment is not available, high-level disinfection (HLD) can be used. In fact, the sole use of sterilization is not possible or practical in many service delivery sites, not only in developing countries, but also in developed ones. For example, laparoscopes, which would be damaged if submitted to either autoclaving or dry heat sterilization, usually are processed between cases by HLD. Therefore, while sterilization, when correctly performed, is clearly the safest and most effective method for processing instruments, if it is neither available or suitable, then HLD is the only acceptable alternative. **Remember:** For both processes the post-procedural handling (decontamination) and preparatory steps (cleaning) for instruments and other items must be properly done.
**Introduction**


<table>
<thead>
<tr>
<th>How to make instruments/items safer to contact:</th>
<th>Appropriate Infection Prevention Process</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intact (unbroken) skin</td>
<td><strong>Decontamination</strong> destroys viruses (such as HBV and HIV), bacteria, fungi or parasites.</td>
<td>Contaminated instruments/gloves prior to cleaning; pelvic exam table or other surfaces contaminated by body fluids.</td>
</tr>
<tr>
<td><strong>Intact mucous membranes or broken skin</strong></td>
<td><strong>High-level disinfection</strong> (HLD) destroys all microorganisms except some endospores*. HLD should be preceded by decontamination and cleaning.</td>
<td>Uterine sounds, specula, IUDs (packed in bulk), IUD inserters: gloves for pelvic exams.</td>
</tr>
<tr>
<td>Blood vessels or tissue beneath the skin</td>
<td><strong>Sterilization</strong> destroys all microorganisms, including endospores. Sterilization should be preceded by decontamination and cleaning.</td>
<td>Surgical instruments such as needles and syringes, scalpels, trocars for Norplant®; reusable gloves for surgery.</td>
</tr>
</tbody>
</table>

* Bacterial endospores are forms of bacteria which are very difficult to kill because of their casing or coating; types of bacteria which can make endospores include the bacteria causing tetanus and gangrene (*Clostridia*). Bacterial endospores can only be reliably killed by sterilization.

Source: Table adapted from Spaulding, 1968.
Because HLD kills all microorganisms but does not reliably kill bacterial endospores, staff must be aware of this limitation if tetanus, an endospore produced by bacteria called Clostridia tetani, is a significant risk. Table 1-2 has been developed to assist service providers and managers in determining when sterilization is preferable to HLD in processing surgical instruments, reusable gloves and other items. In addition, as a further guide, throughout this manual frequent reference is made to the limitations of HLD (i.e., does not reliably kill endospores) against the risk to the client.

Table 1-2. Which Final Process to Use for Instruments, Reusable Gloves and Other Items

<table>
<thead>
<tr>
<th>Method</th>
<th>Sterilization</th>
<th>HLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>IUDs</td>
<td>Acceptable</td>
<td>Acceptable</td>
</tr>
<tr>
<td>Injectables</td>
<td>Preferable</td>
<td>Acceptable</td>
</tr>
<tr>
<td>Norplant</td>
<td>Preferable</td>
<td>Acceptable</td>
</tr>
<tr>
<td>Laparoscopy</td>
<td>Chemical sterilization preferable</td>
<td>Acceptable</td>
</tr>
<tr>
<td></td>
<td>(Heat sterilization not possible for laparoscopes)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Preferable for other instruments</td>
<td>Acceptable</td>
</tr>
<tr>
<td>Minilaparotomy</td>
<td>Preferable</td>
<td>Acceptable</td>
</tr>
<tr>
<td>Vasectomy</td>
<td>Preferable</td>
<td>Acceptable</td>
</tr>
</tbody>
</table>

THE DISEASE TRANSMISSION CYCLE

Microorganisms live everywhere in our environment. Humans normally carry them on their skin and in the upper respiratory, intestinal and genital tracts; these microorganisms are called normal flora. In addition, microorganisms live in animals, plants, the soil, air and water. Some microorganisms are more pathogenic than others, that is, they are more likely to cause disease. Given the right circumstances, however, all microorganisms may cause infection.
For bacteria, viruses and other infectious agents to successfully survive and spread within a community, certain factors or conditions must exist. The essential factors in the transmission of disease-producing microorganisms (pathogens) from person to person are illustrated and defined in **Figure 1-1** (APIC, 1983).

**Figure 1-2** depicts the steps in the transmission of the hepatitis B (HBV) and AIDS (HIV) viruses. Spread of these viruses from client to health worker can occur when workers (surgeon, nurse or cleaning staff) are exposed to the blood or body fluids of an infected person. An example of this would be a needlestick injury where the client’s infected blood is accidentally injected under the health worker’s skin.
Figure 1-1. The Disease Transmission Cycle

AGENT

Disease-producing microorganisms such as hepatitis B and AIDS viruses

SUSCEPTIBLE HOST

Person who can become infected

RESERVOIR

Place where the agent (microorganism) lives, such as in or on humans, animals, plants, the soil, air or water

PLACE OF ENTRY

Where the agent enters the next host (usually the same way as it left the old host)

PLACE OF EXIT

Where the agent leaves the reservoir (host)

METHOD OF TRANSMISSION

How the agent travels from place to place (or person to person)

Source: Adapted from WPRO/WHO, 1990
Introduction

Figure 1-2: Transmission of HBV and HIV from Clients to Family Planning Health Workers

HBV or HIV (agents)

Human body (reservoir)

Susceptible Host (health worker)

Blood, vaginal secretions or semen

Method of Transmission
(contact with contaminated or improperly decontaminated instruments)

To whom

Needlesticks, broken skin, cuts or splashes onto mucous membranes

How virus is spread from infected client
Understanding this process is important if health care workers are:

- to prevent the spread of infection from medical and surgical procedures,
- to teach others the factors required for transmission to occur, and most importantly,
- how to interrupt the process.

Studies in the United States have shown that the risk of disease after exposure to HBV from a needlestick injury ranges from 27 to 37% (Sceff, 1978), while the risk following a single needlestick exposure to HIV is much lower, 0.4% (Gerberding, 1990). The rate of transmission of HIV is considerably lower than for HBV, probably because of the lower concentration of virus in the blood of HIV-infected persons.

The efficiency for transmission of hepatitis B is high. Accidental splash into the eye of as little as $10^{-4}$ ml (0.00000001 ml) of infected blood can transmit HBV to a susceptible host (Bond et al, 1982).

Nearly all cases of transmission of hepatitis B and AIDS to health workers which have been associated with surgical procedures have occurred through preventable accidents such as puncture wounds. However, transmission also can occur through mucous membrane contact, such as a splash of body fluids in the health worker's eye or nose. Also, non-intact skin can be a point of hepatitis B or AIDS virus entry due to dermatitis, acne or chapped skin, for example, when blood splashes onto broken skin (e.g., an unhealed cut or scratch). While the infection risk for HBV and HIV is much lower via mucocutaneous contact, splashes of blood onto mucous membranes should be avoided. If splashing is anticipated, protective apparel such as eye shields, if available, is recommended. This is important because large mucous membrane exposures and prolonged skin contact may be associated with a higher risk of becoming infected (Comm. Disease Bulletin, 1990).
Because it may not be possible to know in advance whether or not a client may be infected with hepatitis B or AIDS, contaminated instruments, needles, syringes and other items from all clients must be handled as if infected.

Client-to-client spread of infectious diseases can occur in the health care setting through use of contaminated surgical instruments, needles, syringes and other equipment which has not been properly decontaminated, cleaned and either sterilized or high-level disinfected between use. Measures which protect clients from serious infection from contaminated instruments or equipment can be implemented and are fully described in subsequent sections. (See Chapters 4 - 7 for details.)

THE PURPOSE OF INFECTION PREVENTION

The primary purpose of infection prevention in family planning and health care facilities, whether free-standing or mobile, is two-fold: to minimize infections due to microorganisms causing serious wound infections, abdominal or scrotal abscesses, pelvic inflammatory disease, gangrene and tetanus; and to prevent the transmission of serious, life-threatening diseases such as hepatitis B and AIDS.

Preventing the spread of infections in family planning and health care facilities can only occur if the disease transmission cycle is broken at some point.

Protective Barriers

Placing a physical, mechanical or chemical "barrier" between microorganisms and an individual, whether a client or health worker, is an effective means of preventing the spread of disease (i.e., the barrier serves to break the disease
transmission cycle). Protective barriers in infection prevention include:

- handwashing;
- wearing gloves, either for surgery or to protect clinic staff when handling contaminated waste materials or used (soiled) instruments;
- using antiseptic solutions for cleaning wounds or preparing the skin prior to surgery; and
- decontaminating, cleaning and sterilizing or high-level disinfecting surgical instruments, reusable gloves and other items.

The protective barriers described in the following sections of this manual are designed to prevent the spread of infection from:

- person to person; and/or
- equipment, instruments and environmental surfaces to people.
REFERENCES


TWO

HANDWASHING AND GLOVING

BACKGROUND

Handwashing and the use of protective gloves, whether in the operating room for surgery or in housekeeping to handle contaminated materials, are key components in minimizing the spread of disease and in maintaining an infection-free environment. Understanding when expensive single use (disposable) or reusable sterile gloves are required and, equally important, when they are not, can reduce costs while maintaining safety for both clients and staff.

HANDWASHING

Handwashing may be the single most important infection prevention procedure.

The microbial flora of the skin consists of both transient and resident microorganisms. Some microorganisms on the skin are acquired through contact with persons or items during the course of the normal work day. These organisms are termed transient flora, and are readily removed by mechanical friction or by washing with plain soap or detergent. Resident flora live on the skin as well as within hair follicles and cannot be completely removed, even by vigorous rubbing and rinsing. In situations where it is desirable to minimize the total number of transient and resident microorganisms on the surface of the hands (for example, during surgical procedures), use of a handwashing product containing an antimicrobial ingredient and/or wearing gloves is necessary.

Absolute indications for handwashing are not really known due to the lack of controlled studies concerning handwashing and its effects on infection prevention. The following guidelines may be helpful in determining when handwashing is considered necessary.

1 Source: Adapted from Garner and Favero, 1986.
Handwashing and Gloving

Handwashing is indicated before:

- examining (direct contact with) a client, and
- putting on sterile or high-level disinfected gloves for surgical procedures.

Handwashing is indicated after:

- any situation in which hands may be contaminated, such as:
  - handling objects, including used (soiled) instruments;
  - touching mucous membranes, blood and body fluids (secretions or excretions); and
- removing gloves.

Wash hands after removing gloves because gloves may have invisible holes or tears.

To encourage handwashing, program managers should make every effort to provide a continuous supply of fresh water, either from the tap or a bucket, and soap.

For most activities, a brief handwashing with plain or antimicrobial soap for about 15 to 30 seconds followed by rinsing in a stream of water is sufficient.

Microorganisms grow and multiply in moisture and in standing water; therefore:

- If bar soap is used, provide small bars and soap racks which drain.
- Avoid dipping hands repeatedly into basins containing standing water, even with the addition of an antiseptic agent, such as Dettol® or Savlon®, because microorganisms may survive and multiply in these solutions.
- Choose from several options when no running water is available:
Handwashing and Gloving

- use a bucket with a tap which can be turned off to lather hands and turned on again for rinsing, or a bucket and pitcher; or

- an antiseptic handrub which does not require water. (See Chapter 3 for how to prepare and use.)

Dry hands with a clean towel or air dry. Shared towels readily become contaminated.

Collect used water in a basin and discard in the latrine if a drain is not available.

Surgical Handwashing or Scrub with an Antimicrobial Soap

See Chapter 3 and Appendix B for instructions on how to perform a surgical handscrub with antimicrobial soap.

GLOVES

When to Wear Gloves

As a precaution, gloves should be worn by all staff prior to contact with blood and body fluids from any client. A separate pair of gloves must be used for each client to avoid cross-contamination. Using new, single-use (disposable) gloves is preferable. However, gloves can be washed and sterilized by autoclaving, or washed and high-level disinfected by boiling before reuse. Gloves may be made of latex, natural materials or synthetic materials such as vinyl. The advantages and disadvantages of different types of gloves are described in Table 2-1.

It is best to buy good quality gloves. They last longer and are less likely to have invisible holes and tears from routine use. Vinyl exam gloves tend to leak more frequently than latex after a single use (Korniewicz, 1989), but are an acceptable alternative when latex gloves are not available.

15
### Table 2-1. Advantages and Disadvantages of Different Types of Gloves

<table>
<thead>
<tr>
<th>Type of Glove</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sterile Surgical Gloves</strong>1:</td>
<td>Gloves are sized to fit, permitting dexterity during surgical procedures.</td>
<td>Expensive; do not use for tasks where other types of gloves can be worn.</td>
</tr>
<tr>
<td>Use for all procedures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>involving contact with tissue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>beneath the skin (e.g.,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>minilap or Norplant insertion)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Examination Gloves</strong>:</td>
<td>Inexpensive; exam gloves are one-quarter to one-third the cost of disposable surgical gloves.</td>
<td>Usually only small, medium and large sizes; not available in every country. When exam gloves are not available, latex surgical gloves may be washed and boiled for patient care tasks requiring exam gloves.</td>
</tr>
<tr>
<td>Use new exam gloves for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>contact with mucous membranes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>and non-intact skin (e.g.,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IUD insertion and removal).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single-use (disposable) exam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gloves are commonly available.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(If gloves are reusable they</td>
<td></td>
<td></td>
</tr>
<tr>
<td>should be decontaminated,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cleaned and either sterilized</td>
<td></td>
<td></td>
</tr>
<tr>
<td>or HLD before being used.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>**Utility or heavy-duty</td>
<td>• Inexpensive</td>
<td>Not available in every country. When not available, washed latex gloves or plastic bags can be used, since there is no patient contact.</td>
</tr>
<tr>
<td>household gloves**:</td>
<td>• Can be rewashed and reused many times</td>
<td></td>
</tr>
<tr>
<td>Use utility gloves when</td>
<td>• The thick rubber surface helps to protect cleaners and waste handlers</td>
<td></td>
</tr>
<tr>
<td>handling used equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>which may be contaminated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>with blood or body fluids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>and for handling waste and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>linens.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 If single-use (disposable) surgical gloves are reused, they should not be reprocessed more than three times because invisible tears may occur (Bagg 1990, Martin 1988). Depending on the situation, the cost of reprocessing and using these gloves three times may be more than the cost of using new gloves. (See Appendix A for steps in reprocessing gloves.)
Which Gloves to Use

- **High-level disinfected** (single-use or reusable) gloves are acceptable when performing medical procedures such as pelvic exams, inserting or removing IUDs, or touching wounds or open sores.

- **Sterile** gloves should be used when performing surgical procedures, such as minilaparotomy or insertion and removal of Norplant® implants. When sterilization facilities are not available, gloves can be high-level disinfected by boiling. **Remember**: Boiling for 90 minutes or more does not reliably kill all bacterial endospores.

- **Clean, thick household** (utility) gloves can be used for cleaning instruments and equipment, as well as contaminated surfaces.

Do not use gloves which are cracked, peeling or have detectable holes or tears.

The steps for processing reusable gloves are outlined in Appendix A.

Listed in Table 2-2 are common procedures in family planning settings which may require the use of protective gloves and how they should be processed prior to use. For the majority of procedures, clean high-level disinfected (HLD) gloves are adequate. (See Chapters 5, 6 and 7 for discussion.)
Table 2-2. Glove Requirements for Medical and Surgical Procedures

<table>
<thead>
<tr>
<th>Task or Activity</th>
<th>Gloves Needed</th>
<th>High-Level Disinfected Gloves</th>
<th>Sterile Gloves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring blood pressure</td>
<td>no</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measuring temperature</td>
<td>no</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Giving an injection</td>
<td>no</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pelvic examination</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Contact with vaginal secretions</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>IUD insertion, when loaded in the sterile package²</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>IUD insertion (IUD supplied non-sterile, bulk-disinfected)</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>IUD removal</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Norplant insertion and removal</td>
<td>yes</td>
<td>acceptable³</td>
<td>preferable</td>
</tr>
<tr>
<td>Surgery (minilaparotomy, laparoscopy, vasectomy)</td>
<td>yes</td>
<td>acceptable³</td>
<td>preferable</td>
</tr>
<tr>
<td>Emergency childbirth</td>
<td>yes</td>
<td>acceptable³</td>
<td>preferable</td>
</tr>
<tr>
<td>Blood drawing</td>
<td>yes</td>
<td>yes⁴</td>
<td>no</td>
</tr>
<tr>
<td>Oral/nasal suctioning, manually cleaning airway</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Handling and cleaning instruments with microbial contamination</td>
<td>yes⁵</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Handling contaminated waste</td>
<td>yes⁵</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Cleaning blood or body fluid spills</td>
<td>yes⁵</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>

1 This includes "never used" individual or bulk-packaged gloves.
2 Loading an IUD in the sterile package is the recommended procedure.
3 When sterilization equipment (autoclave) is not available, HLD is the only acceptable alternative.
4 When blood is being drawn from several people, gloves do not need to be changed between clients; and it is not necessary for gloves to be routinely worn by experienced phlebotomists.
5 Thick household (utility) gloves are most practical when performing these tasks.

Table adapted from: CDC, 1989 and DHHS, 1988.
MINIMIZING BLOOD-HAND CONTAMINATION

A recent report by Tokars et al (1992) found that surgeons wearing two pairs of new, sterile gloves (i.e., double-gloving) have approximately 70% fewer blood-hand contacts than those wearing a single pair of gloves. During this study, nearly 1400 major surgical procedures were observed. Visible glove perforation was present in 53% of 620 blood-hand contacts (defined as "...patient’s blood visible on the health care worker’s hands") and in 26%, glove perforation apparently occurred but was not visible. In 2% of the cases, blood soaked through a gown and dripped onto an intact glove. Surgeons wearing single gloves had a blood-hand contact rate of 14%; while surgeons wearing double gloves had a rate of 5%.

On the basis of this study, reasonable guidelines for when to double glove would be:

- If the procedure is long (more than 60 minutes) and/or requires operating in a small space where the possibility of glove tears or perforations by sharps (needles, scissors and dissecting forceps) is increased

- If the procedure involves coming in contact with large amounts of blood or other body fluids (e.g., obstetrical deliveries and caesarean sections)

- If single-use gloves are reused. (The possibility of perforations in any type of reprocessed glove is high.)

In general, for surgical contraceptive procedures which are short (20 minutes or less) and involve minimal exposure to blood or mucous secretions (e.g., IUD insertion or removal or minilaparotomy), double gloving probably is not necessary. In areas where the risk of hepatitis B and HIV are high (i.e., 10% or more of clients are seropositive for HIV) and gloves are reused, the decision as to whether or not the surgeon, assistant and/or OR nurse should double glove needs to be considered.
Handwashing and Gloving

REFERENCES


THREE

ANTISEPSIS

BACKGROUND

Infection following procedures, such as IUD or Norplant insertion, may be caused by microflora from the skin (or vagina) of the client or the hands of the health care worker. Washing hands and cleaning the client's skin (or vagina) with an antiseptic solution are important infection prevention measures. For example, pelvic infection following IUD insertion is very uncommon, provided the clinician has carefully prepped the vagina and cervix with an antiseptic solution and uses the "no touch" insertion technique.

While plain soap physically removes transient microorganisms from the skin, antiseptic solutions kill or inhibit many resident microorganisms, including most vegetative bacteria and many viruses. Antiseptics are designed to remove as many microorganisms as possible without damaging or irritating the skin or mucous membrane on which they are used. Some antiseptic solutions have residual effect, meaning their killing action continues for a period of time after they have been applied to the skin or mucous membrane.

SELECTION OF ANTISEPTICS

Antiseptics usually do not have the same killing power as chemicals used for disinfection of inanimate objects. Thus, with the exception of iodine and alcohol, which are also disinfectants (see Appendix F), antiseptic solutions should never be used to disinfect inanimate (non-living) objects such as instruments and reusable gloves.

Many chemicals qualify as safe skin antiseptics. Table 3-1 lists several recommended antiseptic solutions, their killing actions, advantages and disadvantages. Additional information on how to prepare and use antiseptics is presented in Appendix C.

USE OF ANTISEPTICS

No definitive studies have proven that routine handwashing with antimicrobial soaps reduces the risk of infections when compared to plain soap. In addition,
Antiseptics

Antimicrobial soaps are costly. Generally speaking, antiseptic solutions should be reserved for certain situations, such as:

- Surgical scrub and/or skin or vaginal preparation for procedures such as minilaparotomy, laparoscopy, vasectomy, Norplant® insertion and removal, IUD insertion and injections
- Handwashing prior to touching clients who are unusually susceptible to infection such as newborns or immunosuppressed persons

Handwashing with Antimicrobial Soaps

The process for handwashing with antimicrobial soaps is the same as that for routine handwashing. For most activities, a brief but vigorous rubbing together of all surfaces of hands lathered with plain or antimicrobial soap for 15 to 30 seconds followed by rinsing in a stream of water is sufficient.

Surgical Handscrub

During surgical procedures such as minilaparotomy or vasectomy, sterile or high-level disinfected gloves must be worn. Applying an antiseptic surgical handscrub prior to putting on gloves minimizes the number of microorganisms on hands under the gloves. (Instructions for how to do a surgical handscrub are outlined in Appendix B.) This is important because gloves may have invisible holes or tears, or may be nicked during surgery.

A three-to-five-minute handscrub with a solution containing chlorhexidine or an iodophor is recommended. (Chlorhexidine has been shown to be less irritating than iodophors.) Alternatively, surgical staff can wash hands with plain soap, then apply alcohol solution containing an emollient and rub until dry (Larson, 1988, Pereira, 1990). See below for directions on how to make an alcohol solution for surgical scrub.
<table>
<thead>
<tr>
<th>Group</th>
<th>Gram Positive</th>
<th>Most Gram Negative</th>
<th>Tb</th>
<th>Viruses</th>
<th>Fungi</th>
<th>Endospores</th>
<th>Relative Speed of Action</th>
<th>Affected by Organic Matter</th>
<th>Surgical Scrub</th>
<th>Skin Preparation</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohols (60-90% ethyl or isopropyl)</td>
<td>Very good</td>
<td>Very good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>None</td>
<td>Fast</td>
<td>Data varies</td>
<td>Yes</td>
<td>Yes</td>
<td>Not for use on mucous membranes</td>
</tr>
<tr>
<td>Chlorhexidine¹ (4%) (Hibitane, Hibiscrub)</td>
<td>Very good</td>
<td>Good</td>
<td>Poor</td>
<td>Fair</td>
<td>Fair</td>
<td>None</td>
<td>Slow</td>
<td>Slight</td>
<td>Yes</td>
<td>Yes</td>
<td>Has good persistent effect</td>
</tr>
<tr>
<td>Hexachlorophene (3%) (pHiscHex)</td>
<td>Good</td>
<td>Poor</td>
<td>None</td>
<td>Fair</td>
<td>Poor</td>
<td>None</td>
<td>Slow</td>
<td>Slight</td>
<td>Yes</td>
<td>No</td>
<td>Rebound growth of bacteria may occur</td>
</tr>
<tr>
<td>Iodine preparations (3%) Iodine and alcohol (tincture of iodine)</td>
<td>Very good</td>
<td>Very good</td>
<td>Good</td>
<td>Good</td>
<td>Poor</td>
<td>Intermediate</td>
<td>Slight</td>
<td>No</td>
<td>Yes</td>
<td>Not for use on mucous membranes</td>
<td></td>
</tr>
<tr>
<td>Iodophors (1:2,500) (Betadine)</td>
<td>Very good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>None</td>
<td>Slow</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Can be used on mucous membranes</td>
</tr>
</tbody>
</table>

¹Note: Savlon, which contains chlorhexidine, is not listed because the concentration of chlorhexidine varies from country to country from as little as 1% to 4%.

Alcohol Solution for Surgical Scrub

A non-irritating alcohol solution for surgical scrub can be made by adding either glycerine, propylene glycol or Sorbitol® to the alcohol (2 ml in 100 ml 60-90% alcohol solution) (Pierce, 1990). Use 3 to 5 ml for each application and continue rubbing the solution over the hands for about 2 minutes, using a total of 6 to 10 ml per scrub (Larson et al, 1990 and Rotter, 1980).

Note: Skin damage caused by allergic reactions provides an ideal place for microorganisms to multiply and should be avoided. Personnel with allergies to antiseptics or detergents may use plain soap followed by an alcohol rub.

Client Skin Preparation Prior to Surgical Procedures

While skin cannot be sterilized, skin preparation with antiseptic solutions minimizes the number of microorganisms on the client's skin that may contaminate the surgical wound and cause infection. Antiseptics should be used for skin preparation prior to injections, surgical procedures (e.g., minilaparotomy, laparoscopy, vasectomy and Norplant insertion and removal), and for vaginal preparation prior to IUD insertion or removal.

Steps for Skin and Mucous Membrane Preparation Prior to Surgical Procedures or IUD Insertion

STEP 1. Do not remove hair from the operative site unless absolutely necessary. If hair removal must be done, trim the hair close to the skin surface immediately before surgery. Shaving increases the risk of wound infection as the tiny nicks in the skin provide an ideal setting for microorganisms to grow and multiply. (Cruse, 1980)

STEP 2. Ask the client about allergic reactions (e.g., to iodine preparations) before selecting an antiseptic solution.

STEP 3. If visibly soiled, thoroughly clean the client's skin or external genital area with soap and water before applying an antiseptic.
STEP 4. Apply antiseptic. Select the antiseptic solution from the following recommended solutions or other locally available and approved products:

- chlorhexidine (e.g., Hibitane®, Hibiclens®)
- chlorhexidine/cetrimide (e.g., Savlon®)
- iodine (1-3%) followed by 60-90% alcohol (not for use on mucous membranes such as the vagina)
- iodophor (e.g., Betadine®)
- 60-90% isopropl, ethyl alcohol or "methylated spirit" (not for use on mucous membranes such as the vagina)
- alcohol based solutions (tinctures) of iodine or chlorhexidine (not for use on mucous membranes such as the vagina)

STEP 5. Using dry, disinfected forceps and cotton soaked in antiseptic, thoroughly cleanse the skin by gently scrubbing. Work from the operative site outward for several inches. (A circular motion from the center out helps to prevent recontamination of the operative site with local skin bacteria.)

STEP 6. Do not allow the antiseptic to pool underneath the client's body. (This step reduces skin irritation.)

STEP 7. Allow the antiseptic to dry before beginning the procedure. (When iodophors are used, allow 1 - 2 minutes, before proceeding. As described in Appendix C, iodophors require up to two minutes contact time to release free iodine.)

For vaginal and cervical preps prior to inserting a uterine elevator for minilaparotomy or IUD insertion or removal, select an aqueous (water-based) antiseptic, such as an iodophor or chlorhexidine gluconate (e.g., Hibiclens® or Savlon®). Do not use alcohols. Alcohols burn; they also dry and irritate mucous membranes, which in turn, promote the growth of microorganisms. Follow STEPS 1-3 above, then:

STEP 4. After inserting the speculum, apply antiseptic solution liberally to the vagina and cervix (2 or 3 times). (It is not necessary to prep the external genital area if it appears clean. If heavily
Antiseptic

soiled, it is better to have the client wash the genital area thoroughly with soap and water before starting the procedure.

STEP 5. If iodophors are used, allow time (1-2 minutes) before proceeding. (As described in Appendix C, iodophors require up to two minutes contact time to release free iodine.)

Skin Preparation for Injections

Skin preparation is done before injections (e.g., injectable contraceptives such as Depo Provera®) to remove as many microorganisms as possible from the client’s skin in order to prevent abscess at the injection site.

Steps for skin preparation prior to injection

STEP 1. Cleanse skin with 60 - 90% ethyl or isopropyl alcohol. (Be careful to remove all visible soil from the proposed injection site before prepping.)

STEP 2. With a fresh cotton swab and alcohol solution, wipe the injection site thoroughly using a circular, overlapping motion starting at the center.

STEP 3. Allow to dry before giving the injection.

STORAGE AND DISPENSING OF ANTISEPTICS

Contamination of every antiseptic has been documented. Microorganisms contaminating antiseptic solutions include staphylococcus, Gram-negative bacilli and some endospores. These organisms can cause subsequent infection when used for handwashing or on a client’s skin. Contamination of antiseptic solutions can be prevented by the following:

- Unless supplied commercially in small quantities, antiseptics should be prepared in a small, reusable container for daily use. Do not store gauze or cotton wool in aqueous antiseptics as this promotes contamination.
Antisepsis

- If antiseptics are supplied in large containers, pour a small amount into the reusable container for daily use. (This prevents evaporation and contamination.)

- Establish a routine schedule (e.g., each week) for preparing new solutions and cleaning reusable containers. (Solutions are at increased risk of becoming contaminated after one week's storage.)

- **Wash** the reusable container thoroughly with soap and water and **dry** before refilling.

- Label reusable containers with the date each time they are washed, dried and refilled.

- Antiseptics 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).

- When using antiseptic solutions, **always pour** the solution out of the container. (Touching the rim or contents of the container with gauze, cotton swab or hand contaminates the entire bottle of antiseptic.)
REFERENCES


FOUR

PROCESSING INSTRUMENTS, GLOVES
AND OTHER ITEMS

BACKGROUND

The basic infection prevention processes should be used to prevent disease transmission from contaminated instruments, gloves and other items are:

- waste disposal and decontamination,
- cleaning and rinsing, and
- sterilization, or
- high-level disinfection.

PROCESSING USED (SOILED) INSTRUMENTS, GLOVES AND OTHER ITEMS

In working to create an infection-free environment it is important that the rationale for each of the recommended infection prevention processes (and their limitations) be clearly understood by clinic staff at all levels - from service providers to cleaning and maintenance staff.

Regardless of the medical or surgical procedure, whether a minilaparotomy or a pelvic examination, the infection prevention process is the same. The infection prevention sequence is illustrated in Figure 4-1. After completing the procedure, and while still wearing gloves, the physician or assistant should properly dispose of contaminated objects (gauze, cotton and other waste items) in a leak-proof container or bag. Do not allow waste to touch the outside of the container or bag. Next, all surgical instruments and reusable needles, syringes and gloves which may have come in contact with blood or body fluids should be decontaminated by soaking for 10 minutes in a disinfectant (0.5% chlorine solution) immediately after use. Surfaces such as examination tables that may have been contaminated by body fluids should also be decontaminated before reuse. Third, instruments and reusable gloves should be thoroughly cleaned with detergent and water and completely rinsed before further treatment. Fourth, whenever possible, instruments and reusable items such as gloves, needles, and
syringes which come in contact with the blood stream or touch tissue beneath the skin, should be sterilized to destroy all microorganisms (including bacterial endospores). When sterilization is not feasible or equipment available, high-level disinfection (HLD) by boiling or soaking in high-level disinfectants is the only acceptable alternative. Because boiling, even for prolonged periods (as long as 90 minutes) or soaking for 20 minutes in a high-level disinfectant does not reliably destroy endospores, staff must be aware of the limitations of HLD (Spaulding, 1939).

Decontamination

Decontamination is the first step in handling used (soiled) surgical instruments and gloves. Decontamination is important for pre-treating instruments and objects that may have come in contact with body fluids. Immediately after use, items should be placed in 0.5% chlorine solution for 10 minutes (see Table 5-1) which rapidly inactivates hepatitis B and AIDS viruses. Decontamination makes items safer to handle by personnel who clean them. (AORN, 1990 and ASHCSP 1986).

After decontamination, instruments should be rinsed immediately with cool water to prevent corrosion and to remove visible organic material before being thoroughly cleaned. Personnel should wear gloves while handling soiled instruments; inexpensive rubber or household (utility) gloves work well for this.

Note: If stainless steel instruments are electroplated and a metal container is used for soaking (even if only in water), a chemical reaction can occur. This reaction will accelerate corrosion of the instruments.

Surfaces especially pelvic examination or operating tables which may have come in contact with body fluids also should be decontaminated. Wiping with a suitable disinfectant such as 0.5% chlorine solution before reuse, when visibly contaminated or at least daily, is an easy-to-do, inexpensive way to decontaminate large surfaces.
Figure 4-1: Processing Instruments, Gloves and Other Items

DECONTAMINATION

Soak in 0.5% chlorine solution
10 minutes

THOROUGHLY WASH AND RINSE

Wear gloves, guard against injury from sharp objects

Preferred Methods

Acceptable Methods

STERILIZATION

HIGH-LEVEL DISINFECTION (HLD)

Autoclave
106 kPa pressure
(15 lbs./in²)
121°C (250°F)
20 min. unwrapped
30 min. wrapped

Dry Heat
170°C
60 minutes

Boil
Lid on
20 minutes

Chemical
Soak
20 minutes

COOL Ready for Use*

* Wrapped sterile packs can be stored for up to one week. Unwrapped items should be stored in a sterile or HLD container with a tight fitting lid or used immediately.
Once instruments and other items have been decontaminated, they can safely be further processed. This further processing consists of cleaning and finally either sterilization or high-level disinfection.

Detailed instructions on how to decontaminate instruments, reusable gloves and other items is provided in Chapter 5.

Cleaning

Cleaning is a crucial step in providing safe, infection-free equipment and instruments. A thorough cleaning with detergent and water physically removes organic material such as blood and secretions. Dried organic material can entrap microorganisms in a residue that protects them against sterilization or chemical disinfection. Organic matter also can partially inactivate disinfectants, rendering them less effective (Porter, 1987).

Instruments should be cleaned with a brush (old toothbrushes work well) in soapy water. Particular attention should be paid to instruments with teeth, joints or screws where organic material can collect. (Because chlorine breaks down protein, decontaminating first by soaking in chlorine solution makes cleaning easier.) After cleaning, instruments should be thoroughly rinsed with water to remove detergent residue which can interfere with chemical disinfection.

Detailed instructions on how to clean instruments, reusable gloves and other items is provided in Chapter 5.

Sterilization

Whenever possible, instruments and other items that come in direct contact with the blood stream or tissues under the skin, such as reusable needles, syringes and scalpels, should be sterilized after first being decontaminated and thoroughly cleaned, rinsed and dried. The sterilization process ensures that all microorganisms, including bacterial endospores, are destroyed. Bacterial endospores are particularly difficult to kill because of their tough coating. Bacteria that form endospores include Clostridia species, which cause tetanus and gangrene.
Heat Sterilization. High-pressure saturated steam (autoclaving) or dry heat (electric oven) are the most readily available methods used for sterilization. Steam sterilization is generally the method of choice for sterilizing instruments and other items used in family planning and health care facilities. Where electricity is a problem, instruments can be sterilized in a non-electric steam autoclave using kerosene as a heat source.

When instruments and equipment are steam-sterilized, it is essential that steam reach all surfaces; autoclaving closed containers will sterilize only the outside of the containers.

Dry heat sterilizers are good in humid climates but need a constant supply of electricity, making them impractical in many remote (rural) areas. Furthermore, dry heat sterilization can be used only with glass or metal objects - other substances will melt or incinerate.

Sterile instruments generally should be used immediately unless they have been wrapped in a double layer of muslin, paper or other appropriate material prior to steam sterilization. The material must be porous enough to let steam through but tightly woven enough to protect against dust particles and microorganisms. Wrapped sterile instruments have a shelf life of up to one week, but only if kept dry and intact (Perkins, 1983). Placing a wrapped pack in a sealed plastic bag will increase its shelf life to a month. All packs should be labeled with an expiration date.

Chemical Sterilization. An alternative to steam or dry heat sterilization is chemical sterilization (often called cold sterilization) by soaking for 8 to 10 hours in a glutaraldehyde or at least 24 hours in an 8% formaldehyde solution. Glutaraldehydes (e.g., Cidex®) often are in short supply and expensive, but they are the only practical sterilants usable for instruments, such as laparoscopes, which cannot be heated. Also, formaldehyde and glutaraldehyde require special handling and leave a residue on treated instruments; therefore, rinsing with sterile water after use of the chemicals is essential. (Using boiled water, since it does not reliably inactivate endospores, can recontaminate sterile instruments.)
Processing Instruments, Gloves & Other Items

Although formaldehyde is less expensive than glutaraldehyde, it is more toxic. The vapors of both chemicals are irritating to the skin, eyes and respiratory tract (see Table 7-1). When using either formaldehyde or glutaraldehyde, gloves should be used, exposure time limited and both chemicals used only in a well-ventilated area (Clark, 1985).

Detailed information on sterilization procedures - steam, dry heat and chemical - is presented in Chapter 6.

High-Level Disinfection

Sterilization is the safest and most effective method for processing instruments which come in contact with the blood stream, tissue beneath the skin or tissues which are normally sterile. When sterilization equipment is either not available or not suitable, high-level disinfection (HLD) is the only acceptable alternative. HLD destroys all microorganisms, including viruses causing hepatitis B and AIDS, but does not reliably kill all bacterial endospores. For example, in family planning facilities, either sterilization or HLD are acceptable for processing instruments and gloves used for pelvic exams and IUD insertion and removal, since problems with endospores have not been reported with IUD use.

HLD can be achieved through boiling in water or soaking instruments in chemical disinfectants such as a glutaraldehyde (e.g., Cidex® or Sporicidin®) or 8% formaldehyde. Because boiling requires only inexpensive equipment, which usually is readily available, it is the preferred method for small clinics or those located in remote areas. Regardless of the method selected, however, HLD can only be effective when used (soiled) instruments and gloves are first decontaminated, thoroughly cleaned and rinsed before disinfection. The whole process must be monitored regularly.

High-Level Disinfection by Boiling. For HLD by boiling, boil instruments for 20 minutes. Timing should begin when the water is at a rolling boil, all instruments should be totally submerged and nothing should be added to the container after boiling begins.

Unless the altitude of the health care facility is over 5,500 meters (18,000 feet) it is not necessary to increase the boiling time (Favero, 1985). Moist heat at 80°C kills essentially all bacteria, viruses, parasites and fungi in 20 minutes.
Boiling Tips

- Start timing when the water begins to boil.
- Always boil for 20 minutes in a pot with a lid.
- Items must be completely covered with water during boiling.
- Do not add anything to the pot after boiling begins.
- Air dry before use or storage.

Chemical Disinfection. A variety of chemical disinfectants are available worldwide which include:

- Ethyl or isopropyl alcohol
- Chlorine
- Formaldehyde (Formalin)
- Glutaraldehyde
- Hydrogen peroxide
- Iodine and iodophors

Although alcohols, iodine and iodophors are inexpensive and readily available, they are no longer classified as HLDs. (Alcohols do not kill some viruses, and Pseudomonas species, a group of Gram-negative bacteria, have been known to multiply in iodophors.) They should be used for disinfection only when HLDs are not available.

Endoscopes (laparoscopes) and other instruments that would be damaged by heat can safely undergo HLD using chemical disinfectants such as gluteraldehydes and formaldehyde. (For HLD, completely immerse the instrument in the disinfectant for 20 minutes and then rinse well with boiled water).
Because both glutaraldehyde and formaldehyde (formalin) solutions leave a residue, instruments must be rinsed well using boiled water after disinfecting with these solutions to prevent skin irritation and remove residue.

The exact steps for performing HLD by boiling or using chemicals are described in Chapter 7. In addition, detailed information and instructions for preparing and using chemical disinfectants (advantages and disadvantages), are presented in Appendix F.

