Application of Infection Prevention and Control in Operating Theatres of Elsha’ab Hospital – an Interventional Study - Khartoum, Sudan

By

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5/9/2012
Dedication

Dedicated to my father's soul

To my mother and family for their encouragement and enthusiasm.

To my supervisors and teachers who taught me much of what I hold meaningful.
Acknowledgement

I would like to thank Professor: Ahmed Sayed Ahmed Elsayed for his support, contribution, encouragement and guidance.

Elsha’ab Hospital administration and health care workers and supporting staff, Dr. Magda Elhadi Ahmed Director of Primary Health Care and Health Education Centre.

Dr. Mohamed A. El-Bashaar Clinical Microbiology and Infection control Consultant, chairman IC committee Saudi German Hospital, Jeddah. Special acknowledgements go to my main supervisor Professor Ahmed Abdalla Mohamedani for his substantial guidance, assistance, help and patience during the conduct of this study.
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Doctor of Philosophy in Community Health - September 2012

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Abstract

Without taking proper precautions, the health care facility can cause the spread of infections and diseases. When providing health services, it is essential to prevent transmission of infections at all times and at different levels. In 1985, largely because of the emergence of HIV/AIDS, guidelines for protecting healthcare workers from becoming infected with HIV and other blood borne infections (e.g., HCV) were quickly developed and became known as universal precautions (UP). This was an interventional cross sectional study to evaluate the application of guidelines for Infection Control in the Operating Rooms (Neuro and Cardiothoracic) among health care workers (HCWs) including surgeons, theatre nurses, surgical technologists, anesthesia assistants, cleaners and porters at Elsha’ab hospital – Khartoum (2009-2011) through a questionnaire, quantitative evaluation (observation/checklist audit) and interventional training of the target group. The questionnaire was completed by 126 HCWs including 28 Theatre nurses and surgical technologists, 11 from the department of Anesthesia, 35 supporting staff (Cleaners and porters), 20 surgeons and 32 ICU nurses. The study revealed that almost all the staff practice hand washing when touching body fluids after each procedure. On the contrary, few of them (33%) practice hand washing when leaving and arriving at work (24%). Regarding the types of gloves used by the cleaners, the majority use single use gloves (65%) and a minority use (4%) use heavy duty gloves. 55% of study group didn't receive any type of training about infection control and prevention with 91% of them having theoretical lectures only. A reduction in infection rates was achieved after intervention. The rate of all cardiothoracic surgical site infections (SSIs) was 16% in the first year and 14% in the second year. Over the same period, the rate of SSIs among clean procedures decreased from 14% to 11%. This reflected the outcome of implementation of comprehensive education and training in an infection control program. Based on the above, we believe that the project goals have been achieved. It is recommended to implement infection prevention and control training programs and guidelines in all surgical and sterilization set units.
تطبيق المبادئ التوجيهية لمكافحة العدوى في غرف العمليات (جراحة القلب والصدر والمخ والإعصاب) وسط العاملين داخل غرف العمليات في مستشفى الشعب التعليمي - الخرطوم

محمد بشير كوكو بركة

دكتورة صحة المجتمع- سبتمبر 2012

مركز الرعاية الصحية الأولية والتنقيف الصحي - كلية الطب
جامعة الجزيرة

الملخص

دون مراعاة الاحتياطات المناسبة لمنع انتقال العدوى، يمكن للأنشطة التي تقدم الرعاية الصحية أن تسبب في انتشار العدوى والأمراض. عندما تقدم الخدمات الصحية من الضروري منع انتقال العدوى في جميع الأوقات وعلى مختلف المستويات. على سبيل المثال، ظهر فيروس نقص المناعة البشرية /الإيدز وظاهرة في CUT (أصبحت تعرف باسم الاحتياطات العالمية). هذه دراسة عرضية تداخلية الهدف منها تقييم تطبيق المبادئ التوجيهية لمكافحة العدوى في غرف العمليات (جراحة القلب والصدر والمخ والإعصاب) وسط العاملين داخل غرف العمليات في مستشفى الشعب التعليمي - الخرطوم (2009-2011). من خلال التقييم الكمي والمراقبة والتدريب للفئة المستهدفة، شملت الدراسة 126 فردا من الفئة المستهدفة من بينهم 28 ممرضا وممرضة بغرف العادات الجراحية و11 من قسم التخدير و35 من قسم النظافة والعمال و20 جراح و32 ممرضة من قسم العناية المركزة. ومن ممارسة غسل اليدين بصورة صحية والوقت المناسب له وسط مجموعة دراسة اظهرت الدراسة أن معظمهم يمارسون غسل اليدين عند لمس سوائل الجسم وبعد كل إجراءات ولكن عدد قليل (33%) منهم يلتزمون هذه الممارسات بشكل متواصل بكمية (24%) فقط عند الوصول إلى العمل وقليلاً بكمية (6%) أن تقبل أنواع القفازات التي يستخدمها عامل النظافة. إذا أغلبهم يستخدمون القفازات الأحادية الاستخدام (65%) والذين يستخدمون القفازات الثقيلة (4%) فقط. واظهرت الدراسة وجود قصور واضح في برامج التدريب والتعليم المستمر بخصوص مكافحة العدوى حيث أن 91% من مجموعة الدراسة لم تتلقوا غير محاضرات نظرية فقط. نتيجة لتدخل الدراسة لوحظ انخفاض معدلات الإصابة بالالتهابات في جرح المريض. وكان معدل الإصابة بالالتهابات في السنة الأولى للدراسة وأرضا إلى 14% في السنة الثانية خلال الفترة نفسها، تم انخفاض معدلات الالتهابات في جرح المريض بنسبة 14% إلى 11%. وهذا يعكس فعالية تنفيذ برامج التدريب والتدريبية تعليمية لمكافحة العدوى وتشجيع الدراسة بالنظر في إنشاء وثيقة برامج تدريبية في جميع مجالات مكافحة العدوى وتطبيقها بصورة مثلى وفي مختلف المؤسسات الصحية بالسودان.
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<td>AIAAAH</td>
<td>American Institute of Architects Academy of Architecture for Health</td>
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<td>AIDS</td>
<td>Acquired Immune Deficiency Syndrome</td>
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<tr>
<td>AMR</td>
<td>Antimicrobial Resistance</td>
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<td>BBPs</td>
<td>Blood Borne Pathogens</td>
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<td>BSI</td>
<td>Body Substance Isolation</td>
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<tr>
<td>CDC</td>
<td>Centre for Disease Control (USA)</td>
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<td>CFUs</td>
<td>Colony-Forming Units</td>
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<td>CSSD</td>
<td>Central Sterilization Supply Department</td>
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<tr>
<td>EPA</td>
<td>Environmental Protection Agency</td>
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<tr>
<td>HAI</td>
<td>Healthcare Associated Infection (previously known as hospital acquired infection and also referred to in other countries as nosocomial infection)</td>
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<tr>
<td>HBV</td>
<td>Hepatitis B Virus</td>
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<tr>
<td>HCV</td>
<td>Hepatitis C Virus</td>
</tr>
<tr>
<td>HCW</td>
<td>Health Care Worker</td>
</tr>
<tr>
<td>HEPA</td>
<td>High Efficient Particulate air</td>
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<tr>
<td>HIV</td>
<td>Human Immune Deficiency Virus</td>
</tr>
<tr>
<td>HLD</td>
<td>High Level Disinfection</td>
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<tr>
<td>HVAC</td>
<td>Heating, Ventilation, and Air Conditioning systems</td>
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<tr>
<td>ICM</td>
<td>Infection Control Manager</td>
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<td>ICN</td>
<td>Infection Control Nurse</td>
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<tr>
<td>ICPs</td>
<td>Infection Control Professional(s)</td>
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<tr>
<td>ICT</td>
<td>Infection Control Team</td>
</tr>
<tr>
<td>ILD</td>
<td>Intermediate Level Disinfection</td>
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JCAHO  Joint Commission on Accreditation of Healthcare Organizations
KAP   Knowledge Attitude and Practices
LAF   Laminar Airflow
LLD   Low Level Disinfection
MRSA  Methicillin-Resistant S. Aureus
OR    Operating Room
ORION Outbreak Reports and Intervention studies Of Nosocomial Infection
OSHA’s Occupational Safety and Health Administration’s
PEP   Post-Exposure Prophylaxis
PPE   Personal Protective Equipment
SP    Standard Precautions
SSI   Surgical Site Infection
TB    Tubercle Bacillus
UP    Universal Precautions
UV    Ultraviolet
UVGI  Ultraviolet Germicidal Irradiation
Chapter one
1. 1 Introduction and Literature Review

Without considering proper precautions, the health care facility can cause the spread of infections and diseases. When providing health services, it is essential to prevent transmission of infections at all times and at different levels.

