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FAST FACTS for
THE OPERATING ROOM NURSE
Theresa Criscitelli, EdD, RN, CNOR, is a doctorally prepared nurse who has spent 26 years working in the operating room. Her career began as a certified surgical technologist when she learned to scrub in on an array of surgical specialties, including neurosurgery, orthopedics, and cardiothoracic open-heart surgery. She completed her nursing degree in order to care for surgical patients as their advocate and to be able to obtain other positions in the perioperative area that could help influence patient outcomes. She has held numerous positions in the perioperative setting as a registered nurse, including staff nurse, assistant nurse manager, nurse educator, director of perioperative education, and assistant director of professional nursing practice and education. Dr. Criscitelli is currently assistant vice president of administration and oversees the perioperative and procedural services at New York University (NYU) Winthrop Hospital, Mineola, New York. She also serves as adjunct nursing professor at Adelphi University, Garden City, New York, and was a clinical instructor in the surgical technology program at Nassau Community College, Garden City, New York. She also collaborates with a research team at NYU Winthrop Hospital.

Her love for the perioperative field does not cease at the end of the workday. She has published numerous articles in journals and has conducted research on the operating room that has been presented internationally. She oversees an operating room fellowship program and helped establish an academic-service partnership at a local university to provide a capstone experience in the operating room for undergraduate nursing students during their senior year. Engaging new nurses in the perioperative setting is her aspiration.
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Every decade the perioperative environment changes significantly, mandating that surgical team members remain current with their skills and knowledge. Patient safety continues to be the foundation upon which this ever-changing arena is based. Evidence-based practices evolve from this foundation as new research lights the path to excellence in perioperative practice. A comprehensive orientation to surgical settings and patient care is mandatory in this fast-paced environment so that learning is unique, all-inclusive, and logical. Therefore, vital to any perioperative educational program is a comprehensive reference book with content that enhances the skill level and knowledge of all surgical team members.

*Fast Facts for the Operating Room Nurse: An Orientation and Care Guide in a Nutshell* by Theresa Criscitelli, EdD, RN, CNOR, is a very handy reference book with vital information that is easy to access, understand, and implement. Perioperative nurses and surgical technologists, whether they are being oriented to the operating room or are skilled healthcare providers, can use this book to guide their surgical practices. Students in academia who are being introduced to perioperative practices will find this book to be a valuable resource in their educational processes.

The format for this reference book is based on the three critical themes of “Personal and Patient Preparation,” “Environment and Processing Considerations,” and “Surgical Basics.” While focusing on patient safety and recommended perioperative practices, the all-inclusive skills required in circulating and scrubbing are highlighted. Explanations and details about surgical techniques, practices, and patient care are provided in concise, step-by-step, logical formats, with illustrations and diagrams to enhance learning.
Evidence-based content that is built on current standards, guidelines, and recommended practices is highlighted to promote patient safety and excellence in the perioperative setting.

This easy-to-use reference book is a vital resource for every surgical suite and academic perioperative program. The book fits nicely into a pocket for easy retrieval and reference during the challenging days in the OR. Any perioperative professional will find this enhanced edition provides the valuable education and information required for critical thinking and clinical reasoning in the perioperative environment. This book is a must for updated learning and comprehensive orientation to the perioperative setting!

Kay Ball, PhD, RN, CNOR, CMSLO, FAAN
Professor, Nursing
Otterbein University, Westerville, Ohio
Past President, Association of periOperative Registered Nurses
Foreword

The role performed by the certified surgical technologist (CST) today was originally performed by operating room nurses. The succession of World War I, World War II, the Korean War, and the Vietnam War, which all occurred within a fairly narrow time frame, created a huge need for healthcare professionals. Veterans from World War I continued to need care when World War II was taking place, and so on. Due to the shortage of nurses, and partly because women were excluded from the battlefield, medical technicians began serving in the scrub role in the operating room. Around the time of the Korean War, physicians began regularly using these medical techs as scrubs rather than as nurses. So, over time, the role evolved into what became the field of surgical technology. Formal hospital-based programs were developed for surgical technologists in the late 1960s. These typically involved 3 to 6 months of on-the-job training. In the 1970s, the education for surgical technologists became formalized and community colleges began to offer programs in it. During this time, the Association of Surgical Technologists (AST; originally called the “Association of Operating Room Technicians”) was organized, and in 1981, AST published the first edition of the Core Curriculum for Surgical Technology. Today, surgical technology is part of the allied health field and CSTs are professionals who work closely with the registered nurses (RNs), surgeons, anesthesiologists, and other surgical personnel delivering quality patient care.

I am thrilled with the second edition of Fast Facts for the Operating Room Nurse by Theresa Criscitelli, EdD, RN, CNOR—a work that will guide seasoned preceptors, students, novice nurses, and novice CSTs through orientation in the perioperative setting. Dr. Criscitelli has an impressive array of clinical, nurse, and CST experience.
educational experience. She is the perfect resource to assist novice as well as seasoned nurses and CSTs through the perioperative journey. Patient safety and perioperative orientation are unique and rewarding experiences that come with many new and distinct challenges. Navigating these challenges with this very handy, all-inclusive reference book will assist the practitioner’s commitment, dedication, and desire to succeed. I thank Dr. Criscitelli for this opportunity to share my appreciation of her contribution to perioperative education once again.