WHICH PROCESS TO CHOOSE

Each item, whether a surgical instrument or pair of gloves, requires special handling in order to minimize the transmission of microorganisms from person to person. Table 4-1 describes the recommended steps for processing instruments, equipment and other items used to provide family planning and other health care services (e.g., immunization). The first column lists the specific item(s) to be processed. The next two columns describe how to decontaminate and clean each item. Finally, the last two columns describe the conditions for how to HLD or sterilize the item(s).

Remember: Proper decontamination and thorough cleaning are the most important processes in rendering instruments and equipment safe for use in surgery.
In summary, the simple, inexpensive and proven infection prevention processes and practices described in this section and summarized in Table 4-1 can be used to safely:

- examine clients and perform pelvic exams
- provide immunizations and other injections
- fit diaphragms
- insert and remove IUDs and manage complications
- administer injectable steroid contraceptives
- insert and remove long-acting progestin implants, such as the Norplant system
- perform vasectomy, minilaparotomy, laparoscopy or other outpatient surgical procedures

When appropriately selected and correctly used, these processes provide excellent barriers to preventing the spread of infection. Moreover, by following the recommended procedures, health workers can minimize the risk of transmitting diseases, such as hepatitis B and AIDS, to their clients, their coworkers and themselves.
### Table 4-1. Infection Prevention in Family Planning Services
Steps in Processing Instruments and Equipment

<table>
<thead>
<tr>
<th>Process</th>
<th>Decontamination</th>
<th>Cleaning</th>
<th>High-Level Disinfection</th>
<th>Sterilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pelvic exam table top, or other large surface area</td>
<td>Wipe off with 0.5% chlorine solution.</td>
<td>Wash with detergent and water if organic material remains after decontamination procedure.</td>
<td>Not necessary</td>
<td>Not necessary</td>
</tr>
<tr>
<td>Linens (caps, gowns, masks and surgical drapes)</td>
<td>Soak in 0.5% chlorine solution for 10 minutes if contaminated with blood or body fluids prior to cleaning. (Rinse and wash immediately.)</td>
<td>Wash with detergent and water, removing all particles. Rinse with clean water, air or machine dry.</td>
<td>Not necessary for caps, gowns and masks. Surgical drapes:</td>
<td>Not necessary for caps, gowns and masks. Surgical drapes:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Boil or chemically HLD as below.</td>
<td>• Autoclave at 121°C (250°F) and 106 kPa (15 lbs/in²) for 30 minutes.</td>
</tr>
<tr>
<td>Gloves (rubber or plastic)</td>
<td>Soak in 0.5% chlorine solution for 10 minutes prior to cleaning. (Rinse or wash immediately.)</td>
<td>Wash with detergent and water, removing all particles. Rinse with clean water and check for holes. If to be sterilized, dry inside and out (air or towel dry).</td>
<td>If touching only mucous membranes or broken skin (e.g., pelvic exam or IUD insertion):</td>
<td>If used for surgery:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Boil for 20 minutes in a pot with a lid (start timing when water begins to boil).</td>
<td>• Autoclave at 121°C (250°F), and 106 kPa (15 lbs/in²) for 20 minutes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Gloves must be covered completely with water</td>
<td>• Do not use for 24-48 hours.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Do not add anything to pot after water begins to boil</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Air dry before use or storage</td>
<td></td>
</tr>
<tr>
<td>Diaphragms and/or fitting rings</td>
<td>Soak in 0.5% chlorine solution for 10 minutes prior to cleaning. (Rinse or wash immediately.)</td>
<td>Wash with detergent and water, removing all particles. Rinse with clean water and check for holes. If to be sterilized, dry inside and out (air or towel dry).</td>
<td>Boil as above or chemically disinfect with:</td>
<td>Not necessary but can be autoclaved at 121°C (250°F) 106 kPa (15 lbs/in²) for 20 minutes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 8% formaldehyde, or</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• a glutaraldehyde and</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>rinse well in water that has been boiled for 20 minutes.</td>
<td></td>
</tr>
<tr>
<td>Instruments/Equipment</td>
<td>Decontamination</td>
<td>Cleaning</td>
<td>High-Level Disinfection</td>
<td>Sterilization¹</td>
</tr>
<tr>
<td>-----------------------------------------------------------</td>
<td>-------------------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>-------------------------</td>
<td>-----------------</td>
</tr>
</tbody>
</table>
| Instruments for pelvic exam and IUD insertion (e.g., specula, tenaculum, forceps, and uterine sounds) | Soak in 0.5% chlorine solution for 10 minutes prior to cleaning. (Rinse or wash immediately².) | Using a brush, wash with detergent and water, removing all particles. Rinse with clean water. If to be sterilized, air or towel dry. | Boiling:  
• Boil for 20 minutes in a pot with a lid (start timing when water begins to boil).  
• Instruments must be covered completely by water during boiling.  
• Do not add anything to pot after water begins to boil.  
• Air dry before use or storage.  
Chemical: soak for 20 minutes in  
• 8% formaldehyde or a glutaraldehyde and rinse well in water that has been boiled for 20 minutes. | Dry heat for one hour after reaching 170°C (340°F), or Autoclave at 121°C (250°F) and 106 kPa (15 lbs/in²) for 20 minutes (30 minutes if wrapped). |
| Instruments for voluntary sterilization and Norplant        | Soak in 0.5% chlorine solution for 10 minutes prior to cleaning. (Rinse or wash immediately?) | Using a brush, wash with detergent and water, removing all particles. Rinse with clean water, air or towel dry. | Acceptable:  
• Boil or chemically HLD as above | Preferable:  
• Dry heat for one hour after reaching 170°C (340°F), or Autoclave at 121°C (250°F) and 106 kPa (15 lbs/in²) for 20 minutes (30 minutes if wrapped). |
| Needles and syringes                                       | Fill assembled needle and syringe with 0.5% chlorine solution and then soak for 10 minutes prior to cleaning. Rinse by flushing (×3) with clean water. | Disassemble, then wash with detergent and water, removing all particles. Rinse with clean water, air or towel dry syringes (only air dry needles). | Acceptable:  
• Boil or chemically HLD as above.  
• Place items that float in a weight: dry, porous bag (see Chapter 4). | Preferable:  
• Dry heat for two hours after reaching 160°C (320°F) (glass syringes only), or Autoclave at 121°C (250°F) and 106 kPa (15 lbs/in²) for 20 minutes (30 minutes if wrapped). |
<table>
<thead>
<tr>
<th>Instruments/Equipment</th>
<th>Decontamination</th>
<th>Cleaning</th>
<th>High-Level Disinfection</th>
<th>Sterilization¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage containers for instruments</td>
<td>Soak in 0.5% chlorine solution for 10 minutes prior to cleaning. (Rinse or wash immediately.)²</td>
<td>Wash with detergent and water, removing all particles. Rinse with clean water, air or towel dry.</td>
<td>Boil container and lid as above. If container is too large then: • Fill container with 0.5% chlorine solution and soak for 20 minutes. • Rinse with water which has been boiled for 20 minutes and air dry before use. Re-disinfect weekly, when empty or contaminated.</td>
<td>• Dry heat for one hour after reaching 170°C (340°F), or • Autoclave at 121°C (250°F) and 106 kPa (15 lbs/in²) for 20 minutes (30 minutes if wrapped). Re-sterilize weekly, when empty or contaminated.</td>
</tr>
<tr>
<td>IUDs and inserters (never reuse)</td>
<td>Not necessary</td>
<td>Not necessary</td>
<td>Not recommended. (If bulk packaged, before insertion chemically disinfect with: • 8% formaldehyde, or • a glutaraldehyde, and rinse well in water which has been boiled for 20 minutes.)</td>
<td>Most IUDs come in sterile packages. Discard if package seal is broken.</td>
</tr>
<tr>
<td>Norplant implants (never reuse)</td>
<td>Not necessary</td>
<td>Not necessary</td>
<td>Never acceptable</td>
<td>Come in sterile packages. Discard if package seal is broken.</td>
</tr>
</tbody>
</table>
Table 4-1: Infection Prevention in Family Planning (continued)

<table>
<thead>
<tr>
<th>Instruments/Equipment</th>
<th>Decontamination</th>
<th>Cleaning</th>
<th>High-Level Disinfection</th>
<th>Sterilization¹</th>
</tr>
</thead>
</table>
| Endoscopes (laparoscopes) | Wipe exposed surfaces with gauze pad soaked with 60-90% alcohol; rinse immediately. | Disassemble, then wash with detergent and water removing all particles. Rinse with clean water, towel dry. | Soak for 20 minutes in:  
  - 8% formaldehyde, or  
  - a glutaraldehyde, rinse in water which has been boiled for 20 minutes. | Sterilize daily if possible using chemical sterilization. Soak in:  
  - 8% formaldehyde for 24 hours, or  
  - a glutaraldehyde for 10 hours  
Rinse with sterile water or water which has been boiled for 20 minutes. |

¹ If unwrapped, use immediately; if wrapped, may be stored up to one week prior to use.
² Avoid prolonged exposure to chlorine solution to minimize corrosion of instruments and deterioration of rubber or cloth products.
³ If sterilization (dry heat or autoclave) not available, these items can be HLD either by boiling or soaking in a chemical disinfectant.
⁴ Instruments with cutting edges or needles should not be sterilized at temperatures above 160ºC to avoid dulling.

Source: Adapted from Perkins, 1983.
REFERENCES


42
BACKGROUND

Health care workers, especially those responsible for:

- performing/assisting surgical procedures (physicians, nurses and midwives),
- processing surgical instruments and equipment, and
- housekeeping and waste disposal;

are increasingly at risk of contracting hepatitis B (HBV) and AIDS. Although at present the potential risk for acquiring hepatitis B, or the newly identified hepatitis C and D, is greater than for AIDS, the modes of transmission for these viruses are similar. Like hepatitis B, the AIDS virus (HIV) is blood-borne.

In family planning and health care facilities, blood is the most common path of transmission of HBV and HIV. Protective measures for clients and staff should focus primarily on preventing inoculation or contact of non-intact skin or mucous membranes with blood or blood-contaminated body fluids.

Note: Staff responsible for processing instruments who have open sores or cuts on their hands or forearms should be assigned other duties until the lesions are healed.

Decontamination and cleaning are two effective infection prevention measures that can minimize the risk of hepatitis B and AIDS transmission to health care workers, including cleaning and housekeeping staff, when handling surgical instruments or needles from potentially infected clients. Similarly, proper decontamination and cleaning of used (dirty) instruments and needles are important steps in breaking the infection transmission cycle for clients as well. Fortunately, both procedures are simple-to-do, inexpensive and can help ensure that clients and staff are at low risk of becoming infected from contaminated instruments and objects.
Decontamination

The objective of **decontamination** is to protect individuals handling surgical instruments and other items which have been in contact with blood or body fluids from serious diseases.

**Decontamination** is the first step in handling used (soiled) surgical instruments, reusable gloves and other items. Decontamination is important for pre-treating instruments and objects that may have been in contact with blood or body fluids. This process makes items safer to handle by personnel who clean them. Thus, immediately after use and before leaving the examining, procedure or operating room, these items should be placed in 0.5% chlorine solution or other locally available and approved disinfectant for 10 minutes. This step rapidly inactivates hepatitis B and AIDS viruses (AORN, 1990 and ASHCSP, 1986). Table 5-1 describes how to make 0.5% chlorine solution using commonly available bleach products.

**Table 5-1: Preparing 0.5% Chlorine Solution from Bleach (Sodium Hypochlorite)**

<table>
<thead>
<tr>
<th>Type or Brand of Bleach (Country)</th>
<th>Chlorine % Available</th>
<th>How to Dilute to an 0.5% Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household bleach (Canada, USA)</td>
<td>5</td>
<td>1 part bleach to 9 parts water</td>
</tr>
<tr>
<td>Eau de Javel (France) (15 °chlorum¹)</td>
<td>5</td>
<td>1 part bleach to 9 parts water</td>
</tr>
<tr>
<td>Chloros (UK)</td>
<td>10</td>
<td>1 part bleach to 19 parts water</td>
</tr>
<tr>
<td>JIK (Kenya)</td>
<td>3.5</td>
<td>1 part bleach to 6 parts water</td>
</tr>
</tbody>
</table>

¹ In some countries the concentration of sodium hypochlorite is expressed in chlorometric degrees (°chlorum); 1 °chlorum is approximately equivalent to 0.3% available chlorine.

Source: Adapted from INTRAH, 1989.
Decontamination and Cleaning

As a further safeguard, personnel should wear gloves while handling used instruments and equipment; inexpensive rubber or vinyl household (utility) gloves work well for this. After decontamination, surgical instruments should be immediately rinsed with water to help prevent corrosion and remove visible organic material before being cleaned.

Surfaces especially pelvic examination or operating tables which may have come in contact with body fluids should be decontaminated. Wiping with a suitable disinfectant such as 0.5% chlorine solution before reuse, when visibly contaminated, or at least daily, is an easy-to-do, inexpensive way to decontaminate large surfaces.

Once instruments and other items have been decontaminated, they need to be further processed by cleaning and finally either sterilization or high-level disinfection.

**Note:** If stainless steel instruments are electroplated and a metal container is used for soaking (even if only in water), a chemical reaction can occur. This reaction will accelerate corrosion of the instruments.

**CLEANING**

Cleaning is a crucial step in providing safe, infection-free equipment and instruments. A thorough cleaning with detergent and water physically removes organic material such as blood and secretions. **Use of a detergent is important for effective cleaning, since water alone will not remove protein, oils and grease.** The use of hand soap is discouraged because the fatty acid in soap reacts with the minerals in hard water leaving a residue or scum (insoluble calcium salt) which is difficult to remove. Detergents, when dissolved in water, break-up and dissolve or suspend grease, oil and other foreign matter in solution so it can easily be removed by the cleaning process. Using liquid detergent (soap) is preferable because it mixes more easily with water than do powdered detergents. Do not use abrasive (e.g., Vim® or Comet®) cleaners or steel wool as these products can scratch or pit metal or
stainless steel. These scratches can become a nesting place for microorganisms and increase corrosion of the instruments. As stated in Chapter 4, instruments should be cleaned with a soft brush in soapy water to remove all foreign matter. It is important to do this cleaning under the surface of the water to prevent infectious material becoming airborne through splashing (IAHCSM, 1986).

As shown in Table 5-2, most microorganisms (up to 80%) harbored in blood and other organic material are removed during the cleaning process. Cleaning also is the best way to reduce the numbers of endospores which cause tetanus and gangrene. When sterilization equipment is not available, thorough cleaning is the only way to mechanically reduce the number of endospores. This is important because organic material can entrap microorganisms including endospores in a residue that protects them against sterilization or chemical disinfection. As mentioned previously (Chapter 1), hepatitis B virus surviving in as little as \(10^{-8}\) ml of blood (invisible to see) can be infectious when splashed into an eye (Bond, 1982). Organic matter also can partially inactivate some disinfectants (e.g., alcohols and iodine), rendering them less effective (Porter, 1987).

**Note:** Cleaning is important because:

- It is the most effective way to reduce the number of microorganisms on used (soiled) instruments and equipment.

- Both sterilization and high-level disinfection procedures are **not effective** without prior cleaning (Porter, 1987).
# Decontamination and Cleaning

## Table 5-2: Effectiveness of Methods for Processing Instruments

<table>
<thead>
<tr>
<th>Effectiveness (removal or inactivation of microbes)</th>
<th>Decontamination</th>
<th>Cleaning (water only)</th>
<th>Cleaning (detergent &amp; rinsing with water)</th>
<th>High-level Disinfection(^1)</th>
<th>Sterilization(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kills HBV and HIV</td>
<td>Up to 50%</td>
<td>Up to 80%</td>
<td>95% (does not inactivate some endospores)</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>End point</td>
<td>10 minute soak</td>
<td>Until visibly clean</td>
<td>Until visibly clean</td>
<td>Boiling: 20 min. Chemical: 20 min.</td>
<td>Steam: 20-30 min. 106 kPa, 121°C Dry heat: 1 hr., 170°C</td>
</tr>
</tbody>
</table>

\(^1\) Prior decontamination and cleaning required.
General guidelines for cleaning items are:

- **Gloves should be worn while cleaning instruments and equipment.** (Thick household or industrial gloves work well.) If torn or damaged, they should be discarded; otherwise they should be cleaned and left to dry at the end of the day for use the following day. In addition to wearing gloves, extreme care must be taken to prevent needle sticks or cuts.

- **Instruments** should be cleaned with a brush (old toothbrushes work well) in soapy water. Particular attention should be paid to instruments with teeth, joints or screws where organic material can collect. (Because chlorine breaks down protein, decontamination by soaking in chlorine solution makes cleaning easier.) After cleaning, instruments should be thoroughly rinsed with water to remove soapy residue which can interfere with chemical disinfection.

- **Reusable needles and syringes** should be disassembled and cleaned with soapy water, paying special attention to the hub area. They then should be rinsed at least three times with clean water, expelling the water through the needle into another container so as not to contaminate the rinse water, and then dried. If possible, single-use (disposable) needles and syringes should be used, and *never* be reused.
Decontamination and Cleaning

- **Operative endoscopes** (e.g., laparoscopes) must be carefully cleaned as improper cleaning is a common cause of mechanical problems. Immediately after use (and before disassembly), wipe all surfaces with a gauze pad soaked with 60 - 90% alcohol and rinse with cool water. (This step kills hepatitis B and AIDS viruses). Completely disassemble the laparoscope. Clean all surfaces with a soft cloth, using mild, non-abrasive detergent and warm water. Particular attention should be paid to areas where blood and tissue can easily collect: the inner channel of the operating laparoscope, the Falope-Ring® applicator and the trocar/cannula. After cleaning, endoscopes should be rinsed thoroughly with clean water two times to remove all detergent residue. Excess water should be removed before proceeding with chemical disinfection so as not to dilute the disinfectant solution. (Savlon should not be used on endoscopes as it may cloud the lens.)

Additional step-by-step instructions on **how** to decontaminate and clean each of these items are provided in several of the appendices:

- surgical instruments (see Appendix E),
- rubber gloves (see Appendix A),
- needles and syringes (see Appendix E),
- linens and other items (see Appendix E), and
- laparoscopes (see Appendix G).
REFERENCES


SIX

STERILIZATION

BACKGROUND

Whenever possible, instruments and other objects that come in direct contact with the blood stream or tissues under the skin, such as reusable needles, syringes and scalpels, should be sterilized after first being decontaminated and thoroughly cleaned, rinsed and dried. The sterilization process ensures that all microorganisms, including bacterial endospores, are destroyed. Bacterial endospores are particularly difficult to kill because of their tough coating. Bacteria that form endospores include Clostridia species, which cause tetanus and gangrene. Sterilization can be achieved by autoclaving (high-pressure steam), dry heat, or by using chemicals ("cold sterilization").

EFFECTIVENESS OF STERILIZATION

To be effective, sterilization must be carried out for a given length of time. The heat or chemical must penetrate the packaging and then the item itself before destruction of microorganisms can begin. When using heat, first the temperature of the sterilizing vessel must reach the optimum level, then the temperature of the packing (if any) and finally, the items being sterilized must reach this temperature. Thus, time is an essential factor in every sterilization process.

The effectiveness of any method of sterilization also is dependent upon four other factors:

- The type of microorganism present. Some microorganisms are very hard to kill. Others die easily.

- The number of microorganisms present. It is much easier to kill one organism than many of them.

- The amount and type of contamination present which protect the organisms. Blood or tissue remaining on poorly cleaned instruments acts as a shield to microorganisms.

- The amount of protection an object being sterilized furnishes the microbes. Microorganisms collect in (and are protected) by cracks and crevices such as the serrated jaws of tissue forceps.
Sterilization

Since the first three factors above are influenced by cleaning, thorough cleaning of objects to be sterilized is absolutely essential. It is far easier to remove the visible contaminants and most of the microorganisms from an object by cleaning than it is to try to sterilize the item without first thoroughly cleaning it. More importantly, even with longer sterilization time, it is not possible to be sure the item is sterile. Because the type and number of microorganisms on a contaminated surgical instrument often are not known, the importance of thorough cleaning prior to sterilization cannot be overemphasized (see Chapter 5).

HEAT STERILIZATION

High-pressure saturated steam (autoclaving) or dry heat (hot air oven) are the most readily available methods used for sterilization. Steam sterilization is generally the method of choice for sterilizing instruments and other items used in family planning and health care facilities. Where electricity is a problem, instruments can be sterilized in a non-electric autoclave using kerosene as a heat source.

When instruments and equipment are autoclaved, it is essential that steam reach all surfaces; autoclaving closed containers will sterilize only the outside.

Dry heat sterilizers are good in humid climates but need a constant supply of electricity, making them impractical in many remote (rural) areas. Furthermore, dry heat sterilization, which requires use of higher temperatures, can be used only with glass or metal objects - other substances will melt.

Note: Some specialized autoclaves, such as high speed vacuum sterilizers, are operated at higher temperatures (134°C/275°F). Sterilizing time for wrapped metal instruments in such autoclaves is shorter, about 15 minutes.

Note: Although rinsing an item with alcohol and then igniting it with a match is used, data suggest this is an ineffective means of sterilization and is not reliable.
Standard Conditions for Heat Sterilization

Steam sterilization: Temperature should be 121°C (250°F); pressure should be 106 kPa (15 lbs/in²); 20 minutes for unwrapped items; 30 minutes for wrapped items. Allow all items to dry before removing.

Note: Pressure settings (kPa or lbs/in²) may vary slightly depending on sterilizer used. When possible, follow manufacturers recommendations.

Dry heat: 170°C (340°F) for one hour (total cycle time - placing instruments in oven, heating to 170°C, timing for one hour - and then cooling is from two to two and a half hours) or 160°C (320°F) for two hours (total cycle time is from three to three and a half hours).

Remember: for dry heat sterilization:
- Exposure time begins only after the oven has reached the specific temperature.
- Do not overload the sterilizer. (Leave at least 7.5 cm [3 inches] between the packs and walls of sterilizer.) Overloading alters heat convection and increases time required to sterilize.


STEAM STERILIZATION BY AUTOCLAVING

General Principles

Steam is an effective sterilant for two reasons. First, saturated steam is an extremely effective "carrier" of thermal energy. It is many times more effective in conveying this type of energy to the item than is hot air. In a kitchen, potatoes can be cooked in a few minutes in a steam pressure cooker while cooking may take an hour or more in a hot-air oven, even though the
oxygen is operated at a much higher temperature. The steam carries thermal energy to the potatoes very quickly, while hot air does so very slowly. Second, steam is an effective sterilant because any resistant outer protective layer of the microorganisms can be softened by the steam, allowing coagulation (e.g., poaching an egg) of the sensitive inner portions of the organism. Certain types of contaminants, however, especially greasy or oily materials, can protect the microorganisms against the effects of steam, thus hindering the process of sterilization. This point, too, re-emphasizes the need for decontamination and thorough cleaning of objects before sterilization.

Requirements

Sterilization by steam requires four conditions: adequate contact, sufficiently elevated temperature, proper time, and sufficient moisture. While all are necessary for sterilization to take place, sterilization failures in clinics and hospitals are most often caused by lack of steam contact or failure to attain adequate temperature. All four conditions will be discussed in order of importance in assuring complete sterilization by steam.

Contact

The most frequent reason for sterilization failure is the lack of contact between the steam and the microorganisms. This failure may be related to human error or mechanical malfunction. Frequent causes of steam contact failure include the following:

1. **Failure to adequately clean the object being sterilized.** Any coating of soil can protect the microorganisms from direct steam contact. In addition, the effectiveness of sterilization is dependant on the "bioload" (number of microorganisms) present prior to the sterilization cycle.
2. **Packages wrapped too tightly.** Air and steam do not mix readily. Air, being heavier than steam, normally is displaced to the bottom of the sterilizer and is then forced out through the drain. If the packs are wrapped too tightly, however, this air is trapped and cannot escape. It forms cool air pockets at the center of the packages, preventing the reaching of temperatures sufficient to kill all microorganisms.

3. **Packs too crowded.** It is essential that the packs be arranged loosely on the cart or the same type of problem as that in #2, above, will occur. It also helps to stand the packs on edge as it is easier for air to be displaced downward between the packs than to go through the many layers of fabric of horizontally placed packs.

4. **Wrong position of container.** If pans, bottles or other airtight containers are to be sterilized, it is essential that the tops be removed (or held loosely in place) and that the containers be placed on their sides. If the containers are placed upright, the air cannot be displaced and will be trapped in them. Steam is lighter than air, and as the steam enters the sterilizer, the air must be displaced downward before the steam can enter, fill all spaces, and raise the temperature sufficiently for sterilization to occur.

5. **Clogged strainer.** At the interior bottom of most sterilizers is a small drain strainer used to keep lint, pins and other small objects from entering the exhaust line. It is essential that these screens be cleaned daily, or they will become clogged and trap air in the sterilizer.

6. **Other mechanical malfunctions.** Several other problems can occur, such as a defective steam trap, clogged exhaust lines, and similar difficulties. Often, the sterilizer operator cannot repair these malfunctions. In some cases, however, a weekly flush of hot detergent through the exhaust line will keep it cleaned out. If the sterilizer manual calls for this weekly flush, it must be performed or sterilization failure may occur.
From a review of the above, it is clear that most errors in sterilization begin with human error. By becoming familiar with these problem areas, staff responsible for operating the autoclave can avoid the major causes of sterilization failure. To detect steam contact failures, the use of an internal (inside the package) indicator is strongly recommended. (See Appendix D for additional information about maintaining and operating autoclaves.)

Temperature

The next most important factor in steam sterilization is temperature. The most commonly encountered temperature for steam sterilization is 121°C (250°F). When an object at room temperature is placed in a sterilizer, the steam transmits thermal energy to the object until the object reaches the same temperature as the steam. Under normal conditions this equilibrium occurs within a few minutes. If the steam is unsaturated (too dry) or if the steam is prevented from reaching all parts of the object, the temperature may never reach the level required for sterilization. The only way to be certain the sterilizer is working correctly is to ensure that the temperatures at all points inside the load reach the full operating temperature of 121°C (250°F).

The temperature gauges and recorders located on the sterilizer control panel sense the temperature of the exhaust line and do not give an indication of center-of-pack temperature. While these sensing devices do give a good indication of overall sterilizer operation, they cannot detect air pockets within packs and similar problems. Therefore, only when the temperature of all objects in the sterilizer chamber reaches the 121°C (250°F), should timing of the sterilization cycle begin.
Sterilization

Sterilizing must always be continuous without interruption (i.e., the temperature must never be allowed to drop below 121°C/250°F even for a second) If this should happen, sterilization will not take place and the following steps should be taken:

- Discontinue the cycle because the items are not sterile.
- Remove the load from the chamber of the sterilizer.
- Remove and replace all wrappers of all packages because all soft goods will be wet.
- Remove and replace all drapes, gowns, towels, dressings, cotton balls, etc. with fresh dry items. Relaunder fabrics (linens) before reusing. Dressings and cotton balls may be reused after drying.
- Reload the sterilizer with fresh packages.
- Resterilize the load.

Timing

Just as it takes a certain amount of time to cook food, it takes a certain amount of time to kill microorganisms. In both cases, the hotter the temperature, the less time is required. For example, while all peas in a pot of boiling water may be cooked in the same amount of time, microorganisms are different than peas in that some microorganisms are harder to kill than others. Sterilization time is measured in D-values. A D-value is the amount of time required to kill 90% of the microorganisms present. Each kind of microorganism has a different set of D-values, and of course, the D-value depends on the temperature.

A highly resistant but relatively harmless (nonpathogenic) microorganism called Bacillus stearothermophilus is used to test steam sterilizers. As used in hospitals and clinics to test sterilizers, this microorganism has a D-value
of about two minutes at 121°C (250°F). In other words, it would take two minutes at 121°C (250°F) to kill 90% of the test microorganisms present. Through research, mathematical calculation and intelligent "guesses," authorities have generally agreed that for normal hospital sterilization about six *Bacillus stearothermophilus* D-values (or about 12 minutes) should be sufficient to kill essentially all pathogenetic microorganisms and give a large margin of safety. Because in many countries internal temperature sensing devices, such as temperature-specific chemical indicators, are not available, extra time (20 minutes for unwrapped and 30 minutes for wrapped packs) is recommended as an added safety margin.

**Moisture**

Last, but not least, is the moisture requirement. Adequate moisture content of the sterilizer atmosphere is mandatory for effective sterilization by steam. Adequate moisture content means that the steam must be "saturated," possessing a relative humidity of 100%. In other words, it is "just about to rain" in a properly operated steam sterilizer. When any cool object is placed in the sterilizer, the steam at the surface of the object is cooled and becomes supersaturated. Water begins condensing on the surface of the object. This condensation produces two immediate effects:

1. The volume of gas in the sterilizer chamber decreases as the steam (water vapor) changes to the liquid state and more steam is drawn into the chamber and into contact with the articles being sterilized.

2. Very large amounts of thermal energy are transferred to the object, raising the temperature of the article significantly. The amount of heat released is best explained by comparing the calories required to change the temperature of steam as compared to the calories absorbed when water is converted to water vapor (steam). One calorie of heat will raise one gram of water or steam one degree Celsius, but 540 calories of heat are required to convert one gram of water to one gram of steam without any change in temperature (see Figure 6-1).
One calorie of heat will raise the temperature of one gram of water 1°C. Thus, 100 calories are required to raise the temperature of one gram of water from 0°C to 100°C. To convert that same gram of water into steam (i.e., vaporize it), an additional 540 calories are required. This is called the latent heat of vaporization since the temperature of the steam remains the same (100°C) as the temperature of the water before vaporization. When the steam condenses (e.g., during the sterilization process), the heat is given off, helping produce the sterilization effect.

If the steam is not saturated (less than 100% relative humidity), two problems will develop, either or both of which will interfere with the adequacy of the sterilization process:

1. Articles in the sterilizer will remain dry, and any microorganisms present cannot be killed as readily as under wet conditions.

Source: Adapted from IAHCSM, 1986, Central Service Technical Manual
2. Articles in the sterilizer will remain "cool" much longer, especially if they are wrapped. Again, using the home kitchen as an example, if a roast or turkey is placed in an oven (dry heat), it may take hours for the center to become heated (as shown on the meat thermometer). On the other hand, if a roast is placed in a pressure cooker (saturated steam), the center will be cooked much more quickly. Saturated steam is a much better "carrier" of thermal energy than is dry air.

In summary, saturation of the steam is vital to sterilizer operation because water vapor is the best carrier of thermal energy. The vapor also softens the capsules of microorganisms, making them more vulnerable to destruction by heat. (IAHCSM, 1986)

Operating Instructions (Gravity Displacement Autoclaves)

To ensure correct operation, when available, consult specific operating instructions supplied by the manufacturer.

STEP 1: Decontaminate, clean and dry all instruments to be sterilized.

STEP 2: All jointed instruments should be in the opened or unlocked position, while instruments composed of more than one part or sliding parts should be disassembled. To help prevent dulling of sharp points and cutting edges, wrap the sharp edges and needle points in gauze before sterilizing.

STEP 3: Instruments should not be held tightly together by rubber bands or any other means that will prevent steam contact with all surfaces.

STEP 4: Arrange packs in the chamber to allow free circulation and penetration of steam to all surfaces.
Sterilization

STEP 5: When using an autoclave, it is best to wrap clean instruments or other clean objects in a double thickness of muslin or newsprint. (Unwrapped instruments are only sterile if used immediately after removal from the autoclave, unless kept in a covered, sterile container.)

If using a pressure cooker or kerosene-powered (non-electric) gravity displacement autoclave, bring water to boil until steam escapes from the pressure valve only; turn down heat but keep steam coming out of pressure valve. Do not allow to boil dry. Steam should always be escaping from the pressure valve.

STEP 6: Sterilize for 30 minutes for wrapped objects, 20 minutes for unwrapped objects; time with a clock. The temperature should be 121°C (250°F); the pressure should be 106 kPa (one atmosphere above atmospheric pressure) or 15 pounds per square inch (15 lbs/in²).

STEP 7: Wait 20 to 30 minutes (or until the pressure gauge reads zero) to permit the sterilizer to cool sufficiently. Then open the lid to allow steam to escape. Allow instrument packs to dry completely before removal, which may take up to 30 minutes. (Damp packs act like a wick drawing in bacteria, viruses and fungi from the environment.) Wrapped instrument packs are considered unacceptable if there are water droplets or visible moisture on the package exterior when removed from the autoclave chamber.

STEP 8: To prevent condensation when removing the packs from the chamber, place sterile trays and packs on a surface padded with paper or fabric. (Do not store trays or packs until they reach room temperature; this usually takes about an hour.)

STEP 9: After sterilizing, objects wrapped in cloth or paper are considered sterile for one week only if kept dry, one month if sealed in a plastic bag. Unwrapped objects must be used
STEP 10: Ideally, a steam sterilizer log should be kept, noting time:

- heat begun,
- correct temperature and pressure achieved,
- heat turned down, and
- heat turned off.

**Note:** Keeping a log can help ensure that the required amount of time will be observed, even when multiple, new or hurried workers are responsible for overseeing the sterilization.

**Note:** For detailed instructions on packaging items, loading and unloading the autoclave and storing sterile packs, see Appendix D.

**Advantages**

- Inactivates all microorganisms (bacteria, fungi, parasites and viruses), including HBV and HIV and all bacterial endospores, including those causing tetanus and gangrene

**Disadvantages**

- Requires source of heat (fire, kerosene or electricity)
- Requires autoclave, which must be expertly maintained in working condition
- Requires strict adherence to time, temperature and pressure settings

**Problem Solving (See also Appendix D)**

- If steam escapes from the safety valve instead of the pressure valve, the pressure valve must be cleaned and inspected
- If steam escapes from under the lid, the gasket (rubber ring) must be cleaned and dried or replaced
Sterilization

- If steam escapes from the safety valve or under lid, the autoclave is not working correctly, and the autoclave is merely a boiling pot

STERILIZATION BY DRY HEAT

When available, dry heat (hot air oven) is a practical way to sterilize reusable needles and syringes and other instruments. A commercial sterilizer with a fan is recommended but dry heat can be done with a simple oven. Because dry heat dulls sharp points and edges less than autoclaving and chemical sterilization, dry heat is ideal for sterilizing reusable needles and syringes.

Note: Use only for items that can withstand a temperature of 170°C (340°F). Needles and other instruments with cutting edges should be sterilized at temperatures no higher than 160°C (320°F), as higher temperatures can destroy the sharpness of cutting edges (Perkins, 1983).

Effectiveness

Dry heat sterilization is accomplished by thermal (heat) conduction. Initially, heat is absorbed by the exterior surface of an item and then passes to the next layer. Eventually, the entire object reaches the temperature needed for sterilization. Death of microorganisms occurs in dry heat with the slow burning-up (coagulation) of the protein in the microorganisms. This is a longer process than steam sterilization (autoclaving) because heating by dry heat is slowed due to lack of moisture (water vapor). The presence of moisture that occurs in steam sterilization significantly speeds up the penetration of heat and shortens the time needed to kill microorganisms.

Remember: Just as with steam sterilization, thorough decontamination and cleaning of the object prior to heat sterilization is critical. If an instrument is not properly cleaned, its sterilization cannot be assured, regardless of how long it’s heated.
Sterilization

Instructions

To ensure correct operation, consult specific operating instructions supplied by the manufacturer.

STEP 1: Decontaminate, clean and dry all instruments to be sterilized.

STEP 2: If desired, wrap instruments in cotton muslin or aluminum foil or place in a metal, lidded container. Needles alone or needles fully attached to glass syringes may be placed in a glass tube with a cotton stopper. (Wrapping helps prevent recontamination prior to use.) Cotton muslin can be used if temperatures in the oven’s chamber do not exceed 204°C (399°F).

STEP 3: Place instruments in metal containers or on trays in oven and heat to desired temperature.

STEP 4: After the desired temperature is reached, begin timing. The following temperature/time ratios are recommended (Perkins, 1983 and APIC, 1983):

Note: Depending upon the temperature selected, the total cycle time (pre-heating, sterilization time and cool-down) will range from about 2 1/2 hours at 170°C to 4 1/2 hours at 140°C.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>170°C (340°F)</td>
<td>60 minutes</td>
</tr>
<tr>
<td>160°C (320°F)</td>
<td>120 minutes</td>
</tr>
<tr>
<td>150°C (300°F)</td>
<td>150 minutes</td>
</tr>
<tr>
<td>140°C (285°F)</td>
<td>180 minutes</td>
</tr>
<tr>
<td>121°C (250°F)</td>
<td>overnight</td>
</tr>
</tbody>
</table>

STEP 5: After cooling remove loose items with sterile forceps/pickups, and store in sterile covered containers.
Sterilization

Advantages

- An ordinary electric household oven is satisfactory for dry heat sterilization
- Very effective method, as dry heat by conduction reaches all surfaces of instruments, even for those instruments that cannot be disassembled
- Less corrosive for metals and sharp instruments, such as reusable needles and scalpel blades if lower temperature (160°C) used
- Does not corrode ground glass surfaces, such as reusable syringe barrels
- Leaves no chemical residue
- In humid climates, dry heat eliminates "wet pack" problems

Disadvantages

- Dry heat penetrates materials slowly and unevenly
- Requires oven and electricity or other fuel source
- Because of higher temperatures required (160° - 170°C), cannot be used for plastic or rubber items (steam sterilization preferred for these)

MONITORING STERILIZATION PROCEDURES (Steam and Dry Heat)

Controversy exists regarding the use of chemical indicators to determine whether or not individual items or packs for sterilization have indeed been sterilized. The cost-effectiveness of these procedures still is not proven because chemical indicators vary in their abilities to monitor sterilization indices. The key indices of steam sterilization include time, temperature, steam saturation and purity while for dry heat sterilization temperature and time are the important indices. Unfortunately heat sensitive tapes or glass
vials containing pellets, which melt at certain temperatures for a given time, do not guarantee that sterilization has been achieved. Furthermore, indicators that measure more than one parameter are not necessarily reliable. Therefore, each program will have to formulate its own policy regarding the use of chemical indicators. Factors to be considered include benefit versus cost, performance limitations and staff knowledge of sterilization principles. By contrast monitoring the sterilization process with reliable biological indicators at regular intervals is strongly recommended. Measurements should be performed with a biologic indicator that employs spores of established resistance in a known population. The biologic indicator types and minimum recommended measurement intervals should be:

- **Steam sterilizers:** *Bacillus stearothermophilus*, weekly and as needed.

- **Dry heat sterilizers:** *Bacillus subtilis*, weekly and as needed.

**CHEMICAL STERILIZATION**

An alternative to steam or dry heat sterilization is chemical sterilization (often called "cold sterilization"). Objects which need to be sterilized but:

- steam or dry heat sterilization would damage, or
- steam or dry heat sterilization equipment is not available,

can be chemically sterilized by using certain chemical sterilants.

Some high-level disinfectants will kill endospores after prolonged (8-24 hour) exposure. High-level disinfectants which can be used for chemical sterilization include glutaraldehydes and formaldehyde.