1.1.1 Importance of good infection prevention practices:

Over the past few decades, the world witnessed increased outbreaks of disease that were once better controlled, and previously unidentified infectious agents that can cause incurable diseases, such as HIV and hepatitis C, have become a significant cause of illness and death in many parts of the world. In addition, hospital-acquired infections are a continuing problem everywhere in the world. There are many complex reasons for these developments, including:

- Rapid population growth, combined with increased poverty
- Expanding populations of "remote" areas
- Environmental degradation
- Improved transportation, leading to easier spread of disease
- Inadequate or deteriorating public health infrastructure
- Wide spread, and often inappropriate, availability and use of antibiotics

1.1.2 Infections in health care settings

Although we do not often think about it, health care facilities are ideal settings for transmission of disease because:

- Invasive procedures, with the potential of introducing microorganisms into the part of the body where they can cause infections.
- Health Service providers and other staff are constantly exposed to potentially infectious material as part of their work.
- Many people seeking health care services are already sick and may be more susceptible to infections.
Some people seeking health care services have infections that can be transmitted to others.

Services are sometimes provided to many clients in a limited physical space, often during a short period of time.

**1.1.3. With appropriate infection prevention practice, you can:**

- Prevent post procedure infections including surgical-site infections
- Provide high-quality, safe services.
- Prevent infections in service providers and other staff.
- Protect the community from infections that originate in health care facilities.
- Prevent the development or emergence of antibiotic-resistant microorganisms.
- Lower the cost of health care services, since prevention is cheaper than treatment.
1.2. OBJECTIVES

1.2.1. General objective:

To evaluate the application of guidelines for Infection Control in the Operating Room (Neuro and Cardiothoracic) among surgeons, theatre nurses, surgical technologist, anesthesia technicians, cleaner and porters at Elsha'ab hospital - Khartoum.

1.2.2. Specific objectives:

1.2.2.1: To assess Knowledge, Attitude and Practices (KAP) of theatre team members (doctors, nurses, surgical technologist and porters about infection control measures).

1.2.2.2: To assess the performance of the existing infection control structures (infection control committee & unit)

1.2.2.3: To design and implement an interventional program (training development of manuals, guidelines …etc.)

1.2.2.4: To assess the outcomes of the interventional program (changes in Knowledge, Attitude and Practices (KAP) of theatre team and infection control structures)

1.2.2.5: To assess the effect of the interventional program on the incidence of postoperative infections
1.3 Literature Review

1.3.1 BACKGROUND

In 1985, largely because of the emergence of HIV/AIDS, guidelines for protecting healthcare workers from becoming infected with HIV and other blood borne infections (e.g., HCV) were quickly developed and became known as Universal Precautions (UP). Almost from the moment they were issued and hospitals and clinics began implementing them, it was recognized that this new strategy, while protecting hospital personnel (patient-to-personnel transmission), sacrificed some measures of preventing patient-to-patient and personnel-to-patient transmission. Also, because many people with bloodborne infections such as HIV/AIDS do not have symptoms, nor can they be visibly recognized as being infected, UP had to be modified to include all persons, patients and clients attending healthcare facilities regardless of whether or not they are infected.

At nearly the same time that UP were being introduced, a new system of health worker and patient precautions was proposed as an alternative to the diagnosis driven UP. This approach, called Body Substance Isolation (BSI), focused on protecting patients and health personnel from all moist and potentially infected body substances (secretions and excretions), not just blood. BSI was based primarily on the use of gloves. Personnel were instructed to put on clean gloves just before touching mucous membranes or non intact skin, and before anticipated contact with moist body fluids (e.g., blood, semen, vaginal secretions, wound drainage, sputum, saliva, amniotic fluid, etc.). Other issues addressed by BSI included:

Protective immunization of susceptible patients and staff against infectious diseases that are transmitted by airborne or droplet routes (measles, mumps, chicken pox and rubella), as well as hepatitis A and B and tetanus toxoid immunization (or a booster dose) of staff; and revised instructions to persons wishing to enter a patient’s room or care for patients with infections transmitted by the airborne route.
BSI quickly gained acceptance over UP because it was simple, easy to learn and implement, and acknowledged that all patients, not just those diagnosed or with symptoms, may be infected and therefore not free of risk to other patients or staff. Disadvantages of BSI included the added cost of protective barrier equipment, particularly gloves, difficulty in maintaining routine use of the protocol for all patients, uncertainty about precautions for patients in isolation rooms and the overuse of gloves to protect staff at the expense of patients.

As a consequence, by the early 1990s healthcare facilities and staff were totally confused regarding what to do about patient and staff precaution guidelines. For example, some hospitals had implemented UP while others had implemented BSI. Indeed, even hospitals and staff that thought they were following UP were really using BSI, and vice versa. There was also much local variation in interpretation and use of both UP and BSI, and a variety of combinations was common. Moreover, there was continued lack of agreement about the role of hand washing when gloves were used. This confusion, coupled with the need to use additional precautions to prevent diseases spread by airborne, droplet and contact routes, were major limitations of BSI.

In view of these problems and concerns, no simple merging together of UP or BSI appeared likely to solve them. What has emerged since then is a new system that provides a single set of isolation guidelines with logistically feasible recommendations for preventing the many infections that occur in healthcare facilities through all known modes of transmission. (Linda, tietjen “et al”, 2003).

The term 'healthcare-associated infection' is now used to replace 'hospital-acquired,' 'nosocomial,' or 'post-operative.' An infection is defined as healthcare associated if it develops more than 48 hours after admission to hospital in a patient who had no indication of an incubating infection at the time of the admission. In addition, an infection that occurs within three days of hospital discharge is considered to be hospital-acquired, and an infection that occurs within 30 days after an operation is generally attributed to the operation. (Lectures in Hospital Infections Part Three 2006)
1.3.2 The infection process

A complete chain of events is necessary for infection to occur. The necessary elements of infection include:

(ENGENDER HEALTH, 2000)

1.3.2.1 Causative organism:
The types of microorganism that cause infection are bacterial, rickettisae, viruses, protozoa, fungi, helimenthes.

1.3.2.2 Reservoir:
Is the term used for any person, plant, animal, substance, or location that provide nourishment for a microorganism and enable further dispersal of the organism. Infection may be prevented by eliminating the causative organism from the reservoir.

1.3.2.3 Mode of exit:
The organism must have a mode of exits from a reservoir and infected host must shed organism to another or to the environment before transmission can
occur. Organisms exist through the respiratory tract, gastrointestinal tract, the genitourinary tract and the blood.

1.3.2.4 Route of transmission;
Route of transmission is necessary to connect the infection source with its new host. Organism may be transmitted through sexual contact, skin to skin contact, percutaneous injection or infections carried in the air. A person who carries or transmits an organism and who does not have apparent signs and symptoms of infection is called carrier, it is important to recognize that different organisms required specific routes of transmission for infection to occur. For example mycobacterium tuberculosis is almost always transmitted by the air borne route. Health care providers do not carry M. tuberculosis bacteria on their hands or clothing. In contrast, bacteria such as staphylococcus aureues are easily transmitted from patient to patient on the hands of health care providers.

1.3.2.5 Susceptible host:
For infection to occur, the host must be susceptible (i.e. not possessing immunity to a particular pathogen) previous infection or vaccine administration may render the host immune (i.e. not susceptible) to further infection with an agent

1.3.2.6 Portal of entry:
A portal of entry is needed for the organism to gain access to the host. For example air borne M. tuberculosis does not cause disease when it settles on the skin of an exposed host, the only entry route for the bacteria that is concerns is through the respiratory system.

1.3.2.7 How are infections transmitted?
Infections are caused by microorganisms, which are tiny organisms that can only be seen under a microscope. If you look at your environment under a microscope, you would see that microorganisms are everywhere on your skin, in the air your breath, and in people, animals, plants, soil, and water. Some microorganisms are normally present on your skin and in your respiratory, intestinal, and genital tracts. These are called normal flora. Other microorganisms are normally not found on or in the human body and usually
associated with diseases. These are known as pathogens. All microorganisms, including normal flora, can cause infection or disease. Infections are transmitted when normal flora are introduced into an area of the body where they are not normally found or when pathogens are introduced into the body. (ENGENDER HEALTH, 2000)

1.3.2.8 Modes of transmission:
There are four ways that infections are transmitted: (Leziady and Small, N. 2006)

- Direct contact: transfer of microorganisms through touch (e.g. staphylococcus), sexual intercourse (e.g. gonorrhea and HIV), fecal/oral transmission (e.g. hepatitis A and shigella), or droplets influenza, (e.g. TB).
- Via a vehicle: Material that serves as means of transfer of microorganisms. This can be food (e.g. salmonella), blood (HIV, HBV), water (cholera, shigella), or instruments and other items used during clinical procedures (HIV, HBV, pseudomonas).
- Air borne: some microorganisms can be carried by air droplets (measles, TB)
- Via vectors: invertebrate animals can transmit the microorganisms (mosquito: malaria and yellow fever, flea: plague).

1.3.2.9 Who is at risk of infection?
Infection prevention is every body’s business. Just as everyone who works at a health care facility is at risk of infection, every health care worker has a role to play in practicing appropriate infection prevention. For infection prevention to be effective, each staff member must do his or her part.