This well-organized, purposeful book is based on current perioperative standards, and is easy to access from your pocket. It teaches you about patient safety, the surgical environment, critical thinking, immediate decision making, and perioperative skills. Take advantage of this book. Read it, highlight it, and keep it with you always.

**Caroline Kaufmann, RN, CNOR**
Program Director and Clinical Coordinator
Surgical Technology
Nassau Community College
Garden City, New York
Preface

Fast Facts for the Operating Room Nurse can be the perfect companion for the registered nurse (RN), certified surgical technologist (CST), or RN first assistant. The Fast Facts series provides essential nursing facts that are needed daily to provide the best practices to each and every patient. This book condenses volumes of operating room content into one handy book that can be tucked away and concealed in a scrub-jacket pocket.

The new RN who comes to the operating room for an orientation program can use this book to better understand complex skills and techniques, which are presented in a very simple and easy-to-follow format. The experienced perioperative nurse can also benefit from this book. Many practices have changed over the years, making it difficult to keep up with the current standards. The second edition of Fast Facts for the Operating Room Nurse provides the up-to-date information necessary to practice in this evidence-based environment. Why cull over multiple textbooks, articles, and guidelines to find the information that you need? Let this Fast Facts series volume be your resource. Although this book is not a comprehensive resource, if more in-depth information is needed for any of the book’s topics, other sources can be consulted. There are many other excellent resources available to provide additional details.

Preceptors can recommend this book to their learners to provide an evidence-based approach to assist in ensuring competent nursing practice. It can also be utilized by new graduates, new hires, or even the onboarding of nurses to the operating room, which may be a new clinical setting for them. This book can provide the perfect content
to reinforce safety and current knowledge relative to perioperative standards.

This book is divided into four sections, beginning with information on preparing yourself and your patient for surgery. Then it extends into all of the relevant facts related to the practice environment of the operating room and the processing of equipment and supplies. The next few chapters discuss surgical procedures and instrumentation. There is a great deal to understand about actual surgical procedures and the devices used during them. Finally, the section on additional operating room considerations provides further information on other important aspects of operating room nursing.

Each chapter introduces concepts and sets clear, obtainable learning objectives. The Fast Facts boxes provide self-assessment questions to help test your knowledge as you go along to see how much you are really learning. These boxes also provide pearls of wisdom—critical pieces of information highlighted for easy access. The tables allow quick reference, so you can find common information quickly and easily when needed. The language of this book is simple and clear, so that complex facts can be easily understood by not only the seasoned nurse, but also the new operating room nurse.

Theresa Criscitelli
Acknowledgments

I would like to thank all of the operating room friends and students I have met along my journey. Special thanks to Dr. Gary Sher, who has always been there through many of my life events to encourage me and assist in guiding my viewpoint on life. I would also like to thank Richard Kraft, CRCST, for not only being a great colleague and friend, but for his vast knowledge and love of central sterile. A special thanks to Richard Ceo for his time and expertise in the creation of the photographs contained in this publication. This book would not have been possible without the love and support from my husband, Perry, who encourages me every step of the way, and is my best friend. Most importantly, I wish to thank my two wonderful children, Walter and Benjamin, who provide never-ending inspiration.
Introduction

The operating room is a fast-paced, technological environment wherein the perioperative registered nurse (RN) must be able to think quickly and accurately, as well as advocate for the patient while the patient is under anesthesia. Working in the operating room is a privilege, and it should always be looked upon as an honor to be the nurse providing optimal care to the surgical patient. This requires the nurse to use not only his or her basic nursing skills, but to have the additional skills of aseptic technique, knowledge of surgical procedures, and familiarity with the specialized equipment—all skills that are many times learned on the job.

The orientation to the operating room can be an overwhelming experience, filled with anxiety, unexpected events, and sometimes even tears; however, those experiences can be mitigated through preparation. Therefore, a comprehensive orientation is necessary to nurture and guide the new operating room nurse in this exciting environment. So, if you do not know where operating room nurses come from, how would you know where they are going? Therefore, understanding the history of the operating room nurse can help define where these nurses are today and where they are going in the future.

In the early 18th century, operating rooms were basically large, crowded areas containing sick patients and a great deal of cluttered medical supplies. This resulted in high infection rates, so a drastic change took place late in the 18th century, when operating rooms became separate spaces and the operating theater was introduced. This amphitheater allowed people to watch the surgeries as they took place, and, in the 1870s and 1880s, became a form of entertainment for the wealthy.
In the 1890s, the position of surgical nurse evolved, which is now known as the “operating room nurse”. The surgical nurse was given specific lectures on preparing a patient for surgery, assisting the surgeon during surgery, surgical emergencies, and the preparation of dressings. Surgeons realized the value that a nurse could provide in the operating room setting. Someone who knew the procedures, the instruments, and the necessary dressings was a welcome addition to this environment.