Sterilization takes place by soaking for at least 8 to 10 hours in a glutaraldehyde or at least 24 hours in 8% formaldehyde solution. Glutaraldehydes, such as Cidex®, often are in short supply and expensive, but they are the only practical sterilants usable for some instruments, such as laparoscopes, which cannot be heated. Also, glutaraldehyde requires special
Sterilization

handling and leave a residue on treated instruments; therefore, rinsing with sterile water after use of the chemicals is essential. (Remember: Rinsing with boiled water, since it does not reliably inactivate endospores, can recontaminate sterile instruments.)

Although formaldehyde is less expensive than glutaraldehyde, it is also more toxic. The vapors of both chemicals are irritating to the skin, eyes and respiratory tract (Table 7-1). When using either formaldehyde or glutaraldehyde, gloves should be used, exposure time limited and both chemicals used only in a well-ventilated area (Clark, 1985). Remember: Do not dilute with chlorinated water as a dangerous gas (bis-chloromethyl-ether) is produced.

Instructions

STEP 1: Decontaminate, clean and dry all instruments to be sterilized.

STEP 2: Prepare a fresh glutaraldehyde solution by adding the powder or liquid supplied with the solution and/or dilute according to manufacturers instructions.

Commercially available solutions of formaldehyde (which contain 35-40% formaldehyde) should be diluted with boiled water 1:5 (final solution contains about 8% formaldehyde). Remember: Do not dilute with chlorinated water.

STEP 3: Using a container with a lid, cover clean instruments and other clean objects completely with the solution.

STEP 4: Allow to soak:

- at least 8-10 hours in a glutaraldehyde (check specific product instructions), or
- at least 24 hours in 8% formaldehyde.

STEP 5: Remove objects from the solution with sterile large forceps/pickups, rinse in sterile water, air dry. Wrap in sterile paper or cloth without touching either the sterilized instruments or the inside of the sterile wrap or place in a
Sterilization

covered sterile container. Thorough rinsing with sterile water is required to remove the chemical residue which is toxic to tissue. Boiled water is accepted for rinsing, but remember, it does not reliably inactivate endospores.

STEP 6: Store in a sterile container with a lid if not used immediately.

Advantages

• Glutaraldehyde and formaldehyde solutions are not readily inactivated by organic materials

• Overnight soaking in glutaraldehyde and 24-hour soaking in formaldehyde kills all microorganisms, including bacterial endospores

• Can be used for items which will not tolerate heat sterilization (i.e., laparoscopes)

Formaldehyde solutions can be used for up to 14 days. Replace sooner if turbid (cloudy). Some glutaraldehyde solutions can be used for up 30 days. (Check the manufacturers instructions and see also Appendix F).

Disadvantages

• Glutaraldehyde and formaldehyde are chemicals which cause skin irritation, thus all equipment soaked in either must be thoroughly rinsed with sterile water after soaking

• Because glutaraldehyde works best at room temperature, in cold environments (temperatures less than 20°C [68°F]) chemical sterilization cannot be assured even with prolonged soaking.

• Glutaraldehydes are expensive

• Formaldehyde, and less so glutaraldehydes, are toxic and their vapors are irritating to the skin, eyes and respiratory tract. Therefore, gloves should be used and exposure time should be limited. Use both only in a well-ventilated area.
Sterilization

- Formaldehyde should never be mixed with chlorine or chlorinated water, as a dangerous gas (bis-chloromethyl-ether) is produced.

Storage of Disinfectants

- Chemical 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).

Disposal of Used Chemical Containers

- Rinse glass container thoroughly with water. Glass containers may be washed with detergent, rinsed, dried, and re-used.
- For plastic containers used for toxic substances such as glutaraldehyde (e.g., Cidex®), rinse three times with water and dispose by burial.

Note: The content of these containers are toxic. Containers must not be reused for other purposes.

OTHER STERILIZATION METHODS

Gas Sterilization

The use of formaldehyde gas for killing microorganisms was practiced before the turn of the century. For example, one of the first uses of formaldehyde gas was to fumigate rooms, a practice long since shown to be ineffective and unnecessary (Schmidt 1899, Perkins 1983). For most purposes, a wet vapor containing formaldehyde gas, which is released from a solution of formaldehyde (formalin), was used. As mentioned previously, however, because formaldehyde vapors are irritating to the skin, eyes and respiratory tract, the use of this chemical is limited. In the United States and several other countries the preferred chemical for gas sterilization of heat- and/or moisture-sensitive surgical instruments, such as laparoscopes, now is ethylene oxide (ETO). Sterilization using ETO, however, is a more complicated process than either steam or dry heat sterilization. In addition to time and
Sterilization

temperature requirements, major factors in steam and dry heat sterilization, with ETO, concentration and moisture are equally important (Perkins, 1983). Furthermore, items which are sterilized by ETO also need to be aerated (from 8 hours to many days) to allow the residual gas to dissipate.

Because ETO is moderately toxic when inhaled, regular exposure to low levels (greater than 1 part per million) may produce harmful effects in humans. Also, the gas is irritating to the eyes and mucous membranes, and residual ETO can cause skin injuries if the item remains in contact with a client’s skin (IAHCSM, 1986). Finally, because ETO sterilization is an expensive process which requires sophisticated equipment and skilled staff specially trained for its safe use, it is impractical for most family planning facilities.

Ultraviolet Light Sterilization

Ultraviolet (UV) light has been used to help disinfect the air for over 50 years. For example, UV irradiation has been shown to be useful in interrupting transmission of airborne infections in enclosed indoor environments where living conditions are poor and people are crowded together. Because UV irradiation has very limited energy, UV light does not penetrate dust, mucous or water well. Therefore, despite manufacturers’ claims, it can not be used to sterilize water. Furthermore, while in theory intense UV light can be both bactericidal and viricidal, in practice, only disinfection of surgical instruments can be achieved (Morris, 1972). This is because the UV rays can only kill microorganisms which are struck by UV light beams. Thus, for surfaces which cannot be reached by the UV rays (e.g., inside the barrel of a needle), microorganisms, if present, will not be killed.

Other disadvantages of UV include:

- ineffective in areas of high relative humidity,
- UV bulbs require frequent cleaning to remain effective, and
- exposure to UV rays can cause skin and eye burns.
Sterilization

As a consequence, UV irradiation is neither a practical nor effective method for disinfecting instruments and other items in most situations (Riley, 1989).

Chemical Sterilization with Paraformaldehyde

Paraformaldehyde, a solid polymer of formaldehyde, may be vaporized by dry heat in an enclosed area to disinfect or sterilize objects (Taylor et al., 1969). Recently, a new technique called "self-sterilization" has been patented (Tulis, 1973). This process is especially well suited for sterilizing endoscopes (laparoscopes) and currently is being evaluated as a practical, inexpensive alternative to other chemical sterilants.
REFERENCES


HIGH-LEVEL DISINFECTION

BACKGROUND

Sterilization is the safest and most effective method for processing instruments which come in contact with the blood stream or tissue beneath the skin. Often, however, sterilization equipment is either not available or not suitable. When sterilization is not possible or not suitable, high-level disinfection (HLD) is the only acceptable alternative. For both processes, however, the preparatory steps and post procedure handling must be properly done.

HLD can be achieved by boiling in water or soaking instruments in various chemical disinfectants. To be effective, disinfection procedures must be monitored carefully.

DEFINITIONS

- **Disinfection** is the process that eliminates most, but not all disease-causing microorganisms.

- **High-level disinfection** will destroy all microorganisms (including vegetative bacteria, tuberculosis, yeasts and viruses) except some bacterial endospores. Objects that have undergone HLD are safe to touch broken skin or intact mucous membranes.

HIGH-LEVEL DISINFECTION BY BOILING

Boiling water is an effective, practical way to provide high-level disinfection of instruments and gloves which contact mucous membranes, and to disinfect equipment and instruments for invasive procedures when sterilization cannot be done. Although boiling instruments in water for 20 minutes will kill all vegetative forms of bacteria, viruses (including hepatitis B and AIDS), yeasts and fungi, boiling will not reliably kill all endospores and thus will not achieve sterilization.
Essentially all vegetative forms of bacteria are killed by moist heat at temperatures of 60-75°C within 10 minutes (Salle, 1973). Hepatitis B is inactivated when boiled for 2 minutes at 98°C (Kobayashi et al, 1984), and is probably inactivated in 10 minutes when heated to 80°C (Russell et al, 1982). By contrast, although many types of spores are killed when boiled at 99.5°C for 20 to 30 minutes (Williams and Zimmerman, 1951), *Clostridium tetani* spores are quite resistant and can survive boiling for 15 to 90 minutes (Spaulding, 1939).

The highest temperature that boiling water will reach is 100°C (212°F) at sea level. Because the boiling point of water is 1.1°C lower for each 1,000 feet in altitude, it is best to boil items to be disinfected for a minimum of 20 minutes. This provides a margin of safety for variations in altitude up to 5,500 meters (18,000 ft) and at the same time eliminates risk of infection from some, but not all, endospores (Favero, 1985).

**Note:** Contaminated (soiled) instruments should be decontaminated and thoroughly cleaned before disinfection. Because items being high-level disinfected cannot be packaged prior to disinfection, it is extremely important to avoid recontamination of instruments and equipment before use.

---

**Remember:** Avoid HLD for needles, syringes and scalpels when dry heat or steam sterilization is available.

---

**Instructions**

**STEP 1:** Decontaminate and clean all instruments or equipment to be disinfected.

**STEP 2:** Completely submerge precleaned objects in the water. Adjust the water level so that there is at least 2.5 cm (1 inch) of water above the instruments. Water must touch all surfaces to be disinfected.
High-Level Disinfection

Make sure all bowls and containers to be boiled are full of water. Utensils which turn bottom side up may contain air pockets which will not reach the required temperatures to kill microorganisms.

**Note:** For items which float in water (e.g., plastic syringes or rubber items):

- place items in a bag made of plastic netting or nylon netting. Cotton bags are less desirable because they dry more slowly after use.
- place a weight in the bag (a speculum or other metal instrument will do), so that all items in the bag are at least 2.5 cm (1 inch) below the surface of the water.

**STEP 3:** Close lid over pan and bring water to a gentle, rolling boil. (When water only simmers, very little steam is formed and the temperature at the water's surface may never get high enough to kill microorganisms [Perkins, 1956]).

**STEP 4:** Start timer or note time on clock and record time rolling boil begins. **No objects or water should be added after timing starts.**

**STEP 5:** Lower heat to keep water at a rolling boil. (Too vigorous boiling wastes fuel, evaporates the water and may damage equipment.)

**STEP 6:** Boil instruments for 20 minutes starting from the time rolling boil begins.

**STEP 7:** After boiling for 20 minutes, remove objects and netted bag with previously HLD, dry forceps/pickups. Never leave boiled instruments in water which has stopped boiling. (As the water cools and steam condenses, air and dust particles are drawn down into the container and may contaminate the instruments [Perkins, 1956].)
STEP 8: Air dry disinfected items in a clean area of the room, away from flying insects, dust particles and contaminated surfaces. (If a netted bag is used for gloves, remove the bag with previously HLD, dry forceps, shake several times to remove excess water, then hang the bag to dry. The netted bag will permit the gloves to dry quickly without being handled.)

Note: See Appendix A for more specific information on how to dry boiled gloves.

STEP 9: Use objects immediately or use previously disinfected forceps (or wear HLD gloves) to place objects in a covered, dry, HLD container. Store for up to one week. Avoid recontamination of objects before use.

Advantages

- Excellent, inexpensive procedure
- Easily controlled
- Requires no dilutions and leaves no chemical residue
- Heat source, pan and water are commonly available

Disadvantages

- Must be correctly performed to ensure effectiveness (i.e., timing started only after water has reached a rolling boil and no items added after timing has started).
- Objects cannot be packaged prior to disinfection; therefore, there is a greater chance of recontamination.
- Requires fuel source which may be unreliable.
PREPARING AN HLD CONTAINER:

To prepare an HLD container, boil (if small), or fill it with 0.5% chlorine solution and soak for 20 minutes. (The chlorine solution can be transferred to a plastic container and reused.) Rinse thoroughly with boiled water, then air dry before use.

PROTECTING THE LIFE OF INSTRUMENTS WHICH ARE FREQUENTLY BOILED (Perkins, 1956)

Lime deposits may form on metal instruments which are frequently boiled. This scale formation, caused by lime salts in the water, is difficult to avoid. By following these steps, the problem of lime deposits can be minimized:

STEP 1: Boil the water for 10 minutes at the beginning of each day before use. (This precipitates much of the lime in the water before objects are added.)

STEP 2: Use the same water throughout the day, adding only enough to keep the surface at least one inch above equipment to be disinfected. (Frequent draining and replacing water, and boiling too vigorously increases the risk of lime deposits on instruments.)

STEP 3: Drain and clean the boiler or pan at the end of each day to remove lime deposits in the boiler. In addition, standing water promotes the growth of bacteria and algae.

Remember: To prevent damage to delicate surgical instruments, do not boil too vigorously! A rolling (gentle) boil is sufficient and will not cause instruments or other items to be bounced around and possibly damaged by striking the sidewalls of the boiling pot or other instruments.
HIGH-LEVEL DISINFECTION BY CHEMICALS

Endoscopes (laparoscopes) and other instruments that would be damaged by boiling can safely undergo HLD using chemical disinfectants such as gluteraldehydes and formaldehyde. A variety of chemical disinfectants are available worldwide. Table 7-1 provides guidelines for preparing and using a number of these disinfectants. Although alcohols and iodophors are inexpensive and readily available, they are not classified as HLDs. (Alcohols do not kill some viruses, and Pseudomonas species, a group of Gram-negative bacteria, have been known to multiply in iodophors.) They should be used for disinfection only when HLDs are not available.

Note: Chemical disinfection of needles and syringes should be avoided because chemical residues, unless completely removed by rinsing, may interfere with the action of medications being injected.

The major advantages and disadvantages of these disinfectants are:

- **Alcohols.** Alcohols are not corrosive to metal and can be used to disinfect rubber or latex items, as well as plastic items. The major disadvantages are that alcohols may be unable to penetrate organic material, may damage the shellac mountings of endoscopes, rapidly evaporate, do not kill some viruses, and may be expensive if imported (INTRAH, 1989).

- **Chlorine Solutions.** Chlorine solutions are fast-acting, very effective against hepatitis B and AIDS viruses, inexpensive and readily available (WHO, 1989 and CDC, 1987). They are extremely useful for decontaminating large surfaces such as examination tables. A major disadvantage is that chlorine solutions can corrode metals; however, stainless steel instruments can be safely soaked using a plastic container in 0.5% chlorine solution for up to 20 minutes. If then rinsed and dried promptly, corrosion is not a problem. Because chlorine solutions deteriorate rapidly, fresh solutions should be made at least daily or more often if the solution is visibly cloudy. WHO (1989) recommends 0.5% solution for decontaminating surface; injured instruments before cleaning or when potable water is not available for making the solution. For HLD disinfection, a 0.1% chlorine solution is satisfactory provided boiled water is used for dilution.
<table>
<thead>
<tr>
<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 Life¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol Ethyl Isopropyl “Methylated spirit”</td>
<td>60-90%</td>
<td>Use full strength</td>
<td>Yes (can dry skin)</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Do not use²</td>
<td>Do not use</td>
<td>Change weekly; daily if heavily used; sooner if cloudy</td>
</tr>
<tr>
<td>Chlorine</td>
<td>0.5%</td>
<td>Dilution procedures vary³</td>
<td>Yes (with prolonged contact)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>20 minutes</td>
<td>Do not use</td>
<td>Change daily; sooner if cloudy</td>
</tr>
<tr>
<td>Formaldehyde (35-40%)</td>
<td>8%</td>
<td>1 part 35-40% solution to 4 parts boiled water</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>20 minutes</td>
<td>24 hours</td>
<td>Change every 14 days</td>
</tr>
<tr>
<td>Glutaraldehyde Cidex® Sporicidin®</td>
<td>Varies</td>
<td>Varies: read instructions on container</td>
<td>Yes</td>
<td>Yes vapors</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>20 mins. at or above 25°C</td>
<td>10 hours for Cidex</td>
<td>Change every 14 days; sooner if cloudy</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20 mins. at or above 20°C</td>
<td>Do not use Sporicidin</td>
<td></td>
</tr>
<tr>
<td>Hydrogen Peroxide (30%)</td>
<td>6%</td>
<td>1 part 30% solution to 4 parts boiled water</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>30 minutes</td>
<td>Do not use</td>
<td>Change daily; sooner if cloudy</td>
</tr>
<tr>
<td>Iodophors (10% povidone iodine-PVI)</td>
<td>Approximately 2.5%</td>
<td>1 part 10% PVI to 3 parts water</td>
<td>No⁵</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Do not use²</td>
<td>Do not use</td>
<td>Change daily</td>
</tr>
</tbody>
</table>

¹ All chemical disinfectants are heat and light sensitive and must be stored appropriately. 
² Alcohol and iodophors are not HLDs; however, they can be used as intermediate-level disinfectants. For this purpose, soak for 20 minutes. 
³ See Table 5-1 for instructions on preparing chlorine solutions. 
⁴ Different commercial preparations of Cidex and other glutaraldehydes (e.g., Wasicide) are effective at lower temperatures (20°C) and have a longer activated shelf life (always check manufacturers instructions). 
⁵ Except in people with allergies to iodophors.

Source: Adapted from Wenzel, 1987
High-Level Disinfection

- **Formaldehyde.** Eight percent formaldehyde, which can be used as a chemical sterilant, is also an effective high-level disinfectant (HLD), but is highly toxic. Care must be taken to protect both staff and clients from the fumes when mixing and using formaldehyde solutions. **Do not dilute with chlorinated water, as a dangerous gas (bis-chloromethyl-ether) can be produced.**

- **Glutaraldehyde.** Glutaraldehydes, which also can be used for chemical sterilization, are effective HLDs as well. Although less irritating than formaldehyde, they too should be used in well-ventilated areas. Avoid skin contact by using gloves and taking care not to splash the solution.

Because both glutaraldehyde and formaldehyde (formalin) solutions leave a residue, instruments must be rinsed well after disinfecting with these solutions to prevent skin irritation and remove residue.

- **Iodophors.** Iodophors (solutions of iodine mixed with a solubilizing agent) are usually readily available locally. Povidone iodine (PVI) is a commonly available iodophor, usually sold as 10% solution (1% iodine). They are no longer classified as HLDs because *Pseudomonas* species have been isolated from iodophor solutions as contaminants; therefore, they should not be used for disinfecting bulk-packaged, inert (plastic) IUDs and their reusable inserters. Iodophors are good for disinfecting stainless steel equipment.

- **Hydrogen Peroxide.** Hydrogen peroxide (H\textsubscript{2}O\textsubscript{2}), which must be diluted to 6% solution, often is available locally and may be less expensive than other chemical disinfectants. (The 3% H\textsubscript{2}O\textsubscript{2} solutions used as antiseptics should not be used for disinfection.) The major disadvantage of H\textsubscript{2}O\textsubscript{2} are that it is corrosive and should not be used to disinfect copper, aluminum, zinc or brass. Also, it loses potency rapidly when exposed to heat and light, so it needs to be stored carefully. **WHO (1989) does not recommend using H\textsubscript{2}O\textsubscript{2} in tropical environments because of its instability in the presence of heat and light.**
High-Level Disinfection

Detailed information and instructions for preparing and using each of these chemical disinfectants (advantages and disadvantages), are presented in Appendix F.

### Key Steps in Chemical Disinfection

- Decontaminate all equipment and instruments that have been contaminated with blood and body fluids; thoroughly clean and dry all equipment and instruments.

- Cover all items completely with correct dilution of properly stored disinfectant.

- Soak for 20 minutes.

- Rinse well with boiled water and air-dry.

- Store for up to one week in a high-level disinfected (HLD), covered container or use promptly. To prepare an HLD container, boil (if small) or fill it with 0.5% chlorine solution and soak for 20 minutes. (The chlorine solution can then be transferred to a plastic container and reused.) Rinse the inside thoroughly with boiled water. Air dry before use.

**Source:** Adapted from Tietjen and McIntosh, 1989.

### Storage of Disinfectants

- 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).

### Disposal of Used Chemical Containers

- Rinse glass container thoroughly with water. Glass containers may be washed with detergent, rinsed, dried, and re-used.

- For plastic containers used for toxic substances such as glutaraldehyde (e.g., Cidex®), rinse three times with water and dispose by burial.
Note: The content of these containers are toxic. Containers must not be reused for other purposes.

Products That Should Not be Used as Disinfectants

While antiseptics (sometimes called skin disinfectants) are adequate for cleaning the skin before an injection or surgical procedure, they are not appropriate for disinfecting surgical instruments and gloves. They do not reliably destroy all bacteria and viruses and do not destroy bacterial endospores. For example, Savlon® (cetrimide with chlorhexidine gluconate), which is readily available worldwide, is an acceptable antiseptic but is often mistakenly used as a disinfectant.

Products that should not be used as high-level disinfectants are:

- acridine derivatives (e.g., gentian or crystal violet),
- benzalkonium chloride, a quaternary ammonium (e.g., Zephiran®),
- cetrimide (e.g., Cetavlon®),
- cetrimide with chlorhexidine gluconate (e.g., Savlon®),
- chlorinated lime and boric acid (e.g., Eusol®),
- chlorhexidine gluconate (e.g., Hibiscrub®, Hibtane®),
- chloroxylenol (e.g., Dettol®)
- hexachlorophene (e.g., Phisohex®), and
- mercury compounds (toxic and not recommended as an antiseptic or a disinfectant).

Mercury solutions (such as mercury laurel), although low-level disinfectants, cause birth defects and are too toxic to use as either disinfectants or antiseptics. (See Appendix C for details.)

Other products frequently used to disinfect equipment are 1 - 2% phenol (e.g., Phenol®) and Lysol® (5% carbolic acid). Phenolics and carbolic acid are low-level disinfectants and should be used only to decontaminate environmental surfaces when chlorine solutions are not available.

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REFERENCES


BACKGROUND

The material in this section focuses on ways to provide a safe, infection-free environment in family planning and health care settings by minimizing traffic flow and activity patterns.

The primary objective of this section is to assist service providers and clinic managers in understanding how to reduce the level of microbial growth and contamination in the general clinic environment, as well as in specialized areas such as examining, minor procedure and operating rooms (ORs).

TRAFFIC FLOW AND ACTIVITY PATTERNS

The number of microorganisms in a designated area tends to be related to the number of people present and their activity (Russell, 1982). For example, microbial contamination is expected to be high in areas of heavy traffic, such as waiting rooms and areas where used (soiled) surgical instruments and other equipment are initially processed. An important goal of infection prevention is to minimize the level of microbial contamination in areas where "clean activities" take place. These include:

- **Procedure areas** where clients are examined, IUDs inserted and removed, injections given, Norplant® implants inserted and removed, and vasectomies performed.

- **Surgical areas** where minilaparotomy, laparoscopy and other ambulatory surgical procedures are performed. (Surgical areas also include pre-operative, staging, and recovery rooms.)

- **Work areas** for disinfecting, sterilizing and storing instruments, gloves and equipment.
Traffic Flow

*Microbial contamination can be minimized by reducing the number of people permitted into these areas and by defining the activities which take place there.* In addition, the traffic flow and activity patterns in health care facilities providing ambulatory surgical procedures should be designed so that clean and contaminated areas are separated as much as possible.

*Separate rooms* should be available in the facility for performing client examinations and minor surgical procedures, such as IUD insertion, ambulatory surgical procedures (minilaparotomy and laparoscopy), and for processing instruments and equipment. The latter must be designed so that soiled objects never cross paths with cleaned, disinfected or sterilized items.

**SPACE AND EQUIPMENT REQUIREMENTS**

Health care facilities vary in the family planning services provided. For example, a rural clinic may offer only reversible contraceptive methods including IUDs and injectables. On the other hand, larger facilities (surgicenters or hospitals), also may provide ambulatory surgical procedures such as interval and postpartum minilaparotomy. *Regardless of the type of services offered, however, specific space and equipment requirements remain the same for each procedure.*

In clinics where minor surgical procedures such as IUD insertion and removal are performed, a *procedure room* (for examining clients and providing services) is required to minimize risk of microbial contamination. Also, a separate room with at least one sink for processing instruments and equipment is desirable.

The space requirements for performing Norplant insertion and removal and vasectomy are similar to those for other minor surgical procedures. However, because it is recommended that instruments and equipment for these procedures be sterilized, a separate area for final processing (sterilization) is desirable, especially if the volume of services is high (5 or more procedures per day). Ideally, the processing area should include more than one room. If only a single room is available, receiving and cleaning used (contaminated) equipment should be done in an area of the room well away from where equipment is sterilized or high-level disinfected. (Suggested floor plans are diagramed in Figure 8-1.)
Ambulatory surgical procedures, including minilaparotomy and laparoscopy, are usually performed only in larger facilities (surgicenters and hospitals). These procedures have special space and equipment requirements which include:

- a processing area for further decontaminating, cleaning, sterilizing or high-level disinfecting instruments (autoclave or dry heat sterilizer);
- space for storing sterile packs and containers with disinfected instruments;
- an operating room, as well as a separate staging area, where clients are examined and evaluated prior to surgery;
- a recovery area for patient observation after surgery; and
- a changing room and scrub area.

Figure 8-1: Floor Plan for Instrument and Equipment Cleaning, Disinfecting and Sterilizing area in a Family Planning Clinic.

Design for small clinic with minimal service space available

Design for larger facility or where volume is greater

Source: Adapted from SEARO/WHO, 1988.
Table 8-1: Space Requirements for a Family Planning or Health Care Facility

<table>
<thead>
<tr>
<th>Services Provided</th>
<th>Procedure Room</th>
<th>Operating Room, Staging and Recovery, Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pills, condoms and spermicides</td>
<td>not necessary</td>
<td>not necessary</td>
</tr>
<tr>
<td>IUDs, injectables</td>
<td>yes</td>
<td>not necessary</td>
</tr>
<tr>
<td>Norplant, vasectomy</td>
<td>yes</td>
<td>not necessary</td>
</tr>
<tr>
<td>Minilaparotomy, laparoscopy</td>
<td>not</td>
<td>recommended</td>
</tr>
</tbody>
</table>

MINIMIZING MICROBIAL CONTAMINATION

The recommended infection prevention practices for minimizing microbial contamination of specific "clean areas" in family planning or health care facilities are briefly described below.

Minor Procedure Area

- At all times, limit entry to only authorized personnel and clients.
- Close doors and curtains during all procedures.
- During procedures, only the client and those persons who are assisting with procedures should be permitted in the procedure room.
- During procedures, have available a covered bucket of 0.5% chlorine solution, or other locally available and approved disinfectant, for immediate decontamination of instruments and other items once they are no longer needed.
- During procedures, have available a leak-proof covered container for disposal of contaminated waste items (cotton, gauze, old dressings).
Provide a puncture-resistant container for safe disposal of used needles and other sharps (e.g., disposable scalpel blades).

Equip procedure room with storage space for clean, high-level disinfected (HLD) and sterile supplies. Storage shelves should be enclosed to minimize dust and debris falling on packages, containers for HLD items and sterile packs.

Surgical Area

The surgical area often is divided into two designated areas (defined by the activities performed: surgical support and operating rooms).

- At all times, limit entry to authorized personnel and clients.
- Personnel should enter the surgical area through a clothes changing room.
- Personnel dress: clean cover gown, cap, and shoe covers or shoes not worn outside the surgical area.
- Client dress: clean clothes or gown, and if possible, cover hair or head. (Hair sheds skin cells which are contaminated with numerous microorganisms.)

Surgical Support Room

This room is the entry or support area for the operating room and can include a surgical scrub area.

- Keep doors closed at all times.
- Keep the surgical scrub area clean and dry (standing water promotes the growth of microorganisms).
- Equip the support room with storage space for clean and sterile or HLD supplies. Storage shelves should be enclosed to minimize dust and debris falling on packages, containers for HLD items and sterile packs.
Traffic Flow

Operating Room

- Keep the door closed at all times, and keep the operating room locked when not in use. **Never use as a storeroom.**

- Equip the operating room with a tile or concrete floor and walls that can be easily cleaned.

- Enclose the operating room to minimize dust and eliminate flies. Air conditioning is preferred. If windows must be opened for ventilation, provide tight fitting screens.

- Provide adequate lighting.

- Locate away from areas of the clinic which are heavily traveled by staff and clients. **Never use the operating room as a thoroughfare.**

During Surgical Procedures:

- Permit only those persons who are assisting with procedures in the operating room. Make the surgical team self-sufficient, so that outside help is not required.

- Keep doors closed at all times (to keep unauthorized persons out, and minimize movement and air flow).

- Keep number of people and movement to a minimum - numbers of microorganisms increase with activity.

- Have available a covered bucket of 0.5% chlorine solution, or other locally available and approved disinfectant, for immediate decontamination of instruments and other items once they are no longer needed.

- Have available a leak-proof covered container for contaminated waste items (cotton, gauze, old dressings).
● Personnel dress: wear mask (covering entire nose) in addition to clean cover gown, cap, and shoe covers or shoes not worn outside the surgical area.

Central Supply Area

In hospitals or health care facilities where minilaparotomy and laparoscopy are performed, processing of used (contaminated) instruments and equipment often is done in a Central Supply Department (CSD) by specially trained staff. Although a properly functioning CSD is the best place for cleaning, sterilizing, storing and issuing instruments and equipment, as described previously, these procedures can be satisfactorily performed in other areas of the hospital or clinic.

Prior to transporting used (soiled) surgical instruments, gloves, and other contaminated items to the CSD, they should be placed in a decontamination container (plastic bucket) of 0.5% chlorine solution, or other locally available and approved disinfectant, at the location (procedure or operating room) where they were used. (Brief, 10 minute immersion in 0.5% bleach solution inactivates hepatitis B and AIDs viruses and renders the items safer for cleaning staff to handle.) The container should then be covered and transported to the CSD or designated instrument and equipment processing area. Alternatively, all soiled instruments can be gathered in the sterile wrap and transported to the CSD where they can be decontaminated before further processing.

Central Supply Department (CSD)

A suggested floor plan for a CSD is diagramed in Figure 8-2. In the CSD:

● Permit only authorized personnel to enter.

● Separate the receiving/clean-up area (1) from the clean work area (2) with a physical barrier (wall and door). If this is not possible, use a screen or paint a red line on the floor to designate area separation.
Traffic Flow

Figure 8-2: Floor Plan for a Central Supply Department.

Note: Objects which are potentially contaminated should never cross paths with items which are clean, disinfected or sterile.
The function and equipment requirements for the four divisions of a typical CSD are briefly summarized below.

**Receiving/Clean-Up Area (1)**

In this area soiled items are:

- received;
- decontaminated (if not done in procedure or operating room);
- disassembled; and
- cleaned (washed and rinsed) and dried.

Equip the receiving/clean-up area with:

- a receiving counter and decontamination counter (if necessary);
- if possible, two sinks (one for cleaning and one for rinsing) with an adequate water supply; and
- a clean equipment counter.

**Note:** Process gloves separately from other objects to prevent damage and tears.

**Note:** Personnel in the receiving/clean-up area should wear a plastic apron, utility gloves and, if available, safety goggles to protect from spills and splashes.

**Clean Work Area (2)**

In the clean work area, cleaned items are:

- inspected for flaws or damage;
- packaged (if indicated), and either sterilized or high-level disinfected; and
- sent for storage as packaged or air dried and placed in a sterile or HLD container.
Traffic Flow

Equip the clean work area with:

- a large work table;
- shelves for holding clean and package items; and
- autoclave, hot air oven and/or boiler.

Note: Persons entering the clean work area should wear a clean cover gown.

Clean Equipment Storage Area (3)

Store clean equipment in this area. CSD staff also should enter the CSD through this area. Equip the area with:

- shelves for storing clean equipment; and
- an office desk for record keeping.

Sterile or HLD Storage Area (4)

Store sterilized packs and covered sterile or HLD containers in a separate area of the central sterile supply area. Do not store unwrapped objects. (Unwrapped objects must be used immediately.)

- Mark expiration date on sterile packs and containers used for storing disinfected items. Store packs and sterile or HLD containers for up to one week. (Sterilized packs sealed in a plastic bag can be stored for one month.)

- Reprocess objects which are not used within one week. (Remember: Linen must be rewashed before autoclaving again.)

- Equip the storage area with enclosed shelves to protect them from dust and debris.

- Dispense sterile and HLD articles from this area. (Cover all items to be carried out of the CSD.)
• Packs and containers with sterile or HLD items should be stored off the floor.

• Do not use cardboard boxes for storage. (Cardboard boxes shed dust and debris and may harbor insects.)

Handling and Transport of Clean and Soiled Items

• Keep clean and HLD or sterile supplies separate from soiled equipment and waste. (Do not transport or store together.)

• Transport HLD and sterile instruments, equipment and linens to the procedure and operating rooms with a cover to prevent contamination.

Note: If supplies are being delivered to the surgical area, one person standing outside should pass them through the door to a person on the inside.

• Remove supplies from all shipping cartons and boxes before bringing supplies into the procedure room, the operating room or the clean work area of the CSD. (Shipping boxes shed dust, harbor insects and may contaminate these areas.)

• Transport soiled (used) supplies and instruments to the receiving/clean-up area of the CSD in covered, leak-proof decontamination buckets.

• Transport contaminated waste in covered, leak-proof waste containers to the disposal site.

For proper handling and disposal of waste items, see Chapter 9: W Disposal.
REFERENCES


WASTE DISPOSAL

BACKGROUND

Wastes from family planning and health care facilities may be non-contaminated or contaminated. **Non-contaminated wastes** pose no infectious risk to persons who handle them. Examples of non-contaminated waste include paper, trash, boxes, bottles and plastic containers which house products delivered to the clinic. Much waste from health care facilities, however, is contaminated. **Contaminated wastes** may carry high loads of microorganisms which are potentially infectious to any persons who contact or handle the waste and to the community at large, if not disposed of properly. Contaminated wastes include blood, pus, urine, stool and other body fluids; and items which contact them such as used dressings. Wastes from operating rooms and laboratories should be considered contaminated. In addition, contaminated wastes may include items which are capable of inflicting injury (e.g., used needles and scalpel blades) and are capable of spreading blood-borne diseases like hepatitis B and AIDS.

Proper handling of waste items minimizes the spread of infection to clinic personnel and to the local community. Where available, non-contaminated wastes should be transported to disposal sites in covered containers. Persons handling wastes should wear heavy gloves. Contaminated clinic wastes should be incinerated (burned) or buried. **Incineration** provides high temperatures and destroys microorganisms; and therefore, is the best method for disposal of contaminated wastes. Incineration also reduces the bulk size of wastes to be buried. **If incineration is not possible, all contaminated wastes must be buried** to prevent scattering the waste materials.

The purpose of proper disposal of clinic wastes is to:

- prevent spread of infection to clinic personnel who handle the waste and to the local community,
- protect those who handle wastes from accidental injury, and
- provide an aesthetically pleasing atmosphere.
Note: Open piles of waste should be avoided because they:

- pose infection risks and fire hazards,
- produce foul odors,
- attract insects, and
- are unsightly.

TIPS FOR HANDLING WASTE CONTAINERS

- Use non-corrosive washable containers (plastic or galvanized metal) with covers for contaminated wastes.

- Place waste containers at convenient places for users (carrying waste from place to place increases the risk of infection for handlers).

- Equipment which is used to hold and transport wastes must not be used for any other purpose in the clinic or health care facility. (Contaminated waste containers should be marked as such.)

- Wash all waste containers with a disinfectant cleaning solution (0.5% chlorine solution) and rinse with water. (Clean contaminated waste containers each time they are emptied and non-contaminated ones when visibly soiled.)

- When possible, use separate containers for combustible and non-combustible wastes. (This prevents workers from having to handle and separate wastes by hand later.)

  - **Combustible (burnable) wastes** include paper, cardboard, and contaminated wastes such as used dressings and gauze.

  - **Non-combustible (non-burnable) wastes** include glass, metals and plastics.

- If available, use heavy work gloves when handling wastes.

- Wash hands after handling wastes.
HOW TO DISPOSE OF SHARP OBJECTS (needles, razors and scalpel blades)

STEP 1. Wear thick, household gloves.

STEP 2. Dispose of all sharp items in a puncture-resistant container. Puncture-resistant containers can be made of easily available objects such as a heavy cardboard box, a tin can with lid, or a heavy plastic bottle. Old glass intravenous fluid bottles may also be used for "sharps", but there is a risk of breakage.

Note: Place the container close to the area where it will be used so that workers do not have to carry sharp items any distance before disposal.

Note: Avoid accidental needlesticks; do not bend or break needles prior to disposal. Needles should not be recapped routinely, but if necessary, a one-handed recap method should be used:

- First, place cap on a hard, flat surface, then remove hand.
- Next, with one hand, hold syringe and use needle to "scoop-up" cap.
- Finally, when cap covers needle completely, use other hand to secure cap on needle.

STEP 3. When the "sharps" container is 3/4 full; cap, plug or tape it tightly closed.

STEP 4. Dispose of container when 3/4 full by burying. (Needles and other sharp objects may not be destroyed by burning, and may later cause injuries which can lead to a serious infection. Incineration or burning in a container, however, does make those items less scavengerable.)

STEP 5. Wash hands after handling sharps containers and decontaminate and wash gloves.
Waste Disposal

HOW TO DISPOSE OF LIQUID CONTAMINATED WASTES (blood, feces, urine, and other body fluids)

STEP 1: Wear thick household (utility) gloves when handling and transporting wastes.

STEP 2: Carefully pour wastes down a utility sink drain or into a flushable toilet. Liquid wastes can also be poured into the latrine. Avoid splashing.

STEP 3: Rinse the toilet or sink carefully and thoroughly with water to remove residual wastes. Avoid splashing.

STEP 4: Decontaminate specimen container with 0.5% chlorine solution, or other locally available and approved disinfectant, by soaking for 10 minutes before washing.

STEP 5: Wash hands after handling liquid wastes and decontaminate and wash gloves.

HOW TO DISPOSE OF SOLID WASTES (used dressings and other items contaminated with blood and organic materials)

STEP 1: Wear thick household (utility) gloves when handling and transporting wastes.

STEP 2: Dispose of solid wastes in non-corrosive washable containers (plastic or galvanized metal) with tight fitting covers.

STEP 3: Collect the waste containers on a regular basis and transport the combustible ones to the incinerator. (If incineration is not available, burn or bury.) Bury non-combustible waste.

STEP 4: Wash hands after handling wastes, and decontaminate and wash gloves.

Note: Incinerate (burn) or bury waste immediately before it can spread into the environment. Incineration is the best method to kill microorganisms.
HOW TO DISPOSE OF USED CHEMICAL CONTAINERS

STEP 1: Rinse glass containers thoroughly with water. Glass containers may be washed with detergent, rinsed and reused.

STEP 2: For plastic containers which contained toxic substances such as glutaraldehyde (e.g., Cidex® or Sporicidin®), rinse three times with water and dispose by burial. Do not reuse these containers for other purposes.