1.3.2.9.1 Risk to staff:
Service providers are at a significant risk of infection because they are exposed to potentially infectious blood and other body fluids on a daily basis. Staff who process instruments and other items, clean up after a procedure room, and dispose of waste are particularly at risk. Client-to-health care worker
transmission can occur through exposure to infectious blood and other body fluids:

- When health care worker’s skin is pierced or cut by a contaminated needle or sharp instruments
- When fluids are splashed on the mucous membrane of health care worker (e.g., eyes nose or mouth)
- Through broken skin due to cuts, scratches, rashes, acne, chapped skin, or fungal infection
- Almost all cases of hepatitis B and HIV transmission to health care worker have occurred through preventable accidents, such as puncture wounds

1.3.2.9.2 Risk to client:

Clients are at risk of post procedure infection when for example service providers do not wash their hands between clients and procedure, when they do not adequately prepare clients before clinical procedure, and when used instrument and other items are not cleaned and processed correctly.

Note: it is very rare for clients to get a blood borne infection like HIV from an infected health care worker. Because this risk is so small, in most cases infected health care worker should not be kept from the irregular activities based solely on their medical diagnosis.

1.3.2.9.3 Risk to the community:

The community is also at risk of infection, particularly from inappropriate disposal of medical waste such as contaminated sharp improperly discarded medical waste including contaminated dressing, tissue, needles, syringes, and scalpel blades. These can be found by children or others scavenging in open dumps or can scatter on the ground where adults and children travel, putting them at risk of injury and infection. In addition, some infection can be spread by staff to their family members or other in the community. For example, the Ebola virus outbreak in Africa in 1995 was spread throughout communities, in part, because of the poor infection prevention practices in health care facilities. (ENGENDER HEALTH, 2000)
1.3.3 Hospital Infection Surveillance and Outbreak Investigation

1.3.3.1 Hospital Infection Surveillance (King FAHD General Hospital 2006-2007)

1.3.3.1.1 Purpose:
To describe the type and scope of infection surveillance activities within the hospital, the reporting system & the method for collecting and organizing data, and to define Nosocomial Infections

1.3.3.1.2 Surveillance process:
- Active prospective hospital infection surveillance shall be done. It shall be hospital wide and laboratory based
- Definitions for Nosocomial Infections shall be those adopted by the Center for Disease Control (CDC).
- Hospital infection surveillance will be performed by the Infection Control Nurse / Officer.

1.3.3.1.3 Surveillance steps:
- The infection control personnel reviews the microbiology results of hospital patients every morning
- Patients with positive culture results will be spotted.
- The infection control personnel evaluate every patient with a new positive culture for nosocomial infections. This will be accomplished using patients’ records, interviewing staff taking care of the patient and examining patient if necessary. CDC definitions to be used when doing the final classification of the nosocomial infection.

1.3.3.1.4 Other actions done for surveillance purposes:
- Make daily systematic rounds to all nursing units as a means of case finding.
- Review patient’s charts and temperature boards.
- Confer with nursing staff regarding infections or suspected cases and those with positive laboratory results.
- Check that appropriate procedures are used in insertion and care of devices to reduce device related infection in Intensive Care Unit.
- Survey the entire patient care wards within a week’s time frame.
- Check the status of all Isolation patients daily.
- Check the status of all patients with an infection present on admission.
- Complete the necessary Communicable Disease Report Forms for the Ministry of Health.
- Microbiology Culture Results: Daily collection of positive results from Microbiology to identify patients and employees with infections.

The following criteria should be utilized to determine if the Positive culture is associated with a nosocomial Process, or if it means colonization:

- Temperature spike of 38.3C (101 F) or over.
- Post operative surgical wounds which are red, open or draining, with pus at the incision site.
- Any draining lesion, skin breakdown, or presence of pus.
- Any patient on whom Acid Fast Bacillus smears, cultures or P.P.D. skin tests have been ordered and tuberculosis is suspected or positive sputum culture is obtained.
- Any patient on whom blood cultures have been ordered and septicemia is suspected or positive blood culture is obtained.
- Jaundice, elevated liver enzymes, a history of recent hepatitis or suspected hepatitis
- Dysuria, frequency, and/ or cloudy urine with Over 100,000 organism of bacterial per ml. any patient with a Foley Catheter in place and if culture is ordered the organism is over 100, 000 per ml.
- Cough with purulent sputum noted after admission and if is not related to the admitting diagnosis and there is infiltrate on the chest x-ray.
- All cases of acute diarrhea with unknown etiology.
- Red, warm, painful intravenous or injection sites.
− Any patient on a ventilator or other devices e.g. central intravascular catheters

1.3.3.1.5 Interdepartmental Functions:

− On a continuing basis, the Infection Control Officer / Nurse confers with department heads to ascertain pertinent information pertaining to infection surveillance. A log is maintained to include the record of general areas applicable to all departments such as:

− Content and Consistency of orientation and in-services of personnel as it is related to infection control (e.g. personal hygiene, attire, safety, health and illness).

− Continuing education of all personnel relative to infection control.

− Current policies and procedures as they relate to infection control including isolation policies and procedures.

− Specific emphasis is assigned to surveillance of high risk areas including Pharmacy (sterile room), Central Sterilizing Service, Housekeeping Laundry, Kitchen and Dietary Service, Operating Room, JKC, and Acute Care Units.

− Review “on the job injuries” or illness of employees with the Employee Health Physician and or / nurse as necessary

1.3.3.1.6 Surveillance Forms:

a. Data Collection Forms:

Keep surveillance worksheets on any patient meeting the following criteria.

− Infection present at time of admission (community acquired).

− Infection developed after admission (nosocomial)

b. Line Listing Forms:

Keep separate form for patients with an infection in the following categories:

− Reportable communicable diseases

− Employee Health Record (King FAHD General Hospital 2006-2007)
1.3.3.2 Outbreak Investigation (infection control compliance Guide 2006)

1.3.3.2.1 DEFINITION
An outbreak is defined as two or more cases over the usual (endemic) number of cases of healthcare-associated infections, usually produced by the same organism. The time period will vary according to the infection.

1.3.3.2.2 RECOGNITION AND NOTIFICATION
Any hospital personnel recognizing a possible epidemic will immediately report this to the Infection Control Department through which the Hospital Epidemiologist will be notified.
In the absence of the Hospital Epidemiologist, the Director of Infection Control, Infection Control Professional(s) (ICPs), or Microbiologist will be notified and temporarily substitute for the Hospital Epidemiologist in the following procedures:

1.3.6.2.3 PRELIMINARY INVESTIGATION
The Hospital Epidemiologist, or his/her designee, is designated as the Investigation Coordinator. He/she will review the charts of the involved patients and determine that an epidemic exists. The Investigation Coordinator, microbiologist, ICP and Director of Nursing of the involved clinical area(s) will immediately confer and prepare a preliminary plan of investigation including the following:

A working definition of a case will be developed:

- The presumptive hypotheses for the mode of transmission of the organism and other circumstances will be developed. Procedures for testing the hypotheses will be outlined.

The Infection Control Department will gather and compile data related to the infection(s) as follows:

- Conduct case finding (review ongoing surveillance charts of other patients at risk and microbiology reports) to determine if there have been other cases of the infection.
- Evaluate previous hospital experience with the infection.
Prepare a line listing of cases to include: hospital identification number, location in hospital, date of admission, date of infection onset, site culture results, medical service and attending physician.

Plot number of cases by date of onset (epidemic curve).

Review patient charts of cases and interview involved hospital personnel for various factors that conceivably may have played a role in transmission of an infection, e.g., geographic locations of patients, specific personnel having contact with patients, medications, and treatments administered, etc.

Review various infection control techniques (handwashing, sterile techniques, etc.) as actually practiced in the involved areas of the hospital.

Maintain surveillance for occurrence of any further infections.

**1.3.3.2.4 The Microbiologist role is to:**

- Determine that all isolates of the involved organism(s) are saved for further study (e.g., biotyping, antimicrobial sensitivity patterns, phage typing, serotyping, etc.) as deemed appropriate. Subcultures are prepared for possible shipment to a reference laboratory.

- Determine what environmental and/or personnel cultures are to be taken by whom and by what technique.

- Determine what patient care items suspected of being possible sources of infection may need to be impounded or quarantined.

**1.3.3.2.5 COMMUNICATIONS**

The Hospital Epidemiologist will ensure that the following other individuals are notified concurrently with the preliminary investigation and advised at reasonable intervals of the progress of the investigation: attending physicians, the department chairman of the medical services involved, and the hospital administrator.
1.3.3.2.6 IMMEDIATE CONTROL
Reasonable immediate control measures are determined by the Hospital Epidemiologist or designee and put into effect on his/her authority in an attempt to halt the spread of infection. Such measures might include but are not limited to: isolation, suspension of certain elective procedures, removal of common suspected sources of personnel from patient contact, or immediate in service training in certain infection control techniques.

1.3.3.2.7 PUBLIC INFORMATION
Any questions from the community, uninvolved hospital personnel, or news media are directed to the hospital administrator who will act as public information coordinator.

1.3.3.2.8 ANALYSIS OF DATA
The data collected in the preliminary investigation are reviewed by the investigators to determine if a common source of infection, break in technique, etc., can be implicated as the cause of the epidemic. A preliminary written report will be prepared.

1.3.3.2.9 FURTHER INVESTIGATION
If the cause of the infection is not evident as a result of the above investigation, a more detailed case control study using statistical epidemiologic methods may be required. The Hospital Epidemiologist may elect to consult the state health department and the USPHS Centers for Disease Control and Prevention for assistance with further studies.