As time went on, in the early part of the 20th century, little was known about bacteria and germs, and, in an effort to reduce infection, nurses spent many hours cleaning and sterilizing instruments and surgical items for reuse. The Spanish-flu pandemic of 1918 brought about the use of cotton masks in the operating room. Until then, doctors and nurses wore only aprons to protect their clothing or uniforms from being soiled. Gowns and gloves were cleaned and then sterilized after each use.

Operating room attire was originally white to represent cleanliness, but changed to green by the 1960s when it was discovered that the white scrubs caused eyestrain for the surgeons. Also, instruments were washed in soap and water, and then placed in carbolic acid to soak. This sterilized the instruments and it was found to reduce post-operative infections. Before 1960, sutures were made from sheep or...
cattle intestines and were called “gut” sutures. These were the most popular type and were hand threaded onto a free suture needle.

Times have changed, and now the operating room is a highly restricted area with numerous regulatory guidelines, specialized technology, and myriad opportunities for both the new operating room nurse and the seasoned professional. Working in the operating room is an interprofessional collaboration involving many roles. Within the scope of the RN, the nurse can take part either as the scrub or as the circulating nurse.

The scrub nurse is responsible for:

- Preparing the room for surgery, including maintaining the sterile field
- Passing instruments to the surgical team
- Preparing medications and other items on the sterile field
- Assisting in the safe transfer of the surgical patient to the postanesthesia care unit

The scrub nurse is gowned and gloved during the procedure and many times assists the surgeon. The certified surgical technologist (CST) can also perform the role of the scrub nurse and, in some states, can perform some circulating nursing roles. It is important to know the policy of the institution regarding each role's job description.

The circulating nurse is responsible for:

- Preparing the patient and the room for surgery
- Assisting in the positioning of the patient
- Assisting the anesthesia care provider
- Completing the nursing documentation
- Acquiring any additional items that need to be provided for surgery

The circulating nurse may leave the operating room for short periods of time to get things that are needed, but along with the surgical team, the nurse is responsible for the patient.

Other members of the surgical team include but are not limited to:

- Attending surgeon
- Additional surgeons
- Anesthesiologist
- Nurse anesthetist
- RN first assistant
- CST
- Residents
- Medical school students
- Physician assistants
- Nurse practitioners
- Unit support personnel
It is important to know exactly who is in the operating room and to try to keep the amount of personnel as low as possible. The surgical suite can become very crowded at times.

It is essential to realize that surgery does not always take place in the hospital. Over the past decade, more and more surgical procedures are being performed in ambulatory care units and centers. Also, doctors have opened up operating rooms in their offices, which must also adhere to strict sterile techniques to prevent surgical-site infections. Many of the basic concepts within this book apply to the very different environments in which an operating room can now be found.

The Association of periOperative Registered Nurses (AORN) is the national organization for operating room nurses. It is important to be part of the national organization in order to:

- Stay current on specific issues
- Effect legislation within your state
- Stay connected to a network of nurses across the country
- Engage in educational opportunities

It is not only important to be part of an organization, but furthering your knowledge within your specialty is equally as important. A specialty nursing certification can be obtained called “CNOR”. This is the gold standard of operating room nursing. CNOR is not an acronym but is considered “the documented validation of the professional achievement of identified standards of practice by an individual RN providing care for patients before, during and after surgery” (Competency & Credentialing Institute, n.d.). CNOR certification can be obtained by sitting for an examination after completing a minimum of 2 years or 2,400 hours of experience in perioperative nursing, with a minimum of 50% (1,200 hours) spent in the intraoperative setting.

The pathway to certification and the importance of membership in a nationally recognized organization, such as AORN, are exciting, and support the RNs’ practice in the operating room. The benefits of belonging to AORN range from the opportunity for grants and scholarships, to connecting with other operating room nurses around the world. As you embark upon your journey as an operating room nurse, remember to stay engaged in not only what is going on at your personal institution, but what is going on around the nation and the world.

Reference

Share


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Surgical attire is the first aspect of preparation for a day in the operating room. It is important to adhere to specific surgical attire standards that will promote a safe environment and ensure cleanliness. Personnel should change into surgical attire in a dressing room that is close to the semirestricted and restricted areas of the operating room. This will prevent contamination of attire and limit the amount of traffic with those in street clothing or anyone from the external environment.

During this part of your orientation, you will learn about:

- The acceptable attire to wear and why
- What not to wear and why
- Related concerns regarding safety and transmission of microorganisms

CONTROLLED AREAS

The surgical environment is a controlled-traffic area that is monitored regarding patients, family, personnel, and materials. Signage should clearly define the surgical attire required.

*Restricted area:* This is an area restricted to specific personnel and patients because a sterile field is established in this area.
and must be monitored. Also, this area contains specialized equipment that is delicate and expensive. Scrubs must be worn, hair covered, and masks worn, if a sterile field is opened. Examples of restricted areas include operating room suites and scrub sink areas.

**Semirestricted area:** This is an area that is restricted to specific personnel and patients, but not where sterile fields are established. Scrubs must be worn and hair covered. Examples of semirestricted areas include storage areas, areas for the processing of instruments, and utility areas.

**Transition area:** This is an area adjacent to the semirestricted or restricted area where staff can enter in street clothing and then exit in scrubs. An example of a transition area is the locker room.