HOW TO BUILD A SIMPLE DRUM INCINERATOR FOR WASTE DISPOSAL (SEARO, 1988)

STEP 1: Select a site downwind from the clinic.

STEP 2: Build a simple incinerator using local materials (mud or stone) or a used oil drum. The size depends on the amount of daily waste collected.

STEP 3: Place the burner on hardened earth or a concrete base.

STEP 4: Make sure the incinerator has:

- Sufficient air inlets underneath for good combustion
- Loosely placed fire bars to allow for expansion
- An adequate opening for adding fresh refuse, and for removal of ashes
- A long enough chimney to allow for a good draught and evacuation of smoke

STEP 5: Burn all combustible wastes, such as paper and cardboard, as well as used dressings and other contaminated wastes.

STEP 6: If the waste or refuse is wet, add kerosene so that a hot fire burns all the waste.

STEP 7: Ash from incinerated material can be treated as non-contaminated waste.
Waste Disposal

Figure 9-1: Design for a Simple Oil Drum Incinerator

Source: Adapted from SEARO, 1988

Note: Open burning is not recommended, because it results in scattering of waste, is dangerous and unsightly. If open burning must be done, burn in a small, designated area, transport wastes to the site just before burning, and remain with the fire until it is out.
HOW TO MAKE AND USE A BURIAL SITE FOR WASTE DISPOSAL (SEARO, 1988)

STEP 1: Bury in a specified location.
- Select a site at least 50 meters away from any water source, to prevent contamination of the water table.
- The site should have proper drainage, be located downhill from any wells, and free of standing water.
- Make certain the burial site is not in an area which floods.

STEP 2: Dig a pit 1 meter (3 - 4 feet) wide and 2 meters (6 feet) deep. The bottom of the pit should be 6 feet above the water table.¹

STEP 3: Cover with 15 - 30 cm (6 - 12 in) of earth each day. (Final cover should be 30 cm (24 in) deep.

STEP 4: Fence the site to keep animals and children away.

REFERENCES


¹Burial can only be used as a method of waste disposal where the water table is more than 12 feet below the surface.
TEN

HOUSEKEEPING

BACKGROUND

Housekeeping refers to the general cleaning of the clinic environment which includes floors, walls, tables and other surfaces. General housekeeping is important in order to:

- reduce the number of microorganisms which may come in contact with clients or staff;
- reduce the risk of accidents through prevention of falls; and
- provide a pleasant atmosphere.

Cleaning methods should be determined by the type of surface, the amount and type of organic matter present, and the purpose of the area. Most areas of the clinic can be cleaned with detergent and water (low-risk areas such as waiting rooms and administrative areas). In high-risk areas where heavy contamination is expected, such as toilets and latrines, or for blood or body fluid spills, a disinfectant should be added. Using a disinfectant in addition to a detergent is also recommended in other areas of high risk, such as the operating room, staging (pre-op) and recovery area.

Note: Do not use disinfectant fogging (e.g., fumigation with Formalin) to reduce microbial contamination of environmental surfaces such as walls, ceilings and floors. Fogging may be toxic and is time consuming (requires 24 hours). Scrubbing with soap and water is a safe, quick, more effective way to reduce microbial contamination on these surfaces.

The following tips will make cleaning more effective for both low and high-risk areas of the health facility:

- Frictional cleaning (scrubbing) is the best way to remove dirt and microorganisms. Always use frictional cleaning for each procedure.
- Always wear gloves to clean heavily contaminated areas such as toilets and spills of blood and body fluids. If gloves are not available, use a plastic bag over the hand.
• Use a **damp or wet** cloth or mop for walls, floors and halls. Avoid dry sweeping and dusting as these practices spread dust, debris and microorganisms into the air and onto clean surfaces.

• Use separate equipment (brushes, cloths) for high-risk cleaning areas which are likely to be contaminated (e.g., toilets).

• Change cleaning solutions when they are obviously dirty. (The killing power of disinfectants is decreased the heavier the load of soil and organic material.)

• Clean and dry mops, brushes, cloths and other housekeeping equipment between uses. (Soiled and contaminated cleaning equipment spread microorganisms in the environment.)

• Wash from top to bottom, so that debris which falls on the floor will be cleaned-up last.

• When using disinfectants, **follow dilution instructions**. Too much or too little water may reduce the killing activity of disinfectants.

**HOW TO PREPARE A DISINFECTANT CLEANING SOLUTION**

A disinfectant cleaning solution is one that contains both a disinfectant and a detergent (soap). Although chlorine-type (sodium hypochlorite) bleaches are excellent inexpensive disinfectants, they should not be mixed with cleaning solutions containing an acid (e.g., phosphoric acid), ammonia or ammonium chloride (NH₂Cl). To do so will release chlorine gas and other chemical by-products (Figure 10-1) which could result in temporary illness in exposed persons. (Symptoms of exposure may include: Nausea, eye irritation, tearing, headache and shortness of breath; and they may persist for several hours.)

**Note:** If exposed to chlorine or ammonium chloride, unpleasant (noxious) gases with strong odors, leave the room or area immediately until ventilation (air exchange) has been completed.
Figure 10-1. Chemical reaction following mixing of sodium hypochlorite with acid or ammonia-containing cleaning products.

\[
2\text{OCl}^- + 4\text{H}^+ \rightarrow \text{Cl}_2 \text{ (gas)} + 2 \text{H}_2\text{O}
\]

or

\[
\text{NH}_3 + \text{OCl}^- \rightarrow \text{NH}_2\text{Cl} \text{ (gas)} + \text{OH}^-
\]

Instructions

STEP 1: Prepare 0.5% chlorine solution from liquid concentrates (see Table 5-1 for preparation directions) or from chlorine compounds (see Appendix F: Chemical Disinfectants). Alternative disinfectants are 1-2% phenols (e.g., Phenol®) or 5% carbolic acid (e.g., Lysol®).

STEP 2: Add enough detergent to the 0.5% chlorine solution or other disinfectant to make a mild soapy cleaning solution.

WHEN AND HOW TO CONDUCT ROUTINE CLEANING IN LOW-RISK AREAS

Establish a schedule and provide written guidelines for cleaning environmental surfaces.

- **Walls and ceilings** - Wipe when visibly dirty with a damp cloth, detergent and water. In general, routine damp dusting is adequate for these areas (disinfection is unnecessary). (These surfaces are rarely heavily contaminated with microorganisms, as long as the surfaces remain dry and intact [Russell, 1982].)

- **Chairs, lamps, tabletops and counters** - Wipe daily and whenever visibly soiled with a damp cloth, detergent and water. A disinfectant should be used when contamination is expected, such as for blood spills as described below.
**Floors** - Clean floors frequently (twice each day, and as needed) with a damp mop, detergent and water.

**Sinks** - Use a disinfectant cleaning solution; scrub frequently (daily or more often as needed) with a separate cloth or brush. Rinse with water.

**Toilets and latrines** - Wear gloves. Use a disinfectant cleaning solution; scrub frequently (daily and more often as needed) with a separate cloth or brush. (Toilets and latrines carry heavy microbial contamination.)

**Waste containers** - Wear gloves. Use a disinfectant cleaning solution; scrub to remove soil and organic material. Clean contaminated waste containers after emptying each time. Clean non-contaminated waste containers when visibly soiled and at least once a week.

**WHEN AND HOW TO CLEAN THE OPERATING ROOM**

- Total cleaning of the operating room (scrubbing all surfaces top to bottom) should be done at the end of each day.

- Total cleaning is not necessary between each case for clean surgical procedures.

- At the beginning of each day all surfaces (table, lights, etc.) should be damp wiped or mopped to remove dust and lint which may have collected overnight.

**Total Cleaning**

**STEP 1:** Remove covered decontamination bucket and transport to central supply or processing room. A fresh bucket containing 0.5% chlorine solution, or other locally available and approved disinfectant, should be provided at the beginning of each day and as necessary.
Housekeeping

STEP 2: Remove covered contaminated waste container and replace with a clean container. Transport for incineration or burial as soon as possible.

STEP 3: With a cloth soaked in disinfectant cleaning solution, wipe down all surfaces, including counters, table tops, sinks, lights, etc. Wash from top to bottom, so that debris which falls on the floor will be cleaned-up last.

- **Walls and ceilings:** Wipe with a damp cloth, detergent and water as needed for visible soil. **If walls and ceilings are deteriorating or damp,** cover with clean cloth or plastic sheet during procedures.

- **Lamps, chairs, sinks, tabletops and counters:** Wipe with a damp cloth and disinfectant cleaning solution.

- **Operating room lamp:** Wipe with a damp cloth and disinfectant cleaning solution.

- **Operating table:** Decontaminate top with 0.5% chlorine solution. Clean sides, base and legs with a damp cloth and disinfectant cleaning solution.

- **Floors:** Clean with a **damp** mop, detergent and water.

**Note:** Do not dry sweep the operating room. This causes dust, debris and microorganisms to rise and contaminate clean surfaces.

**Between each client,** do the following:

STEP 1: **Operating and instrument tables (trolley or Mayo stand):** Decontaminate with a cloth dampened with 0.5% chlorine solution and rinse with clean water.

STEP 2: **Spills:** Clean spills with 0.5% chlorine solution or other locally available and approved disinfectant (see below).
Note: After clients with infections, do total cleaning. No additional measures are necessary.

Remember: Remove covered contaminated waste container when 3/4 full and transport to be incinerated or buried. Replace with clean container.

HOW TO CLEAN SPILLS OF BLOOD AND OTHER ORGANIC MATERIAL

Clean spills of blood, body fluids and other potentially infectious fluids immediately.

- For small spills, wear gloves. Remove visible material using a cloth soaked in 0.5% chlorine solution.

- For large spills, wear gloves. Flood the area with 0.5% chlorine solution, mop up solution, then clean as usual with detergent and water.

HOW TO CLEAN SOILED AND CONTAMINATED CLEANING EQUIPMENT

STEP 1: Decontaminate cleaning equipment which has been contaminated with blood or body fluids by soaking for 10 minutes in 0.5% chlorine solution or other locally available and approved disinfectant.

STEP 2: Wash cleaning cloths, brushes and mops in detergent and water daily or sooner if visibly dirty.

STEP 3: Rinse in clean water.

STEP 4: Dry completely before reuse. Drying mops and cloths in the sun is best because the sun’s ultraviolet rays can aid in killing microorganisms. (Wet cloths and mopheads are heavily contaminated with microorganisms.)
REFERENCES


ELEVEN

MANAGEMENT OF AN
INFECTION PREVENTION PROGRAM

BACKGROUND

This section provides guidelines for implementation and management of an infection prevention program in family planning and health care facilities. The major components of a program include:

- administration,
- on-site training,
- monitoring and evaluation, and
- trouble-shooting.

Success in implementing and managing an infection prevention program in family planning and health care facilities providing surgical contraceptive methods depends on good management and the knowledge, creativity and energy of the entire health care team. Because resources available invariably are limited, careful planning and a well organized logistics system are necessary to ensure a steady supply of essential materials and equipment.

ADMINISTRATION - WHO SHOULD BE INVOLVED

It is important to identify and bring together key people in the clinic to form an infection prevention group. The purpose of this group is to implement and support the use of recommended infection prevention practices and to review related problems which may arise. This group should include representatives from a variety of aspects of client care (e.g., service providers, central services, housekeeping, laboratory and administration). In small clinics and mobile units, these jobs may overlap so the group may consist of only two or three individuals.

Although risk of infection cannot always be completely eliminated, it can be minimized by following recommended infection prevention practices. The infection prevention group must decide how to implement these processes, based on available equipment, budget, personnel and administrative support.
Certain basic principles that will help managers implement infection prevention measures include:

- Procedures should be established to handle situations where clients and staff are exposed to risk of infection
- All staff should receive an orientation before new procedures or processes are started and follow-up training to reinforce new or difficult concepts
- Adequate facilities should be provided for staff and clients to follow the new or revised infection prevention guidelines
- Regular reviews should be conducted to ensure the adequacy of the recommended infection prevention practices and staff concerns about them or any other aspects of infection prevention

Finally, it is important for managers to help staff regard all clients and all staff as potentially infected with bloodborne pathogens such as HBV and HIV, and to understand that a person cannot tell from another's appearance whether or not she/he is infected. In addition, confidentiality must be ensured at all times regarding a client's or staff's infection status.

**Remember**: Good communication with all levels of the health care team is the key to developing the support needed for a successful program. Include them in what you are doing, share ideas and materials with them and be ready to listen to their points of view.

**MAKING MANAGEMENT DECISIONS**

**Available Resources**

In infection prevention, as in any clinical situation, there are a number of instances where decisions and judgments have to be made by weighing advantages and disadvantages of the procedure against possible risk to the client or health care worker. These decisions must be practical and consistent, and should include:
• Appropriate selection and use of gloves for various health care tasks

• Selecting the most appropriate chemical disinfectant, one that is affordable and locally available

• Using single-use (disposable) needles and syringes whenever possible, and never reusing them

• Choosing sterilization or high-level disinfection for selected equipment based on available fuel, fuel costs, and ability to maintain equipment

• Provision of protective equipment and clothing, especially gloves. These items should be provided based on available resources, and should be made available in areas of the health care facility where they are most needed and will be used

These often difficult decisions should be made by local managers who must find a balance between available equipment and supplies, cost, and acceptable levels of safety for specific health care tasks.

Appropriate Selection of Gloves

Gloves account for the greatest proportion of direct costs associated with protective barriers. Therefore, using gloves appropriately and selecting the right type of glove are important in preventing unnecessary costs. The following flowchart (Figure 11-1) will assist the health care manager select the appropriate type of gloves for different tasks. (Also see Chapter 2, Tables 2-1 and 2-2.)
Management

Figure 11-1. Summary of Glove Choice

Contact with blood or other body fluids?

YES

NO

no gloves

client contact?

YES

Surgical gloves, HLD or new exam gloves

NO

utility gloves

Hand contact with tissue beneath the skin?

YES

Sterile (or HLD) gloves

NO

HLD or new exam gloves
Prophylactic Antibiotics

Another area where much needed resources are inappropriately used, concerns the so-called use of "prophylactic antibiotics." For example, many service providers feel that because client hygiene is poor and/or clients are poorly nourished, giving a 5 - 7 day course of antibiotics - usually a tetracycline - will prevent infections following surgical contraceptive procedures. This is a management issue where education of staff is extremely important and should include:

- Reviewing existing literature documenting that routine use of post-operative antibiotics for voluntary sterilization, IUD or Norplant insertion, does not prevent infections (Ladipo, et al, 1991).

- Pointing-out that the inappropriate use of antibiotics increases the prevalence of antibiotic resistance in the community and wastes precious resources.

- Reminding staff that when recommended infection prevention practices are conscientiously followed, prophylactic antibiotics are not necessary. (See Chapters 12 - 16 for specific recommendations.)

ON-SITE TRAINING

The decisions and actions of health care staff are largely influenced by:

- personal feelings, attitudes and beliefs, and

- their level of knowledge.

With the advent of HIV infection and AIDS, health care staff have become increasingly concerned about their own safety and about working in places where they come into contact with people who may be HIV-infected. This is a particularly difficult issue where the risk to the staff stems from the provision of health-related services such as family planning (e.g., voluntary sterilization, IUDs and Norplant) as opposed to medical-related services (e.g., surgery for an ectopic pregnancy).
Management

These concerns lead to:

- adoption of unnecessary and often excessive precautions, and
- taking pointless risks in the mistaken belief that for a particular situation, there is little risk or nothing can be done to minimize the risk.

Examples of excessive use of precautions include washing hands after shaking hands with people believed to be HIV-infected, and wearing gloves for routine cleaning of the environment (e.g., washing walls or dusting furniture). As a consequence, adequate supplies of valuable equipment (e.g., soap and water and gloves) may not be available for situations where they are needed, such as for minor surgical procedures or vaginal exams. On the other hand, when precautions are not used when they are needed, health care workers place themselves and their clients at risk of infection. This can occur when needles and syringes are not adequately decontaminated, cleaned and sterilized or high-level disinfected between each use.

The primary way to prevent the spread of infection in health care facilities is through education which leads to positive behavioral changes. Health care workers at all levels should understand the risk of infection and the protective barriers that can be used to stop transmission of infectious agents. Personal concerns should be addressed. Studies in various parts of the world have shown that health care workers are often willing to change attitudes and work habits related to infection prevention when they understand the reason for, and importance of, a procedure (Seto et al, 1990; Raven and Haley, 1982).

Training Staff about Infection Prevention Practices

Initially, all levels of health care workers (e.g., nurses, physicians, housekeepers and cleaners) need to be oriented to the importance of infection prevention. Some of the topics to be discussed should include:

- The disease transmission cycle and routes of infection in the clinic setting (see Figures 1-1 and 1-2)
- The importance of each staff member in preventing transmission of infection
- Methods of minimizing disease transmission (i.e., protective barriers)
including "hands-on" practice of specific methods. (Use a checklist to evaluate practice.) Examples include:

- handwashing,
- decontaminating gloves,
- disinfecting a laparoscope, and
- cleaning a reusable needle and syringe.

Finally, follow initial training with continuing education targeted toward identifying and solving specific problems, introducing new techniques and providing general reminders of the importance of maintaining an infection-free environment for the safer delivery of family planning services.

**MONITORING EFFECTIVENESS**

Regular monitoring of infection prevention processes is important not only to assess their effectiveness, but also to determine the topics about which staff need more training or review. To monitor effectiveness:

- Spot check how procedures are being performed
- Assess whether recommended precautions are being observed
- Note whether needed equipment and supplies are available and used properly

Based on the findings, future topics for training can be identified, and changes in training, work practice or provision of needed equipment can be undertaken. *Tables 11-1 and 11-2 below are sample checklists which managers can use to see if infection prevention practices are being followed.*
Table 11-I. Sterilization and Disinfection Practice Checklist

Health facility/clinic: ______________________________ Date: __________________
Designation of FP/MCH worker: _________________________ Evaluator: __________________
(e.g., matron, sister, midwife, nursing assisting)

Observations

<table>
<thead>
<tr>
<th>Sterilization/High-level Disinfection</th>
<th>Response (Circle response, N/A, not applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Instruments are decontaminated in 0.5% chlorine solution immediately after use</td>
<td>Yes</td>
</tr>
<tr>
<td>2. Instruments are thoroughly cleaned before sterilization or HLD</td>
<td>Yes</td>
</tr>
<tr>
<td>3. Blood spills are flooded with disinfectant and then wiped up</td>
<td>Yes</td>
</tr>
<tr>
<td>4. What method of sterilization or HLD is used:</td>
<td></td>
</tr>
<tr>
<td>• autoclaving? (if yes go to #5)</td>
<td>Yes</td>
</tr>
<tr>
<td>• dry heat? (if yes go to #6)</td>
<td>Yes</td>
</tr>
<tr>
<td>• boiling? (if yes go to #7)</td>
<td>Yes</td>
</tr>
<tr>
<td>• chemical disinfectants (if yes go to #8)</td>
<td>Yes</td>
</tr>
<tr>
<td>5. When autoclaving is the autoclave operating:</td>
<td></td>
</tr>
<tr>
<td>• at least 121°C (250°F)</td>
<td>Yes</td>
</tr>
<tr>
<td>• at a pressure of 106 kPa, 15 lb/in² (1 atmosphere)</td>
<td>Yes</td>
</tr>
<tr>
<td>• for at least 20 minutes</td>
<td>Yes</td>
</tr>
<tr>
<td>6. When using dry heat, are the instruments kept:</td>
<td></td>
</tr>
<tr>
<td>• at 170°C (340°F) or 160°C (320°F) for sharps</td>
<td>Yes</td>
</tr>
<tr>
<td>• at the required temperature for at least 1 hour (170°C)?</td>
<td>Yes</td>
</tr>
<tr>
<td>• or 2 hours (160°C)?</td>
<td>Yes</td>
</tr>
<tr>
<td>7. When boiling, are the instruments:</td>
<td></td>
</tr>
<tr>
<td>• completely submerged under the water?</td>
<td>Yes</td>
</tr>
<tr>
<td>• boiled for at least 20 minutes once boiling begins?</td>
<td>Yes</td>
</tr>
<tr>
<td>• Nothing added after timing started</td>
<td>Yes</td>
</tr>
<tr>
<td>8. When chemical disinfectants are used:</td>
<td></td>
</tr>
<tr>
<td>• is the appropriate chemical used?</td>
<td>Yes</td>
</tr>
<tr>
<td>• are instruments soaked for at least 20 minutes?</td>
<td>Yes</td>
</tr>
<tr>
<td>Any other comments or observations?</td>
<td></td>
</tr>
<tr>
<td>Any problems with implementation?</td>
<td></td>
</tr>
</tbody>
</table>

Source: Adapted from WHO/MCH/GPA 90.2 (1990)
Table 11-2. Checklist for Assessing Whether Infection Prevention Guidelines are Being Followed.

<table>
<thead>
<tr>
<th>Observations</th>
<th>Response (Circle response, N/A, not applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Observation During Family Planning Procedures</strong></td>
<td></td>
</tr>
<tr>
<td>1. * HLD or exam gloves are worn for each vaginal examination</td>
<td>Yes No N/A</td>
</tr>
<tr>
<td>* sterile (or HLD) gloves are used for minilaparotomy or Norplant insertion</td>
<td>Yes No N/A</td>
</tr>
<tr>
<td>2. HLD or exam gloves are worn for IUD insertion</td>
<td>Yes No N/A</td>
</tr>
<tr>
<td>3. Hands are thoroughly washed, immediately:</td>
<td>Yes No N/A</td>
</tr>
<tr>
<td>* before donning gloves</td>
<td>Yes No N/A</td>
</tr>
<tr>
<td>* after handling objects which might be contaminated</td>
<td>Yes No N/A</td>
</tr>
<tr>
<td>* after contact with blood or mucous membranes</td>
<td>Yes No N/A</td>
</tr>
<tr>
<td>* after removing gloves</td>
<td>Yes No N/A</td>
</tr>
<tr>
<td>4. Waste is disposed of by incineration or burying</td>
<td>Yes No N/A</td>
</tr>
<tr>
<td><strong>Observation of the Single-Use of Needles, Scalpel Blades and Other Sharp Objects</strong></td>
<td></td>
</tr>
<tr>
<td>1. Needles, scalpel blades and other sharp objects are disposed of immediately after use</td>
<td>Yes No N/A</td>
</tr>
<tr>
<td>2. Needles, scalpel blades and other sharp objects are disposed of in a puncture-proof container</td>
<td>Yes No N/A</td>
</tr>
</tbody>
</table>

Any other comments or observations: __________________________________________

Any problems with implementation: __________________________________________

Source: Adapted from WHO/MCH/GPA/90.2 (1990).
SURVEILLANCE OF CLIENT INFECTION

Keeping records of infections which occur in clients who have undergone procedures such as minilaparotomy, vasectomy, IUD or Norplant insertion can help to identify breaks in infection prevention techniques. When a series of similar infections occur, "trouble-shooting" should be done.

TROUBLE-SHOOTING

When one type of infection occurs in several clients in a short period of time, trouble-shooting should be done to identify the problem. For example, suppose a number of surgical wound infections occur. Monitoring of practices and processes should be focused on possible sources of infection. Examples include:

• Are instruments and equipment being thoroughly cleaned prior to sterilization or high-level disinfection?

• Is the autoclave working properly?

• Is sterilization or high-level disinfection being timed correctly?

• Are recommended infection prevention practices being followed in the procedure and operating rooms?

• Is the surgical site being thoroughly washed if client hygiene is poor?

• Is the client's skin prepared with an appropriate antiseptic?

If the answer to any of these questions is "no", equipment should be repaired and training should be conducted to correct the identified problems.
POST EXPOSURE TREATMENT OF HEALTH CARE WORKERS

When any exposure to blood, semen or vaginal secretions occurs, the following steps may reduce the risk of infection with HBV, HIV and other bloodborne pathogens. For exposure to skin or mucous membranes, wash the affected area immediately with soap and water, and rinse thoroughly to remove any potentially infectious particles. When a deep puncture wound occurs, force blood from the wound, if possible. Cleanse and rinse the wound with soap and water. (Using a more radical approach, such as irrigating with saline, alcohol and iodine, has not been shown to decrease risk of infection with HBV or HIV, and may even result in irritation and scarring.) For exposure to the eyes, flush the eye immediately with water, then irrigate with sterile saline (Flexner, 1991).

RECOMMENDED READING

For further information on management, such as supply procurement or problem-solving, refer to the following publications:


REFERENCES


BACKGROUND

Many thousands of minilaparotomy and laparoscopy procedures are safely performed throughout the world each year without serious infectious complications. Occasionally, however, life-threatening infections are associated with these two surgical procedures. They include tetanus, gangrene and abdominal sepsis. Other more common, but less serious, infectious complications include minor surgical wound infections.

In order to prevent these infectious problems good surgical technique including careful aseptic technique must be followed during each procedure. Moreover, to minimize the risk of disease transmission from soiled instruments, gloves and other items, these items must be decontaminated, cleaned and sterilized, or high-level disinfected after completing each procedure.

Because tetanus and gangrene are caused by spore-forming bacteria, equipment should be sterilized whenever possible. Sterilization is the only method which reliably destroys bacterial endospores. When sterilization facilities are not available, high-level disinfection (HLD) is the only acceptable alternative.

Remember:

- Regardless of whether sterilization or high-level disinfection is used, thorough cleaning to remove soil and organic material is the most effective way to reduce the risk of tetanus and gangrene from instruments (see Chapter 5).

- Operating room (OR) staff who are ill (e.g., have a cold or the flu), infectious or have draining lesions or cuts on exposed areas (face, arms or hands) should be excused or assigned other duties out of the OR area until they are well.
IP for Minilaparotomy or Laparoscopy

The infection prevention (IP) processes recommended in this chapter are practical, feasible and can be used in any type of health care facility. Moreover, unless indicated, the recommended processes are the same for both minilaparotomy and laparoscopy.

HANDWASHING, SURGICAL SCRUB AND GLOVES

Handwashing may be the single most important procedure in preventing infection. The vigorous rubbing together of all surfaces of lathered hands mechanically removes and often inactivates most organisms.

Handwashing is indicated before:

- examining (direct contact with) a patient, and
- putting on sterile or high-level disinfected gloves.

Handwashing is indicated after:

- any situation in which hands may be contaminated such as;
  - handling objects, including used (soiled) instruments; and
  - touching mucous membranes, blood or other body fluids (secretions or excretions); and
- removing gloves.
The surgical team (physician and OR nurse/technician) should perform a 3-5-minute surgical handscrub prior to performing either operation using Betadine® or other locally available antiseptics (see Chapter 2 and Appendix B). Alternatively, when only soap and water are used for the surgical handscrub, rinsing with a 60-90% alcohol solution is recommended. Additional information on how to prepare and use antiseptics is presented in Chapter 3 and Appendix C.

The surgical handscrub is performed before gowning (if used) and putting on sterile or HLD gloves. Ideally, the surgeon and assistant should scrub thoroughly between each procedure. In high-volume settings, this may not be feasible because the skin cannot tolerate the irritation caused by frequent scrubbings. In such settings, surgical staff should do a 3-minute scrub every hour or after every four or five cases (whichever comes first), to minimize recolonization of the skin by microorganisms. They also should scrub after every infected case, if they leave the operating room for any reason, and after every case where glove(s) are torn.

As a precaution, gloves should be worn by all staff prior to contact with blood and body fluids from any client. Finally, a separate pair of gloves must be used for each client to avoid cross contamination.

For both operations use:

- **High-level disinfected** (single-use or reusable) gloves for the placement of the uterine elevator (or uterine manipulator), if used.

- **Sterile** gloves when performing the surgical procedure. (When sterilization facilities are not available, gloves can be high-level disinfected by boiling.)

- **Clean, thick household** (utility) gloves for cleaning instruments and equipment, as well as contaminated surfaces.
Do not use gloves which are cracked, peeling, or have detectable holes or tears. (For a discussion of whether or not the surgeon, assistant and/or nurse should "double glove" for these operations, refer to Chapter 2: Minimizing Blood-Hand Contamination.)

Instructions for how to sterilize or HLD reusable gloves are outlined in Appendix A.

PROCESSING USED (SOILED) INSTRUMENTS, GLOVES AND OTHER ITEMS

For minilaparotomy or laparoscopy, the basic infection prevention processes which should be used to reduce disease transmission from contaminated instruments, gloves and other items are:

- waste disposal and decontamination,
- cleaning and rinsing, and
- sterilization, or
- high-level disinfection.

The sequence and details for performing each of these processes are summarized in Tables 12-1 and 12-2. After completing surgery, and while still wearing gloves, OR staff should properly dispose of contaminated objects (gauze, cotton and other waste items) in a leak-proof container or bag. Following this, surgical instruments and reusable gloves, which were in contact with blood or body fluids, should be decontaminated by soaking for 10 minutes in a disinfectant (0.5% chlorine solution) immediately after use. (To decontaminate the laparoscope, fiberoptic light source and cable, and plastic tubing with Luer-Lok, carefully wipe each item with a soft cloth soaked in 60-90% ethyl or isopropyl alcohol to remove all blood and organic material.) Surfaces such as OR tables, instrument stands and lamps that may have been contaminated by body fluids also should be decontaminated before further treatment. Next, instruments, reusable gloves and surgical drapes should be thoroughly cleaned with detergent and water and completely rinsed before further use. Finally, instruments, gloves and surgical drapes should be sterilized. If sterilization is not possible, these items should undergo high-level disinfection by boiling. (See Chapters 5 - 7 and Appendix E for detailed instructions on how to process surgical (metal) instruments and other items and Appendix G for laparoscopic equipment.)
### Table 12-1: Infection Prevention Guidelines for Minilaparotomy or Laparoscopy

#### WASTE DISPOSAL AND DECONTAMINATION

**STEP 1:** After completing the minilaparotomy or laparoscopy, and while still wearing gloves, dispose of contaminated objects (gauze, cotton and other waste items) in a properly marked leak-proof container (with a tight fitting lid) or plastic bag. (See Chapter 9 for details.)

**STEP 2:** Fully immerse all metal instruments in a plastic bucket containing 0.5% chlorine solution for 10 minutes before allowing staff and cleaning personnel to handle or clean them. Before immersing needles and syringes, fill with chlorine solution. (This pre-wash soak kills most microorganisms, including HBV and HIV.) Surgical drapes may also be decontaminated by soaking in chlorine solution.

**STEP 3:** All surfaces (such as the OR table, instrument stands and OR lamps) that could have been contaminated by blood and mucus also should be decontaminated by wiping down with chlorine solution. (See Chapters 5 and 10 for details.)

**STEP 4:** If single-use (disposable) gloves were used, carefully remove them by inverting, and place in a leak-proof container. However, if the gloves are reusable, first immerse both gloved hands in the bucket containing the chlorine solution briefly and then carefully remove by inverting. Deposit the gloves in the chlorine solution.

#### CLEANING AND RINSING

After decontamination, thoroughly clean instruments with water, detergent and soft brush, taking care to brush all teeth, joints and surfaces. Next, rinse well after cleaning to remove all detergent (some detergent can render chemical disinfectants inert). Dry instruments before further processing. Surgical drapes should be washed with detergent and water and machine or air dried. (See Chapter 5 and Appendices A, E and G for details.)

#### STERILIZATION

Instruments, reusable gloves, needles and syringes, and surgical drapes used for minilaparotomy and laparoscopy should be sterilized by autoclaving. Metal instruments, needles and glass syringes can also be sterilized by dry heat. (See Chapter 6 for details.) Laparoscopes and accessories should be chemically (cold) sterilized or high-level disinfected as described in Appendix G.

**Standard Conditions for Heat Sterilization**

**Steam sterilization:** 121°C (250°F) at 106 kPa (15 lbs) pressure for 20 minutes for unwrapped items; 30 minutes for wrapped items. Allow all items to dry thoroughly before removing.

**Dry heat:** 170°C (340°F) for one hour (total cycle time - placing instruments in oven, heating to 170°C, timing for one hour and then cooling - is from two to two and a half hours) or 160°C (320°F) for two hours (total cycle time is from three to three and a half hours).

**Storage:** Unwrapped instruments must be used immediately. Wrapped instruments, gloves and drapes can be stored for up to one week if the package remains dry and intact, one month if sealed in a plastic bag.

#### HIGH-LEVEL DISINFECTION

High-level disinfection by boiling in water or soaking in a chemical disinfectant is recommended if sterilization is not possible. Surgical (metal) instruments, reusable gloves, needles and syringes, and surgical drapes should be boiled for 20 minutes and allowed to dry. Air dried surgical drapes should be ironed before use. Alternatively, surgical instruments can be soaked for 20 minutes in a glutaraldehyde or 8% formaldehyde solution, thoroughly rinsed with boiled water and air dried. Use immediately or store for up to one week in a clean, dry disinfected container with a tight-fitting lid or cover. (See Chapter 7 for details.)
Table 12-2: Infection Prevention for Female Sterilization by Minilaparotomy or Laparoscopy
Steps in Processing Instruments and Equipment

<table>
<thead>
<tr>
<th>Process</th>
<th>Decontamination</th>
<th>Cleaning</th>
<th>High-Level Disinfection</th>
<th>Sterilization*</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR table top and other large</td>
<td>Wipe off with 0.5% chlorine solution.</td>
<td>Wash with detergent and water if organic material remains after decontamination procedure.</td>
<td>Not necessary for caps, gowns and masks. Surgical drapes:</td>
<td></td>
</tr>
<tr>
<td>surface area</td>
<td></td>
<td></td>
<td></td>
<td>*Autoclave at 121°C (250°F) and 106 kPa (15 lbs/in²) for 30 minutes.</td>
</tr>
<tr>
<td>Linens (caps, gowns, masks and</td>
<td>Soak in 0.5% chlorine solution for 10 minutes if contaminated with blood or body fluids prior to cleaning. (Rinse or wash immediately.)</td>
<td>Wash with detergent and water, removing all particles. Rinse with clean water, air or machine dry.</td>
<td>Not necessary for caps, gowns and masks. Surgical drapes:</td>
<td></td>
</tr>
<tr>
<td>surgical drapes</td>
<td></td>
<td></td>
<td></td>
<td>*Autoclave at 121°C (250°F), and 106 kPa (15 lbs/in²) for 20 minutes.</td>
</tr>
<tr>
<td>Gloves (rubber or plastic)</td>
<td>Soak in 0.5% chlorine solution for 10 minutes prior to cleaning. (Rinse or wash immediately.)</td>
<td>Wash with detergent and water, removing all particles. Rinse with clean water and check for holes. If to be sterilized, dry inside and out (air or towel dry).</td>
<td>If touching only mucous membranes or broken skin (e.g., pelvic exam):</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*Boil for 20 minutes in a pot with a lid (start timing when water begins to boil).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*Gloves must be covered completely with water</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*Do not add anything to pot after water begins to boil</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*Air dry before use or storage</td>
</tr>
</tbody>
</table>

Not necessary

* Not necessary for caps, gowns and masks. Surgical drapes:  
  - Autoclave at 121°C (250°F) and 106 kPa (15 lbs/in²) for 30 minutes. 
  - Autoclave at 121°C (250°F), and 106 kPa (15 lbs/in²) for 20 minutes. 
  - Do not use for 24-48 hours.
<table>
<thead>
<tr>
<th>Instruments/Equipment</th>
<th>Decontamination</th>
<th>Cleaning</th>
<th>High-Level Disinfection</th>
<th>Sterilization</th>
</tr>
</thead>
</table>
| Instruments for pelvic exam (e.g., specula, forceps and uterine elevators) | Soak in 0.5% chlorine solution for 10 minutes prior to cleaning. (Rinse or wash immediately.) | Using a brush, wash with detergent and water, removing all particles. Rinse with clean water. If to be sterilized, air or towel dry. | Boiling:  
- Boil for 20 minutes in a pot with a lid (start timing when water begins to boil).  
- Instruments must be covered completely during boiling.  
- Do not add anything to pot after water begins to boil.  
- Air dry before use or storage.  
Chemical: soak for 20 minutes in  
- 5% formaldehyde, or  
- a glutaraldehyde. | • Dry heat for one hour after reaching 170°C (340°F), or  
• Autoclave at 121°C (250°F) and 106 kPa (15 lbs/in²) for 20 minutes (30 minutes if wrapped) |
| Instruments (metal) for voluntary sterilization | Soak in 0.5% chlorine solution for 10 minutes prior to cleaning. (Rinse or wash immediately.) | Using a brush, wash with detergent and water, removing all particles. Rinse with clean water, air or towel dry. | Acceptable:  
- Boil or chemically HLD as above. | Preferable:  
- Dry heat for one hour after reaching 170°C (340°F), or  
• Autoclave at 121°C (250°F) and 106 kPa (15 lbs/in²) for 20 mins. (30 minutes if wrapped). |
| Needles and syringes | Fill assembled needle and syringe with 0.5% chlorine solution and then soak for 10 minutes prior to cleaning. Rinse by flushing (x3) with clean water. | Disassemble, then wash with detergent and water removing all particles. Rinse with clean water, air or towel dry syringes (only air dry needles). | Acceptable:  
- Boil or chemically HLD as above.  
- Place items that float in a weighted, porous bag. | Preferable:  
- Dry heat for two hours after reaching 160°C (320°F) (glass syringes only), or  
• Autoclave at 121°C (250°F) and 106 kPa (15 lbs/in²) for 20 minutes (30 minutes if wrapped). |
<table>
<thead>
<tr>
<th>Instruments/Equipment</th>
<th>Decontamination</th>
<th>Cleaning</th>
<th>High-Level Disinfection</th>
<th>Sterilization¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage containers for instruments</td>
<td>Soak in 0.5% chlorine solution for 10 minutes prior to cleaning. (Rinse or wash immediately.)</td>
<td>Wash with detergent and water removing all particles. Rinse with clean water, air or towel dry.</td>
<td>Boil container and lid as above. If container is too large then: * Fill container with 0.5% chlorine solution and soak for 20 minutes * Rinse with water which has been boiled for 20 minutes and air dry before use. Re-disinfect weekly, when empty or contaminated.</td>
<td>Dry heat for one hour after reaching 170°C (340°F), or * Autoclave at 121°C (250°F) and 106 kPa (15 lbs/in²) for 20 mins. (30 minutes if wrapped). Re-sterilize weekly, when empty or contaminated.</td>
</tr>
<tr>
<td>Endoscopes (laparoscopes)</td>
<td>Wipe exposed surfaces with gauze pad soaked with 60-90% alcohol; rinse immediately.</td>
<td>Disassemble, then wash with detergent and water, removing all particles. Rinse with clean water, towel dry.</td>
<td>Soak for 20 minutes in: * 8% formaldehyde, or * a glutaraldehyde, and rinse well with water which has been boiled for 20 minutes.</td>
<td>Sterilize daily if possible using chemical sterilization. Soak in: * 8% formaldehyde for 24 hours, or * a glutaraldehyde for 10 hours. Rinse with sterile water or water which has been boiled for 20 minutes.</td>
</tr>
</tbody>
</table>

¹ If unwrapped, use immediately; if wrapped, may be stored up to one week prior to use.
² Avoid prolonged exposure to chlorine solution to minimize corrosion of instruments and deterioration of rubber or cloth products.
³ If sterilization (dry heat or autoclave) not available these items can be either HLD by boiling or soaking in a chemical disinfectant.
⁴ Instruments with cutting edges or needles should not be sterilized at temperatures above 160°C to avoid dulling them.