1.3.3.2.10 CONCLUSION OF INVESTIGATION
The investigation is continued at least as long as there are cases of the infection occurring above the endemic level.

A final written report of the investigation, outlining findings and recommendations, is prepared by the investigation coordinator and issued to the Infection Control Committee, others participating in the investigation, attending physician(s), department chairpersons of the medical service(s) involved, and the hospital administrator.
### 1.3.3.2.11 Outbreak Investigation Form (infection control compliance Guide 2006)

#### 1. Verify the diagnosis; identify the agent.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Describe the initial magnitude of the problem and what symptoms got the facility's attention.</td>
</tr>
<tr>
<td></td>
<td>What diagnosis has been established?</td>
</tr>
<tr>
<td></td>
<td>What agent (bacterial, viral, other) has been identified? (Review microbiology/laboratory records to identify cluster or confirm increase of certain pathogens. Consult with staff to identify problem and monitor use of infection control procedures.)</td>
</tr>
<tr>
<td></td>
<td>Develop a case definition (specific criteria for a case).</td>
</tr>
<tr>
<td></td>
<td>Example: All patients who have had loose stools for &gt;12 hours.</td>
</tr>
</tbody>
</table>

**CASE DEFINITION:**

#### 2. Confirm that an outbreak exists.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Use your case definition to find all cases.</td>
</tr>
</tbody>
</table>
|      | Based on your knowledge in #1, are the numbers of cases above what is endemic (usually seen) in the facility?  
|      | If yes, consider that an outbreak exists. |
|      | Total number of cases so far: |
|      | Do you have an outbreak? |
|      | If yes, proceed. |

#### 3. Search for additional cases.

Encourage immediate reporting of cases (laboratory, physicians, personnel).

Search for other cases by retrospective record review, lab reports, etc.

#### 4. Characterize the cases by person, place and time.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person</td>
<td>(Patient characteristics - age, sex, disease, exposures, treatments)</td>
</tr>
<tr>
<td>Place</td>
<td>(Consider ward, hall, room, outside exposures. May use facility maps. Check and confirm status of air exchange, pattern of flow [positive/negative] and environment as they relate to outbreak.)</td>
</tr>
</tbody>
</table>
| Time     | What is the period of the outbreak? What is the probable source of exposure?  
|          | Record dates of onset and draw an epidemic curve. |

#### 5. Form a tentative hypothesis (best guess at the time).

Review data to determine common host factors and exposures. Develop a best guess on the:

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reservoir</td>
<td></td>
</tr>
<tr>
<td>Source</td>
<td></td>
</tr>
<tr>
<td>Mode of transmission</td>
<td></td>
</tr>
</tbody>
</table>
6. Institute preliminary control measures.
Initiate control measures based on what you know (handwashing, isolation, cohorting, etc.). Determine if you need outside assistance.

<table>
<thead>
<tr>
<th>Control measures:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Date implemented:</td>
<td></td>
</tr>
<tr>
<td>Assistance needed?</td>
<td>□ Yes □ No</td>
</tr>
</tbody>
</table>

7. Test the hypothesis.
Many hospital problems never reach this stage. It may end without intervention or simple control measures may cause the problem to cease. Special epidemiologic studies may be needed and staff may need to seek help.

8. Refine the control measures.
Additional measures, if needed:

9. Monitor and evaluate the control measures.

<table>
<thead>
<tr>
<th>Are control measures being used appropriately?</th>
<th>□ Yes □ No</th>
</tr>
</thead>
<tbody>
<tr>
<td>If no, ensure compliance.</td>
<td></td>
</tr>
<tr>
<td>Evaluate control measures. Did cases cease?</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>If no, consider additional actions.</td>
<td></td>
</tr>
</tbody>
</table>

10. Prepare and disseminate a final report.
This form in a completed state may serve as the final report. Make the report as detailed as possible.
- The ORION (Outbreak Reports and Intervention studies Of Nosocomial Infection) guidelines were recently published with the aim of raising methodological standards and the clarity of reporting of intervention studies in hospital infection control. The guidelines provide advice on use of appropriate statistical analysis techniques and the measures necessary to prevent bias, with the aim of ensuring complete transparency in reports of such interventional, their epidemiological context and potential founders. Authors and reviewers should consider these helpful proposals when designing, reporting and assessing intervention and outbreak studies. Use of these guidelines should contribute to the construction of a solid evidence base for control of antimicrobial resistance and healthcare-associated infection. (Clinical Microbiology and infection 2007)
1.3.4 Administration and responsibility (Ayliffe "et al", 2001)

In many hospitals the incidence of infection is unknown, and techniques of
ascertainment or surveillance (i.e. discovery and recording) of infection are often
not used. Infection records, when kept by the ward staff, are often inaccurate,
and it is unusual for measures of control based on these records to be carried
out. Surveillance has been defined as ‘the continuing scrutiny of all aspects of a
disease that are pertinent to effective control’ surveillance of infection in hospital
is necessary for the following reasons:

- To recognize, by any unusual level or change in level of incidence, the
  existing or impending spread of an outbreak, and to identify the
  appearance of any particular hazardous organism;
- To judge the desirability of introducing special measures to control an
  outbreak, or threatened outbreak, and to assess the efficacy of such
  measures;
- To assess the efficacy of the regular preventive measures in use in the
  hospital.
- Of major importance is early recognition of an impending outbreak, or of
  possible hazards, such as contaminated incubators, which might be
  followed by infection.

- It is the responsibility of the hospital authority to ensure that adequate
  arrangements are made to control hospital infection. These
  arrangements should include the setting up of a control of Infection
  committee and the appointment of a control of Infection officer and
  Nurse. The health authority should be responsible for implementing
  recommendations of the officer or committee. It is the responsibility of all
  members of staff to the infection control officer or Nurse of potential
  hazards of infection. Without this information the team cannot be fully
  effective. Over and above the official responsibilities of the health
  authority and the Infection Control Team is the personal care and
  responsibility of clinician in charge.
1.3.4.1 Infection control program

The facility will minimize the risk of development of a health care associated infection (HAI) through the a hospital wide infection control (IC) program

The purposes of infection control program:

- To identify potential infectious patients or staff who may transmit disease to others.
- To reduce the risk of disease transmission and ensure maximal protection of patients, visitors, and health care workers from infection
- To recommend risk reduction practices by integrating infection control principles in to all standards of practice
- To achieve and maintain compliance with standards of infection prevention and control.
- To provide feedback to clinicians and other health care workers.

(SGH2009)

1.3.4.2 Infection control team

The team consists of members of the staff with a special interest in and knowledge of infection control in hospital. The head of the team will be the infection control officer; it will include the microbiologist (who will usually also be the infection control officer), Infection control nurse, and a member of the scientific or technical staff with responsibilities in infection control. Although most of the problems occur within hospital, the present administrative structure also involves the community. The medical officer for Environmental Health should be co-opted on to the team if community problems are being considered or an outbreak of a particular dangerous infection has occurred for which he has legal responsibilities. The team is responsible for investigations of outbreaks or other problems and for giving advice, making day-to-day decisions and evaluating methods, policies and products involved in the control of infection.

1.3.4.3 Infection Control Officer:

The individual holding this appointment should be a senior member of medical staff with ready access to committees and sufficient authority to command respect. He should have a special interest and training in hospital infection, and
should be aware of recent developments in the subject. He should be appointed by the health authority in consultation with the medical staff. The microbiologist is usually the logical choice, as he is suitably qualified and in an ideal position to keep the record system under constant scrutiny. The functions of the Infection Control Officer in conjunction with other members of the team are to assess risks of infection, to advice on preventive measures and to check their efficacy in all parts of the hospital, including catering, laundry and central sterilization supply department (CSSD), in domestic, pharmaceutical and engineering departments, as well as clinical and other areas. Information and advice may be given by him informally or at meetings of the medical staff committee, control of Infection committee or District or Hospital Management Team. However, if any immediate action is required the Infection Control Officer or Chairman of the Infection Control Committee should be empowered to take whatever steps may be necessary without prior reference to the Control of Infection Committee.

1.3.4.4 Infection Control Nurse

The infection control officer usually has commitments which prevent regular visit to wards and theatres and do not allow him personally to carry many of the day-to-day duties of the team, such as recording of infections and ensuring that procedures are satisfactorily performed. At least one infection control nurse or other suitable person should be appointed to assist with these duties in every large hospital (or district). If a nurse is appointed he/she should be state registered, preferably with surgical, pediatric or infectious diseases experience.

Day to day tasks of an Infection Control Nurse might include:

- Identifying as promptly as possible potential infection hazards in patients, staff or equipments;

- Compiling records of infected patients from ward notification, case notes, laboratory reports and information collected in routine visits and discussions;

- Arranging prompt isolation of infected patients (in co-operation with the ward sister and consultant, who have initial responsibility), in accordance with hospital or area policy, and ensuring that there are adequate
facilities for isolating the patients. Introducing other measures as necessary to prevent the spread of infection or organisms highly resistant to antibiotics.