**Monitored unrestricted area:** This is an area where patients, families, and staff are permitted. The staff would be in scrubs, the patient in a gown, and the family in street clothing. Examples of monitored unrestricted areas include the preoperative holding area and the postanesthesia care unit.

**SCRUBS**

**Description of Scrubs**

- Scrubs consist of a scrub top and scrub pants.
- The top should be tucked into the pants to prevent skin cells from shedding.
- The drawstring waist should be tied and tucked in to prevent the strings from flapping around and contaminating the sterile field.
- Scrubs should be made of a low-lint material that is tightly woven.
- Scrubs should be made of material that is stain resistant, durable, and has a low flammability rate.
- Fleece material is not recommended. Fleece may be warm, but it is highly flammable, can shed lint, accumulates dust and skin, and harbors moisture.
- Disposable scrubs are another alternative and must be discarded at the end of the day.
- Scrubs should not fit too loosely or too tightly. This will ensure a professional look.
The Do Nots of Scrubs

- Scrubs should not be in a locker where they may be exposed to personal clothing, pocketbooks, food, or any outside items.
- No undergarments should extend out of the neckline or sleeve line of the scrub top.
- Soiled or wet scrubs should not be worn. They should be changed as soon as possible to prevent exposure to pathogens.

Laundering of Scrubs

- Laundering should occur at a healthcare-accredited laundry facility (Table 1.1).
- It is important to know the type of washer, the water temperature, the laundry soap strength, and the rinse cycle; this will ensure that the scrubs that are placed against the perioperative personnel’s skin are clean and free of microorganisms.
- Due to the increasing number of resistant bacteria and their ability to survive, the home laundry cycle can transfer bacteria or pathogens to other fabrics and subsequent loads.

Fast Facts

Home laundering of scrubs is not recommended. Remember, the operating room is a source of microbial transmission and contamination.

<table>
<thead>
<tr>
<th>Cycle</th>
<th>Temperature</th>
<th>Time</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wash</td>
<td>At least 160°F (71°C)</td>
<td>At least 25 min</td>
<td>Mechanical, thermal, chemical</td>
</tr>
<tr>
<td>Chlorine bleach or oxygen-based bleach</td>
<td>135°F–145°F (57.2°C–62.7°C)</td>
<td>Until chlorine residual of 50–150 parts per million (ppm) achieved</td>
<td>Mechanical, thermal, chemical</td>
</tr>
<tr>
<td>Rinse</td>
<td>pH 5–12</td>
<td>Dictated by manufacturer</td>
<td>Neutralizes alkalinity</td>
</tr>
<tr>
<td>Dry</td>
<td>At least 180°F (82°C)</td>
<td>Dictated by fabric</td>
<td>Thermal</td>
</tr>
<tr>
<td>Press/iron</td>
<td>State regulated</td>
<td>Dictated by fabric</td>
<td>Thermal</td>
</tr>
</tbody>
</table>
**Question:** Why should surgical attire be laundered by an accredited laundry facility?

**Answer:** It establishes quality controls and monitoring and prevents contamination of personnel’s own washers and dryers.

### HEAD COVERINGS

Head coverings, such as a bouffant hat (Figure 1.1), should cover the perioperative personnel’s hair. If there is facial hair, sideburns, or neck hair, it must also be covered. This will prevent the shedding of hair and skin cells from the scalp and other areas that can potentially contaminate the surgical environment. Head covers must be changed daily, and if the head cover is made of scrub material, it must be laundered daily at a healthcare-accredited laundry facility.

**The Do Nots of Head Coverings**

- Skull caps (Figure 1.2) are not recommended because they do not cover well.
- Never wear a head covering that allows hair to protrude.
- Never rewear cloth hats without proper washing at a healthcare-accredited laundry facility.
Scrub jackets should be made of the same material as scrubs and be limited to 1 day of use. The scrub jacket should have long sleeves and snaps. Nonscrubbed personnel are encouraged to wear a scrub jacket, not only because the operating room may be cool, but to prevent skin shedding from the arms. This will also protect the nonscrubbed personnel from liquids or body fluids splashing onto their bare arms. Another option is a disposable scrub jacket that can be thrown away at the end of the day.

The Do Nots of Scrub Jackets

- Do not wear fleece scrub jacket materials.
- Do not home launder scrub jackets.
- Do not leave the scrub jacket unsnapped whereby the edge of the jacket can flap and contaminate the sterile field.

**Fast Facts**

**Question:** How should scrub jackets be worn?

**Answer:** Scrub jackets should be snapped closed, cuffed at the wrists, and only worn for 1 day.
SHOES

Shoes that are worn in the operating room should be worn only in that setting. No one should wear the same shoes outside and/or at home. Wearing those shoes in other settings would spread microorganisms and debris to outside areas and would also introduce microorganisms and debris from the outside.

Shoes should have a closed toe and closed back, have a low heel, and the sole should be made of a nonskid material to prevent slipping or tripping. The top surface of the shoe should not have any holes or perforations, to prevent blood and body fluids, liquids, or sharp objects from penetrating the perioperative personnel’s skin.