Source: Adapted from Perkins, 1983.
Sterilization, a process which destroys all microorganisms, including bacterial endospores, is the preferred practice for processing instruments and other items that come in contact with the blood stream or touch tissue beneath the skin.

CLIENT SELECTION

Both minilaparotomy and operative (single puncture) laparoscopy are intended for use on healthy women in surgical facilities with limited resources and equipment. When combined with the use of local only or modified local anesthesia/analgesia, both surgical approaches have proven to be extremely safe, low-risk procedures.

Selecting clients who are acceptable (low-risk) for having either procedure performed in an ambulatory (outpatient) setting is a key factor in minimizing the risk of complications - both technical and infectious. Guidelines for selecting acceptable (low-risk) clients are presented in Table 12-3.

Only those clients who meet the acceptable criteria should have their surgery in ambulatory facilities. Attempting to perform either operation in women who do not meet these criteria (e.g., obese women or those with extensive pelvic adhesions) invariably necessitates:

• more sedation/analgesia for patient comfort,
• larger incisions,
• longer operating time, and
• prolonged recovery

As a consequence, there is an increased risk of complications, especially infections, in this high-risk group.
Table 12-3: Guidelines for Selecting Clients for Bilateral Tubal Ligation in Ambulatory Health Care Facilities.

<table>
<thead>
<tr>
<th>Category</th>
<th>Acceptable</th>
<th>Not Acceptable</th>
</tr>
</thead>
<tbody>
<tr>
<td>General health (Assessed by H/P)</td>
<td>negative history (allergies, coagulopathy, etc.) and no current systemic heart, lung or kidney disease</td>
<td>current symptomatic heart, lung or kidney disease and coagulopathy</td>
</tr>
<tr>
<td>Emotional State</td>
<td>calm, stable</td>
<td>unresolved fear and anxiety</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>normotensive</td>
<td>&gt; 140/90 mm/Hg</td>
</tr>
<tr>
<td>Height/weight (H/W)</td>
<td>normal H/W ratio</td>
<td>&gt; 75 kg</td>
</tr>
<tr>
<td></td>
<td>maximum weight: 75 kg (165 lbs)</td>
<td>&lt; 35 kg</td>
</tr>
<tr>
<td></td>
<td>minimum weight: 35 kg (77 lbs)</td>
<td></td>
</tr>
<tr>
<td>Previous abdominal surgery</td>
<td>C-sections only plus mobile abdominal scar and normal pelvic exam</td>
<td>other abdominal surgery plus fixed scar or abnormal pelvic exam</td>
</tr>
<tr>
<td>Previous pelvic disease (PID, ectopic pregnancy or ruptured appendix)</td>
<td>negative history and normal pelvic exam</td>
<td>abnormal abdominal/pelvic exam</td>
</tr>
<tr>
<td>Anemia (hemoglobin)</td>
<td>≥ 9 gm/dl</td>
<td>&lt; 9 gm/dl</td>
</tr>
</tbody>
</table>
OPERATING ROOM

The OR should be an enclosed area with doors that can be locked and should be located away from heavily used areas of the clinic or hospital. The OR should:

- have adequate lighting;
- have tile or concrete floors to facilitate cleaning;
- be kept free of dust and insects; and
- be air-conditioned as appropriate and possible. (If windows need to be open for ventilation, they should have tight fitting screens.)

There should be adequate handwashing facilities including a supply of clean water nearby (i.e., clear, not cloudy with sediment) and a clothes changing room for staff. This area should be positioned so that staff can enter directly into the OR area without passing through high-traffic areas (e.g., client waiting area) or high-risk (contaminated) areas such as hospital wards or treatment rooms. (See Chapter 8 for additional information.) Suitable containers, with tight fitting lids or plastic bags for disposal of contaminated waste items should also be available.

TRAFFIC FLOW

The number of microorganisms in a designated area tends to be related to the number of people present and their activity. To help reduce the level of microbial contamination in the OR:

- Keep number of people and movement to a minimum during surgery.
- Keep doors closed to discourage entrance of unauthorized persons and to reduce movement and air flow.
- Separate clean and soiled items.
- Finally, clients should enter the OR and go to the OR table without crossing through areas where sterile or clean instruments are set up and stored.
IP for Minilaparotomy or Laparoscopy

PREPARATION OF CLIENTS

While human skin cannot be sterilized, pre-operative cleansing of the surgical site and antiseptic preparation minimizes the number of microorganisms on the client's skin which may contaminate the surgical wound and lead to infection.

- Clients selected for surgery should bathe prior to surgery. (If this is not possible, staff should thoroughly clean the operative site with soap and water before entering the OR.)

- Pubic and abdominal hair does not have to be cut unless it obstructs the operative area. (If necessary, trim hair immediately before the procedure to reduce time for bacterial growth on the skin.)

- Liberally apply a locally available antiseptic, such as an iodophor (PVI), to the operative site.

- If an iodophor is used, leave for two minutes.

For a listing of antiseptic solutions, their use and relative advantages and disadvantages, see Table 3-1 and Appendix C.

SURGICAL ATTIRE FOR CLIENTS AND OPERATING ROOM STAFF

The OR is designated as a clean area; therefore, clients and OR staff should be attired appropriately:

- Clients should change into a clean gown preoperatively. (A clean cloth wrap can be used if gowns are not available.)

- OR staff (including cleaning staff) should change into clean scrub suits or gowns, caps and masks prior to entering the OR.

- Masks should fully cover the nose and mouth and should be replaced when damp.

- Caps should cover all hair.

- Street shoes should be covered or changed to shoes or boots that are worn only in the OR.
Are face masks necessary for observers in the OR?

According to the results of a study reported in a recent article in the *Journal of Hospital Infection* (Mitchell, 1991), oral microbial flora dispersed by unmasked volunteers standing one meter from the OR table failed to contaminate exposed bacterial dishes (settle plates) placed on the table. According to the article, the numbers of air-borne bacteria expelled from the nose and mouth are insignificant compared with the substantial amount of bacteria shed from the skin. This study confirms earlier findings that during quiet breathing few, if any, nasal bacteria are expelled into the air, despite heavy colonization of the nose.

The article concludes that surgical masks are costly and not necessary for all OR personnel in all cases, but it states that masks should be worn by the surgeon and all personnel who are scrubbed.

SURGICAL TECHNIQUE

Good surgical technique that minimizes tissue trauma and ensures adequate control of bleeding (hemostasis) will reduce the occurrence of infection. For both interval and postpartum minilaparotomy, the technical aspects of performing each procedure should be standardized to reduce the potential for intra-operative and post-operative problems.

INFECTION PREVENTION TIPS

To minimize the client's risk of post-operative infection, OR staff should strive to maintain an infection-free environment.

Before Procedure

- Select clients who are low-risk for infection and pelvic adhesions, and who are not grossly malnourished or obese.

- Where possible, have client bathe and thoroughly wash her genital and abdominal areas before entering the OR.
IP for Minilaparotomy or Laparoscopy

- Surgically scrub hands with antiseptic solution and water.

- After gloving and while looking at the cervix, liberally apply antiseptic solution several (at least two) times to the cervix and vagina before applying the uterine elevator (or manipulator). (If iodophors such as Betadine® are used, give them time to work, 1 - 2 minutes to allow for release of free iodine and contact time to kill the microorganisms)

- Wash/scrub abdomen and liberally apply antiseptic solution to the operative site, starting at the center and moving towards the sides of the abdomen. (Give special attention to the navel as appropriate.)

During Procedure

- Keep movement and number of people to a minimum.

- Wear appropriate surgical attire.

- Use sterilized or high-level disinfected instruments, gloves and surgical drapes.

- Use good surgical technique that minimizes tissue trauma and controls bleeding (hemostasis).

After Procedure

- While still wearing gloves properly dispose of contaminated wastes (gauze, cotton and disposable gloves) in a covered, leak-proof container or plastic bag.

- Decontaminate instruments and reusable items immediately after use (while they are still in the OR) or before cleaning (See Chapter 5).

- Decontaminate operating table, instrument stands, lamps and other surfaces contaminated during surgery.
Follow guidelines for cleaning and processing used (soiled) instruments, gloves, linens and needles and syringes (See Chapters 5-7) and (Appendices A, E and G).

Wash hands after removing gloves.

"Hand-free" Technique for Passing Surgical Instruments

A safer method of passing sharp instruments (needles, scissors and scalpels) during surgery has been developed recently. Called the "hands-free" technique of instrument transfer, this technique is inexpensive and simple to use and ensures that the surgeon, assistant and/or nurse never touch the same instrument at the same time (Bessinger, 1988).

Instruments passed with the hands-free technique include anything sharp enough to puncture a glove (e.g., scalpels, mosquito forceps, loaded needle holders). Using the hands-free technique, the scrub nurse places a sterile or HLD kidney basin or other suitable small container on the sterile field between him or herself and the surgeon. The container is designated as the neutral zone on which the assistant places sharp instruments. The assistant alerts the surgeon that a sharp instrument has been placed in the neutral zone by saying "scalpel," or "suture ligature", while placing it there. The surgeon then picks up the instrument and returns the instrument to the container after using it.

Another way to do this is to have the assistant place the instrument into a container such as a kidney basin and pass it to the surgeon. The surgeon lifts the instrument out of the container which is left on the field until the surgeon returns the instrument to it. The assistant then picks up the container and returns it to the Mayo stand.

Note: If the surgeon complains that the scalpel blades are dulled because the cutting edge touches the metal container, a plastic container may be used.

MAINTENANCE OF A SAFE ENVIRONMENT

Maintaining a safe, infection-free environment is an on-going process which requires frequent retraining of clinic staff and close supervision. With diligent application of recommended practices, infections following surgery and transmission of HBV and HIV can be avoided. The practices described above,
IP for Minilaparotomy or Laparoscopy

however, must be conscientiously applied before, during and after each procedure. Laxity at any point in the routine can have disastrous results for the safety level of the next procedure.
REFERENCES


MALE STERILIZATION BY VASECTOMY

BACKGROUND

In many areas of the world vasectomy is becoming an increasingly popular method of permanent contraception. Each year many thousands of vasectomies are safely performed. Occasionally, however, serious and even life-threatening infections are associated with this procedure. These include tetanus, gangrene, and scrotal and abdominal sepsis.

In order to prevent these infectious problems good surgical technique including careful aseptic techniques must be followed during each procedure. To minimize the risk of disease transmission from soiled instruments, gloves and other items, after completing the procedure these items must be decontaminated, cleaned and sterilized, or high-level disinfected.

Because tetanus and gangrene are caused by spore-forming bacteria, equipment should be sterilized whenever possible. Sterilization is the only method which reliably destroys bacterial endospores. When sterilization facilities are not available, high-level disinfection (HLD) is an acceptable alternative.

Remember: Regardless of whether sterilization or high-level disinfection of instruments and other items is used, thorough cleaning of the scrotum as well as the instruments to remove soil and organic material is the most effective way to prevent infection and reduce the risk of tetanus and gangrene.

Finally, the infection prevention processes recommended in this chapter are practical, feasible and can be used in any type of health care facility.

HANDWASHING, SURGICAL SCRUB AND GLOVES

Thorough handwashing coupled with the use of protective gloves are key components in minimizing the risk of infection for clients, clinicians and housekeeping staff.

Handwashing may be the single most important procedure in preventing infection. The vigorous rubbing together of all surfaces of lathered hands mechanically removes and often inactivates most organisms.
Handwashing is indicated before:

- examining (direct contact with) a client, and
- putting on sterile or high-level disinfected gloves to perform a vasectomy.

Handwashing is indicated after:

- any situation in which hands may be contaminated, such as:
  - handling objects, including used (soiled) instruments; and
  - touching mucous membranes, blood and body fluids (secretions or excretions);
- removing gloves.

Wash hands after removing gloves as they may have invisible holes or tears.

The surgeon should perform a 3-5-minute surgical handscrub prior to performing a vasectomy using Betadine®, Savlon® or other locally available antiseptics (see Chapter 2 and Appendix B). Alternatively, when only soap and water are used for the surgical handscrub, rinsing with a 60 - 90% alcohol solution is recommended. (See Chapter 3 for how to prepare a non-irritating solution.)

The surgical handscrub is performed before putting on sterile or HLD gloves. Ideally, the surgeon should scrub thoroughly between each procedure. In high-volume settings, this may not be feasible because the skin cannot tolerate the irritation caused by frequent scrubbings. In such settings, surgical staff should do a 3-minute scrub every hour or after every four or five cases (whichever comes first), to prevent recolonization of the skin by microorganisms. They also should scrub after every infected case, if they leave the operating area for any reason, and after every case where glove(s) are torn.
As a precaution, **gloves should be worn by all staff** prior to contact with blood and body fluids from any client. **Finally, a separate pair of gloves must be used for each client.**

**Which Gloves to Use**

- **Clinicians:** Sterile gloves should be used when performing a vasectomy. (When sterilization procedures are not available, gloves can be **high-level disinfected** by boiling. **Remember:** Boiling, even for 90 minutes or more, will not reliably kill bacterial endospores.)

- **Cleaning Staff:** Clean, thick household (utility) gloves should be used for cleaning instruments and equipment as well as contaminated surfaces.

**Do not use gloves which are cracked, peeling or have detectable holes.**

Instructions for how to sterilize or HLD reusable gloves are outlined in Appendix A.

**PROCESSING USED (SOILED) INSTRUMENTS, GLOVES AND OTHER ITEMS**

For vasectomy, the infection prevention processes which should be used to reduce disease transmission from contaminated instruments, gloves and other items are:

- waste disposal and decontamination,
- cleaning and rinsing, and
- sterilization, or
- high-level disinfection.

The sequence and details for performing each of these processes are summarized in Tables 13-1 and 13-2. After completing surgery, and while still wearing gloves, the surgeon or his assistant should properly dispose of contaminated objects (gauze, cotton and other waste items) in a leak-proof container or bag. Following this, surgical instruments and reusable gloves, which were in contact
with blood or body fluids should be decontaminated by soaking for 10 minutes in a disinfectant (0.5% chlorine solution) immediately after use. Surfaces such as examination tables, instrument stands and lamps that may have been contaminated by body fluids also should be decontaminated before reuse. Next, instruments and reusable gloves should be thoroughly cleaned with soap and water and completely rinsed before further treatment. Finally, instruments, gloves and drapes should be sterilized. If sterilization is not possible, these items should undergo high-level disinfection by boiling. (See Chapters 5 - 7 and Appendix E for how to process instruments and other items.)

Sterilization, a process which destroys all microorganisms including bacterial endospores, is the preferred practice for processing instruments and other items that come in contact with the blood stream or touch tissue beneath the skin.

CLINIC SITE FOR PERFORMING VASECTOMY SERVICES

Any outpatient procedure or minor surgery room is a suitable area for performing vasectomy services. If possible, the room should be located away from heavily used areas of the clinic or hospital. The room should:

- have adequate lighting,
- have tile or concrete floors to facilitate cleaning,
- be kept free of dust and insects, and
- be air-conditioned if necessary and possible. (If windows need to be open for ventilation, they should have tight fitting screens.)

There should be adequate handwashing facilities including a supply of clean water (i.e., clean not cloudy with sediment), nearby and suitable containers, with tight-fitting lids, or plastic bags for disposal of contaminated waste items.
Table 13-1: Infection Prevention Guidelines for Vasectomy

**WASTE DISPOSAL AND DECONTAMINATION**

**STEP 1:** After completing the procedure and while still wearing gloves, dispose of contaminated objects (gauze, cotton and other waste items) in a properly marked leak-proof container (with a tight fitting lid) or plastic bag. (See Chapter 9 for details.)

**STEP 2:** Fully immerse all metal instruments in a plastic bucket containing 0.5% chlorine solution for 10 minutes before allowing staff and cleaning personnel to handle or clean them. Before immersing needles and syringes, fill with chlorine solution. (This pre-wash soak kills most microorganisms, including HBV and HIV.) Surgical drapes may also be decontaminated by soaking in chlorine solution.

**STEP 3:** All surfaces (such as the procedure table or instrument stands) that could have been contaminated by blood and mucus also should be decontaminated by wiping down with chlorine solution. (See Chapters 5 and 10 for details.)

**STEP 4:** If single-use (disposable) gloves were used, carefully remove them by inverting, and place in a leakproof container. However, if the gloves are reusable, first immerse both gloved hands in the bucket containing the chlorine solution briefly and then carefully remove by inverting. Deposit the gloves in the chlorine solution.

**CLEANING AND RINSING**

After decontamination, thoroughly clean instruments with water, detergent and soft brush, taking care to brush all teeth, joints and surfaces. Next, rinse well after cleaning to remove all detergent (some detergents can render chemical disinfectants inert). Dry instruments before further processing. Surgical drapes should be washed with detergent and water, air or machine dried. (See Chapter 5 and Appendices A and E for details.)

**STERILIZATION**

Instruments, reusable gloves, needles and syringes, and surgical drapes used for vasectomy should be sterilized by autoclaving. Metal instruments, needles and glass syringes can also be sterilized by dry heat. (See Chapter 6 for details.)

**Standard Conditions for Heat Sterilization**

Steam sterilization: 121°C (250°F) at 106kPa (15 lbs/in²) pressure for 20 minutes for unwrapped items; 30 minutes for wrapped items. Allow all items to dry thoroughly before removing.

Dry heat: 170°C (340°F) for one hour (total cycle time - placing instruments in oven, heating to 170°C, timing for one hour and then cooling - is from two to two and a half hours) or 160°C (320°F) for two hours (total cycle time is from three to three and a half hours).

Storage: Unwrapped instruments must be used immediately. Wrapped instruments, gloves and drapes can be stored for up to one week if the package remains dry and intact, one month if sealed in a plastic bag.

**HIGH-LEVEL DISINFECTION**

High-level disinfection by boiling or soaking in a chemical disinfectant is recommended if sterilization is not possible. Surgical (metal) instruments, reusable gloves, needles and syringes, and surgical drapes should be boiled for 20 minutes and allowed to dry. Air dried surgical drapes should be ironed before use. Alternatively, surgical instruments can be soaked for 20 minutes in a glutaraldehyde or 8% formaldehyde solution, thoroughly rinsed with boiled water and air dried. Use immediately or store for up to one week in a clean high-level disinfected container with a tight-fitting lid or cover. (See Chapter 7 for details.)
### Table 13-2: Infection Prevention for Vasectomy Services

**Steps in Processing Instruments and Equipment**

<table>
<thead>
<tr>
<th>Process</th>
<th>Decontamination</th>
<th>Cleaning</th>
<th>High-Level Disinfection</th>
<th>Sterilization</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exam table top, or other large surface area</strong></td>
<td>Wipe off with 0.5% chlorine solution.</td>
<td>Wash with detergent and water if organic material remains after decontamination procedure.</td>
<td>Not necessary</td>
<td>Not necessary</td>
</tr>
<tr>
<td><strong>Linens (caps, gowns, masks and surgical drapes)</strong></td>
<td>Soak in 0.5% chlorine solution for 10 minutes if contaminated with blood or body fluids prior to cleaning. (Rinse and wash immediately.)</td>
<td>Wash with soap and water, removing all particles. Rinse with clean water, air or machine dry.</td>
<td>Not necessary for caps, gowns and masks. Surgical drapes: * Boil or chemically HLD.</td>
<td>Not necessary for caps, gowns and masks. Surgical drapes: * Autoclave at 121°C (250°F) and 106 kPa (15 lbs/in²) for 30 minutes.</td>
</tr>
<tr>
<td><strong>Gloves (rubber or plastic)</strong></td>
<td>Soak in 0.5% chlorine solution for 10 minutes prior to cleaning. (Rinse or wash immediately.)</td>
<td>Wash with detergent and water, removing all particles. Rinse with clean water and check for holes. If to be sterilized, dry inside and out (air or towel dry).</td>
<td>Acceptable</td>
<td>Preferable: * Autoclave at 121°C (250°F), and 106 kPa (15 lbs/in²) for 20 minutes. * Do not use for 24-48 hours</td>
</tr>
<tr>
<td><strong>Instruments for vasectomy</strong></td>
<td>Soak in 0.5% chlorine solution for 10 minutes prior to cleaning. (Rinse or wash immediately.)</td>
<td>Using a brush, wash with detergent and water, removing all particles. Rinse with clean water, air or towel dry.</td>
<td>Acceptable</td>
<td>Preferable: * Dry heat for one hour after reaching 170°C (340°F)*, or * Autoclave at 121°C (250°F) and 106 kPa (15 lbs/in²) for 20 minutes (30 minutes if wrapped).</td>
</tr>
</tbody>
</table>

*Decontamination is the first step in handling dirty instruments; reduces risk of hepatitis B and AIDS.

Cleaning removes particulate matter and improves the quality of subsequent high-level disinfection or sterilization.

High-Level Disinfection destroys all viruses, bacteria, parasites, fungi and some endospores.

Sterilization destroys all microorganisms, including endospores.
## IP for Vasectomy

### Table 13-2: Infection Prevention for Vasectomy Services (continued)

| Instruments/Equipment | Decontamination | Cleaning | High-Level Disinfection | Sterilization
|-----------------------|-----------------|----------|-------------------------|------------------|
| Needles and syringes  | Fill assembled needle and syringe with 0.5% chlorine solution and then soak for 10 minutes prior to cleaning. Rinse by flushing (x3) with clean water. | Disassemble, then wash with detergent and water, removing all particles. Rinse with clean water, air or towel dry syringes. | Acceptable¹ | Preferable:  
| | | | | • Dry heat for two hours after reaching 160°C (320°F), or  
| | | | | • Autoclave at 121°C (250°F) and 106 kPa (15 lbs/in²) for 20 minutes (30 minutes if wrapped). |
| Storage containers for instruments | Soak in 0.5% chlorine solution for 10 minutes prior to cleaning. (Rinse or wash immediately.²) | Wash with detergent and water removing all particles. Rinse with clean water, air or towel dry. | Boil container and lid as above. If container is too large, then:  
| | | | | • Fill container with 0.5% chlorine solution and soak for 20 minutes  
| | | | | • Rinse with water which has been boiled for 20 minutes and air dry before use.  
| | | | | Re-disinfect weekly, when empty or contaminated. | | | | | • Dry heat for one hour after reaching 170°C (340°F), or  
| | | | | • Autoclave at 121°C (250°F) and 106 kPa (15 lbs/in²) for 20 minutes (30 minutes if wrapped).  
| | | | | Re-sterilize weekly, when empty or contaminated. |

¹ If unwrapped, use immediately; if wrapped, may be stored up to one week prior to use.
² Avoid prolonged exposure to chlorine solution to minimize corrosion of instruments and deterioration of rubber or cloth products.
³ If sterilization (dry heat or autoclave) not available, these items can be H.1.D. by boiling or soaking in chemical disinfectants as follows:

**Boiling:**
- Boil for 20 minutes in a pot with a lid (begin timing when water begins to boil).
- All items must be covered completely during boiling. (Place items that float in a weighted, porous bag. See Chapter 7.)
- Do not add anything to the pot after water begins to boil.
- Air dry before use or storage. (Air dried surgical drapes should be ironed before use.)

**Chemical HLD with 8% formaldehyde or glutaraldehyde:**
- Cover all items with correct dilution of properly stored disinfectant.
- Soak for 20 minutes or as per manufacturers instructions.
- Rinse well with water which has been boiled for 20 minutes and air dry before use or storage.

**Chemical HLD with 3% glutaraldehyde:**
- **Disinfect:**  
  - Soak for 20 minutes.
  - Rinse well with water which has been boiled for 20 minutes and air dry before use or storage.

**Chemical HLD with 3% glutaraldehyde:**
- **Sterilize:**  
  - Soak in 3% glutaraldehyde solution for 30 minutes.  
  - Rinse well with water which has been boiled for 20 minutes and air dry before use or storage.

4 Instruments with cutting edges and needles should not be sterilized at temperatures above 160°C to avoid dulling them.

Source: Adapted from Perkins, 1983.
CLIENT SELECTION

Certain medical conditions may make the client at higher risk for complications such as postoperative infection. For example, local skin/scrotal infections or sexually transmitted genital tract infections (GTIs), such as gonorrhea or chlamydia, must be treated before a vasectomy is performed. Other conditions which can make the operation more difficult and increase risks of infection include:

- Large varicocele
- Inguinal hernia
- Filariasis
- Scar tissue
- Previous scrotal surgery
- Intrascrotal mass

In addition certain systemic disorders require special precautions and possible treatment before surgery; they include:

- Severe anemia
- Bleeding disorders
- Diabetes (should be under control before surgery)
- Heart disease

**Remember:** To avoid problems the physical assessment should be performed as part of the medical screening - not as part of the surgical procedure. It should always be performed before the client has received local anesthesia.
PREPARATION OF CLIENTS

While human skin cannot be sterilized, preoperative cleansing of the surgical site (scrotum) and antiseptic preparation minimize the number of microorganisms on the client’s skin which may contaminate the surgical wound and lead to infection.

- Clients selected for surgery should bathe and wear clean, loose-fitting clothing to the surgical facility. (If this is not possible, staff should thoroughly clean the operative areas - scrotum, penis and groin - with soap and water before entering the procedure room). In addition, the client should be asked to bring a clean scrotal support, if none is provided.

- Pubic and abdominal hair does not have to be cut unless it obstructs the operative area. (If necessary, trim hair immediately before the procedure to reduce time for bacterial growth on the skin.)

- Thoroughly clean the operative area (scrotum, penis and adjacent perineum) with soap and water.

- Liberally apply locally available antiseptic, such as an iodophor (PVI) to the operative area. Scrub the operative area, working in a small circular overlapping motion.

- If an iodophor is used, leave for 2 minutes.

For a listing of antiseptic solutions, their use and relative advantages and disadvantages, see Table 3-I and Appendix C.

SURGICAL ATTIRE FOR CLIENTS AND STAFF

Because vasectomy is a minor surgical procedure, i.e., minimal or no incision required and only superficial tissues (skin and subcutaneous layer) are entered:

- clients can wear their own clothing provided they are clean, and

- staff do not have to wear a cap, mask or gown.
SURGICAL TECHNIQUE

Surgical techniques for performing vasectomy, which minimize the risk of serious infection and other complications, rely on small incisions, adequate local anesthesia, gentle tissue handling, hemostasis and careful attention to aseptic technique. Until recently, the standard vasectomy procedure involved making either one or two small incisions in the scrotum over the stabilized vas deferens and required considerable blunt and sharp surgical dissection. Because of this, obtaining hemostasis sometimes was difficult, and the risk of scrotal hematoma increased. To combat this problem, as well as to increase acceptability of vasectomy by eliminating the fear of an incision, a modified approach developed in the People's Republic of China, the so-called "no scalpel vasectomy", is gaining popularity. In a recent study involving 1203 vasectomy acceptors 19 complications were reported during the subsequent two weeks: 16 occurred after use of the standard method (3.1 complications per 100 procedures) and 3 following the no-scalpel method (0.4 complications per 100 procedures) \((p < 0.001)\) (Nirapathpongpornt et al, 1990). Scrotal hematoma was the most common complication (11 of 16 cases). It occurred in 64% of those clients having the standard procedure and was associated with infection in 73%. Thus, using the no-scalpel vasectomy technique can significantly reduce the incidence of a major infectious complication of vasectomy.

INFECTION PREVENTION TIPS

Before Procedure

- Surgically scrub hands with antiseptic soap and water.
- Wash/scrub scrotum, penis and adjacent pubic area with soap and water and liberally apply antiseptic solution to operative area.

During Procedure

- Use sterilized or high-level disinfected instruments, gloves and surgical drapes.
- Use good surgical technique that minimizes tissue trauma and controls bleeding (hemostasis).
IP for Vasectomy

After Procedure

- While still wearing gloves, properly dispose of contaminated wastes (gauze, cotton and other waste items) in a covered, leak-proof container or plastic bag.

- Decontaminate instruments and reusable items immediately after use (while they are still in the OR or procedure room) or before cleaning (see Chapter 5).

- Decontaminate operating table, instrument stands, lamps and other surfaces contaminated during surgery.

- Follow guidelines for cleaning and processing used (soiled) instruments, gloves, linens and needles and syringes (see Chapters 5 - 7 and Appendices A and E).

- Wash hands after removing gloves.

MAINTENANCE OF A SAFE ENVIRONMENT

Maintaining a safe, infection-free environment is an on-going process which requires frequent retraining of clinic staff and close supervision. With diligent application of recommended practices, infections following vasectomy and transmission of diseases, such as hepatitis B and AIDS, can be avoided. The practices described above, however, must be conscientiously applied before, during and after each procedure. Laxity at any point in the routine can have disastrous results for the safety level of the next procedure.
REFERENCES


FOURTEEN

NORPLANT® INSERTION AND REMOVAL

BACKGROUND

With the recent approval of the Norplant® Contraceptive Implant System in the United States and 20 other countries, worldwide use of Norplant is expected to dramatically increase over the next few years. To date, infection-related problems, as reported in introductory trials where the clinical setting usually is optimal, have been limited to minor wound infections (less than 1%), and infrequently abscess formation which necessitates removal. As countries begin to expand Norplant services and regularize them into their family planning programs, however, the number of infections are likely to increase.

Although insertion and removal of Norplant subdermal implants are minor surgical procedures, careful aseptic technique, including good surgical technique, must be followed to prevent an increase in infections at the insertion site. These infections, though usually mild, are one of the major reasons for early removal of the device. Infection may also result in spontaneous expulsion of the Norplant capsules.

Another concern is the increasing problem of transmission of hepatitis B and AIDS viruses to clients, health care providers and clinic staff, especially cleaning personnel. To minimize this risk, blood contaminated waste must be properly disposed of and soiled instruments, gloves and other items must be decontaminated, thoroughly cleaned and sterilized or high-level disinfected (HLD) after every case.

Remember: Regardless of whether sterilization or high-level disinfection of instruments and other items is used, thorough cleaning of the client’s arm and hand to remove soil and organic material is the most effective way to prevent infection.

Norplant® is the registered trademark of The Population Council for subdermal levonorgestral implants.
HANDWASHING AND GLOVES

Thorough handwashing coupled with the use of protective gloves are key components in minimizing the risk of infection for clients, clinicians and housekeeping staff.

Handwashing may be the single most important procedure in preventing infection. The vigorous rubbing together of all surfaces of lathered hands mechanically removes and often inactivates most organisms.

Handwashing is indicated before:

- examining (direct contact with) a client and;
- putting on sterile or high-level disinfected gloves for insertion or removal of Norplant capsules.

Handwashing is indicated after:

- any situation in which hands may be contaminated, such as:
  - handling objects, including used (soiled) instruments; and
  - touching mucous membranes, blood and body fluids (secretions or excretions);
- removing gloves.

Wash hands after removing gloves because gloves may have invisible holes or tears.
A separate pair of gloves must be used for each client to avoid cross contamination.

Which Gloves to Use

- **Clinicians**: Sterile gloves should be used when inserting or removing Norplant. (When sterilization procedures are not available, gloves can be high-level disinfected by boiling. **Remember**: Boiling, even for 90 minutes or more, will not reliably kill bacterial endospores.)

- **Cleaning Staff**: Clean, thick household (utility) gloves should be used for cleaning instruments and equipment as well as contaminated surfaces.

**Do not** use gloves which are cracked, peeling or have detectable holes.

Instructions for sterilizing or HLD reusable gloves are outlined in Appendix A.

**PROCESSING USED (SOILED) INSTRUMENTS, GLOVES AND OTHER ITEMS**

For Norplant insertion or removal, the infection prevention processes which should be used to reduce disease transmission from contaminated instruments, gloves and other items are:

- waste disposal and decontamination,
- cleaning and rinsing, and
- sterilization, or
- high-level disinfection.

The sequence and details for performing each of these processes are summarized in Tables 14-1 and 14-2. After completing surgery, and while still wearing gloves, properly dispose of contaminated objects (gauze, cotton and other waste items) in a leak-proof container or bag. Following this, surgical instruments and reusable gloves, which were in contact with blood, should be decontaminated by soaking for 10 minutes in a disinfectant (0.5% chlorine solution) immediately after use. Surfaces such as procedure tables, instrument stands and lamps that may have been contaminated by blood also should be decontaminated before reuse. Next, instruments and reusable gloves should be thoroughly cleaned with soap and water and completely rinsed before further treatment.
Finally, instruments, gloves and surgical drapes should be **sterilized**. If sterilization is not possible, these items should undergo **high-level disinfection** by boiling.

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**Sterilization**, a process which destroys all microorganisms including bacterial endospores, is the **preferred practice** for processing instruments and other items that come in contact with the blood stream or touch tissue beneath the skin.

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Detailed step-by-step instructions for decontaminating, cleaning and either sterilization or high-level disinfection of instruments and other items are provided in Chapters 5 - 7 and Appendix E.

### CLINIC SITE FOR NORPLANT INSERTION AND REMOVAL

Any outpatient procedure or minor surgery room is a suitable area for Norplant insertion or removal. If possible, the room should be located away from heavily used areas of the clinic or hospital. The room should:

- have adequate lighting;
- have tile or concrete floors to facilitate cleaning;
- be kept free of dust and insects; and
- be air-conditioned if necessary and possible. (If windows need to be open for ventilation, they should have tight fitting screens.)

There should be adequate handwashing facilities including a supply of clean water (i.e., clear not cloudy or with sediment) nearby and suitable containers, with tight-fitting lids, or plastic bags for disposal of contaminated waste items.
STEP 1: After completing the insertion or removal and while still wearing gloves, dispose of contaminated objects (gauze, cotton and other waste items) in a properly marked leak-proof container (with a tight fitting lid) or plastic bag.

STEP 2: Fully immerse all metal instruments in a plastic bucket containing 0.5% chlorine solution (bleach) for 10 minutes before allowing staff and cleaning personnel to handle or clean them. Before immersing needles and syringes, fill with chlorine solution. (This pre-wash soak kills most microorganisms, including HBV and HIV.) Surgical drapes may also be decontaminated by soaking in chlorine solution.

STEP 3: All surfaces (such as the procedure table or instrument stands) that could have been contaminated by blood and mucus also should be decontaminated by wiping down with chlorine solution. (See Chapters 5 and 10 for details.)

STEP 4: If single-use (disposable) gloves were used, carefully remove them by inverting, and place in a leakproof container. However, if the gloves are reusable, first immerse both gloved hands in the bucket containing the chlorine solution briefly and then carefully remove by inverting. Deposit the gloves in the chlorine solution.

CLEANING AND RINSING
After decontamination, thoroughly clean instruments with water, detergent and soft brush, taking care to brush all teeth, joints and surfaces. Next, rinse well after cleaning to remove all detergent (some detergents can render chemical disinfectants inert). Dry instruments before further processing. Surgical drapes should be washed with detergent and water and air or machine dried. (See Chapter 5 and Appendices A and E for details.)

STERILIZATION
Instruments, reusable gloves, needles and syringes, and surgical drapes used for Norplant insertion or removal should be sterilized by autoclaving. Metal instruments, needles and glass syringes can also be sterilized by dry heat. (See Chapter 6 for details.)

Standard Conditions for Heat Sterilization
Steam sterilization: 121°C (250°F) at 106 kPa (15 lbs/in²) pressure for 20 minutes for unwrapped items; 30 minutes for wrapped items. Allow all items to dry thoroughly before removing.

Dry heat: 170°C (340°F) for one hour (total cycle time - placing instruments in oven, heating to 170°C, timing for one hour and then cooling - is from two to two and a half hours) or 160°C (320°F) for two hours (total cycle time is from three to three and a half hours).

Storage: Unwrapped instruments must be used immediately. Wrapped instruments, gloves and drapes can be stored for up to one week if the package remains dry and intact, one month if sealed in a plastic bag.

HIGH-LEVEL DISINFECTION
High-level disinfection by boiling or soaking in a chemical disinfectant is recommended if sterilization is not possible. Surgical (metal) instruments, reusable gloves, needles and syringes, and surgical drapes should be boiled for 20 minutes and allowed to dry. Air dried surgical drapes should be ironed before use. (Alternatively, surgical instruments can be soaked for 20 minutes in a glutaraldehyde or 8% formaldehyde solution, thoroughly rinsed with boiled water and air dried.) Use immediately or store for up to one week in a clean, high-level disinfected container with a tight-fitting lid or cover. (See Chapter 7 for details.)
Table 14-2: Infection Prevention for Norplant Services
Steps in Processing Instruments and Equipment

<table>
<thead>
<tr>
<th>Process</th>
<th>Decontamination is the first step in handling dirty instruments; reduces risk of hepatitis Band AIDS.</th>
<th>Cleaning removes particulate matter and improves the quality of subsequent high-level disinfection or sterilization.</th>
<th>High-Level Disinfection destroys all viruses, bacteria, parasites, fungi and some endospores.</th>
<th>Sterilization destroys all microorganisms, including endospores.</th>
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<tbody>
<tr>
<td>Instruments/Equipment</td>
<td>Decontamination</td>
<td>Cleaning</td>
<td>High-Level Disinfection</td>
<td>Sterilization</td>
</tr>
<tr>
<td>Exam table top, or other large surface area</td>
<td>Wipe off with 0.5% chlorine solution.</td>
<td>Wash with detergent and water if organic material remains after decontamination procedure.</td>
<td>Not necessary</td>
<td>Not necessary</td>
</tr>
<tr>
<td>Linens (caps, gowns, masks and surgical drapes)</td>
<td>Soak in 0.5% chlorine solution for 10 minutes if contaminated with blood or body fluids prior to cleaning. (Rinse and wash immediately.)</td>
<td>Wash with detergent and water, removing all particles. Rinse with clean water, air or machine dry.</td>
<td>Not necessary for caps, gowns and masks. Surgical drapes: • Boil or chemically HLD.</td>
<td>Not necessary for caps, gowns and masks. Surgical drapes: • Autoclave at 121°C (250°F) and 106 kPa (15 lbs. in²) for 30 minutes.</td>
</tr>
<tr>
<td>Gloves (rubber or plastic)</td>
<td>Soak in 0.5% chlorine solution for 10 minutes prior to cleaning. (Rinse or wash immediately.)</td>
<td>Wash with detergent and water, removing all particles. Rinse with clean water and check for holes. If to be sterilized, dry inside and out (air or towel dry).</td>
<td>Acceptable&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Preferable: • Autoclave at 121°C (250°F), and 106 kPa (15 lbs. in²) for 20 minutes. • Do not use for 24-48 hours.</td>
</tr>
<tr>
<td>Instruments including Norplant trocars.</td>
<td>Soak in 0.5% chlorine solution for 10 minutes prior to cleaning. (Rinse or wash immediately.)</td>
<td>Using a brush, wash with detergent and water, removing all particles. Rinse with clean water, air or towel dry.</td>
<td>Acceptable&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Preferable: • Dry heat for one hour after reaching 170°F (340°F) or • Autoclave at 121°C (250°F) and 106 kPa (15 lbs. in²) for 20 minutes (30 minutes if wrapped).</td>
</tr>
</tbody>
</table>
Table 14-2: Infection Prevention for Norplant Services (continued)

<table>
<thead>
<tr>
<th>Instruments/Equipment</th>
<th>Decontamination</th>
<th>Cleaning</th>
<th>High-Level Disinfection</th>
<th>Sterilization¹</th>
</tr>
</thead>
</table>
| Needles and syringes  | Fill assembled needle and syringe with 0.5% chlorine solution and then soak for 10 minutes prior to cleaning. Rinse by flushing (x3) with clean water. | Disassemble, then wash with detergent and water, removing all particles. Rinse with clean water, air or towel dry (only air dry needles). | Acceptable¹ | Preferable:  
- Dry heat for two hours after reaching 160°C (320°F) (glass syringes only), or  
- Autoclave at 121°C (250°F) and 106 kPa (15 lbs. in²) for 20 minutes. (30 minutes if wrapped), |
| Storage containers for instruments | Soak in 0.5% chlorine solution for 10 minutes prior to cleaning. (Rinse or wash immediately.²) | Wash with detergent, water and brush, removing all particles. Rinse with clean water, air or towel dry. | Boil container and lid. If container is too large, then:  
- Fill container with 0.5% chlorine solution and soak for 20 minutes  
- Rinse with water which has been boiled for 20 minutes and air dry before use.  
Re-disinfect weekly, when empty or contaminated. |  
- Dry heat for one hour after reaching 170°C (340°F), or  
- Autoclave at 121°C (250°F) and 106 kPa (15 lbs. in²) for 20 minutes. (30 minutes if wrapped).  
Re-sterilize weekly, when empty or contaminated. |

Norplant implants (never reuse)  
Not necessary | Not necessary | Never acceptable | Come in sterile packages.  
Discard if package seal broken.