- Checking by inspection that infection control and aseptic procedures are being carried in accordance with hospital policy;
- Liaison between laboratory and ward staff; informing heads of departments and giving advice on infection control problems;
- Collaboration with occupational health staff in maintaining records of infection in medical, nursing, catering, domestic and other grades of staff; ensuring clearance specimens are taken before infected staff return to duty. (Ayliffe, et al, 2001)
1.3.5 Surgical environment and traffic (Gruendemann barbara, and Mangumm Sandra, 2001)

1.3.5.1 Floors, Walls, and Ceilings

Floors, walls, and ceilings are made of various materials and installed with many specifications. It behooves infection control and surgical personnel to be knowledgeable about these materials and specifications and to properly care for and closely monitor operating room (OR) floors, walls, and ceilings for any changes that may signal possible risks for infection.

**FLOORS Materials**

Flooring is available in many materials suitable for the OR, including asphalt tile, vinyl, and terrazzo. The most common flooring used today is seamless vinyl. The surface of all floors must not be porous but instead be suitably hard, particularly for cleaning by the flooding, wet-vacuuming technique. Cushioned flooring is available.

Floors in an OR should be hard, seamless, and easy to clean and should not be affected by germicidal cleaning solutions (e.g., staining, degrading). Plastic terrazzo floor covering should not be used because the surface becomes pockmarked during installation and, therefore, hinders adequate cleaning.

Floor materials should be easily cleanable and appropriately wear-resistant for the location. In new construction or after major renovation work, the floors and wall bases of all ORs and any delivery rooms used for cesarean sections should be monolithic and joint free.

**Floor Drains**

Floor drains should not be installed in operating and delivery rooms. If a floor drain is installed in cystoscopy, it should contain a nonspash, horizontal-flow flushing bowl beneath the drain plate.

**WALLS**

The floor and the bases of walls in an OR should be one continuous surface and free of seams. Walls should have a satin or matte finish because reflection and glare can be disturbing to the OR team. In ORs, delivery rooms for cesarean sections, isolation rooms, and sterile processing rooms, wall finishes shall be
free of fissures, open joints, or crevices that may retain or permit passage of dirt particles.

Wall paneling made of hard vinyl materials is easy to clean and maintain. Plastic filler can seal seams. Laminated polyester or smooth, painted plaster provides a seamless wall, but epoxy paint on walls has a tendency to flake or chip. Wall tiles can present problems such as cracking and breaking, collecting dust and microorganisms in areas between the tiles, and having porous grout lines that harbor microorganisms.

1.3.5.2 CEILINGS

Finishes of all wall and ceiling surface materials should be hard, nonporous, fire resistant, waterproof, stain proof, seamless, nonreflective, and easy to clean. The ceiling should be a minimum of 10 feet high, depending on ceiling-mounted equipment, and may have soundproof, acoustic tiles. Ceiling-mounted equipment is common in ORs. Suspended track mounts, however, can release dust and microorganisms when moved. Movable track-ceiling devices should not be mounted directly over the OR bed but instead be recessed into the ceiling to minimize dust accumulation fallout.

1.3.5.3 Airborne Contamination, Ventilation Systems, and Laminar Airflow

The beneficial effects of clean air with regard to prevention of contagious diseases were documented throughout the early ages, including in the works of such leaders as Lister, Hippocrates, and Florence Nightingale. Many of these leaders thought that exposure to fresh air minimized disease. Since early times, the topic of airborne contamination has received variable emphasis, which is surprising considering that it is a potential risk factor in the genesis of SSIs. Even today, in some parts of the world a great deal of emphasis is placed on the airborne contamination factor; in other parts, very limited emphasis is placed.

There is no clear-cut decisive mandate for either using or not using LAF systems in operating rooms (ORs); in fact) the studies on these systems are often conflicting. The reader is urged to consider all aspects of LAF and to temper decision-making by: considering the current ventilation system in use,
the types of procedures performed, and the types of patients cared for and performing a risk analysis after thoroughly reviewing the literature.

**1.3.5.3 AIRBORNE CONTAMINATION**

Many factors affect the patient’s risk for infection during surgical procedures; therefore every step taken to minimize postoperative infections and patient suffering is valuable. It is thought that airborne contamination from bacteria-carrying particles is one of the causes of postoperative infection in clean surgery. Therefore one of the major goals of surgical team members is to reduce or minimize the counts of bacteria-carrying particles in the air, which are generated almost exclusively by OR staff members.

**1.3.5.4 Operating Room Airflow**

Much effort and many resources have been devoted to improving airflow in the OR. Even though it was well documented in the 1960s that multiple air changes were associated with decreased infection rates, most current infection control practices emphasize contact as the major mechanism for the spread of nosocomial infections. Despite this, some research demonstrates that if there is a widespread presence of organisms, such as staphylococci, in the OR, a biomaterial surface can become contaminated, leading to late-onset infections. Surgical personnel should consider methods of reducing the levels of airborne particulates that may serve as vectors to increase the transport of microbes in the OR environment. It is suggested, for example that prosthetic grafts and other implantable devices not be left exposed (uncovered) for long periods before insertion. Also, aerosols need further study.

Interest in airborne sources of infection in the hospital environment continues. These sources are primarily related to the spread of multidrug-resistant tuberculosis, aerosol spread of saprophytic fungi in the transplant population, and the potential spread of multidrug-resistant microorganisms in healthcare facilities.

Infections are usually multifactorial. The importance of environmental factors in the origin of postoperative surgical infection is difficult to assess in prospective, well designed studies. Patient associated risk factors for infection certainly
remain predominant in the infectious process. Thus the importance of patient-associated, environment-associated, and procedure-associated factors may be difficult to assess apart from certain clean surgeries associated with low rates of surgical wound infection.

1.3.5.5 VENTILATION SYSTEMS
According to the American Institute of Architects Academy of Architecture for Health (AIAAAH), design of an OR ventilation system should consider comfort as well as asepsis and should provide air movement that is from clean to less-clean areas. If any form of variable air volume or load shedding system is used for energy conservation, it must not compromise the corridor-to-room pressure balancing relationships or the minimum air changes required (e.g., 15 total air changes per hour), with a minimum of three of these being outdoor air changes. The Centers for Disease Control and Prevention (CDC) Surgical Site Infection (SSI) guideline specifies that OR ventilation should be maintained at positive pressure with respect to the corridors and adjacent areas because positive pressure prevents airflow from less clean areas into more clean areas. The guideline also reiterates the AIAAAH specifications of 15 air changes per hour, of which at least 3 (20%) should be fresh air. All air should be introduced at the ceiling and exhausted at the floor. All recirculated and fresh air should be filtered through appropriate filters, according to AIAAAH recommendations. All ventilation or air conditioning systems in hospitals, including those in ORs, should have two filter beds in series, with the efficiency of the first filter bed being 30% and that of the second filter bed being 90%.

OR air may contain microbial-laden dust, lint, skin squames, or respiratory droplets. Since the microbial level in OR air is directly proportional to the number of people moving around in the room, efforts should be made to minimize personnel traffic during operations. OR doors should be kept closed except as needed for passage of equipment, personnel, or the patient.

LAMINAR AIRFLOW SYSTEMS
Controversy exists about the efficacy of LAF in decreasing wound infections. Researchers conclude that a clean wound infection rate of less than 1% to 2%
should be achievable with standard OR air handling. It is not reasonable to consider adding on the capital cost, maintenance expense, and noise and communication problems of LAF rooms until the less expensive infection control measures are rigorously applied in daily practice, and infection rates are at or above the standard. These less expensive measures include good surgical technique; meticulous hemostasis; gentle handling of tissue; reduction of traffic, use of appropriate antibiotic prophylaxis, and avoidance of surgery when the patient has infected skin lesions, dermatitis, or a urinary tract infection.

LAF is an option to be considered when addressing ventilation in the surgical suite. However, surgical infections could be reduced in rooms with modern standard ventilation systems and meticulous aseptic techniques. The consequences of infection are greater with certain surgical procedures, such as total joint replacement or bone marrow transplantation, than with others, owing to the devastating effect an infection would have on these patients. In addition to scrupulous surgical technique, some facilities have installed LAF systems simply to provide a clean-air environment.

**Purpose and use**

**NOTE:** There is disagreement among several of the authors concerning LAF.

- LAF is defined as an airflow in which the entire body of air within a confined area moves with uniform velocity along parallel flow lines (i.e., laminar) with a minimum of eddies.

- The purpose of OR ventilation is to dilute and remove airborne bacteria-carrying particles. LAF units recirculate excessive volumes of high-efficiency particulate air (HEPA), filter sterile air, and usually have up to 400 to 500 air changes per hour. If used correctly, LAF systems provide <10 CFU/m³ during surgical procedures. This usually will result in an infection rate of <1%, even after infection-prone, clean surgery.