The Do Nots of Shoes

- Cloth shoes should not be worn in the operating room because they are porous.
- Clogs without a secure back should not be worn, due to the potential for tripping.
- Crocs™, although fashionable, should not be worn, due to the lack of support and the fenestrations on the top surface.

SHOE COVERS

Shoe covers come in different lengths, beginning with covers that just cover the shoe. They may also be longer and cover up to the knee. They are made of an impervious material to prevent fluid penetration and absorption. Shoe covers are recommended when the surgical procedure may result in extensive fluid release. Shoe covers should be worn over any shoes that are worn outside of the hospital or healthcare facility.

The Do Nots of Shoe Covers

- Shoe covers should not be worn outside of the transition area into the overall hospital setting.
- Shoe covers should not be worn when visibly soiled or saturated with fluids.
- Shoe covers should not be taken off with bare hands; utility gloves must be worn when discarding shoe covers.
ADDITIONAL ITEMS

Jewelry

Jewelry, including but not limited to earrings, necklaces, watches, bracelets, and body piercings, should not be worn in the operating room due to the high risk of contamination. The cracks and crevices in jewelry harbor bacteria that can spread in the healthcare setting and in patients. Another safety concern is the chance of injury as jewelry may become caught on equipment, fabric, or patients.

Fast Facts

Research has shown that bacterial counts are nine times higher on the skin beneath rings than on skin that does not have any jewelry on it.

Stethoscopes

Stethoscopes, although essential for some operating room personnel, should not be worn around the neck. They must be cleaned between patients. They are an inanimate object that can transmit pathogens by indirect contact.

Identification Badges

The identification badge should be worn in order to identify all personnel and to determine whether they are authorized to be in the surgical area or even the hospital. This practice will help maintain a safe environment and deter unauthorized visitors. Vendors and visitors may be provided with a 1-day pass or be required to use an automated badge terminal. This terminal will check the vendor’s credentials and health records before printing out an identification pass.

One-day identification badges should contain:

- Date
- Time
- Photo
- Company information
- Name
- Areas of access
Personal Items

Any personal items that are brought into the operating room must be cleaned with a low-level disinfectant and should not be placed on the floor. If the item is difficult or impossible to clean, and the item is necessary in the operating room, it must be placed in a clean plastic bag while in the operating room.

Personal items include:

- Briefcase
- Backpack
- Cellphone
- Tablet

Masks

The surgical mask protects the patient and the perioperative personnel from being exposed to germs. Wearing a mask prevents droplets greater than 5 microns from being inhaled or exhaled.

- Masks should cover the nose and mouth.
- Masks are secured behind the head and at the neck.
- A mask should be tight enough to prevent space at the sides.
- A mask should not be worn around the neck or have the strings hanging.
- Masks should be removed at the end of the surgery and replaced.
- Masks should be changed when they are soiled or wet.
- After changing a mask, hands should be washed with soap and water to prevent contamination.

Because eye protection is recommended, a mask with an attached fluid shield (Figure 1.3) is one option that can be disposed of

Figure 1.3 Mask with fluid shield.
after each surgery. It also provides protection around the sides of the face.

**Fast Facts**

It is difficult for beginners to get used to wearing a surgical mask. You may feel as though you cannot breathe or that you are going to pass out. Stay calm. You will get acclimated to its use in a few weeks.

**INFECTION CONTROL CONCERNS**

Surgical personnel who must leave the operating room area may be asked to wear a cover jacket. This protocol should be regulated by the institution’s infection control department. Doctors and nurses who go to patient rooms, the cafeteria, or another department within the hospital may have to don a cover coat.

If surgical personnel need to travel to another healthcare facility, they must change from surgical attire into street clothing and don clean surgical attire at the next facility. This will prevent the transfer of pathogens.
All instrumentation and equipment used during a surgical procedure that are not disposable must go through a stringent process in order to be sterilized for reuse (Figure 8.1).

During this part of your orientation, you will learn about:

1. The components of each sterilization process
2. Different types of sterilization
3. Parameters of each type of sterilization
4. Advantages and disadvantages of each type of sterilization
CLEANING AND DECONTAMINATION

Upon the completion of surgery, all instrumentation and equipment from the sterile field must be prepared to be decontaminated before being sterilized for use. During this process, all personnel involved must protect themselves from blood or body fluids by wearing personal protective equipment, such as:

- Gown
- Gloves
- Mask with eye protection
- Shoe covers

Preparing the instruments and equipment for decontamination involves:

- Wiping off blood or debris with water because if not wiped it will dry and be more difficult to remove
- Opening instruments so box locks are exposed
- Flushing lumens or cannulated instruments
- Placing sharp instruments together and facing downward
- Disassembling instruments that have multiple parts
- Preventing the placement of heavy instruments on top of delicate instruments
- Placing cameras, scopes, and cords in their canisters

**Fast Facts**

It is important to remember not to use saline on instruments or equipment. The salt in the saline solution will rust or pit the instruments. Surgical instruments and equipment are very expensive and delicate, and must be treated with the utmost care.