¹ If unwrapped, use immediately; if wrapped, may be stored up to one week prior to use.  
² Avoid prolonged exposure to chlorine solution to minimize corrosion of instruments and deterioration of rubber and cloth products.  
³ If sterilization (dry heat or autoclave) not available, these items can be HLD by boiling or soaking in chemical disinfectants as follows:  
Boiling:  
- Boil for 20 minutes in a pot with a lid (begin timing when water begins to boil).  
- All items must be covered completely during boiling. (Place items that float in a weighted, porous bag. See Chapter 7.)  
- Do not add anything to the pot after water begins to boil.  
- Air dry before use or storage. (Air dried surgical drapes should be ironed before use.)  
Chemical HLD with 8% formaldehyde or glutaraldehyde:  
- Cover all items with correct dilution of properly stored disinfectant.  
- Soak for 20 minutes or as per manufacturers instructions.  
- Rinse with water which has been boiled for 20 minutes and air dry before use or storage.  
⁴ Instruments with cutting edges and needles should not be sterilized at temperatures above 160°C to avoid dulling them.  

Source: Adapted from Perkins, 1983.
PREPARATION OF CLIENTS

While skin cannot be sterilized, pre-operative washing of the surgical site and antiseptic preparation minimizes the number of microorganisms on the client’s skin. Both are important in reducing the risk of infection following insertion or removal of Norplant implants. (Because the rate of infection following insertion or removal is low—less than 1%—when cleansing and antiseptic preparation are correctly done, use of prophylactic antibiotics is not recommended.)

SURGICAL ATTIRE FOR CLIENTS AND STAFF

Because insertion and removal of Norplant are minor surgical procedures (i.e., minimal or no incision required and only superficial tissues are entered):

- clients can wear their own clothing provided they are clean, and
- staff do not have to wear a cap, mask or gown.

INFECTION PREVENTION TIPS: INSERTION

To avoid infection, the following steps should be taken during Norplant insertion and removal.

Getting Ready

- Have the client wash her entire arm and hand thoroughly with soap and water, and rinse, being sure to remove all traces of soap. (This step is particularly important where client hygiene may be poor. It may be easier to wash her arm before she enters the procedure area.)

- Cover procedure table (and arm support or side table, if available) with a clean cloth.

- Ask the client to lie down on the table so that her non-dominant arm (the one she uses less) is comfortably extended and is well supported.
IP for Norplant

- Place a clean, dry cloth under the client's arm.
- Surgically drape the arm with a sterile cloth. (Alternatively, a cleaned, HLD, air-dried and ironed cloth can be used.)

Aseptic Insertion

- Prepare an instrument tray and open the sterile instrument pack.
- Carefully open the sterile pouch containing the Norplant capsules by pulling apart the sheets of the pouch and allowing the six capsules to fall on a sterile cloth or HLD bowl. Remember: Contact with cotton or other cloth makes the capsules more reactive (i.e., more apt to cause adhesions or scarring because minute particles of the cotton adhere to the silastic capsules).

Note: If a sterile cloth is not available after opening the sterile pouch, the capsules can be dropped into a HLD bowl or onto the HLD tray containing the instruments. Alternatively, partially open the pouch and remove the capsules one at a time, as needed, using HLD forceps. (To avoid dropping the capsules, practice using the tweezers or forceps to pick up and insert them in the trocar.) Do not touch the inside of the package or its contents except with a HLD instrument. Count to make sure there are six capsules.

Note: If a capsule falls on the floor, leave it for later disposal. It is contaminated. Open a new package and continue with the procedure. (Never attempt to resterilize contaminated capsules. They should be handled as contaminated waste and destroyed by burning or burying.
- Wash hands with antiseptic soap and water.
- When putting on sterile or high-level disinfected gloves, do not use powder. The tiny powder granules (talc) may fall into the insertion site and cause a fibrous reaction (scarring). If gloves are powdered, wipe off fingers with sterile gauze soaked with sterile or boiled water.
When prepping the insertion site with an antiseptic solution, select from among the following chemicals (or those locally available):

- 1-3% iodine, followed by 60-90% alcohol
- Iodophor such as povidone iodine (PVI) or Betadine
- 60-90% isopropyl or ethyl alcohol
- 4% chlorhexidine (e.g., Hibiclens)
- Savlon

It is preferable to use a sterile or high-level disinfected (HLD) sponge forceps to prep the insertion site with a cotton or gauze swab soaked with antiseptic. (If prepping is done with a gloved hand, care must be taken not to contaminate the glove by touching any unprepped skin.) Begin wiping at the proposed insertion site and move outward in a circular motion for 8-13 cm (3-5 in). Wipe off excess antiseptic with sterile gauze.

After inserting all six capsules, clean the area around the insertion site with a small amount of antiseptic solution applied to a cotton or gauze swab.

Bring the edges of the incision together and use a butterfly bandage, an ordinary bandaid or surgical tape with sterile cotton to cover the incision.

Cover the insertion area with a dry sterile compress and snugly wrap with gauze around the arm.

Before removing gloves, gently place instruments into a bucket of 0.5% chlorine solution or other approved disinfectant for decontamination. Before immersing the needle and syringe, fill with chlorine solution. Separate plunger from trocar and immerse. (Dried blood makes it difficult to separate them later.) Soak for 10 minutes then rinse immediately with clean water to avoid corrosion of metal items.
• While still wearing gloves, dispose of contaminated objects (gauze, cotton and other waste items) in a properly marked leak-proof container with a tight-fitting lid, or in a plastic bag. If single-use (disposable) gloves were used, carefully remove them by inverting and place in the waste container.

• For reusable gloves first immerse both hands in the chlorine solution and then remove by inverting. Place gloves in the chlorine solution and soak for 10 minutes.

• Follow guidelines for cleaning and processing of used (soiled) instruments, gloves, and needle and syringe for next use (see Chapters 5-7 and Appendices A and E).

Client Instructions for Wound Care at Home

• Keep the area dry and clean for at least 48 hours. The incision could become infected if the area gets wet while bathing or washing clothes.

• There may be bruising, swelling or tenderness at the insertion site for a few days. This is normal.

• Routine work can be done immediately. Avoid bumping, straining the area or applying unusual pressure to the site.

• Leave the gauze pressure dressing in place for 48 hours, and the bandaid or surgical tape in place until the incision heals (i.e., normally 3 to 5 days).

• After healing, the area can be touched and washed with normal pressure.

• If signs of infection occur, such as fever, inflammation (redness and heat) at the site, or if there is persistent pain for several days, return to the clinic.
If Infection Occurs

- Treat infections with appropriate therapy for local wound infections.
- If there is an abscess (with or without beginning expulsion of any implants), remove all implants.

INFECTION PREVENTION TIPS: REMOVAL

Getting Ready

- Have the client wash her entire arm and hand thoroughly with soap and water, and rinse, being sure to remove all traces of soap. (Residual soap decreases the effectiveness of some antiseptics.) This step is particularly important when client hygiene is poor.
- Cover procedure table (and arm support or side table, if available) with a clean sheet.
- Ask the client to lie down on the table so that her arm with the capsules rests on the table (or arm support).
- Place a clean, dry cloth under the woman's arm.

Aseptic Removal

- Prepare instrument tray. Open the sterile tray exposing instruments and supplies, without contaminating it.
- Wash hands with antiseptic soap and water.
- Put on sterile or HLD gloves and arrange instruments and supplies.
IP for Norplant

- Prep the insertion site with an antiseptic solution. Select from among the following chemicals (or those locally available):
  - 2-3% iodine followed by 60-90% alcohol
  - Iodophor such as povidone iodine (PVI) or Betadine
  - 60-90% isopropyl or ethyl alcohol
  - 4% chlorhexidine (e.g., Hibiclens)
  - Savlon

- It is preferable to use a sterile or high-level disinfected (HLD) sponge forceps to prep the removal site with a cotton or gauze swab soaked with antiseptic. (If prepping is done with a gloved hand, care must be taken not to contaminate the glove by touching any unprepped skin.) Begin wiping at the proposed removal site and move outward in a circular motion for 8-13 cm (3-5 in). Wipe off excess antiseptic with sterile gauze.

- Surgically drape the arm with a sterile cloth. (Alternatively, a cleaned, HLD, air-dried and ironed cloth can be used.)

- After all six capsules have been removed, clean the area around the wound with a small amount of antiseptic solution applied to a sterile cotton or gauze swab.

- Bring the edges of the incision together and use a bandaid or surgical tape with sterile cotton to cover the incision.

- Cover with a sterile compress and wrap snugly with gauze around the arm.

- Before removing gloves, gently place instruments into a bucket of 0.5% chlorine solution for decontamination before cleaning. Before immersing the needle and syringe, fill with chlorine solution. Also, separate the plunger from trocar. (Dried blood makes it difficult to separate them later.) Soak for 10 minutes then rinse immediately with clean water to avoid corrosion of metal items.
While still wearing gloves, dispose of contaminated objects (Norplant capsules, gauze, cotton and other waste items) in a properly marked leak-proof container (with a tight-fitting lid) or plastic bag. If single-use (disposable) gloves were used, carefully remove them by inverting and place in the waste container.

For reusable gloves first immerse both hands in the chlorine solution and then remove by inverting. Place gloves in the chlorine solution and soak for 10 minutes.

Follow guidelines for decontamination, cleaning and re-processing of instruments, gloves, and needles and syringes for next use (see Chapters 5-7 and Appendices A and E).

Client Instructions for Wound Care at Home

Keep the area dry and clean for at least 48 hours. The incision could become infected if the area gets wet while bathing or washing clothes.

There may be bruising, swelling or tenderness at the removal site for a few days. This is normal.

Routine work can be done immediately. Avoid bumping or straining the area, or applying unusual pressure to the site.

Leave the gauze pressure bandage in place for 48 hours, and the bandaid or surgical tape in place until the incision has healed (usually 3-5 days).

After healing, the area can be touched and washed with normal pressure.

If signs of infection occur, such as fever, inflammation (redness and heat) at the site, or persistent pain for several days, return to the clinic.

If Infection Occurs

Treat infections with appropriate therapy for local wound infections.
CARE OF TROCAR

The trocar used for Norplant insertion must be kept sharp to help decrease skin infections caused by tissue trauma. Process trocars as you would any metal instrument but check to make sure the trocar remains sharp.

Tips for Keeping Trocars Sharp (The Population Council, 1987)

- Examine the trocar after every 10 insertions for dullness (repeated use of a trocar will cause it to become blunt)
- Use a smooth grindstone to sharpen the trocar in the same way you would sharpen a knife or a pair of scissors
- When sharpening a trocar, avoid excessive grinding that could damage the angle of the point, thereby making the trocar unusable
- After many insertions, perhaps 100, the trocar should be replaced not sharpened.

MAINTENANCE OF A SAFE ENVIRONMENT

Maintaining a safe, infection-free environment for the delivery of Norplant services is an on-going process, which requires frequent retraining of clinic staff and close supervision. With diligent application of recommended practices, infections following Norplant insertion and removal and transmission of diseases, such as hepatitis B and AIDS, can be avoided. The practices described above, however, must be conscientiously applied before, during and after each procedure. Laxity at any point in the routine can have disastrous results for the safety level of the next procedure.
REFERENCES


FIFTEEN

IUD INSERTION AND REMOVAL

BACKGROUND

The potential for infection in IUD users is increased in areas where genital tract infections (GTIs) such as gonorrhea and chlamydia are prevalent. By following recommended infection prevention processes however, health workers can minimize the risk of post-IUD insertion infection to clients and the danger of transmitting infections, even hepatitis B or AIDS, to their clients, their coworkers or themselves.

The emphasis in this chapter is on the use of infection prevention practices that are practical and feasible in any health care facility. For example, many family planning and health clinics often provide only reversible contraceptive methods such as oral pills, injectables and barrier methods. As a consequence, they may not have an autoclave or dry heat sterilizer. Even for clinics such as these, it is not necessary to have sterile instruments or gloves; high-level disinfection by boiling is sufficient to provide safe, low-risk IUD services for both clients and health care providers (Block, 1983).

HANDWASHING AND GLOVES

Thorough handwashing coupled with the use of protective gloves are key components in minimizing the risk of infection for clients, clinicians and housekeeping staff.

Handwashing may be the single most important procedure in preventing infection. The vigorous rubbing together of all surfaces of lathered hands mechanically removes and often inactivates most organisms.

Handwashing is indicated before:

- examining (direct contact with) a client, and
• putting on high-level disinfected or sterile gloves for IUD insertion or removal.

Handwashing is indicated after:

• any situation in which hands may be contaminated, such as:
  • handling objects, including used (soiled) instruments; and
  • touching mucous membranes, blood or other body fluids (secretions or excretions);

• removing gloves.

Wash hands after removing gloves because gloves may have invisible holes or tears.

A separate pair of gloves must be used for each new client to avoid cross-contamination.

As a precaution, gloves should be worn by all staff prior to contact with blood or body fluids from any client.

Which Gloves to Use

• Clinicians: When performing pelvic exams or inserting or removing IUDs, clean, high-level disinfected (disposable or reusable) gloves can be used (sterile gloves are not necessary).

• Cleaning Staff: Clean, thick household (utility) gloves should be used for cleaning instruments and equipment, as well as contaminated surfaces.

Note: Do not use gloves which are cracked, peeling or have detectable holes or tears.
Instructions for how to sterilize or HLD reusable gloves are outlined in Appendix A.

PROCESSING USED (SOILED) INSTRUMENTS, GLOVES AND OTHER ITEMS

With either IUD insertion or removal, the infection prevention processes which should be used to reduce disease transmission from contaminated instruments and gloves are:

- waste disposal and decontamination,
- cleaning and rinsing, and
- high-level disinfection, or
- sterilization.

The sequence and details for performing each of these processes are described in Table 15-1. After completing either an IUD insertion or removal, and while still wearing gloves, properly dispose of contaminated objects (gauze, cotton and other waste items) in a leak-proof container or plastic bag. Following this, surgical instruments and reusable gloves, which were in contact with blood or body fluids should be decontaminated by soaking for 10 minutes in a disinfectant (0.5% chlorine solution) immediately after use. Surfaces such as examination tables that may have been contaminated by body fluids also should be decontaminated before reuse. Next, instruments and reusable gloves should be thoroughly cleaned with detergent and water and completely rinsed before further treatment. Finally, instruments that only touch broken skin or mucous membranes (such as vaginal specula) should be high-level disinfected by boiling - a process that destroys all microorganisms except some bacterial endospores. (See Chapters 5 - 7 for a detailed description of how to process instruments and other items.)

In practice, only instruments that come in contact with the blood stream or touch tissue beneath the skin, such as reusable needles and scalpels, need to be sterilized, a process which destroys all microorganisms, including bacterial endospores (Tietjen, 1989).
Because intact mucous membranes generally are resistant to infections caused by common bacterial endospores (Block, 1983), boiling satisfactorily renders surgical instruments and gloves safe for use in inserting or removing IUDs.

Table 15-2 outlines the steps in processing the instruments, gloves and other items used for inserting and removing IUDs. This system was specifically developed to meet the infection prevention requirements for providing safe, low-risk IUD services in family planning and health care clinics. When used in conjunction with a "no-touch" IUD insertion technique (i.e., passage of high-level disinfected instruments only once through the cervix), this approach has several advantages:

- it does not require the use of sterile instruments (high-level disinfection of decontaminated and cleaned instruments by boiling is sufficient);
- it eliminates the need for disposable sterile gloves (if IUDs are loaded in the sterile package as recommended); and
- it employs readily available, inexpensive materials for decontamination (chlorine solution), cleaning (detergent and water) and disinfection (boiling).

Used together, these approaches provide a practical and acceptable solution to preventing infection - one which enables clinics with limited facilities and resources to provide IUD services safely.
Table 15-1: Infection Prevention Guidelines for IUD Insertion or Removal

WASTE DISPOSAL AND DECONTAMINATION

STEP 1: After completing either IUD insertion or removal, and while still wearing gloves, dispose of contaminated objects (gauze, cotton and other waste items) in a properly marked leak-proof container (with a tight-fitting lid) or plastic bag. (See Chapter 9 for details.)

STEP 2: Fully immerse all metal instruments in a plastic bucket containing 0.5% chlorine solution for 10 minutes before allowing staff and cleaning personnel to handle or clean them. (This pre-wash soak kills most microorganisms, including HBV and HIV.)

STEP 3: All surfaces (such as the procedure table or instrument stand) that could have been contaminated by blood and mucus, also should be decontaminated by wiping down with chlorine solution. (See Chapters 5 and 10 for details.)

STEP 4: If single-use (disposable) gloves were used, carefully remove them by inverting, and place in the waste container. If the gloves are reusable, first immerse both gloved hands in the bucket containing the chlorine solution briefly and then carefully remove by inverting. Deposit the gloves in the chlorine solution.

CLEANING AND RINSING

After decontamination, thoroughly clean instruments with water, detergent, and soft brush, taking care to brush all teeth, joints and surfaces. Next, rinse well after cleaning to remove all detergent (some detergents can render chemical disinfectants inert). Dry instruments before further processing. Surgical drapes should be washed with detergent and water, air or machine dried. (See Chapter 5 and Appendices A and E for details.)

HIGH-LEVEL DISINFECTION

High-level disinfection by boiling is the recommended practice. Surgical (metal) instruments and reusable gloves should be boiled for 20 minutes. Alternatively, they can be soaked for 20 minutes in a glutaraldehyde or 8% formaldehyde solution. After cooling (if boiled) or rinsing in boiled water (if chemical disinfectants used) and drying, instruments are ready to use. Use immediately or store for up to one week, in a clean, dry high-level disinfected container with a tight-fitting lid or cover. After HLD, air dried surgical drapes should be ironed before use. (See Chapter 7 for details.)

STERILIZATION

Alternatively, instruments and reusable gloves used for IUD insertion and removal can be sterilized by autoclaving at 121°C (250°F) and 106kPa (15lbs/in²) pressure for 20 minutes if unwrapped and 30 minutes if wrapped. Note: Dry heat sterilization at 170°C (340°F) for 60 minutes can only be used for metal or glass instruments. (See Chapter 6 for details.)

Storage: Unwrapped instruments must be used immediately. Wrapped instruments, gloves and drapes can be stored for up to one week if the package remains dry and intact, one month if sealed in a plastic bag.
<table>
<thead>
<tr>
<th>Process</th>
<th>Decontamination</th>
<th>Cleaning</th>
<th>High-Level Disinfection</th>
<th>Sterilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pelvic exam table top, or other large surface areas</td>
<td>Wipe off with 0.5% chlorine solution.</td>
<td>Wash with detergent and water if organic material remains after decontamination procedure.</td>
<td>Not necessary</td>
<td>Not necessary</td>
</tr>
<tr>
<td>Gloves (rubber or plastic)</td>
<td>Soak in 0.5% chlorine solution for 10 minutes prior to cleaning. (Rinse or wash immediately.)</td>
<td>Wash with detergent and water, removing all particles. Rinse with clean water and check for holes. If to be sterilized, dry inside and out.</td>
<td>• Boil for 20 minutes in a pot with a lid (start timing when water begins to boil)</td>
<td>Autoclave at 121°C (250°F), and 106 kPa (15 lbs/in²) for 20 minutes. Do not use for 24-48 hours</td>
</tr>
<tr>
<td>Instruments for pelvic exam and IUD insertion (e.g., specula, tenaculum, forceps, and uterine sounds)</td>
<td>Soak in 0.5% chlorine solution for 10 minutes prior to cleaning. (Rinse or wash immediately.)</td>
<td>Using a brush, wash with detergent and water, removing all particles. Rinse with clean water. If to be sterilized, air or towel dry.</td>
<td>• Boiling: Boil for 20 minutes in a pot with a lid (start timing when water begins to boil). Instruments must be covered completely by water during boiling. Do not add anything to pot after water begins to boil. Air dry before use or storage. Chemical: Soak for 20 minutes in 8% formaldehyde, or a glutaraldehyde, and rinse well in water which has been boiled for 20 minutes.</td>
<td>Dry heat for 1 hour after reaching 170°C (340°F), or Autoclave at 121°C (250°F) and 106 kPa (15 lbs/in²) for 20 minutes if unwrapped, 30 minutes if wrapped.</td>
</tr>
<tr>
<td>Instruments/Equipment</td>
<td>Decontamination</td>
<td>Cleaning</td>
<td>High-Level Disinfection</td>
<td>Sterilization</td>
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</tr>
<tr>
<td>IUDs and inserters</td>
<td>Not necessary</td>
<td>Not necessary</td>
<td>If bulk packaged, high-level disinfect with:</td>
<td>Most IUDs come in sterile packages. Discard if package seal broken.</td>
</tr>
<tr>
<td>(never reuse)</td>
<td></td>
<td></td>
<td>• a glutaraldehyde, or</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• 8% formaldehyde, and</td>
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<td></td>
<td>rinse in water which has</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>been boiled for 20 minutes.</td>
<td></td>
</tr>
<tr>
<td>Storage containers for</td>
<td>Soak in 0.5% chlorine solution</td>
<td>Wash with detergent and water removing all particles. Rinse with clean water, air or towel dry.</td>
<td>Boil container and lid as above. If container is too large, then:</td>
<td>Dry heat for one hour after reaching 170°C (340°F), or</td>
</tr>
<tr>
<td>instruments</td>
<td>for 10 minutes prior to cleaning. (Rinse or wash immediately.)</td>
<td></td>
<td>• Fill container with 0.5% chlorine solution and soak for 20 minutes.</td>
<td>Autoclave at 121°C (250°F) and 106 kPa (15 lbs in²) for 20 minutes if unwrapped, 30 minutes if wrapped.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Rinse with water which has been boiled for 20 minutes and air dry before use.</td>
<td>Re-sterilize weekly, when empty or contaminated.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Re-disinfect weekly, when empty or contaminated.</td>
<td></td>
</tr>
</tbody>
</table>

1 If unwrapped, use immediately; if wrapped, may be stored up to one week prior to use.
2 Avoid prolonged exposure to chlorine solution to minimize corrosion of instruments and deterioration of rubber or cloth products.

Source: Adapted from Perkins, 1983
CLIENT SELECTION

The increasing problem of sexually transmitted genital tract infections, such as gonorrhea, chlamydia and syphilis, in addition to hepatitis B and AIDS, requires that potential IUD acceptors be screened before an IUD is inserted.

The first step in screening a client who is a potential IUD acceptor is to do a GTI screening history. It should include the following questions:

- Are you having a vaginal discharge?
- Have you had abnormal vaginal bleeding with the last two menstrual periods?
- In the past year, have you had a genital tract problem such as a vaginal discharge, ulcers or skin lesions in your genital area?
- Has your sex partner (husband) been treated for a genital tract problem, such as discharge (drip) from the penis, an ulcer, or swollen groin glands, in the last three months? Which?
- Does your sex partner (husband) have other sex partners that you know of?
- Do you think that you might have a genital tract infection?
- Have you had more than one sex partner in the last two months?

If the client answers "yes" to any of the above questions, she should undergo further evaluation for a possible GTI. In addition, she should be counseled concerning the risks of transmission and the possible consequences of untreated GTIs.

Remember: Because some of these questions are very sensitive, it may not be possible to ask them in a direct way. As the client-clinician relationship allows, determine this information in a respectful and culturally sensitive manner. Confidentiality must be assured for all patients.

The second step in screening a female client for possible sexually transmitted GTIs is to perform a careful abdominal and pelvic examination.
IP for IUDs

In women it is important to check for:

- Lower abdominal pain or tenderness.
- Genital ulcers, sores or swellings (buboes) in the groin.
- The presence of a purulent cervical discharge, friable (easily bleeding) cervix or unrecognized vaginal discharge.
- Pain on cervical motion.
- Suprapubic, adnexal or pelvic mass.

Safety Tip: In the presence of any of the above, the decision as to whether or not an IUD should be inserted should be deferred until the client has been further evaluated.

INFECTION PREVENTION TIPS: INSERTION

To minimize the client's risk of post-insertion infection clinic staff should strive to maintain an infection-free environment. To do this:

- Exclude clients who are by history or physical examination at risk for sexually transmitted GTIs.
- Wash hands thoroughly with soap and water before and after each procedure.
- When possible, have the client wash her genital area before the screening pelvic examination.
- Use high-level disinfected (or sterilized) instruments and gloves (both hands). Alternatively, disposable (single-use) exam gloves can be used.
- After inserting the speculum and while looking at the cervix, liberally apply antiseptic solution several times to the cervix and vagina before beginning the procedure.
- Load the IUD in the sterile package.
IP for IUDs

- Use a "no touch" insertion technique to reduce contamination of the uterine cavity (i.e., do not pass the uterine sound or loaded IUD more than once through the cervical os).

- Properly dispose of waste material (gauze, cotton and disposable gloves) after inserting the IUD.

- Decontaminate instruments and reusable items immediately after using them.

When these tips are followed, post-insertion infection rates are low; therefore, use of prophylactic antibiotics is not recommended.

INFECTION PREVENTION TIPS: REMOVAL

Although rarely associated with pelvic infection, IUD removal should be performed with similar care. To minimize risk to service providers and their co-workers during IUD removal, key infection prevention tips are presented in the box below.

- Wash hands thoroughly with soap and water before and after each procedure.

- Where possible, have the client wash her genital area before doing the pelvic examination.

- Use clean, high-level disinfected (or sterilized) instruments and gloves (both hands). Alternatively, disposable (single-use) exam gloves can be used.

- Liberally apply antiseptic solution several times to the cervix and vagina before beginning the procedure.
IP for IUDs

- Properly dispose of waste material (gauze, cotton and disposable gloves) after removing the IUD.
- Decontaminate instruments and reusable items immediately after using them.

DISINFECTING BULK-PACKAGED IUDS AND OTHER PROBLEMS

IUDs, even inert ones, should never be reused.

If supplied in bulk, inert IUDs must be high-level disinfected using chemical agents as described in Chapter 7 and Appendix F. IUDs should never be boiled or autoclaved because heat deforms them.

If it is necessary to HLD bulk-packaged IUDs, the following should be taken into consideration:

- Glutaraldehydes and formaldehyde are expensive, often difficult to supply and, additionally, are toxic to human tissue. Once disinfected, the IUDs must be thoroughly rinsed with boiled water to remove the chemical residue.
- Following rinsing and air drying, the IUDs must be transferred to an HLD container with a tight-fitting lid without contaminating them.
- The IUDs can be considered disinfected only for about one week - less if the container is repeatedly opened or the IUDs are inadvertently touched by a non-sterile instrument such as a sponge forceps or lifter.
- A disinfected IUD can be contaminated easily during loading in the inserter tube.

Iodophors and alcohols are not classified as HLDs, and therefore should not be used for disinfesting IUDs. In addition, low-level disinfectants, such as benzalkonium chloride (Zephiran®) or Savlon®, a mixture of cetrimide and chlorhexidine, should never be used to disinfect IUDs.
Fortunately, the vast majority of IUDs inserted worldwide, both the copper- and hormone-releasing ones, are supplied in pre-sterilized packages. Because they can be easily loaded in the package in a few seconds, sterility is assured prior to insertion. However, even IUDs packaged in a sterile wrapper can become contaminated if the package is torn or opened or if the shelf life has expired (i.e., the shelf life of the Copper T 380A IUD is four years). If the package seal is broken or there is any possibility the IUD may be contaminated, use another IUD from an unopened, sterile package. Attempting to disinfect a contaminated IUD by soaking in one of the high-level chemical disinfectants listed above clearly is not recommended in this instance.

TARNISHING

The occasional presence of tarnish on the surface of copper-releasing IUDs has caused unnecessary concern among family planning providers and other clinic staff. In particular, providers often think that a tarnished IUD may not be sterile or the tarnish may block the release of copper in the uterus (thereby reducing the effectiveness of the device).

All available evidence suggests that tarnished IUDs are safe and effective and can be inserted and used in the same way as untarnished IUDs.

The copper wire or sleeves on IUDs tarnish because moisture and gases penetrate the IUD package, causing an oxide film to form on the copper. The IUD packaging material is designed to be permeable to ethylene oxide gas (used to sterilize packaged IUDs), but not to disease-causing microorganisms, including spores.

Because tarnish can form even when IUD packages remain sealed, its presence does not suggest a non-sterile device. (As noted above, IUD packages always should be examined to check for the possibility of visible breaks in the seal before an IUD is inserted.) The extremely thin layer of tarnish (about 0.016% of the copper wire radius) is not harmful and is unlikely to interfere with the release of copper ions in the uterus based on a recent report from The Population Council’s Center for Biomedical Research. The study showed that the copper release rate of the IUD remained the same even when tarnished. Moreover, tarnished devices that have been inserted and later removed after successful use
IP for IUDs

show satisfactory evidence of copper dissolution (release of copper ions). In conclusion, research suggests that the tarnish sometimes observed on copper IUDs does not pose a risk to the user (Outlook, 1989).

MAINTENANCE OF A SAFE ENVIRONMENT

Maintaining a safe, infection-free environment for the delivery of IUD services is an on-going process which requires frequent retraining of clinic staff and close supervision. With diligent application of recommended practices, infections following IUD insertion and removal and transmission of diseases, such as hepatitis B and AIDS, can be avoided. The practices described above, however, must be conscientiously applied during every insertion and removal and after each procedure. Laxity at any point in the routine can have disastrous results for the safety level of the next procedure.

REFERENCES


BACKGROUND

Administering an injectable steroid contraceptive, such as Depo Provera®, is an invasive procedure. Because an injection penetrates the protective skin barrier, careful aseptic technique must be followed to prevent infection. One type of infection associated with this procedure is an injection abscess, commonly caused by normal skin flora (staph and strep). Thorough skin preparation done before the injection will remove most microorganisms from the client’s skin which helps prevent cellulitis (skin infection) and abscess formation at the injection site.

Another concern is the increasing problem of transmission of hepatitis B and AIDS viruses to clients, health care providers and clinic staff, especially cleaning and housekeeping personnel (Capps, 1948). To minimize this risk, whenever possible, single-use (disposable) needles and syringes should be used. If reusable needles and syringes are used, they should be decontaminated immediately after use by soaking in 0.5% chlorine solution or other locally available and approved disinfectant. These practices, when combined with the proper disposal of single-use needles and syringes, protects clinic staff, especially cleaning and housekeeping personnel, from contracting hepatitis B or AIDS following accidental needlesticks. Following decontamination, reusable needles and syringes should be thoroughly cleaned and finally sterilized or high-level disinfected.

Remember: Thorough cleaning and prepping of the injection site, to physically remove soil and organic material, are the most effective ways to prevent local infection.
HANDWASHING AND GLOVES

Thorough handwashing coupled with the use of protective gloves are key components in minimizing the risk of infection for clients, clinicians and housekeeping staff.

Handwashing may be the single most important procedure in preventing infection. The vigorous rubbing together of all surfaces of lathered hands mechanically removes and often inactivates most organisms.

Handwashing is indicated before:

- examining (direct contact with) a client, and
- giving an injection.

Handwashing is indicated after:

- any situation in which hands may be contaminated, such as:
  - handling objects, including used (soiled) needles and syringes; and
  - touching mucous membranes, blood and body fluids (secretions or excretions);
- removing gloves

Wash hands after removing gloves because gloves may have invisible holes or tears.
Which Gloves to Use

- **Clinicians:** Gloves are not necessary for administering injections because there should be no direct contact with blood or body fluids.

- **Cleaning Staff:** Clean, thick household (utility) gloves should be used for cleaning needles and syringes as well as contaminated surfaces.

Do not use gloves which are cracked, peeling or have detectable holes.

**PROCESSING USED (SOILED) NEEDLES AND SYRINGES**

For administering injectable contraceptives such as Depo Provera®, the infection prevention processes which should be used to reduce disease transmission from contaminated needles and syringes are:

- waste disposal and decontamination,
- cleaning and rinsing, and
- sterilization, or
- high-level disinfection.

The sequence and details for performing each of these processes are summarized in Tables 16-1 and 16-2. After completing each injection, staff should properly dispose of contaminated objects (gauze, cotton and other waste items) in a leak-proof container or bag. Single use needles and syringes should be placed in a puncture-proof container made of cardboard, metal or glass. To prevent needlestick accidents, single use needles and syringes should not be disassembled after use, and needles should not be recapped, bent or broken prior to disposal. **Reusable** needles and syringes, which were in contact with blood or body fluids, should be **decontaminated** by first filling them with 0.5% chlorine solution and then soaking for 10 minutes in this solution. Next the needles and syringes should be thoroughly **cleaned** with detergent and water and completely rinsed before further treatment. Finally, they should be **sterilized**. If sterilization is not possible, these items should undergo **high-level disinfection** by boiling.
Sterilization, a process which destroys all microorganisms including bacterial endospores, is the preferred practice for processing items that come in contact with the bloodstream or touch tissue beneath the skin.

When available and affordable, single-use needles and syringes are recommended for all client procedures.

Safety Tips When Using Single-Use Needles and Syringes

When single-use (disposable) needles and syringes are used, it is important that:

- Each needle and syringe is used only once.
- Needles and syringes are not disassembled after use.
- Needles are not recapped, bent or broken prior to disposal.
- They are properly disposed of in a puncture-proof container.
- Adequate supplies are maintained.

Note: If needles must be recapped, use "one-handed" recap method:

- First, place cap on a hard, flat surface, then remove hand.
- Next, with one hand, hold syringe and use needle to "scoop-up" cap.
- Finally, when cap covers needle completely, use other hand to secure cap on needle hub.

Detailed step-by-step instructions for decontaminating, cleaning and either sterilization or high-level disinfection of needles and syringes are provided in Chapters 5 - 7 and Appendix E.
Table 16-1: Infection Prevention Guidelines for Administration of Injectable Contraceptives

WASTE DISPOSAL AND DECONTAMINATION

STEP 1: After completing the injection, dispose of contaminated objects (gauze, cotton and other waste items) in a properly marked leak-proof container (with a tight fitting lid) or plastic bag. Place single use needles and syringes in a puncture-proof container. Do not bend or break needles prior to disposal. (See Chapter 9 for details.)

STEP 2: Fully immerse all reusable needles and syringes in a plastic bucket containing 0.5% chlorine solution for 10 minutes before allowing staff and cleaning personnel to handle or clean them. Before immersing needles and syringes, fill with chlorine solution. (This pre-wash soak kills most microorganisms, including HBV and HIV.)

STEP 3: All surfaces (such as the procedure table or instrument stands) that could have been contaminated by blood and mucus also should be decontaminated by wiping down with chlorine solution. (See Chapters 5 and 10 for details.)

CLEANING AND RINSING

After decontamination, disassemble needles and syringes and thoroughly clean with water, soap and soft brush. Insert stylet or needle wire through the hub of the needle to ensure that the cannula is not obstructed. Next, reassemble and rinse at least three times with clean water, expelling the water through the needles into another container so as not to contaminate the rinse water. Flush needles with boiled or distilled water just prior to pricking for steam sterilization. Dry before further processing. (See Chapter 5 and Appendix E for details.)

STERILIZATION

Reusable needles and syringes should be sterilized by autoclaving or dry heat. (See Chapter 6 for details.)

Standard Conditions for Heat Sterilization
Steam sterilization: 121°C (250°F) at 106kPa (~15 lbs/in²) pressure for 20 minutes for unwrapped needles and syringes; 30 minutes for wrapped items. Allow all items to dry thoroughly before removing.

Dry heat: (glass or metal items only) 160°C (320°F) for two hours (total cycle time is from three to three and a half hours). Needles should be sterilized at temperatures no higher than 160°C (320°F) because higher temperatures can dull sharp edges.

Storage: Wrapped needles and syringes can be stored for up to one week if the package remains dry and intact, one month if sealed in a plastic bag.