- Ultraclean air systems have the potential to protect the patient, but users need to wear proper basic OR attire (see the chapter “Surgical Attire”), manage intraoperative activities correctly, and respect the aseptic zones.
- LAF is designed to move particle-free (ultraclean) air over the aseptic operating field at a uniform velocity, sweeping away particles in its path. LAF can be directed vertically or horizontally, and recirculated air is usually passed through a HEPA filter.
- Performance of orthopedic implant operations in ORs supplied with ultraclean air should be considered.
- The CDC SSI guideline states that most of the studies examining the efficiency of ultraclean air involve only orthopedic operations. Findings suggest that both ultraclean air and antimicrobial prophylaxis can reduce SSI following orthopedic implant operations, but antimicrobial prophylaxis is more beneficial than ultra-clean air.
- Results of studies on the value of an LAF system in reducing airborne contamination are inconclusive. Other types of filtered air-delivery systems that have a high rate of airflow are as effective in controlling airborne contamination.
- It is clear that airborne bacteria-carrying particles play a role in causing wound infections. A reduction in the number of these particles is definitely beneficial; however, there is a threshold below which further reduction in colony-forming units (CFUs) fails to yield a corresponding reduction in wound infection rates.
- LAF systems will reduce CPUs. The question remains, however, regarding whether this practice translates into a lower infection rate. Studies during the past 25 years have failed to show that LAF systems are necessary when prophylactic antibiotics are used in conventional ORs. The need for the expensive ultraclean LAF OR in an era of restricted financial resources is not warranted.
- The ultraclean LAF system has yet to demonstrate its value. As a rule, consensus holds that airborne organisms are an important factor in causing wound infection only in the following scenarios:
  • When an air-handling system is grossly contaminated
  • When an otherwise effective air-handling system is abused
• During highly specialized surgical procedures in which a large foreign body is implanted.

1.3.5.6 Garb
The combination of disposable non-cotton, nonwoven clothing with modern face masks and wide surgical hoods that reach out over the shoulder to prevent skin bacteria emission spread from the neck, worn in conventional ORs, has been found to be as efficient as body exhaust systems worn in ORs with vertical or horizontal LAF systems. Reusable, tightly woven clothing may offer comparable results but so far have not been adequately evaluated. In addition, the barrier efficiency of woven clothing may decrease when washed and, if so, the number of washings must be tracked.

1.3.5.7 Body Exhaust Systems in Laminar Airflow Operating Rooms
The late British orthopedic surgeon Sir John Charnley championed ultraclean air in the OR to prevent deep joint sepsis following total hip replacement. He developed a total body exhaust system that had an impervious gown, visored hood, and total body aspiration via a nonportable filtered blower. Various types of body gear have been developed since Charnley’s time and are still being used today.

Laminar and exponential airflow systems offer significant reductions in air contamination and further reduction is possible with body exhaust apparatus. The value of these body suits, however, continues to be questionable. An ultraclean air system (LAF system) may be used for high-risk procedures such as total joint replacement, cardiac surgery, or organ transplantation. In addition to the LAF air system, sterile team members wear total body exhaust gowns resembling space suits and covering the whole body. Air is piped into the headpiece and removed through filtered tubes; the hood or helmet is equipped for hearing and speaking. Negative pressure is maintained under the gown by a vacuum hose and body cooling is provided for the wearer. LAF with a total body exhaust system reliably reduces bacterial contamination at the wound site. The LAF system is an adjunct to the control of airborne contamination, not a substitute for meticulous surgical technique.
1.3.5.8 Body Exhaust Systems in Conventional Operating Rooms

There are few data regarding the performance of body exhaust suits in conventional ORs, without ultraclean air systems. To this end, Bohn, et al, assessed the effect of a portable HEPA-filtered body exhaust system on OR airborne microbial contamination. Equivalent levels of airborne contamination, with and without these portable body exhaust systems, were found in a conventional OR during total knee and hip replacement surgeries. The conclusion was that these air exhaust hoods did not further lower airborne microbial contamination compared with standard head covers and masks in a modern conventional OR.

1.3.5.9 Contaminated or Dirty Procedures

The concept of contaminated or dirty procedures has historically meant that patients with certain suspected or diagnosed conditions (e.g., those with draining infected wounds) were treated differently than other patients. Extraordinary precautions such as removing all room furniture before the procedure, having an extra or outside circulator, decontaminating instruments differently, scheduling procedures at the end of day, or only using certain rooms would be taken. Often, this so-called treatment would be used for patients with blood borne diseases such as hepatitis B or acquired immunodeficiency syndrome (AIDS).

We now know that this “extra treatment” was very time consuming, often caused discrimination among patients, and furthermore was not considered an efficacious infection control process. Also, patients with unknown infections were not appropriately treated. In other words, this treatment was neither cost effective nor advantageous. Dirty-case technique has no place in modern surgical settings.

The advent of Universal Precautions (UP) (6) has helped to put this practice to rest, even though Standard Precautions (SP) do stipulate that patients with documented or suspected highly transmissible or epidemiologically significant pathogens receive care patterned after Transmission-Based Precautions, namely Airborne, Droplet, and Contact Precautions. UP, as advocated by the
Centers for Disease Control and Prevention (CDC) and regulated by the Occupational Safety and Health Administration (OSHA) in the 1991 Blood borne Pathogen Rule, are not particularly difficult to implement in preoperative settings. The concept of treating all patients as though they are potentially infectious has become the impetus for eliminating the practice of dirty-case management.

1.3.5.10 Ultraviolet Irradiation and Lights
The use of ultraviolet (UV) irradiation in surgical settings is controversial. Most commonly UV irradiation has been used for treatment of the tubercle bacillus of tuberculosis (TB) or other airborne contaminants. In operating rooms (ORs) where airborne contamination is a major concern, UV irradiation as an engineering control has been used as a form of germicidal disinfection or air treatment. Currently UV lights are seldom used in the United States for germicidal effects, but occasionally interest in their use is rekindled.

1.3.5.11 Tacky (Sticky) Mats
Tacky floor mats with sticky surfaces were historically placed at the entrance of operating rooms (ORs). The intent was for the mats to collect dust, dirt, and microorganisms from shoes and gurney wheels. The mats were thought to reduce the amount of dirt and debris being carried into a surgical setting and therefore contribute to cleanliness and, possibly, a decrease in surgical site infection (SSI) rates. Tacky mats are not commonly used today. Their use is not normal practice and is not recommended.

USAGE
It is thought that few bacteria are brought into the OR on the feet of personnel; therefore using tacky mats to reduce floor contamination is unnecessary and the practice should be abandoned.

- The use of tacky, or antiseptic, mats at the entrance of the OR for infection control is contraindicated
- Tacky mats placed outside the entrance to OR suites have not been shown to reduce the number of organisms on shoes or stretcher wheels, nor do they reduce the risk of SSI. Therefore the Centers for Disease
Control and Prevention (CDC) recommend that tacky mats not be used at the entrance to OR suites, or individual ORs, for infection control.

- Tacky mats are ineffective and expensive. There is no evidence that their use reduces postoperative wound infection rates. Also, the use of mats soaked with disinfectant is ineffective in preventing contamination of floors in the OR. Such mats may also be hazardous because the floor becomes slippery after the disinfectant is tracked onto the surface adjacent to the mat.

![Figure (1.2) Tacky (Sticky) Mats](image)

**1.3.5.12 Construction and Renovation (C/R)**

In the past few years, much progress has been made in healthcare facility construction/renovation (C/R) but risks related to possible hazards and contaminants still remain. Balancing indoor air quality health risks with the challenges of managing construction costs is always a challenge.

**GUIDELINES AND INFECTION CONTROL INVOLVEMENT** (Gruendemann barbara and Mangumm Sandra, 2001)

Infection control professionals play a crucial role in minimizing risks to patients and staff in facilities where construction renovation (C/R) projects are taking place. Infection control personnel can be valuable educators and advisors during construction renovation (C/R). Infection control personnel should collaborate with the facilities, engineering, nursing, and administration
departments in developing construction related policies, educational materials, and survey tools. Infection control personnel educate the hospital staff, architects, engineers, construction crew and maintenance personnel about infection risks associated with construction, and they collaborate with specific departments to monitor compliance with infection control standards. The Association for Professionals in Infection Control and Epidemiology (APIC) State-of-the-Art Report (SOAR) points to the need for infection control personnel to be actively involved in construction projects from the inception, planning, and design stages through the implementation stage. The SOAR includes a discussion of an infection control risk assessment, also recommended by the American Institute of Architects Academy of Architecture for Health (AIAAAAH). Also discussed in the report are the following major design components, which need to be addressed at the beginning of any operating room (OR) project:

- Design to support infection control practice
- Design, number, and type of isolation rooms
- Heating, ventilation, and air conditioning systems (HVAC)
- Mechanical systems involving water supply and plumbing
- Number, type, and placement of handwashing fixtures, clinical sinks, dispensers for hand washing soap, paper towels, and lotion
- Sharps disposal unit placement
- Accommodation for personal protective equipment
- Surfaces, such as ceiling tiles, walls, counters, floor coverings, and furnishings
- Utility rooms
- Storage of movable and modular equipment

The AIAAAAH suggests, among other things, that qualified risk assessment personnel be included in the planning and design process for any C/R project. **Risks associated with C/R include the following:**

- Construction dust and debris that can carry microorganisms into patient care areas
- Roof leaks caused by construction that can lead to water damage with subsequent mold formation.
- Plugging of ventilation system filters, leading to decreased airflow.
- Penetration of exterior of building, disrupting normal airflow.
- Interruption of utilities, leading to insufficient airflow to critical facility areas, lack of exhaust air for removal of airborne pathogens, and lack of water for sanitation and disinfection