**Enzymatic Solution**

Enzymatic solution will soften the dried blood or debris on instruments, resulting in much easier removal. Enzymatic cleaners can be liquid or come in a gel spray, which is very convenient and easy to apply to the instruments. Therefore, it is important to pretreat the instruments with enzymatic solution as soon as feasibly possible, preferably prior to transport from the operating room to the central processing area. Remember, enzymatic solution is not a disinfectant; it is just a way to help break down dried blood or debris.
Manual Cleaning

Some instruments are manually cleaned, based upon the instructions for use (also called IFU), which are the manufacturer’s recommendations. The solution of an enzymatic cleaner and detergent must reach temperatures of approximately 80°F to 110°F or 27°C to 44°C to be effective. Some instruments that are manually cleaned include:

- Laparoscopes
- Cords
- Camera heads
- Delicate instruments
- Power saws or drills

Detergents that are used on any instrument or equipment should have the following characteristics:

- Neutral pH of 7
- Low foam
- Rinse easily
- Nonabrasive
- Nontoxic
- Biodegradable
- Cost-effective

Ultrasonic Cleaning

Delicate instruments may be too fragile to withstand mechanical cleaning and thus need to be placed in an ultrasonic cleaner. The ultrasonic cleaner works by cavitation, which is a process that creates small bubbles that implode. This creates a suction-like action that pulls the debris from the instrument surface. An ultrasonic detergent is added to the water to aid in the cleaning process. Upon removal from the ultrasonic cleaner, the instruments must be rinsed with pure water. It is recommended that all laparoscopic instruments receive ultrasonic cleaning.

Final Rinse of All Instruments

All instruments that were manually cleaned, ultrasonically cleaned, or mechanically cleaned must go through a final rinse with pure...
water to remove any residuals that could stain the instruments or affect sterilization. Pure water can be:

- Reverse-osmosis water
- Deionized water
- Distilled water

**Mechanical Cleaning**

The instruments, depending upon the manufacturer’s directions, are placed in a washer/disinfector or a washer/sterilizer, whereby they are treated with an enzymatic cleaner and a detergent during an automated process that uses hot water (approximately 150°F to 170°F or 65°C to 77°C).

**Washer-Decontamination Cycles**

Each washer/disinfector or washer/sterilizer has different yet similar cycles to clean and decontaminate the instrumentation and equipment. Some such cycles are:

- Cool-water rinse to remove any debris
- Enzymatic rinse
- Detergent wash
- Ultrasonic clean
- Hot-water rinse
- Deionized-water final rinse
- Lubrication rinse
- Dry cycle
- Sterilization (only on washer/sterilizer units)

**Fast Facts**

**Question:** A tray of specialty instruments was used for a surgery and the surgeon would like you to wash the instruments between the cases in the operating room. What should you do?

**Answer:** These instruments need to go to the central processing area of the hospital where they are treated with the enzymatic solution, detergent, and all other necessary steps prior to sterilization. Washing instruments between surgeries in the operating room is discouraged and should be done only in emergency situations.
After the instruments and equipment are cleaned and decontaminated, it is time to prepare and package them properly for the sterilization process. Each instrument or piece of equipment should be inspected for:

- Cleanliness
- Proper alignment
- Corrosion, cracks, pitting, and rust
- Sharpness
- Loose screws
- Wear and tear
- Missing pieces
- Overall functionality

This will ensure that the instrument tray or piece of equipment opened on the sterile field will be optimum for use. It is also important to make sure that the instrument or piece of equipment is completely dry before packaging. Any residual moisture can create damage, such as rust, pitting, or compromise the sterility of the item.

**Fast Facts**

After surgical scissors have been in use for a while, the sharp cutting edge will become dull and under magnification will look rounded off and may have formed pits. Because this is not visible with the naked eye, in central processing, it is important to test each scissor by cutting the appropriate testing material for the specific scissor. The testing material is designed to especially test even the most delicate scissors. The cutting action should be smooth as the scissor closes and should not grind, jump, feel loose, or feel too tight. The scissors should not pinch or grate the testing material. If the scissors are working well, they will produce a nice, straight cut.

**Preparation**

Instruments should be packaged so that the sterilant comes in contact with all exposed surfaces. Packaging requirements include:

- The container must be large enough so that instruments are contained in a single layer.
- The instruments should be placed on their sides to facilitate drying (steam sterilization).
Hinges should be open. An instrument stringer should be used to ensure ring-handled instruments are kept in the open position.

Stopcocks should be in the open position, so all surfaces are completely exposed to the sterilant.

Perforated tip protectors should be placed on delicate or sharp instruments.

Heavy instruments should be placed at the bottom of the tray, unless indicated otherwise by the manufacturer’s IFU.

Items that should not be used when packaging instruments for sterilization include:

- Rubber bands around instruments
- Paper/plastic peel-packages used to segregate instruments within the tray
- Stylets in lumen items, unless manufacturer’s IFU specifically recommends leaving it in

**Specialty Equipment**

Power equipment (e.g., drills, saws) should be sterilized according to the manufacturer’s IFU and be lubricated and tested before sterilization. This will increase the life expectancy of the power equipment.

Scopes and cords should be cleaned according to the manufacturer’s IFU and checked for visibility and functionality before sterilization.