HIGH-LEVEL DISINFECTION

High-level disinfection by boiling is recommended if sterilization is not possible. Needles and syringes should be boiled for 20 minutes. Store for up to one week in a clean high-level disinfected container with a tight-fitting lid or cover. (See Chapter 7 for details.) Avoid chemical disinfection of needles and syringes.
Table 16-2: Infection Prevention for Administering Injectable Contraceptives
Steps in Processing Instruments and Equipment

<table>
<thead>
<tr>
<th>Process</th>
<th>Decontamination</th>
<th>Cleaning</th>
<th>High-Level Disinfection</th>
<th>Sterilization</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Instruments/Equipment</strong></td>
<td><strong>Decontamination</strong></td>
<td><strong>Cleaning</strong></td>
<td><strong>High-Level Disinfection</strong></td>
<td><strong>Sterilization</strong></td>
</tr>
</tbody>
</table>
| Needles and syringes | Fill assembled needle and syringe with 0.5% chlorine solution and then soak for 10 minutes prior to cleaning. Rinse by flushing (x3) with clean water. | Disassemble, then wash with detergent and water, removing all particles. Rinse with clean water, air or towel dry syringes (only air dry needles). | Boiling:  
- Boil for 20 minutes in a pot with a lid (start timing when water begins to boil).  
- Needles and syringes must be covered completely by water during boiling.  
- Do not add anything to pot after water begins to boil.  
- Air dry before use or storage.  
Chemical:  
- Soak for 20 minutes in  
  - 8% formaldehyde or  
  - glutaraldehyde and rinse well in water that has been boiled for 20 minutes.  
- Boil as above.  
If container is too large, then:  
- Fill container with 0.5% chlorine solution and soak for 20 minutes.  
- Rinse with water which has been boiled for 20 minutes and air dry before use.  
Re-disinfect weekly, when empty or contaminated. | Preferable:  
- Dry heat for two hours after reaching 160°C (320°F) (glass syringes only), or  
- Autoclave at 121°C (250°F) and 106 kPa (15 lbs/in²) for 20 minutes (30 minutes if wrapped).  
- • Dry heat for one hour after reaching 170°C (340°F), or  
• Autoclave at 121°C (250°F) and 106 kPa (15 lbs/in²) for 20 minutes (30 minutes if wrapped).  
Re-sterilize weekly, when empty or contaminated. |
| Storage containers for instruments | Soak in 0.5% chlorine solution for 10 minutes prior to cleaning. (Rinse or wash immediately.) | Wash with detergent and water, removing all particles. Rinse with clean water, air or towel dry. | Boil as above.  
If container is too large, then:  
- Fill container with 0.5% chlorine solution and soak for 20 minutes.  
- Rinse with water which has been boiled for 20 minutes and air dry before use.  
Re-disinfect weekly, when empty or contaminated. | |

1 If unwrapped, use immediately; if wrapped, may be stored up to one week prior to use.
2 Place items that float in a weighted, porous bag (see Chapter 7.) Source: Adapted from Perkins, 1983.
CLINIC SITE FOR ADMINISTERING INJECTABLE CONTRACEPTIVES

Any outpatient procedure or treatment room is a suitable area for administering injectable contraceptives. If possible, the room should be located away from heavily used areas of the clinic or hospital. The room should:

- have adequate lighting;
- have tile or concrete floors to facilitate cleaning;
- be kept free of dust and insects; and
- be air-conditioned if necessary and possible. (If windows need to be open for ventilation, they should have tight fitting screens.)

There should be adequate handwashing facilities nearby, including a supply of clean water (i.e., clear not cloudy or with sediment) and suitable containers, with tight-fitting lids, or plastic bags for disposal of contaminated waste items. Puncture-proof containers should be conveniently placed for safe disposal of needles and syringes.

PREPARATION OF CLIENTS

While skin cannot be sterilized, antiseptic preparation of the injection site minimizes the number of microorganisms on the client's skin. This is important because it helps reduce the risk of infection following the injection.

- If the arm or buttocks are visibly dirty, either thoroughly wash the area with soap and water or pre-wipe with antiseptic to clean the injection site.
- Using a fresh cotton swab, liberally apply 60 - 90% alcohol to the injection site, working in a circular, overlapping motion starting at the center.
- Allow to dry.
INFECTION PREVENTION TIPS

Getting Ready

- Wash hands thoroughly with soap and water.
- Wipe the top of the vial with a cotton swab soaked in 60-90% alcohol. Allow to dry.
- If using a sterile syringe and needle, open the sterile pack. If using a boiled needle and syringe, remove syringe and needle from covered container with dry, boiled forceps/pickups.

Note: Never use a syringe which has not been processed between each use. Studies have shown that changing only the needle, not the syringe, between clients can result in transmission of hepatitis B virus (Capps et al, 1948).

- Attach needle to syringe by holding the hub (base) of the needle and the barrel of the syringe.
- Turn the vial containing the injectable steroid upside-down and draw the fluid into the syringe. Use the same needle you will use for the injection.

Note: Avoid the practice of leaving one needle inserted in the vial cap for multiple uses. This practice is dangerous because it provides a direct route for bacteria to enter the medicine vial and contaminate the fluid between each use.

Prepping the Injection Site

- Cleanse skin with 60 - 90% ethyl or isopropyl alcohol, removing all visible soil, as described above.
- Allow to dry before giving the injection.
- Administer the injection.
After the Injection

Single-use needles and syringes:

- Do not recap, bend or break needle. Discard assembled needle and syringe in a puncture-proof container, such as a heavy cardboard box, plastic bottle or tin can with lid. Old intravenous fluid bottles may also be used, but there is a risk of breakage.

Avoid accidental needlesticks. Do not disassemble single use needles or syringes after use, and do not recap, bend or break before disposal.

- Place the container close to the area where it will be used so that workers do not have to carry sharp items.

- Dispose of container when full by burying.

Reusable Needles and Syringes:

- Decontaminate in 0.5% chlorine solution to make the syringe and needle safer to handle. (Chlorine solution rapidly inactivates HBV and HIV.) (See Chapter 5 and Appendix E for details.) Following decontamination, disassemble and clean, then reprocess by sterilizing (steam or dry heat) or high-level disinfecting by boiling.

If Infection Occurs

Treat injection abscess with appropriate therapy for local wound infections.
MAINTENANCE OF A SAFE ENVIRONMENT

Maintaining a safe, infection-free environment for the delivery of injectable steroid contraceptive services is an on-going process which requires frequent retraining of clinic staff and close supervision. With diligent application of recommended practices, infections following injection and the transmission of diseases, such as hepatitis B and AIDS, can be avoided. The practices described above, however, must be conscientiously applied before, during and after each procedure. Laxity at any point in the routine can have disastrous results for the safety level of the next procedure.

REFERENCES


APPENDIX A

PROCESSING REUSABLE GLOVES

HOW TO DECONTAMINATE AND CLEAN RUBBER GLOVES BEFORE HIGH-LEVEL DISINFECTION OR STERILIZATION

STEP 1: Before removing reusable gloves which may be soiled with blood, body fluids or semen, immerse hands briefly in a bucket of 0.5% chlorine solution or other locally available and approved disinfectant.

STEP 2: Remove gloves by inverting them, and soak the gloves in the chlorine solution for 10 minutes in order to kill hepatitis B and AIDS viruses before handling, even though cleaning staff wear gloves. This insures that both surfaces of the gloves are decontaminated.

STEP 3: Wash in soapy water. Clean gloves inside and out.

STEP 4: Rinse in clean water until no detergent (soap) remains. (Detergent can interfere with disinfection.)

STEP 5: Test gloves for holes by inflating them by hand and holding them under water. (Air bubbles will appear if holes are present.)

STEP 6: Gently dry gloves inside and out before proceeding with disinfection or sterilization. (Gloves which remain wet for long periods of time will absorb water and become tacky.)

STEP 7: For gloves which are to be steam sterilized, package before further processing. For high-level disinfection, packaging is done after disinfection.

Note: Gloves should not be reprocessed more than three (3) times as invisible tears may occur.

STERILIZATION OF GLOVES

After decontamination, cleaning and thorough drying, gloves need to be packaged prior to autoclaving: the cuffs should be rolled up, so that the gloves can be put
Processing Reusable Gloves

on after sterilizing without contamination. If autoclaving, put gauze inside each glove and under the fold of the cuff (Figure A-1) and place them in a wire basket on their sides to allow optimum steam penetration. (If gloves are stacked in piles, penetration of steam under the cuffs may be poor.) (Do not tie tightly or wrap glove packs with rubber bands.) Autoclave at 121°C (250°F) for 20 minutes. Remember: Pressure of 106 kPa/15 lbs/in² adequate; higher pressures are destructive to gloves. (See Appendix C for additional information on packaging and sterilizing gloves.)

Figure A-1. Gloves with gauze inside glove and under fold.


Immediately after autoclaving, gloves are extremely friable and tear easily. Gloves should not be used for 24 to 48 hours, to allow the elasticity to be restored and to prevent tackiness/stickiness (Figure A-2).
**Figure A-2. Tips to Help Avoid Glove Problems**

### PROBLEM: TACKY OR STICKY GLOVES

<table>
<thead>
<tr>
<th>Probable Cause</th>
<th>Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Residual detergent/soap</td>
<td>• Reduced amount of detergent used when washing</td>
</tr>
<tr>
<td></td>
<td>• Rinse gloves well in clean water at least three times</td>
</tr>
<tr>
<td>• Excessive exposure to high temperature</td>
<td>• Use 20 minutes sterilizing exposure at 121°C (250°F) and remove gloves from sterilizer as soon as cycle is completed</td>
</tr>
<tr>
<td>• Sterilize gloves with other goods</td>
<td>• Sterilize gloves separately</td>
</tr>
<tr>
<td>• Poor powdering</td>
<td>• Use absorbable glove powder and follow manufacturer's instructions to insure a film of powder on all surfaces.</td>
</tr>
<tr>
<td>• Allowing surfaces of rubber/latex to touch each other</td>
<td>• Good powdering</td>
</tr>
<tr>
<td></td>
<td>• Poor packaging - Paper or cloth wicks should be inserted between the palm and back of hand of each glove and between the hand of the glove and turned back cuff. This allows steam to contact all surfaces during sterilization and prevent surfaces from adhering to each other.</td>
</tr>
<tr>
<td>• Deterioration of rubber/latex</td>
<td>• Rubber/latex gloves self-deteriorate while stored, even though they have not been used. They become soft, sticky and unusable.</td>
</tr>
<tr>
<td></td>
<td>• Do not overstack gloves</td>
</tr>
<tr>
<td></td>
<td>• Store in a dry and cool area</td>
</tr>
<tr>
<td></td>
<td>• Do not store in direct sunlight</td>
</tr>
</tbody>
</table>

### PROBLEM: EXCESSIVE TEARING OR RUPTURING

<table>
<thead>
<tr>
<th>Probable Cause</th>
<th>Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Air testing too soon</td>
<td>• Air test (only 8 hours or more after drying)</td>
</tr>
<tr>
<td>• Gloves used too soon following sterilization</td>
<td>• Do not use gloves for 24-48 hours after sterilization. This allows gloves to regain their elasticity before use.</td>
</tr>
</tbody>
</table>

Source: Adapted from Tomlinson, 1991
HIGH-LEVEL DISINFECTION OF GLOVES

After gloves have been decontaminated and thoroughly washed in detergent and water, they are then ready for high-level disinfection (HLD) by boiling for 20 minutes. Gloves which have been HLD by boiling and have air dried do not need paper wrapping. They should be stored in an HLD container and removed as needed with HLD large forceps/pickups. Ideally, these gloves will have the cuffs folded over.

Instructions

STEP 1: Place gloves in a bag made of plastic or nylon netting. Cotton bags are less desirable because they dry slowly after use.

STEP 2: Place a weight in the bag so that all gloves and the bag are at least 1 inch below the surface of the water.

STEP 3: Close lid over pan and bring water to a full, rolling boil. (When water only simmers, very little steam is formed and the temperature at the water’s surface may never get high enough to kill microorganisms.)

STEP 4: Reduce heat so that water continues to boil at a rolling boil. (When water boils too violently, it evaporates quickly and wastes fuel.)

STEP 5: Start timer or note time on clock and record time rolling boil began on sterilization log. (No objects or water should be added after timing starts.)
STEP 6: Boil gloves for 20 minutes, starting from the time a rolling boil begins.

STEP 7: After boiling for 20 minutes, remove netted bag with high-level disinfected, dry large forceps/pickups. Never leave boiled objects sitting in water which has stopped boiling. (As the water cools and steam condenses, air and dust particles are drawn down into the container and may contaminate the gloves.)

STEP 8: Shake off excess water and hang the bag out to dry. (The netted bag will permit the gloves to dry quickly without being handled.) Avoid areas where dust or other particles may contaminate the contents of the bag.

STEP 9: Wearing previously HLD gloves, place bag in dry, HLD container. Next, open bag and remove gloves, reverse them and replace in bag. (This step permits drying of the gloves both inside and out.)

STEP 10: Shake off excess water and re-hang the bag to dry.

STEP 11: Using previously HLD forceps or glove, open bag and place gloves in a covered, dry, high-level disinfected container.

STEP 12: Fold cuffs over and place together by pairs for easy donning later.

STEP 13: Use gloves immediately, or cover and store for later use (up to one week). Avoid recontamination of gloves before use.
Processing Reusable Gloves

STEP 14: To prepare an HLD 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 inside thoroughly with boiled water. Air dry before use.

Note: If supplies of gloves are limited and/or they will be used immediately after boiling (see STEP 6 above), they can be worn "wet".

Instructions

STEP 7: After boiling for 20 minutes, remove with HLD forceps/pickups.

STEP 8: Allow excess water to drip off gloves (shake gently) and place in an HLD container with a cover and allow to cool (about 5 minutes) before using.
ACCIDENTAL CONTAMINATION OF STERILE OR DISINFECTED GLOVES

There are several ways to contaminate HLD or sterile gloves:

- by tearing or puncturing the glove,
- by touching any unsterile object with the sterile glove, or
- by touching the outside of a sterile glove with an ungloved hand.

Service providers wearing sterile or HLD gloves should be careful not to contaminate gloved hands inadvertently by touching nonsterile objects, unprepped skin or mucous membranes.

REGLOVING AFTER CONTAMINATION

There are two ways to reglove after contaminating a glove during a procedure:

- remove contaminated glove by the cuff, dispose in appropriate container;
- have circulating nurse open a new sterile glove pack, laying the glove package on a clean surface, and
- put on replacement glove in the usual manner.

Alternatively:

- remove contaminated glove by the cuff, dispose in appropriate container;
Processing Reusable Gloves

- have scrub nurse open another sterile glove package, and after removing a sterile glove, hold the glove open by the cuff, which allows you to put your hand into the glove without touching the outside of the glove yourself; and then

- adjust the glove after the scrub nurse lets go of the cuff (Sorensen, 1979).
REFERENCES


Surgical Handscrub

APPENDIX B

SURGICAL HANDSCRUB

SUPPLIES

• Soap (plain or antiseptic - antiseptic is preferred) as provided by the facility
• Running water
• Stick or brush for cleaning the fingernails
• Soft brush or sponge for cleaning the skin
• Towels (sterile towels are provided in the operating room)

PREPARATION

The surgeon or OR nurse/technician should be in a short-sleeved uniform or scrub suit to perform this procedure since it involves scrubbing to the elbows.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remove all jewelry.</td>
<td>1. Jewelry harbors microorganisms and is difficult to clean.</td>
</tr>
<tr>
<td>2. Adjust water to comfortable temperature.</td>
<td>2. Comfort of surgeon or OR nurse/technician. Also, excessively hot water opens pores to bacteria. Warm water enhances action of the soap.</td>
</tr>
<tr>
<td>3. Holding hands above the level of the elbow, wet hand thoroughly. Apply soap.</td>
<td>3. Water flows from area of least contamination to most contamination. Soap can kill some microorganisms.</td>
</tr>
<tr>
<td>4. Beginning at the fingertips, lather and wash, using a circular motion. Wash between all fingers. Move from fingertips to the elbows of one hand and repeat for the second hand.</td>
<td>4. Friction and lather raise microorganisms. Wash from area of least contamination to area of most contamination.</td>
</tr>
<tr>
<td>Procedure</td>
<td>Explanation</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
</tr>
<tr>
<td>5. Rinse each arm separately, fingertips first, holding hands above the level of elbows.</td>
<td>5. Do not let rinse water flow over clean area. Water should flow from area of least contamination to area of most contamination.</td>
</tr>
<tr>
<td>6. Wash for three-to-five minutes (when using alcohol, pour or dip for 2 minutes).</td>
<td>6. Adequate time is required to inhibit or kill as many microorganisms as possible.</td>
</tr>
<tr>
<td>7. Using a separate towel for each hand, wipe from the fingertips to the elbow, and then discard the towel.</td>
<td>7. Do not contaminate clean hand by using contaminated towel. During drying move from area of least contamination to area of most contamination.</td>
</tr>
<tr>
<td>8. If donning sterile gloves and gown: hold hands above the level of the waist and do not touch anything. Immediately get into sterile garb.</td>
<td>8. Contact with contaminated object renders clean object contaminated. Area below the level of the waist is considered contaminated.</td>
</tr>
<tr>
<td>9. If scrubbed hands touch any &quot;dirty&quot; object during the procedure, steps 3 through 8 must be repeated.</td>
<td>9. Same as #8.</td>
</tr>
</tbody>
</table>

**REFERENCES**


Many chemicals qualify as safe skin antiseptics. The following solutions are commonly available in different parts of the world:

- Alcohols (60 to 90%), ethyl, isopropyl or "methylated spirit";
- Cetrimide and chlorhexidine gluconate, various concentrations (e.g., Savlon®);
- Chlorhexidine gluconate (4%) (e.g., Hibiclens®, Hibiscrub®, Hibitane®);
- Parachlorometaxylenol (PCMX or chloroxylenol), various concentrations (e.g., Dettol®);
- Hexachlorophene (3%) (e.g., Phisohex®);
- Iodines (1 to 3%), tincture and aqueous (e.g., Lugol’s); and
- Iodophors, various concentrations (e.g., Betadine®).

ALCOHOL SOLUTIONS (60-90% ETHYL OR ISOPROPYL)

60-90% ethyl and isopropyl alcohol are excellent antiseptics, commonly available and inexpensive. Their rapid killing action makes them very effective in reducing numbers of microorganisms on skin, even under gloves. Alcohols are effective against HBV and HIV.

Alcohols are among the safest known antiseptics. A 60-70% solution of ethyl or isopropyl alcohol is effective, is less drying to the skin and is less expensive than higher strengths. Because isopropyl alcohol tends to be a more efficient fat solvent it causes dry skin when used repeatedly; therefore, ethyl alcohol may be more gentle for frequent use on skin (Larson 1988).

Note: In many countries, alcohols are available as "industrial methylated spirit," or ethyl alcohol denatured with a small amount of wood (methyl) alcohol. (Harpin & Rutter, 1982). (Because methyl alcohol is the least effective of the alcohols it should not be used alone as an antiseptic or disinfectant.) Be sure the ethyl alcohol is of adequate strength (60-90%) in locally available "spirit."
Advantages

- Rapidly kill all fungi and bacteria including mycobacteria; isopropyl alcohol kills most viruses, including HBV and HIV, and ethanol kills all viruses.

- Although alcohols have no persistent killing effect, the rapid reduction of microorganisms on skin protects against regrowth of organisms, even under gloves, for several hours.

- Are relatively inexpensive, but must be replaced more often because they evaporate.

Disadvantages

- Evaporate rapidly, and cause drying of skin. (Ethyl alcohol may be less drying than isopropyl.) Do not use alcohols for vaginal preparation before IUD insertion or removal or other procedures.

- Easily inactivated by organic materials.

- Flammable, requiring storage in cool, well-ventilated areas.

CHLORHEXIDINES

Chlorhexidine gluconate (CHG) is an excellent antimicrobial. It remains active against microorganisms on skin many hours after use, and is safe even for use on newborn infants. Because CHG is inactivated by soap, its antimicrobial activity is dependent upon the amount (concentrations) used. 4% CHG is commonly available and is the recommended concentration. 0.5% CHG in 60-90% alcohol is also effective.

Advantages

- Has persistent action on skin.
Antisepsis

- Chemical protection (the number of microorganisms inhibited) increases with repeated use.
- Minimally affected by organic material.

Disadvantages

- Expensive and not always available.
- Action reduced or neutralized by natural soaps, and by substances present in hard tap water.
- Must be used repeatedly for maximum effectiveness and residual activity.

**HEXACHLOROPHENE**

3% hexachlorophene is active against gram-positive cocci such as staphylococcus, but has little or no activity against gram-negative bacteria, viruses, *Mycobacterium tuberculosis* and fungi. Hexachlorophene has neurotoxic side effects which make it risky to use on newborn infants. Use on broken skin or mucous membranes and for routine bathing is not recommended. When used intermittently, bacteria may grow back in large numbers (rebound growth) between uses.

Advantages

- Residual activity excellent when used repeatedly.

Disadvantages

- Inactivated by iodine and alcohol.
- May lead to serious neurotoxic side effects.
- Rebound growth of bacteria when use is discontinued or intermittent.
IODINE AND IODOPHOR SOLUTIONS

Iodines are very effective antiseptics. 1-3% iodines are available as both aqueous (Lugol®) and tincture (iodine in 70% alcohol) solutions. Iodophors are solutions of iodine mixed with a carrier which releases small amounts of iodine and usually are available locally. Povidone iodine is the most common iodophor. The iodophors kill vegetative bacteria, mycobacterium viruses and fungi. Iodophors require up to two minutes of contact time to release free iodine (Larson, 1988). Once released, however, the iodine has rapid killing action. It is not usually necessary to dilute commercially available iodophors manufacture for antisepsis (e.g., Betadine® or Wesodyne®). Iodophors are generally non-toxic and non-irritating to skin and mucous membranes.

Note: Iodophors manufactured for use as antiseptics are not effective for disinfecting inorganic objects and surfaces. Antiseptic solutions have significantly less iodine (Rutala, 1990).

Advantages

- Inexpensive, effective and commonly available.

- Iodophors are non-irritating (unless the person is iodine allergic) on skin or mucous membranes, making them ideal for vaginal preparation before IUD insertion.

- Do not stain skin at 1:2,500 concentration.

Disadvantages

- Iodophors have little residual effect.

- Like alcohols, iodine and iodophors are inactivated by organic materials.

- Iodine (tincture or aqueous) may cause skin irritation and must be removed from skin after drying. Use alcohol to remove iodine. Iodine (aqueous or tincture) must never be used on mucous membranes.

- Iodine skin absorption may cause hypothyroidism in newborn infants (Newman, 1989).
Antisepsis

SOLUTIONS TO AVOID

Zephiran® (benzalkonium chloride)

Zephiran is commonly used in many parts of the world as an antiseptic, however, it has several distinct disadvantages:

- Solutions of benzalkonium chloride have repeatedly been shown to become contaminated by *Pseudomonas* and other common bacteria. (Block, 1983)

- Solutions of benzalkonium chloride are easily inactivated by cotton gauze and other organic material and are incompatible with soap. (Block, 1983)

- Zephiran takes at least 10 minutes to kill HIV, the virus causing AIDS. (By contrast, 0.5% chlorine solution kills HIV in less than a minute.) (INTRAH, 1989)

Mercury Laurel or other Mercury-Containing Compounds

Although frequently sold for antisepsis, mercury-containing chemicals should be avoided due to their high toxicity (INTRAH, 1989):

- Skin exposure to low levels of mercury causes blister formation and contact dermatitis.

- Inhalation or ingestion of low levels of mercury causes central nervous system effects (numbness, speech impairment, deafness), and higher levels (200 mg) are fatal.

- Skin contact alone can result in absorption of measurable amounts of mercury.

- Pregnant women exposed to small doses may not show toxic effects themselves, but their fetus may be harmed: mercury is a potent teratogen (causes birth defects, including cleft palate, cerebral palsy, and other central nervous system abnormalities).
REFERENCES


APPENDIX D

INSTRUCTIONS FOR MAINTAINING AND OPERATING AUTOCLAVES

BACKGROUND

Instructions for operation and routine maintenance of steam sterilizers (autoclaves) should be included in the basic training of family planning staff. An autoclave will reliably sterilize items only when kept in good working condition and operated correctly.

The proper operation of an autoclave depends on correctly following certain practices and processes. These include:

- routine maintenance of the autoclave;
- preparing items (decontamination, cleaning and drying) to be sterilized;
- packaging and wrapping;
- loading and unloading the autoclave;
- operating the autoclave.

Only when these procedures are done properly will items processed be sterilized.

Remember: Sterile packs will remain sterile only if properly stored.
TYPES OF STEAM STERILIZERS (AUTOCLAVES)

There are three types of steam sterilizers:

- Gravity displacement
- Pre-vacuum
- Flash

Gravity Displacement Sterilizers

These are the small (table-top) to intermediate size sterilizers frequently used in clinics and physicians' offices (Figure D-1). Larger in-wall mounted, scaled-up versions of this type of sterilizer are the work horses of hospital steam sterilization. Small pressure cooker-type autoclaves frequently are used in clinics.

Figure D-1: Simplified Diagram of a Gravity Displacement Autoclave
Autoclaves

Table-top models are relatively simple to operate and are essentially horizontal pressure cookers. A pool of water in the bottom of the sterilizer is electrically (or with kerosene) heated until it turns into steam. The steam then rises to the top of the chamber because it is lighter than the cool air in the chamber. As more and more steam is produced, the cool air is forced out of the chamber through the drain near the bottom of the chamber. When the steam has pushed all the cool air out, steam will enter the drain, triggering the thermally (heat-regulated) value to close. Once the value is closed the steam continues to build up pressure until the operating temperature (normally 121°C/250°F) is reached. The timer can now be activated and timing begun. At the end of the cycle (normally 20 minutes for unwrapped items and 30 minutes for wrapped items), the relief valve is opened which allows the steam to escape. Usually the steam passes through the water reservoir where it condenses back to water and thus does not enter the room. After the pressure on the gauge reads zero, the door can be opened 12-14 cm (5-6 inches). Then wait 30 minutes for items to cool. If steam is still present (and the chamber quite warm), condensation of the moist air may cause wetness of the items or packs if they are placed on a cool or cold surface.

This type of sterilizer should be routinely checked by running a biologic indicator test (see Chapter 6). Also, when possible, it is recommended that temperature-specific indicators (as well as autoclave tape) be used with each cycle. (IAHCSM, 1986)

Small table top (gravity displacement) sterilizers should not be confused with the small office “sterilizers”. They have a tray on which instruments are placed and when the lid is lowered the items are immersed in boiling water. These inexpensive office “sterilizers” are really just boilers and can be used for HLD only.
Pre-vacuum Sterilizers

These autoclaves are similar to the gravity displacement type except that they have a vacuum pump system to rapidly remove the air in the chamber before the steam is let in. This step reduces the total cycle time. Most pre-vacuum autoclaves are operated at the same temperature (121°C/250°F) as gravity displacement autoclaves. (A special type of vacuum sterilizer, called a high speed vacuum sterilizer, however, is operated at a higher temperature, 134°C/275°F.) The vacuum system not only shortens the cycle time but also reduces the chance of air pockets from forming. Because this type of sterilizer is more complex to operate, it is important, to monitor its use closely and for it to be regularly maintained.

Flash Sterilizers

These are small sterilizers, usually located in operating rooms or adjacent to them. They operate at a high temperature (134°C/275°F) and thus have a shorter cycle time. Normally their use is limited to sterilization of unwrapped surgical instruments for emergency purposes (e.g., dropped instruments, etc.) because of their small size.

In summary, in most family planning clinics and other health facilities gravity displacement sterilizers (autoclaves) are the type most frequently encountered. High speed vacuum and flash sterilizers usually are found only in large referral hospitals in most countries. (IAHCSM, 1986)

ROUTINE MAINTENANCE

Although there are many brands of autoclaves, routine maintenance practices generally are the same regardless of the make or type. (See Figure D-1 for a simplified diagram of a gravity displacement autoclave.)

For routine maintenance:

- The chamber should be cooled before any procedure is undertaken (e.g., cleaning or loading).
The outlet screen (or pin-trap) should be removed daily and cleaned using a mild detergent and brush under running water.

The chamber should be cleaned daily using a soft cloth, or for large sterilizers, a long-handled mop which is used only for this purpose. Do not use abrasives or steel wool as they may scratch the stainless steel surface and increase the occurrence of corrosion.

All door gaskets should be cleaned daily with a lint-free cloth and checked for defects. Defective rubber gaskets should be replaced.

The carriage (loading cart used to hold the packs placed in an autoclave) should be cleaned daily using a mild detergent and lint-free cloth. (The wheels of the loading cart also should be cleaned, removing any string or other debris daily.)

The exhaust line (or chamber drain) should be flushed weekly. This will keep the drain free of clogging substances that might hinder air or steam removal from the chamber. Before flushing the exhaust line, check the maintenance instructions because trisodium phosphate solution (a special type of detergent) often is recommended (IAHCSM, 1986; DHEW, 1975). If this chemical is not available the exhaust line can be flushed with hot water containing a mild detergent. To do this, first remove the screen. Then pour one liter of the solution down the drain using a funnel. Complete the process by pouring a liter of hot water to rinse out the detergent solution and replace the screen. (One ounce trisodium phosphate to 1 litre/1 quart hot water).

Because the specific operating instructions for an autoclave usually also contain instructions for routine maintenance, managers should have copies of these instructions available for staff to use. If other copies are needed, they can be obtained by writing to the individual manufacturer (normally the address can be found on the autoclave) or from the donor agency providing the equipment.
PREPARING ITEMS FOR AUTOCLAVING

All items should be decontaminated and thoroughly cleaned and dried before being autoclaved. An exception to this is when a small amount of water is required to assist in the process of steam sterilizing items with small openings (lumens), such as needles. In this case, after cleaning, flush needles with distilled or boiled water just prior to packaging for steam sterilization.

Washable cloth items should be laundered and dried before sterilization in order to:

- remove organic matter (dirt), and
- prolong the life of the material

PACKAGING AND WRAPPING

- Instruments should be clean and dry prior to packaging while needles should be flushed with distilled or boiled water just prior to packaging.

- Packs containing gowns, drapes and other linens should not exceed 30 x 30 x 50 cm (12 x 12 x 20 inches) or 5 kg (12 lbs) to allow proper steam penetration.

Remember: Linen should be laundered between sterilizations, even if unused, in order to restore moisture to it (dried out fibers decrease the ability of the cloth to form a barrier to microorganisms).

- For packs use permeable material for wrapping (APIC, 1983). Examples of square and envelope packaging or wrapping are given in Figure D-2. Types of materials that can be used include:
Autoclaves

- **Muslin cloth** (140 thread count): Use two double thickness wraps (4 layers in all) as this is the least effective of the materials used for wrapping. Use for both steam and dry heat sterilization.

- **Jean cloth** (160 thread count): Use double thickness wraps for each package. Use for steam sterilization only.

- **Barrier cloth** (272-288 thread count): Use one thickness but two wraps. Retains moisture which increases the drying time. Use for steam sterilization only.

- **Paper**: Double wrapping (two layers) recommended. Use for steam sterilization only and do not re-use.

**Note:** Do not use canvas for wrapping as steam cannot penetrate this material.

- When loading the chamber of an autoclave, nested items should be positioned in the same direction (usually lying on their sides) so that air pockets are not created, condensation can drain out, and steam can circulate freely.
Figure D-2: Typical Wrapping Techniques

Envelope Wrap

1
2
3
4
5
6
7
8
9

Square Wrap

1
2
3
4
5
6
7
8
9

Source: Perdue University (1989)
Packaging and Wrapping Tips

Do not wrap packages too tightly. If wrapped too tightly air can become trapped at the center of packages preventing the temperature from getting high enough to kill all the microorganisms. Also, wrapping with strings or rubber bands can prevent steam from reaching all surfaces, as does packing the drums or other containers to full. Finally, all jointed instruments should be open (or in the unlocked position) and disassembled.

LOADING AND UNLOADING THE AUTOCLAVE

Objectives

* To load items into the autoclave in such a manner as to present the least possible resistance to the passage of steam through the load.

* To unload the steam autoclave in such a manner as to maintain the sterility of the items that have been processed through a sterilizing cycle.

General Principles

* When loading, leave sufficient space for steam to circulate freely.

* Allow for steam to circulate freely when loading. Do not overload.

* Place all packs (linen, gloves) on edge, canisters, utensils and treatment trays on their sides.

* Place instrument sets in trays having mesh or perforated bottoms flat on the shelves.
Autoclaves

- In combination loads of cloth (or paper) packs and instruments trays, place linens on top shelves and trays on lower shelves. This prevents any condensation (moisture), which forms on cool metal when steam initially contacts the item, from dripping onto linen packs (DHEW, 1975).

- Gloves should be autoclaved by themselves or placed on the top shelves.

- Nested packs should be positioned in the same direction to help prevent air pockets, so condensation can drain and steam to circulate freely.

- Shelves (metal wire) or a loading cart must be used to assure proper loading.

See Figure D-3 and Tables D-1 and D-2.

Metals and Glassware

- Instrument sets should not exceed 8 kg (18 lbs). Basin sets should not exceed 3 kg (7 lbs). This is to limit the amount of condensation which forms when steam contacts cool metal so that the items may dry during sterilization cycle.

- Solid containers should be placed on their sides to allow air flow out of them. If air is trapped in a solid container, it will prevent the steam from contacting the inner surface and prevent sterilization.

- If an item goes in wet, it will come out wet. All items (instruments, basins and glassware) should be dry before loading into the sterilizer. This helps prevent "wet packs." The sterilizer is capable of drying items that have become moist during a properly loaded and operated sterilization process, but it can not remove excess moisture.
Autoclaves

Figure D-3: Loading the Autoclave

Mixed load

Wrapped instruments load: Perforated or wire mesh bottom trays

All-linen load

Loading using wire-type baskets to keep the packages in position

Source: Adapted from AAMI (1990).
Table D-1. Loading Using Loading Carts or Shelves

<table>
<thead>
<tr>
<th>Essential Steps</th>
<th>Key Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Place all items on a shelf. Use either a loading cart or shelves in the sterilizer.</em></td>
<td>Never place items (wrapped or unwrapped) on the floor of the sterilizer. Items placed on the floor could block discharge of air from sterilizer, or allow air and moisture to be trapped in pockets, resulting in sterilization failure and “wet packs.”</td>
</tr>
<tr>
<td><em>Items must not touch chamber walls.</em></td>
<td>Packs touching the chamber walls can be scorched or contents damaged due to excessive heat of the metal walls.</td>
</tr>
<tr>
<td><em>Always allow 7 - 8 cm (3 inches) of space between top-most package and top of chamber.</em></td>
<td>This allows displacement of air and free flow of steam.</td>
</tr>
<tr>
<td><em>Place all fabric packs on edge (folds perpendicular to shelf); and when loading two layers on one shelf, place the upper layer crosswise to the bottom layer.</em></td>
<td>It is easier for steam to flow down through the folds to penetrate each fiber than through flat, compressed surfaces.</td>
</tr>
<tr>
<td><em>Place all bottles, solid metal and glass containers of dry materials on their sides with lids held loosely in place.</em></td>
<td>Air will drain out and steam will take its place.</td>
</tr>
<tr>
<td><em>Place treatment trays and utensils on edge, tipped slightly forward.</em></td>
<td>To prevent pooling of condensation, and to facilitate drying.</td>
</tr>
<tr>
<td><em>Place instrument trays (mesh or perforated bottom only) flat on shelves. If instruments have been placed in a solid tray or on a Mayo tray, the tray must be placed on edge and tipped slightly forward.</em></td>
<td>This helps maintain an orderly arrangement of contents and reduces damage caused by “dumping” all the instruments into bottom of tray if instrument tray is placed on its side. This also facilitates drying.</td>
</tr>
<tr>
<td><em>Solutions must be sterilized by themselves, and placed on the shelves not touching each other.</em></td>
<td></td>
</tr>
<tr>
<td><em>Gloves must be sterilized by themselves. Place glove packages loosely on edge with thumbs up, well away from the walls of the chamber.</em></td>
<td>Use a wire basket to hold glove packages upright. Never place packages on top of each other as the compression at the bottom of the pile will prevent access of steam to the gloves.</td>
</tr>
<tr>
<td><em>Use only the upper shelves for gloves. Never place them on the bottom shelf of the chamber.</em></td>
<td>Residual air gravitates to the lower part of the chamber and will hasten the rate of deterioration of the rubber.</td>
</tr>
<tr>
<td><em>Do not compress packages or overload the chamber.</em></td>
<td>When placing packages on shelves, put hand between them to be sure packages are not compressed and give least possible resistance to steam throughout the load.</td>
</tr>
</tbody>
</table>

Source: Adapted from Tomlinson, 1991.
Table D-2. Unloading the Autoclave.

<table>
<thead>
<tr>
<th>Essential Steps</th>
<th>Key Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>• After the sterilizing cycle has been completed and the chamber pressure gauge reaches “0,” open the door 12-14 cm (5-6 inches).</td>
<td>Always keep the door between you and the sterilizer when opening the door.</td>
</tr>
<tr>
<td>• Wait 30 minutes before unloading the sterilizer.</td>
<td>This allows residual moisture to dry and the load to cool.</td>
</tr>
<tr>
<td><strong>Unloading using a loading cart</strong></td>
<td></td>
</tr>
<tr>
<td>• Remove the loading cart from the sterilizer and place it where there is no open window or fan in close proximity.</td>
<td>Do not place freshly sterilized packages, especially those not completely cooled, in front of an open window or a fan because there may be residual humidity in the packages, and dust and dirt could be forced through the wrappers, contaminating contents. If there are water droplets or visible moisture on the outside of the wrapper or package, or on the tape used to secure it, the package is contaminated. <strong>Do not use.</strong></td>
</tr>
<tr>
<td>• Look at, but do not handle, the outside of the package for dryness.</td>
<td></td>
</tr>
<tr>
<td>• When they reach room temperature, remove packs from the loading cart and place on storage shelves. They may be dispensed or placed in sterile storage for up to one week.</td>
<td>This may be one hour or longer. <strong>Avoid unnecessary handling.</strong></td>
</tr>
<tr>
<td><strong>Unloading Using Shelves (loading cart not used)</strong></td>
<td></td>
</tr>
<tr>
<td>• Remove packages from the sterilizer shelves.</td>
<td><strong>Avoid unnecessary handling.</strong></td>
</tr>
<tr>
<td>• Look at outside of the wrappers for dryness.</td>
<td>If there are water droplets or visible moisture on the outside surfaces of packages, or on the tape used to secure it; package is contaminated. <strong>Do not use.</strong></td>
</tr>
<tr>
<td>• Place packages on a surface well padded with paper or fabric, away from open windows or in front of a fan.</td>
<td>In order to prevent condensation from forming, do not place on a cool or cold surface.</td>
</tr>
<tr>
<td>• When packages have cooled to room temperature, they may be dispensed or placed into sterile storage.</td>
<td></td>
</tr>
<tr>
<td>• Expiration date (1 week for wrapped items, up to one month if sealed in a plastic bag or dust cover) is placed on package after sterilization.</td>
<td>Use soft lead pencil. Place date on indicator tape or tag tied to security string.</td>
</tr>
</tbody>
</table>

Source: Adapted from Tomlinson, 1991.
**Linens**

- Linen packs should not exceed 12" x 12" x 20" in size and weigh no more than 12 pounds in order to assure steam penetration of the pack in 30 minutes (the time allowed for sterilizing wrapped items).

- Packs containing sheets, table covers and towels are the most difficult for steam to penetrate and contact each fiber. Such packs must be placed on edge on the shelf to insure steam penetration.

**Liquids**

- Liquids must be sterilized by themselves.

- The amount of liquid in the bottle, not the size of the container, determines the time required for sterilization.

- Use only Borosilicate heat resistant glass (Pyrex).

- Use only automatic self-sealing caps for closure.

**Gloves**

- Sterilize in separate loads (see Appendix A for step-by-step instructions).

**Combination Loads**

- In loads which combine linens (fabrics) and metal goods, place linens on top shelves and metal goods below. This prevents condensation from dripping onto the linen packs, causing them to absorb the excess moisture. **Remember:** the sterilizer is unable to remove excess moisture.
Autoclaves

- When a load is made up of wrapped and unwrapped items requiring different sterilization times to assure sterilization the longest required time (i.e., 30 minutes) must be used as the sterilizing time for that load.