**Suggested interventions to prevent risks of C/R are as follows:**
- Assuring clean-to-dirty airflow in and around construction areas
- Erecting barriers to contain dust and debris
- If possible, removing patients from C/R area
- Assuring window seals that minimize infiltration of outside dust and debris
- Recognizing that simple procedures (e.g., removing old water-damaged ceiling tile) might cause significant mold exposure
- Advising on infection prevention implications of ventilation systems maintenance
- Providing input regarding scheduling of C/R interruptions and provision of back-up strategies, such as portable water supply

**DESIGN AND CONSTRUCTION ERRORS**
Carter and Barr have encountered the following design and construction errors in their infection control practice:
- Air intakes placed too close to exhausts, or other mistakes in the placement of air intakes
- Incorrect number of air exchanges
- Air handling systems that function only sporadically
- Air vents not reopened after construction completed
- Large new inpatient facility built without negative-air pressure rooms
- Carpet placed where vinyl should be used
- Wet-vacuum system in an OR that pulls water up one floor into a holding tank rather than down one floor
- Aerators on faucets
- Sinks located in inaccessible places
- Patient and treatment rooms without sinks in which healthcare workers can wash their hands
- Doors too narrow to allow beds and equipment to be moved in and out of rooms

Infection control personnel should be involved in all phases of C/R projects to ensure that patients, visitors, and staff are protected from unnecessary exposure to infectious agents. Infection risks posed by each project must be identified, and ways to minimize risks and avoid errors must be planned.

1.3.5.13 Traffic Patterns:

Use of aseptic principles begins when personnel enter the doors of the surgical area. The entire area has been designed to facilitate movement of patients, personnel, equipment, and supplies in a manner that protects the safety and privacy of patients and the cleanliness and integrity of the environment. Traffic patterns have been established to limit access by outsiders and increase the control of contact as patients and personnel move closer to restricted areas that include the rooms where sterile procedures take place.

DISTINCT AREAS AND ATTIRE REQUIREMENTS

Surgical suites and traffic patterns are designed to facilitate movement of patients and personnel into, through, and out of defined areas within the surgical suite. Increasing environmental controls and the use of additional surgical attire as the progression is made from unrestricted to restricted areas decreases the potential for cross-contamination. Signs should be posted that clearly indicate the appropriate environmental controls and surgical attire required. All persons (staff, patients, and visitors) should follow the delineated patterns in appropriate attire.
Unrestricted Area
The unrestricted area includes a control point that serves to monitor the entrance of patients, personnel, and materials. Street clothes are permitted in this area, and traffic is not limited. A corridor on the periphery accommodates traffic from the outside, including patients. This area is isolated from the main hospital corridor and elevators and from other areas in the operating room (OR) suite

![Diagram of OR Areas]

Figure (1.3) OR Areas

Transition Zone
The transition zone allows for movement of personnel from unrestricted areas to either the semirestricted or restricted areas inside the surgical suite. This zone (locker and dressing rooms) allows personnel to enter in street clothes and exit into a semirestricted or restricted area with proper attire. It also allows for security because people can be monitored before admission to the surgical suite.

Semirestricted Area
The semirestricted area includes the peripheral support area of the surgical suite that may have storage space for clean and sterile supplies, work areas for storage and processing of clean instruments, and corridors leading to the
restricted area of the surgical suite. Traffic in this area is limited to patients and authorized personnel. Persons who work in this area are required to wear surgical attire and cover all head and facial hair, including sideburns and necklines, by a surgical cap or hood. Nonscrubbed personnel should wear long-sleeved jackets that are buttoned or snapped closed during use. Because coughing or sneezing explodes droplets into the environment, persons with respiratory infections should not be permitted in the surgical suite. NOTE: Persons with skin infections should not be permitted in the semirestricted area of the surgical suite.

**Restricted Area**
The restricted area includes operating and procedures rooms, the sterile core, and scrub sink areas. Persons in this area are required to wear full surgical attire and cover all head and facial hair including sideburns and necklines. Nonscrubbed personnel should wear long-sleeved jackets that are buttoned or snapped closed during use. Masks are required where open sterile supplies or scrubbed persons are located. Sick personnel, or those with skin infections, should not work in restricted areas.

**ADDITIONAL ATTIRE CONSIDERATIONS**
Patients entering the surgical suite should be clean, be wearing clean gowns, be covered with clean linens, and have their hair covered. This practice will minimize particulate shedding during surgical procedures. During transport, patients are not required to wear masks unless they are under respiratory precautions (e.g., with active tuberculosis [TB] or other airborne respiratory disease).

Persons from other departments (e.g., maintenance technicians, computer support personnel) entering the semirestricted or restricted areas of the OR for a brief time for a specific purpose may don a disposable coverall suit, designed to totally cover outside apparel, or a cover gown that covers outside apparel. Shoe and hair covers should be donned as well.
FLOW OF SUPPLIES
Separation of sterile supplies and equipment from soiled materials by space, time, and traffic patterns decreases the risk of infection. Supplies in external shipping containers should be removed from the container in an unrestricted area or transition zone before transfer into the surgical suite. External shipping containers may collect dust, debris, and insects during shipment and could carry contamination into the surgical suite. Supplies prepared for surgical procedures should be transported to the OR in a manner that maintains cleanliness and sterility and prevents physical damage. Protecting items from contamination facilitates their safe use and preserves the qualities of the clean and sterile (restricted) environment. NOTE: Examples of this practice would be to cover unopened sterile items that must be transported from a semi-restricted or restricted area to another restricted area in the hospital.

The flow of clean and sterile supplies and equipment should be separated from contaminated supplies, equipment, and water by space, time, and traffic patterns. The flow of supplies should proceed from the sterile core through the operating room to the peripheral corridor following use. Soiled supplies, instruments, and equipment should not reenter the sterile core area. They should be contained in closed or covered carts or containers for transport to a designated decontamination area. Decontamination and collection areas for soiled linen and trash should be separated from personnel and patient traffic areas. Contaminated objects and waste disposal operations should be kept out of patient care areas. Contamination can be contained by transporting trash, soiled linen, soiled instruments, and nonsterile equipment and supplies in an enclosed cart or an impervious system.

ACTIVITY WITHIN SEMIRESTRICTED AND RESTRICTED AREAS
Because air is a potential source of microorganisms that can contaminate surgical wounds, and microbial shedding from surgical personnel is known to
increase with activity, greater amounts of airborne contamination can be expected with increased movement of surgical team members. Careful assessment of and planning for patient care needs by surgical team members can reduce the need for excess movement or activity during procedures. Increased activity has been found to cause airborne contamination of the sterile field.

— Doors to the ORs should be closed except during movement of patients, personnel, supplies and equipment.
— Doors should be kept closed. Doors are only opened when transporting patients, supplies, or equipment.

NOTE: Open doors, or cupboards being opened and closed, causes disruption of the air currents. Instead of going from intake ducts in the ceiling to exhaust ducts near the floor, the air is pulled more laterally toward the open door or cupboard. This alteration in air flow can cause airborne contamination from personnel, supplies, and equipment in the OR.
— Talking and the number of people present should be minimized.

1.3.5.14 Visitors
Maintaining safety in surgical settings where patients are undergoing surgical procedures that put them at risk for developing surgical site infections requires careful monitoring of infection control practices. For this reason, hospital policy and procedures for visitors and observers in the surgical suite should provide guidelines that help maintain the integrity of the surgical environment. All areas should be carefully protected and monitored to ensure the highest level of quality patient care. Patient privacy must be maintained. For these reasons, special protocols for supervision of visitors should be followed. Visitors may include those who are in the area to accompany patients (e.g., a family member, significant other, guard, or interpreter). Observers need access to the surgical suite as part of their educational experience (e.g., radiology, medical, and nursing students). Professionals (e.g., visiting surgeons, residents and interns, sales representatives) may request entrance to the
operating room (OR) suite as part of their work. Other hospital employees (e.g., biomedical equipment technicians, maintenance or computer support personnel) may need entrance to repair equipment.

**General guidelines:**

Policies or guidelines regarding visitors in the surgical setting may vary, but they should be based on institution policy and on established infection control practices regarding surgical attire and restriction of traffic in the surgical suite. Infection control considerations include the following:

- Persons with an acute infection such as a cold or sore throat should not be permitted within the surgical suite.
- All persons within semirestricted and restricted areas should wear clean, freshly laundered attire intended for use in the OR. In addition, hair and shoe covers should be worn within these areas.
- Visitors whose presence in the OR will be brief may don a one-piece coverall, in addition to hair and shoe covers.

**1.3.5.16 Following designated traffic patterns:**

Visitors should follow the delineated traffic patterns and wear the proper attire. Areas should be marked and signs posted that clearly indicate what attire and environmental restrictions are required.

**1.3.5.17 Visiting Physicians and Residents**

Physician visitors should be credentialed and/or given temporary privileges through the medical staff office. Medical, nursing, or radiology students should have received information regarding aseptic technique. In addition, they must have current immunizations, cardiopulmonary resuscitation (CPR) certification, negative tuberculosis (TB) test results, and carry malpractice insurance. Students must be adequately supervised while in the surgical setting. Agreements between educational programs and hospitals should specifically give details outlining expectations of both students and faculty.
1.3.5.18 Limiting the number of observers:
Policies may be needed that limit the number of observers. Reducing the number of persons in the surgical suite is known to decrease the amount of bacterial shedding and the possibility of accidental contamination of sterile items. Movement within the OR should be kept to a minimum while invasive procedures are in progress.