Ophthalmic instruments require specific care due to toxic anterior segment syndrome (TAS). This is a contaminant that is introduced to the eye, due to the inadequate cleaning, rinsing, and sterilization process of eye surgery instruments. Often, single-use items, especially with lumens, are used to reduce the risk.

**Packaging**

Packaging materials can be:

- Single-use nonwoven material
- Multiuse woven textile (not as common)

Basic guidelines for packaging of instruments and equipment are often dependent upon the type of sterilization process used. Some general guidelines are:

- Trays should not weigh over 25 pounds.
- Trays should include a proper indicator for the sterilization modality.
Trays should be labeled with product identification, lot number, and process date.

**Indicators**

*Indicators* are types of monitoring devices that offer evidence that the sterilization process has occurred.

There are three different types of indicators used during the sterilization process:

- Chemical: Validates one or more parameters typically with a color change
- Biological: Validates sterilization by achieving microbial kill
- Mechanical: Sterilizer sensor prints out and alarms

Type 5 integrators are the most widely used as they measure time, temperature, and pressure.

Chemical indicators are placed inside and outside of a package prior to sterilization. The chemical indicator undergoes a visual color change if a package was exposed to the proper physical conditions of sterilization (temperature, pressure, and time). Note that chemical indicators do not guarantee sterility. Biological indicators are used in every load. This requires placing a prepackaged, self-contained vial of a bacterial spore in an appropriate test/challenge pack—*Bacillus stearothermophilus* for steam sterilizers or *Bacillus subtilis var. niger* for ethylene oxide (EtO) sterilizers—in the sterilizer for a cycle to see whether the cycle kills all the spores. If it does, then the sterilizer is working properly. The results from the biological indicator must be *negative* and the load should not be released and/or utilized until a negative result is confirmed.

Mechanical indicators, Bowie–Dick tests, are used daily to monitor the function of the steam sterilizers. Sterilizer program parameters, specifically Bowie–Dick tests, are used to validate the efficacy of the prevac cycle of these sterilizers. This test consists of a series of air removal and steam penetration barriers with a chemical indicator in the center of each pack. The pack is placed directly into an empty steam sterilizer to see whether the steam displaces the air through the barrier material within the pack. A uniform change in color from yellow to blue/purple on the indicator sheet indicates that all the air was displaced and the appropriate vacuum was achieved for optimal steam penetration.

Validation of the sterilization cycle should include the use of chemical and biological indicators, mechanical monitoring of the sterilizer.
STERILIZATION

Within an organization, sterilization cycles include different parameters for different types of sterilization. Common types of sterilization are:

- Steam: Gravity displacement
- Steam: Dynamic air removal (prevac or steam-flush pressure-pulse)
- Chemical: Ethylene oxide
- Chemical: Vaporized hydrogen peroxide
- Chemical: Peracetic acid

In order to determine the type of sterilization necessary for instruments or devices, it is important to look at the manufacturer’s instructions for use for compatibility and specific parameters. Some instruments and equipment that are commonly steam sterilized are:

- Stainless steel or laparoscopic instrument trays
- Some scopes
- Drills, saws, and other power equipment

Some instruments and equipment that are commonly chemically sterilized are:

- Laparoscopes
- Camera heads
- Flexible scopes
- Batteries for power equipment

Table 8.1

<table>
<thead>
<tr>
<th>Item Type</th>
<th>Exposure Time at 250°F or 121°C</th>
<th>Exposure Time at 270°F or 132°C</th>
<th>Exposure Time at 275°F or 135°C</th>
<th>Dry Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrapped instrument tray</td>
<td>30 min</td>
<td>15 min</td>
<td>10 min</td>
<td>15–30 min 30 min</td>
</tr>
<tr>
<td>Textile pack</td>
<td>30 min</td>
<td>25 min</td>
<td>10 min</td>
<td>15 min 30 min</td>
</tr>
<tr>
<td>Unwrapped instruments</td>
<td>3 min</td>
<td>3 min</td>
<td>0–1 min</td>
<td></td>
</tr>
<tr>
<td>Unwrapped porous item or lumen/cannula item</td>
<td>10 min</td>
<td>10 min</td>
<td>0–1 min</td>
<td></td>
</tr>
</tbody>
</table>
Parameters for the different types of sterilization are shown in Tables 8.1 through 8.5. Parameters for hydrogen peroxide plasma sterilization are set by the sterilizer manufacturer. They should fall within the ranges shown in Table 8.4.

### Table 8.2
**Parameters for Dynamic Air-Removal Steam Sterilization**

<table>
<thead>
<tr>
<th>Item Type</th>
<th>Exposure Time at 270°F or 132°C</th>
<th>Exposure Time at 275°F or 135°C</th>
<th>Dry Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrapped instrument tray</td>
<td>4 min</td>
<td>3 min</td>
<td>20–30 min 16 min</td>
</tr>
<tr>
<td>Textile pack</td>
<td>4 min</td>
<td>3 min</td>
<td>5–20 min 3 min</td>
</tr>
<tr>
<td>Unwrapped instruments</td>
<td>3 min</td>
<td>3 min</td>
<td>None</td>
</tr>
<tr>
<td>Unwrapped porous item or lumen/cannula item</td>
<td>4 min</td>
<td>3 min</td>
<td>None</td>
</tr>
</tbody>
</table>