- The fundamental rule in loading the sterilizer is to prepare all items and to arrange the load in such a manner as to present the least possible resistance to the passage of steam through the load (i.e., from the top of the chamber towards the bottom).

**Unloading Tips**

- Allow instrument packs to dry completely before removal (takes 30 minutes).
- Place sterile trays and packs on surfaces padded with paper or fabric. (Do not place warm packs on cold metal surface as condensation will occur.)
- Store when packs reach room temperature (usually takes about an hour.)
- Sterilized packs and articles should be handled gently and as little as possible.

**Note:** If pack is dropped, tears or has come in contact with moisture, it must be considered contaminated.
GENERAL INSTRUCTIONS FOR OPERATING GRAVITY DISPLACEMENT NON-ELECTRIC (PRESSURE COOKER TYPE) AUTOCLAVES

The autoclave should be run at 121°C (250°F) 106 kPa (15 lbs/in²) for 20 minutes for unwrapped items, 30 minutes for wrapped items. As moist heat is the sterilizing agent (i.e., what kills the microorganisms), the temperature gauge on the exhaust line should be used to monitor when to begin timing the sterilization cycle, not just the pressure gauge alone. (DHEW 1975).

Figure D-4. Gravity Displacement Autoclave. (Nor-Electric)

To ensure correct operation, when available, consult specific operating instructions supplied by the manufacturer.
Instructions

STEP 1: Decontaminate, clean and dry all instruments to be sterilized.

STEP 2: All jointed instruments should be in the opened or unlocked position, while instruments composed of more than one part or sliding parts should be disassembled. To help prevent dulling of sharp points and cutting edges, wrap the sharp edges and needle points in gauze before sterilizing.

STEP 3: It is best to wrap clean instruments or other clean objects in a double thickness of muslin or newsprint. (Unwrapped instruments are only sterile if used immediately after removal from the autoclave, unless kept in a covered, sterile container.) Instruments should not be held tightly together by rubber bands or any other means that will prevent steam contact with all surfaces.

STEP 4: Arrange packs in the chamber to allow free circulation and penetration of steam to all surfaces.

STEP 5: When using a pressure cooker or kerosene-powered autoclave, bring water to boil until steam escapes from the pressure valve only; turn down heat but keep steam coming out of pressure valve. Do not allow to boil dry. Steam should always be escaping from the pressure valve.

STEP 6: Sterilize for 30 minutes for wrapped objects, 20 minutes for unwrapped objects; time with a clock. The temperature should be 121°C (250°F); the pressure should be 106 kPa (one atmosphere above atmospheric pressure) or 15 pounds per square inch (15 lbs/in²).
STEP 7: Wait 20 to 30 minutes (or until the pressure gauge reads zero) to permit sterilizer to cool sufficiently. Then open the lid to allow steam to escape. Allow instrument packs to dry completely before removal, which may take up to 30 minutes. (Damp packs act like a wick drawing in bacteria, viruses and fungi from the environment.) Wrapped instrument packs are considered unacceptable if there are water droplets or visible moisture on the package exterior when removed from the autoclave chamber.

STEP 8: To prevent condensation when removing the packs from the chamber, place sterile trays and packs on a surface padded with paper or fabric. (Do not store trays or packs until they reach room temperature; this usually takes about an hour.)

STEP 9: Objects wrapped in sterile cloth or paper are considered sterile for one week only if kept dry, up to one month if sealed in a plastic bag. Unwrapped objects must be used immediately or placed in a sterile, covered container.

STEP 10: Ideally, a steam sterilizer log should be kept, noting time:

- heat begun,
- correct temperature and pressure achieved,
- heat turned down, and
- heat turned off.

Note: Keeping a log can help ensure that the required amount of time will be observed, even when multiple, new or hurried workers are responsible for overseeing the sterilization.
AUTOCLAVING LIQUIDS

Sterile or High-Level Disinfected Water

Sterile water can only be prepared by autoclaving.

Instructions

- Load sterilizer with liquids only.

- Wait until thermometer indicator shows 121°C (250°F).

- Time the sterilization using a clock. The amount (volume) of solution in the bottle determines the sterilization time, not the size of the bottle:

<table>
<thead>
<tr>
<th>Volume (ml)</th>
<th>Time (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
<td>20</td>
</tr>
<tr>
<td>250-500</td>
<td>25</td>
</tr>
<tr>
<td>1000</td>
<td>30</td>
</tr>
<tr>
<td>1500</td>
<td>35</td>
</tr>
<tr>
<td>2000</td>
<td>40</td>
</tr>
</tbody>
</table>

Remember: If bottles of solutions with different volumes are sterilized in the same load, use the sterilization time recommended for the bottle containing the largest amount (volume) of liquid.

- When the sterilization cycle has ended, release the pressure slowly, taking not less than 15 minutes, until the chamber pressure is at "0". Turn operating valve off and open the door only 1 cm (½ inch). (Suddenly opening the door all the way after a sterilization cycle could cause liquids to boil over or bottles to burst.) Wait an additional 30 minutes for the chamber to cool before removing the load.
High-level disinfected (HLD) water can be prepared either by boiling or by adding chlorine to clean, potable water to make 0.1% solution. It must be remembered that neither boiling nor chlorine reliably kill all bacterial endospores. It is best to filter the water before boiling or chlorinating if the water is potentially contaminated with microorganisms. Remember: Once the water has been high-level disinfected, be careful not to dip contaminated objects into it.

Note: Chlorinated water should not be used to dilute formaldehyde as a dangerous gas, bis-chloromethyl-ether, is formed. Chlorinated water also should not be used for diluting cetrimide-containing antiseptics such as Savlon and Cetavlon because ammonium chloride (NH₃Cl) gas and other by products are produced. If inhaled, these gasses may produce temporary illness: nausea, headache and difficulty breathing (Morbidity and Mortality Weekly Report, 1991). Finally, chlorinated water is not ideal as a final rinse for sterilized or high-level disinfected metal items because prolonged exposure to chlorine can corrode metal. In all of these situations, boiled water should be used.

STORAGE

Sterile packs will not remain sterile unless properly stored. A separate area which has limited access should be provided for storage of sterile supplies. This storage area should be kept as clean, dust-free and lint-free as possible. (Storage areas next to or under sinks, near water or drain pipes are not acceptable.) Closed cabinets are preferred, or if not available, open shelving is acceptable. Ideally, the lowest shelf should be 25 cm (10 inches) from the floor, the top shelf, 45 cm (18 inches) from the ceiling and 5 cm (2 inches) from outside walls.
When stored, sterilized instruments and other items should be either wrapped prior to sterilization (then the entire pack is sterilized) or if not wrapped, stored in sterile containers with tight fitting lids. Wrapped sterilized packs can be stored up to one week on an open shelf or for up to one month if placed in a plastic dust cover or in a sealed plastic bag. All packs should be labeled with an expiration date. Where storage in either a sterile wrap or sterile container is not possible, store unwrapped items such as scalpels and scissors in a dry, HLD, covered container. (See Chapter 7 for preparation of a high-level disinfected container.) Store for one week. Do not store unwrapped items submerged in antiseptics, because Pseudomonas and other common bacteria have been shown to grow in iodophors (e.g., Betadine), chlorhexidine (e.g., Hibitane, Savlon), benzalkonium chloride (e.g., Zephiran) and other antiseptics.
REFERENCES


APPENDIX E

DECONTAMINATING AND CLEANING INSTRUMENTS, NEEDLES, SYRINGES AND LINENS

HOW TO DECONTAMINATE AND CLEAN SURGICAL (METAL) INSTRUMENTS

STEP 1: After use, gently immerse all instruments used for pelvic examination, IUD insertion or removal or any other surgical procedure in a plastic bucket of freshly prepared 0.5% chlorine solution or other locally available and approved disinfectant for at least 10 minutes before starting the cleaning process. This step is necessary to help prevent transmission of hepatitis B virus (HBV) or AIDS virus (HIV) to clinic staff.

STEP 2: After this pre-soak in chlorine solution, rinse the objects in warm or cool water to remove any blood, body fluids and chlorine if instruments are not to be washed immediately. (Hot water can coagulate protein, making it hard to remove.)

STEP 3: Next, scrub instruments (hold under water to prevent aerosolization and splashing of infectious material) with a soft brush in detergent and water (be sure to clean the teeth, joints and screws - an old toothbrush works well for this).

STEP 4: Rinse again in clean water until no detergent remains. (Detergent can interfere with the action of some chemical disinfectants.)

STEP 5: Dry by air or with a clean towel. (Water from wet instruments will dilute chemicals used for high-level disinfection [HLD], making them ineffective.) Drying is not necessary for instruments which are to be boiled.

STEP 6: Proceed with sterilization (if available) or HLD by boiling or use of chemical disinfectants.
HOW TO DECONTAMINATE AND CLEAN NEEDLES AND SYRINGES

When available and affordable, single-use (disposable) syringes and needles are recommended for all client care and surgical procedures. If syringes are to be reused, needles and syringes should be sterilized either by autoclaving (steam) or by dry heat. When sterilization facilities are not available, needles and syringes may be high-level disinfected by boiling. Remember: boiling, even for several hours, will not reliably kill bacterial endospores. When single-use needles and syringes are used, it is important to:

- maintain adequate supplies, and
- ensure that the disposable items are not reused.

Note: After use, dispose of used needles and syringes in special puncture proof containers for sharp objects to avoid accidental injury and possible infection of workers during refuse removal.

When single-use syringes and needles are not available, the following steps should be taken to decontaminate and then clean needles and syringes:

STEP 1: Leave needle attached to syringe.

STEP 2: Fill syringe with high-level disinfectant such as 0.5% chlorine solution by drawing up through the needle.

STEP 3: Cover syringe and attached needle with chlorine solution by laying them horizontally in a flat tray and leave immersed in decontamination solution for 10 minutes.

STEP 4: Expel disinfectant solution from syringe and needle.

STEP 5: Disassemble and clean with soapy water. (Be sure to clean hub area.) Insert stylet or needle wire through hub of needle to ensure that the cannula is not obstructed.

STEP 6: Reassemble and rinse syringe and needle in water by filling and expelling water at least three times (fill and expel through needle).
Decontaminating & Cleaning Instruments

**STEP 7:** Detach needle from syringe and make sure hub area is clean.

**STEP 8:** Examine needle and syringe for bent needle tips or other damage, syringe seal condition (rubber ring), needle hub fit to syringe, readable syringe markers, etc. Dispose of damaged needles and syringes in a special impervious container for sharp objects (See Chapter 9: Waste Disposal).

**STEP 9:** After cleaning as described above, it is critical that the syringe and needle be sterilized by either autoclaving or dry heat, or high-level disinfected by boiling prior to use.

**HOW TO DECONTAMINATE AND CLEAN LINENS, SURGICAL DRAPES AND OTHER ITEMS**

**STEP 1:** Pre-soak linens or clothing contaminated with blood or other body fluids in 0.5% chlorine solution or other locally available and approved disinfectant to kill HBV and HIV. This will minimize the risk to those staff responsible for washing these items.

**STEP 2:** After pre-soaking, wash linens and clothing with detergent and hot water.

**STEP 3:** Rinse thoroughly.

**STEP 4:** Dry linens and clothing in the sun or machine dry. To avoid recontamination, limit handling.

**STEP 5:** If air dried, iron surgical drapes when sterilization (autoclaving) is not available. (Other linens also can be ironed.)

HBV and HIV are not transmitted by routine household objects. Routine washing of dishes, glasses and utensils in warm, soapy water is sufficient. Routine laundering of personal linens in hot water also is sufficient.
APPENDIX F

CHEMICAL DISINFECTANTS

ALCOHOL SOLUTIONS (60-90% Ethyl or Isopropyl [2-propyl])

60-90% ethyl and isopropyl alcohol are excellent disinfectants, commonly available and inexpensive. Their rapid killing action and lack of chemical residue makes them ideal for disinfection of many clean, dry objects used in family planning procedures.

Ethyl alcohols and isopropyl alcohols are not considered to be high-level disinfectants because they do not inactivate bacterial endospores, and isopropyl alcohol does not kill hydrophilic viruses (e.g., echovirus, coxsackievirus) (Rutala, 1990). However, alcohols are effective against HIV and HBV.

Note: In many countries, alcohols are available as "industrial methylated spirit," or ethyl alcohol denatured with a small amount of wood (methyl) alcohol. Be sure the ethyl alcohol is of adequate strength (60-90%) in locally available "spirit" (Harpin and Rutter, 1982). (Because methyl alcohol is the least effective of the alcohols it should not be used alone as a disinfectant or an antiseptic.)

Note: Instrument strength Dettol® (chloroxylenol 4%) and Cetavlon® (cetrimide, various strengths) come in 70% alcohol. However, both are expensive when used in the proper dilution and offer no advantages over the 70% ethyl or isopropyl alcohol they come in.

Advantages

• Rapidly kill all fungi and bacteria including mycobacteria; isopropyl alcohol kills most viruses, including HBV and HIV, and ethanol kills all viruses.

• Are not corrosive to metal.

• Are not as expensive as glutaraldehydes in bulk, but must be replaced more often because they evaporate.

• Useful for soaking of rubber or latex items, but prolonged or frequent soaking causes deterioration.

• Leave no chemical residue, and therefore do not require rinsing.
Chemical Disinfectants

Disadvantages

- Evaporate rapidly.
- Do not penetrate organic material, and appear to be easily inactivated by organic materials.
- Flammable, requiring storage in cool, well-ventilated areas.
- May swell or harden rubber and plastics if used repeatedly or for prolonged periods of time.

Note: Rinsing with alcohol then lighting with a match (carbolization) is an ineffective means of disinfection and should not be used.

CHLORINE SOLUTIONS

Chlorine solutions are high-level disinfectants (HLDs) because they inactivate all bacteria, viruses, fungi, parasites and some spores. They are fast-acting, very effective against HBV and HIV, inexpensive and readily available. They are extremely useful for decontaminating large surfaces such as examination tables.

When potable (clean) water is available, 0.1% chlorine solution is satisfactory. However, if the chlorine is to be diluted with contaminated (non-boiled, impure or unfiltered) water, a high (0.5%) concentration should be used since much of the chlorine will be inactivated by the microscopic organic matter in the water. (Instructions for preparing 0.5% chlorine solutions from bleach are listed in Table F-1.)

Chlorine solutions can be made from liquid household bleach (sodium hypochlorite) or from other chlorine compounds available in powder (calcium hypochlorite or chlorinated lime) or tablet form (sodium dichloroisocyanurate).
Table F-1: Preparing 0.5% Chlorine Solution from Bleach (Sodium Hypochlorite)

<table>
<thead>
<tr>
<th>Brand of Bleach (Country)</th>
<th>Percent(%) Available Chlorine</th>
<th>How to Dilute to a 0.5% Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>JIK (Kenya)</td>
<td>3.5</td>
<td>1 part bleach to 6 parts water</td>
</tr>
<tr>
<td>Household bleach (USA, Canada)</td>
<td>5</td>
<td>1 part bleach to 9 parts water</td>
</tr>
<tr>
<td>Eau de Javel (France)</td>
<td>5</td>
<td>1 part bleach to 9 parts water</td>
</tr>
<tr>
<td>Extrait de Javel (France)</td>
<td>15</td>
<td>1 part bleach to 29 parts water</td>
</tr>
<tr>
<td>Chloros (UK)</td>
<td>10</td>
<td>1 part bleach to 19 parts water</td>
</tr>
</tbody>
</table>

* In some countries the concentration of sodium hypochlorite is expressed in chlorometric degrees (*chlorum*); 1 *chlorum* is approximately equivalent to 0.3% available chlorine.

Source: Adapted from: INTRAH, 1989.

**Sodium Hypochlorite (Chlorine Bleach)**

**Advantages**

- Chlorine solution is usually the least expensive disinfectant (despite needing daily replacement).

- **Quickly inactivates** HBV and HIV (the viruses causing hepatitis B and AIDS).

- Very useful for decontamination of large surface areas (high-level disinfection takes 20 minutes, but decontamination can take as little as 60 seconds) (INTRAH, 1989).
Chemical Disinfectants

Disadvantages

- Corrodes metal instruments with prolonged exposure\(^1\). Solutions should not be prepared or stored in metal containers. Exposure time should not exceed 20 minutes. Metal must be thoroughly rinsed and dried individually after soaking in chlorine, to avoid corrosion. (Use plastic containers when possible.)

- WHO recommends that chlorine solutions be replaced daily, or more often if necessary, because sodium hypochlorite looses potency rapidly over time or after exposure to sunlight.

Calcium Hypochlorite or Chlorinated Lime

Calcium hypochlorite and chlorinated lime are available in powder form. Recommended dilutions are listed in Table F-2.

- Calcium hypochlorite contains approximately 70% available chlorine.

- Chlorinated lime contains approximately 35% available chlorine.

- The availability of pre-diluted chlorinated lime solutions can be confusing: Eusol\(^{\circledR}\) is chlorinated lime and boric acid and contains 0.25% available chlorine. This is sufficient for disinfection of clean equipment, but is half the WHO-recommended level for decontamination of contaminated equipment.

Advantages

- Both decompose more slowly than sodium hypochlorite, though these chemicals also will decompose gradually if not protected from heat and light.

---

\(^1\) Electrolytic type of corrosion occurs when two or more dissimilar metals are placed in water alone, especially if they are actually touching each other. For example, steel and aluminum instruments should be immersed in separate trays. If metal trays (e.g., stainless steel) are used, a plastic mat or gauze pad should be placed in the bottom of the tray to prevent metal-to-metal contact during soaking periods of up to 24 hours.
Disadvantages

- Like all chlorine compounds, they may corrode metal with prolonged exposure and unless properly rinsed.

Sodium Dichloroisocyanurate

Sodium dichloroisocyanurate (NaDCC) forms hypochlorous acid when dissolved in water. It is available as powder or tablets. NaDCC powder has 60% available chlorine; NaDCC tablets contain 1.5g available chlorine per tablet. (See Table F-2 for how to make recommended dilutions.)

Advantages

- NaDCC is much more stable than sodium or calcium hypochlorite.

- Tablets are easy to use.

Disadvantages

- Like all chlorine compounds, it may corrode metal with prolonged exposure and unless properly rinsed.

Table F-2: Recommended Dilutions of Chlorine-Releasing Compounds

<table>
<thead>
<tr>
<th>Available chlorine required</th>
<th>0.5% (5 g/L), 5000 ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium hypochlorite solution (5% available chlorine)</td>
<td>100 ml/liter</td>
</tr>
<tr>
<td>Calcium hypochlorite (70% available chlorine)</td>
<td>7.0 g/liter</td>
</tr>
<tr>
<td>NaDCC (60% available chlorine)</td>
<td>8.5 g/liter</td>
</tr>
<tr>
<td>NaDCC-based tablets (1.5 g of available chlorine per tablet)</td>
<td>4 tablets/liter</td>
</tr>
<tr>
<td>Chloramine (25% available chlorine)</td>
<td>20 g/liter</td>
</tr>
</tbody>
</table>

Source: Adapted from WHO, 1988.
Chemical Disinfectants

8% FORMALDEHYDE

Formaldehyde in both liquid and gaseous forms can be used as a chemical sterilant, as well as an HLD. It is highly toxic. Extreme care must be taken to protect both staff and clients when making and using formaldehyde solutions (see Disadvantages, below).

A commercially available solution of formaldehyde (which contains 35-40% formaldehyde) should be diluted with boiled water (1:5) to a final solution containing about 8% formaldehyde. Do not dilute with chlorinated water as a dangerous gas can be produced (see Disadvantages, below). (Aqueous solutions of formaldehyde are known as formalin.)

Paraformaldehyde, a solid polymer of formaldehyde, may be vaporized by dry heat in an enclosed area to disinfect or sterilize objects (Tulis, 1973, Taylor et al, 1969).

Details for preparing and using formaldehyde (formalin) are provided in Table F-3.

Advantages

- Formaldehyde solutions are not readily inactivated by organic materials.
- 24-hour soaking in formaldehyde kills all microorganisms, including bacterial endospores.
- Can be used for up to 14 days. Replace sooner if turbid (cloudy).
- Can safely be used on surgical endoscopes (laparoscopes) because they will not corrode metal or damage lensed instruments, plastics or rubber.

Disadvantages

- Formaldehyde can cause skin irritation, thus all equipment soaked in either must be thoroughly rinsed with boiled water after soaking.
Formaldehyde is toxic and its vapors are irritating to the skin, eyes and respiratory tract. It should be handled with care. Gloves should be used and exposure time should be limited. Use only in a well-ventilated area.

When formaldehyde is mixed with chlorine, a dangerous gas (bis-chloromethyl-ether) is produced.

**GLUTARALDEHYDE**

Most glutaraldehydes can be used for chemical sterilization and also are HLDs. Instruments must be rinsed well after HLD to remove residue and prevent skin irritation. In addition, operating laparoscopes and other items with removeable parts need thorough rinsing after soaking in glutaraldehyde to prevent from sticking.

Glutaraldehyde products are available in alkaline, neutral or acid forms. Reports document that neutral or alkaline glutaraldehydes have superior killing power and anticorrosion properties when compared with acid glutaraldehyde (Rutala, 1990).

There are many types of glutaraldehyde available worldwide. The two most commonly used are:

- A 2% glutaraldehyde available commercially as Cidex® or Cidex™
- Sporicidin®
Chemical Disinfectants

Cidex is activated by adding a powder or liquid supplied with the solution, and is available fully prepared. (Do not dilute unless specified in the manufacturer's instructions.) Cidex must be used at temperatures of 25°C (77°F) or above. For effective HLD, instruments and other items should be soaked for 20 minutes. For sterilization, instruments should be soaked for 10 hours.

Sporicidin is also activated by adding activator (supplied) to the solution (buffer). Sporicidin should be diluted 1:16 for high-level disinfection (soak for 20 minutes). A temperature of 20°C (68°F) or above is adequate. At this time, Sporicidin should only be used for HLD as research is inconclusive for its use as a sterilant.

Further details for preparing and using glutaraldehydes are provided in Table F-3 and F-4.

Advantages

- Are not readily inactivated by organic materials.
- Can be used for up to 14 days. Replace sooner if turbid (cloudy). (Some brands can be used for longer periods of time, check manufacturers instructions.)
- Can safely be used on surgical endoscopes (laparoscopes) because they will not corrode metal or damage lensed instruments, plastics or rubber.

Disadvantages

- Can cause skin irritation. Use gloves and thoroughly rinse equipment with boiled water after soaking.
- Vapor may be irritating to eyes and respiratory tract. Use in a well-ventilated area.
- Works best at room temperature. Prolonged soaking (longer than 20-30 minutes) may be required to kill mycobacterium in cold climates.
- Glutaraldehyde is expensive.
### Table F-3: Preparing and Using Chemical Disinfectants

<table>
<thead>
<tr>
<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 Life¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol Ethyl Isopropyl &quot;Methylated Spirit&quot;</td>
<td>60-90%</td>
<td>Use full strength</td>
<td>Yes (can dry skin)</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Do not use²</td>
<td>Do not use</td>
<td>Change weekly; daily if heavily used; sooner if cloudy</td>
</tr>
<tr>
<td>Chlorine</td>
<td>0.5%</td>
<td>DILUTION procedures vary³</td>
<td>Yes (with prolonged contact)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>20 minutes</td>
<td>20 minutes</td>
<td>Do not use</td>
</tr>
<tr>
<td>Formaldehyde (35-40%)</td>
<td>8%</td>
<td>1 part 35-40% solution to 4 parts boiled water</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>20 minutes</td>
<td>24 hours</td>
<td>Change every 14 days</td>
</tr>
<tr>
<td>Glutaraldehyde Cidex® Sporicidin®</td>
<td>Varies</td>
<td>Varies: read instructions on container</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>20 mins. at or above 25°C</td>
<td>10 hours for Cidex</td>
<td>Change every 14 days²; sooner if cloudy</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20 mins. at or above 20°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrogen Peroxide (30%)</td>
<td>6%</td>
<td>1 part 30% solution to 4 parts boiled water</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>30 minutes</td>
<td>Do not use</td>
<td>Change daily; sooner if cloudy</td>
</tr>
<tr>
<td>Iodophors (10%; Povidone Iodine-PVI)</td>
<td>Approximately 2.5%</td>
<td>1 part 10% PVI to 3 parts water</td>
<td>No⁴</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Do not use</td>
<td>Do not use</td>
<td>Change daily</td>
</tr>
</tbody>
</table>

¹ All chemical disinfectants are heat and light sensitive and must be stored appropriately.
² Alcohol and iodophors are not HLDs, however, they can be used as intermediate-level disinfectants. For this purpose, soak for 20 minutes.
³ See Table F-3 for instructions on preparing chlorine solutions.
⁴ Different commercial preparations of Cidex and other glutaraldehydes (e.g., Wasicide) are effective at lower temperatures (20°C) and have a longer activated shelf life (always check manufacturers instructions).
⁵ Except in people with allergies to iodophors.

Source: Adapted from Wenkel, 1987
<table>
<thead>
<tr>
<th>STERILIZATION/DISINFECTION SOLUTIONS</th>
<th>Ready to use-no mixing</th>
<th>Activated shelf life</th>
<th>Sterilization time at room temperature</th>
<th>EPA registered for dilution as a disinfectant</th>
<th>Number of days for sterilization re-use at 20°C-21°C (68°-70°F)</th>
<th>Maximum number of days solution is EPA registered for disinfection reuse</th>
<th>Primary Dermal Irritation score of full strength solution (EPA skin irritation ratings)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cidex&lt;sup&gt;®&lt;/sup&gt;</td>
<td>No</td>
<td>14 days</td>
<td>10 hours</td>
<td>No</td>
<td>14 days</td>
<td>14 days</td>
<td>ND&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Cidex Plus&lt;sup&gt;®&lt;/sup&gt;</td>
<td>No</td>
<td>28 days</td>
<td>10 hours</td>
<td>No</td>
<td>28 days</td>
<td>28 days</td>
<td>1.5 (mild)</td>
</tr>
<tr>
<td>Cidex&lt;sup&gt;7&lt;/sup&gt; and equivalent products</td>
<td>No</td>
<td>28 days</td>
<td>10 hours</td>
<td>No</td>
<td>14 to 28 days</td>
<td>28 days</td>
<td>1.17 (slight)</td>
</tr>
<tr>
<td>Glutarex&lt;sup&gt;®&lt;/sup&gt;</td>
<td>No</td>
<td>28 days</td>
<td>10 hours</td>
<td>No</td>
<td>None</td>
<td>28 days</td>
<td>0.86 (slight)</td>
</tr>
<tr>
<td>Sonacide&lt;sup&gt;®&lt;/sup&gt;</td>
<td>Yes</td>
<td>3 years</td>
<td>ND</td>
<td>No</td>
<td>None</td>
<td>35 days</td>
<td>ND</td>
</tr>
<tr>
<td>Sporicidin&lt;sup&gt;®&lt;/sup&gt;</td>
<td>No</td>
<td>30 days</td>
<td>10 hours</td>
<td>Yes</td>
<td>2&lt;sup&gt;2&lt;/sup&gt;</td>
<td>30 days</td>
<td>2.89 (mild)</td>
</tr>
<tr>
<td>MetriCide&lt;sup&gt;®&lt;/sup&gt;</td>
<td>No</td>
<td>14 days</td>
<td>8 hours</td>
<td>Yes</td>
<td>14 days</td>
<td>14 days</td>
<td>ND</td>
</tr>
<tr>
<td>MetriCide&lt;sup&gt;®&lt;/sup&gt; Long Lasting</td>
<td>No</td>
<td>30 days</td>
<td>6 hours</td>
<td>No</td>
<td>30 days</td>
<td>30 days</td>
<td>ND</td>
</tr>
<tr>
<td>Wavicide&lt;sup&gt;®&lt;/sup&gt;-01</td>
<td>Yes</td>
<td>2 years</td>
<td>10 hours</td>
<td>Yes (1:4)</td>
<td>30 days</td>
<td>42 days</td>
<td>0.34 (minimal)</td>
</tr>
</tbody>
</table>

Source: Adapted from Wave Energy Systems, Inc. (1990)

<sup>1</sup> ND means no supporting data released in scientific publication.

<sup>2</sup> Conclusive data pending.
Chemical Disinfectants

6% HYDROGEN PEROXIDE

30% hydrogen peroxide (H$_2$O$_2$), which must be diluted to a 6% solution, often is available locally and may be less expensive than other chemical disinfectants. (The 3% H$_2$O$_2$ solutions used as antiseptics should not be used as disinfectants.) The major disadvantages of H$_2$O$_2$ are that it is corrosive and should not be used to disinfect copper, aluminum, zinc or brass. Also, it loses potency rapidly when exposed to heat and light, so it needs to be stored carefully. **WHO does not recommend using H$_2$O$_2$ in hot environments because of its instability.**

IODINES AND IODOPHOR SOLUTIONS

Iodines (1-3% aqueous or tincture) and iodophors (solutions of iodine mixed with a solubilizing agent) usually are available locally. Povidone iodine (PVI) is a commonly available iodophor, usually sold as a 10% solution (1% iodine). (For instructions on preparing an iodophor solution, see Table F-3.)

Iodophors are not high-level disinfectants because conclusive evidence is lacking that they are effective against bacterial endospores. Also, *Pseudomonas* species, a group of gram-negative bacteria, have been known to multiply in iodophors (Rutala, 1990). Iodophors, however, are an excellent choice for disinfection of most instruments and equipment used in family planning clinics. They are generally non-irritating to skin and mucous membranes.

**Note:** Iodophors must be properly diluted to be effective. Correctly diluted iodophors have more active killing power than full-strength iodophors.

**Note:** Iodophors manufactured for use as antiseptics are not effective for disinfecting inorganic objects and surfaces. **Antiseptics have significantly less iodine** (Rutala, 1990). Be sure to check the label.
Chemical Disinfectants

Advantages

• Iodines and or iodophors do not cause deterioration or softening of plastic items if items are kept dry between soakings.

• Diluted solutions of iodine and iodophor are non-toxic and non-irritating (unless the person is allergic to iodine).

• Iodophors are recommended for plastic devices, such as IUDs and inserters, but not for copper IUDs as they can damage the copper wire. It should be noted, however, that IUDs may lose elasticity if left in the solution overnight.

• Iodophors also are good for disinfecting stainless steel equipment.

Disadvantages

• Iodine is an oxidizing agent (causing rust), and should only be used for stainless steel equipment or plastic materials.

• Like alcohol and chlorine, iodine and iodophors are inactivated by organic materials, thus only precleaned instruments should be put into iodine or iodophor solutions.

PRODUCTS INCORRECTLY USED AS DISINFECTANTS

Many antiseptic solutions are used incorrectly as disinfectants. While antiseptics (sometimes called skin disinfectants) are adequate for cleaning skin before an injection or surgical procedure, they are not appropriate for disinfecting instruments. They do not destroy all bacteria and viruses unless they contain 70% alcohol (even then they still do not destroy bacterial endospores). For example, Savlon® (chlorhexidine gluconate with or without cetrimide), which is readily available worldwide, is a good antiseptic but is often mistakenly used as a disinfectant (Lowbury et al, 1981). Antiseptics that should not be used as disinfectants are:
Chemical Disinfectants

- hexachlorophene (Phisohex®)
- chlorhexidine gluconate (Hibiscrub®, Hibitane®)
- cetrimide (Cetavlon)
- cetrimide with chlorhexidine gluconate (Savlon®)
- mercury compounds (toxic and not recommended as an antiseptic or a disinfectant)
- acridine derivatives

Other products frequently but incorrectly used to disinfect equipment are 1-2% phenol (e.g., Phenol®) Lysol® (5% carbolic acid) and benzalkonium chloride, a quaternary ammonium (Zephiran®). These are low-level disinfectants and should be used only to decontaminate environmental surfaces. (See Appendix C, Solutions to Avoid.)
REFERENCES


APPENDIX G

DECONTAMINATION, CLEANING, DISINFECTION AND CHEMICAL STERILIZATION OF LAPAROSCOPIES

BACKGROUND

Surgical endoscopes (laparoscopes) are delicate instruments which must be handled with great care to prevent damage. The following suggestions will help to protect the instruments and prolong their use. Laparoscopes and accessories should be sterilized or high-level disinfected (HLD) by soaking in chemical agents. Glutaraldehyde and formaldehyde are the best chemical HLDs for soaking laparoscopic instruments because they do not damage rubber, plastics or lens cements. Other HLDs, such as hydrogen peroxide ($H_2O_2$) and chlorine, may be corrosive.

TIPS FOR PROLONGING THE LIFE OF LAPAROSCOPIES (κ. Wolf, 1984)

- Failure to clean equipment properly is the most common cause of equipment problems. In addition, blood and other organic material left to dry on instruments are difficult to remove and may be a source of infection.

- Never autoclave or boil laparoscopes as heat will damage the optics. Always chemically sterilize or HLD with chemical disinfectants such as glutaraldehyde or formaldehyde.

- Remove instruments from the disinfectant solution as soon after timing requirements are met. Prolonged immersion may shorten the life of the instrument.

- Rinse well with cooled sterile or boiled water after cold sterilization or disinfecting respectively, to remove residue. Residue can cause sticking of movable parts.

- Use gloved hands to handle instruments. Forceps and clamps may damage the laparoscope.
Laparoscopes

- Avoid picking up or handling instruments in groups or bunches.
- Always grasp the telescope at the eyepiece end rather than at the distal end.
- Avoid piling instruments or cables on top of each other to prevent damage or fiber breakage.
- Do not use Savlon® as it has been associated with clouding laparoscope optical lenses and is not a high-level disinfectant.

HOW TO DECONTAMINATE AND CLEAN LAPAROSCOPES AFTER USE (Altobelli, 1980)

STEP 1: Immediately after use, gently wipe the laparoscope, fiberoptic light source and cable and plastic tubing with luer-lok with a cloth soaked in 60-90% ethyl or isopropyl alcohol to remove all blood and organic material. Because alcohol rapidly kills HBV and HIV, this step protects handlers against possible hepatitis B and AIDS infections.

STEP 2: Completely disassemble the laparoscopic equipment: operating laparoscope or Laprocator™, trocar, uterine manipulator, cervical vulsellum forceps, Verres or Touhy needle, Falope Ring® guide kit or Filshie® clip.

STEP 3: Place disassembled parts in a basin of clean water and mild, non-abrasive detergent.

STEP 4: Wash all outer surfaces, using a soft cotton cloth.

STEP 5: Clean inner channels with a cleaning brush supplied with the laparoscope kit. Use a rotary motion to remove particulate matter. (Organic matter hidden in the narrow channels may cause infection later.) Be careful not to forcibly push the brush against the closed end of the inner tube as this may damage it.
STEP 6: Rinse all parts thoroughly with clean water (running water or from a basin). Use the brush to remove detergent and particles from the inner channels. (Detergent, if not thoroughly rinsed away, will decrease the effectiveness of the disinfectant.)

STEP 7: Dry equipment with a clean soft cotton cloth or air dry. (Excess water will dilute the disinfectant, decreasing its effectiveness.)

STEP 8: Clean lenses at least weekly, and more often as needed, but do not touch the lenses with fingers (see STEP 3, below).

STEP 9: High-level disinfect (for 20 minutes) or sterilize (overnight), or if not needed immediately carefully store in instrument container after cleaning and drying until next use. (Instruments should be disinfected immediately prior to use to prevent recontamination.)

HOW TO CLEAN LENSES ON LAPAROSCOPES

STEP 1: Remove the plastic eye-piece of the laparoscope prior to cleaning the proximal lens with acetone or 60 - 90% alcohol. (Acetone and other organic solvents can severely damage plastic.)

STEP 2: Clean lenses with a cotton swab soaked in alcohol or acetone. (Cotton will not scratch the lens, and alcohol and acetone will not weaken the cement around the lens.)

STEP 3: While cleaning, do not touch lenses with fingers. (Skin oils may damage the lenses.)

STEP 4: Clean lenses at least weekly, and more often as needed.
Laparoscopes

HOW TO HIGH-LEVEL DISINFECT LAPAROSCOPES

STEP 1: Decontaminate, wash and dry all items to be high-level disinfected.

STEP 2: In a well-ventilated area, wearing gloves to prevent skin irritation, completely immerse clean, dry disassembled instruments and cleaning brush in a basin of either 8% formaldehyde or a glutaraldehyde. The disinfectant must touch all surfaces in order to be effective. (See Appendix F for directions on how to prepare and use these disinfectants.)

Note: Avoid placing instruments on top of each other, as this may damage them.

STEP 3: Cover the basin during the disinfection procedure. (This will decrease the rate of evaporation and will keep dust out of the solution.)

STEP 4: Allow to soak for 20 minutes.

STEP 5: After 20 minutes, use high-level disinfected or sterile gloves to carefully remove instruments from the solution. (Forceps or lifters may damage the instruments.)

STEP 6: Rinse twice with cooled sterile water or water which has been boiled for 20 minutes and cooled in order to completely remove all traces of the disinfectant. (This will prevent the solution from irritating the client’s skin and keep the movable parts from sticking.) Use a high-level disinfected brush to assist with rinsing the narrow channels of the instruments.

STEP 7: Allow to air dry in a protected area or dry with a sterile or high-level disinfected soft cotton cloth, and place immediately on the instrument table.
HOW TO STERILIZE LAPAROSCOPES

STEP 1: Decontaminate, wash and dry all instruments to be sterilized.

STEP 2: In a well-ventilated area, wearing gloves to prevent skin irritation, completely immerse clean, dry disassembled instruments and cleaning brush in a basin of either 8% formaldehyde or a glutaraldehyde. The disinfectant must touch all surfaces in order to be effective. (See Appendix F for directions on how to prepare and use these disinfectants.)

Note: Avoid placing instruments on top of each other, as this may damage them.

STEP 3: Cover the basin during the disinfection procedure. (This will decrease the rate of evaporation and will keep dust out of the solution.)

STEP 4: Allow to soak 8 - 10 hours in most glutaraldehydes, and at least 24 hours in 8% formaldehyde. (Both agents work best at room temperature. In cold environments, sterilization cannot be assured at temperatures less than 20°C [68°F].) (As instructions vary, carefully read manufacturers instructions for each product.)

STEP 5: Remove objects from the solution with sterile gloves

STEP 6: Rinse twice with sterile water to completely remove all traces of the disinfectant. If sterile water unavailable, rinse in water which has been boiled for 20 minutes. Use the sterilized brush to assist with rinsing the narrow channels of the instruments. (This keeps movable parts from sticking due to residual disinfectant.)

STEP 7: Air dry in a protected area or dry with a sterile or high-level disinfected soft cotton cloth and place immediately on the instrument table.
HOW TO STORE LAPAROSCOPES

STEP 1: Decontaminate, wash and dry all instruments to be stored.

STEP 2: Assemble laparoscope and trocar.

STEP 3: Place laparoscope and trocar in the padded container supplied with the equipment and store in a cool, dry place.
Figure G-1: ATLAS OF LAPROCATORM™ SYSTEM

Source: Adapted from Altobelli, LC (1980).
REFERENCES