### Table 8.3
**Parameters for Ethylene Oxide Chemical Sterilization**

<table>
<thead>
<tr>
<th>Humidity</th>
<th>Temperature</th>
<th>Exposure Time</th>
<th>Aeration Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>50%–75%</td>
<td>85°F–145°F</td>
<td>2 hr</td>
<td>8 hr at 140°F/60°C 12 hr at 122°F/50°C</td>
</tr>
<tr>
<td>30°C–63°C</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 8.4
**Parameters for Vaporized Hydrogen Peroxide Sterilization**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>104°F–131°F 40°C–55°C</td>
<td>28–75 min</td>
</tr>
</tbody>
</table>

### Table 8.5
**Parameters for Peracetic Acid Sterilization**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>122°F–131°F 50°C–55°C</td>
<td>12 min</td>
</tr>
</tbody>
</table>
Exhibit 8.1

Handling of Flexible Endoscopes

A northeastern Illinois hospital had a cluster of carbapenem-resistant Enterobacteriaceae [CRE] outbreaks in 2013, the Centers for Disease Control and Prevention launched an investigation and traced it back to a duodenoscope used during an endoscopic retrograde cholangiopancreatography (ERCP). This hospital moved from using high-level disinfection, using an automated endoscope reprocessors (AERs), to using EtO gas sterilization when duodenoscopes were used on patients with known CRE infection. Additional CRE outbreaks followed during 2015 in the United States and were also traced to duodenoscopes that were not adequately reprocessed. The following process should be used when handling any flexible endoscope:

- It is imperative to preclean flexible endoscopes and accessories at the point of use or as soon as possible.
- Process flexible endoscopes and accessories as soon as transported.
- Leak testing should be performed right before manual cleaning and before the endoscope is placed into cleaning solutions.
- All accessible channels and the distal end of the endoscope should be cleaned with an appropriate-sized cleaning brush.
- Endoscope valves should be manually actuated during cleaning.
- Channels of the endoscope should be flushed with cleaning solution.
- AER or EtO specifically for duodenoscopes should be used according to IFU.
- Integrity of flexible endoscope should be visually inspected and hung in a drying cabinet with all valves open, and removable parts should be detached if AER is used for high-level disinfection.
- A duodenoscope is EtO gas sterilized, it should be stored in a manner that minimizes contamination and protects the scope from damage (Bashaw, 2016; Kenters, Huijskens, Meier, & Voss, 2015; Ray, Lin, Weinstein, & Trick, 2016).

Immediate-Use Steam Sterilization

Unwrapped sterilization takes place when an item is dropped during surgery or when a tray of instruments or equipment needs to be processed right away. This is considered immediate-use steam sterilization (IUSS) and is discouraged except in emergency situations. It was formerly called flash sterilization.
Advantages and Disadvantages of Sterilization Types

Both steam and chemical sterilization have many advantages and disadvantages.

Common advantages of steam sterilization are:
- Nontoxic
- Cost-effective
- Penetrates packaging and lumens/cannulas
- Large capacity sterilizers are available

Common disadvantages of steam sterilization are:
- Damages heat-sensitive items
- Can lead to moisture in packages
- Has the potential to burn staff

Common advantages of EtO chemical sterilization are:
- Compatible with most materials
- Penetrates packaging and lumen/cannulas
- Simple to operate and monitor

Common disadvantages of EtO chemical sterilization are:
- Requires aeration time to remove EtO residue
- Toxic, uses a carcinogen, and flammable
- Long sterilization process
- Burdensome regulatory monitoring required

Common advantages of vaporized hydrogen peroxide sterilization are:
- Environmentally safe
- Nontoxic, no venting required
- Short cycle time

Common disadvantages of vaporized hydrogen peroxide sterilization are:
- Cannot process textiles, liquids, or anything containing absorbable items
- Cannot process some long lumens
- Requires special packaging
- Small capacity

Common advantages of peracetic acid sterilization are:
- Quick turnaround time
- Less damaging to instruments
- Easy to use

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Common disadvantages of peracetic acid sterilization are:

- Can only be used with instruments that can be immersed
- Potential for eye and skin damage
- May be materials compatibility concerns for lead, brass, copper, and zinc
- Immediate use only, cannot be stored sterile

**STERILE STORAGE**

After instruments and equipment are sterilized, it is important to store them in the proper place.

The temperature of the storage area should be approximately 75°F (24°C) and the humidity should not exceed 70%.

Other guidelines include:

- Use a maintenance cover (dust cover) on items that are not commonly used to insure package integrity.
- Keep items in closed or covered cabinets.
- Shelves, if racks, should be clean and dry with plastic shelf liners used to protect packages from becoming perforated.
- Supplies should be rotated.
- Touch supplies with clean hands.

Stringent guidelines are followed and a great deal of care is involved in the processing of sterile instruments and equipment used during the surgical procedure. Properly processing instruments and equipment is an important measure to prevent surgical-site infections and promote patient safety. It is important to be able to distinguish between sterile and nonsterile items through visibly identifying chemical indicators in order to prevent nonsterile items from entering a sterile field.

**References**