1.3.5.19 Alternative Surgical Settings
Infection control issues have been pushed to the forefront of health-care practice concerns for the following reasons: re-emergence of infectious diseases such as hepatitis, acquired immunodeficiency syndrome (AIDS), and multidrug-resistant tuberculosis (TB); earlier discharge from acute care settings; reduction in lengths of stay; and patient care moving to ambulatory, sub acute, rehabilitation, and home settings. All of these factors are increasing the risk of infection at all points in the care continuum, and many nosocomial infections are now being identified. Governmental and regulatory agencies are requiring that more stringent attention be paid to the rapid spread of infectious diseases. At the same time, the growth of managed care has increased the pressure to reduce costs in all settings, and program cuts have sometimes included infection control personnel and activities. Because of these challenges, it is essential for providers in all settings to review, revise, and improve their programs for infection surveillance, control, and prevention (and adapt the programs to out-of-hospital settings even when resources for infection prevention may be scarce). Furthermore, lines of communication must be established and promoted among all healthcare organizations along the entire continuum of care so that infection prevention and control programs remain viable wherever patients are located.

Because of the previously mentioned issues, and because surgery is now often performed in settings other than acute care hospital operating rooms (ORs) settings such as ambulatory surgery centers endoscopy and gastrointestinal (G-I) laboratories, cardiac catheterization laboratories, dialysis centers, interventional radiology units, and physician offices we deem this chapter
necessa-ry. Discussion will focus on general guidelines for effective program planning that can apply to all out-of-hospital settings, regardless of locale, size, specialization, or governance, and comments from textbooks and the literature regarding specific setting recommendations. It is important to realize that infection risks in surgical settings outside of the hospital are usually related more to patient populations and procedures than to designated settings; therefore we begin with a section on general guidelines. However, certain settings, such as cardiac catheterization laboratories, have unique structural and procedural characteristics that have implications for infection risks; therefore we have included a section on recommendations for infection prevention practices applicable to multiple settings.

**General guidelines:**

Hospitals comprise different units (e.g., neonatal and the intensive care unit [ICUI]), each with a specific set of patient populations and surveillance procedures. However, infection control surveillance is more difficult in nonacute settings, which often combine a number of services and serve medically complex patients.

The delivery of health care in the outpatient setting is very different from that in the acute care facility. The patient mix and interactions are more varied, patient clinical statuses can range from healthy to acutely ill, and visits can range from brief to all day. Infection control professionals have usually considered the risk for infection in the outpatient setting to be low. However, as more invasive procedures are performed in the ambulatory care setting, patients and healthcare workers (HCWs) alike are at risk for developing or transmitting infection.

On the other hand, immunocompromised persons, the frail elderly, and newborns, regardless of the setting, are at high risk for infections. Others at high risk include cancer, transplant, radiation therapy, and trauma patients and those with surgical wounds, pressure ulcers, invasive devices, and malnutrition. Nonacute care organizations should be careful of implementing acute care hospital infection control policies and procedures without special adaptation for
use in other settings. Because of the rapid and recent growth of ambulatory surgical care, time has not allowed for adequate validation of many procedures and guidelines that would apply to out-of-hospital settings. At this stage, we use the science that is available and continue to study its application to outpatients. The literature on infection prevention in alternative surgical settings continues to grow.

The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) states that an effective infection control program regardless of setting, must take into account the following:

- Patient population(s)
- Patients at high risk for infection
- Common patient diagnoses
- Types of care provided
- Risks of infection transmission
- Types of medical devices, equipment and supplies used
- Types of medical waste generated
- Risks of employee and staff occupational exposures

High-risky high-volume problem-prone populations and procedures/treatments are usually the focus of infection control efforts because they have the greatest number of actual exposure and infection incidents, and they represent an organization’s greatest investment of resources, both physical and financial.

A healthcare organization with a successful infection control program will identify the following:

- At-risk patient populations (e.g. immunocompromised patients, or patients with multiple co-morbidities).
- At-risk procedures (e.g., those involving invasive devices).
- Causes, risks, and patterns of infections that can and do arise in a particular setting

Regardless of the setting, policies and procedures should address the following:

- Bloodborne pathogen exposure control.
– Standard Precautions (SP), including hand washing.
– TB exposure control.
– An employee health program, including staff work restrictions, screening, and follow-up after occupational exposures
– Medical waste and specimen handling and disposal.
– Surveillance and reporting activities for patients and staff.
1.3.6 Infection prevention practices (Gruendemann barbara and Mangumm Sandra, 2001)

1.3.6.1 Preparation of personnel/ Surgical Attire

Special clothing is required in surgical settings to protect patients from microorganisms brought in from the outside. The purpose of this long-standing practice is to prevent the spread of infection from staff to patient. The use of surgical attire (e.g., scrub suit, shoe covers, hair covering) minimizes patient exposure to microorganisms from skin, mucous membranes, or the hair of surgical team members. However, definitive studies have not shown that the use of special attire actually decreases infection rates.

Masks, shoe covers, hair covering, eye protection, nonsterile gloves, and sterile surgical gowns and gloves also protect personnel from possible contamination. These can be considered personal protective equipment (PPE) if they are specifically made and worn to prevent spread of contamination from the patient.

1.3.6.2 Basic attire /The Scrub Suit

The scrub suit consists of a dress or pants and shirt. Policies vary regarding wearing, covering, changing, and laundering scrub suits. This variation exists because there are few definitive studies concluding that scrub suit use and particular methods of laundering decrease surgical site infection (SSI) risk. Policies range from allowing home laundering of scrub suits to protecting scrub suits outside the surgical suite with a cover gown or lab coat. Some agencies require laundering of uniforms in a hospital-approved facility. Others allow staff to launder scrub suits at home. The following standards can provide guidelines until definitive studies provide more direction:
- All persons who enter the semirestricted and restricted areas of the surgical suite should wear attire intended for use within the surgical area. The attire should be approved, clean, and freshly laundered in a hospital-approved laundry facility. The uniform should prevent shedding and promote environmental control.
- Reusable, clean attire should be protected from contamination during transfer and storage.
- Unless the style of scrub suit dictates otherwise, the shirt should be tucked in the pants to prevent the shedding of body scurf (flakes of dry skin) by surgical personnel.
- When a scrub uniform becomes visibly wet or contaminated by blood, body fluid, sweat, or food, the attire should be changed as soon as possible to reduce the possibility of cross contamination or spread of infection to the healthcare worker.
- The Occupational Safety and Health Administration (OSHA) states: “If a pull-over scrub becomes minimally contaminated, the employee should be trained to remove the pull-over scrub in such a way as to avoid contact with the outer surface. If the amount of blood exposure is such that the blood penetrates the scrub and contaminates the inner surface, it
may be prudent to train employees to cut such a contaminated scrub to aid removal and prevent exposure to the face.
- Used scrub suits should be placed in an appropriately designed container for washing or disposal and should not be hung in a locker for wearing at another time.

1.3.6.2.1 Cover Gowns and Lab Coats
Policy regarding the wearing of cover gowns and lab coats outside the surgical suite should be determined by the individual practice setting. Use of this apparel has not been shown to decrease the rate of surgical site infection (SSI). The CDC has no recommendation regarding restricting use of scrub suits to the operating suite or wearing cover gowns over scrub suits outside of the surgical area.

1.3.6.2.2 Surgical mask
Healthcare professionals should wear a mask and eye protection or a face shield to protect mucous membranes of the eyes, nose and mouth during procedures and patient-care activities that are likely to generate splashes or sprays of blood, body fluids, secretions or excretions. Masks are effective only if worn properly. Masks reduce the passage of bacterial particles from the wearer into the environment and help protect the wearer from blood and body fluid splash or spatter. Masks should be comfortable and cover both the nose and mouth completely. A face shield or protective eyewear should be worn by staff within the sterile field. The fit should assure that there is no tenting at the sides of the mouth that would allow dispersion or entry of microbes. A small pliable strip at the nose area should promote a close fit. Masks should be changed frequently and anytime they become wet. When removing the mask, handle only by the strings and promptly discard it into a waste receptacle. It is not uncommon to see masks poorly fitted, placed below the nose, or wet with blood or body fluids. A mask should never be allowed to hang or dangle around the neck, nor should it be folded and placed in a pocket for later use; masks should be either on or off. (Rawson D2003)
1.3.6.2.3 Warm-up Jackets

Warm-up jackets) either reusable or disposable, are used by non-scrubbed surgical staff to cover the arms and body for warmth in a cool environment and to prevent shedding. Long sleeved attire is advocated to prevent shedding from bare arms. Jacket sleeves should not be pushed up, but instead should cover the arms. Jackets should be buttoned or snapped closed during use. Rules for laundering or discarding warm-up jackets are the same as for the scrub suit.

1.3.6.2.4 Shoes

Comfortable, supportive shoes should be worn for personal safety. Shoes should have enclosed toes and heels. Cloth shoes should not be worn because they do not protect from spilled liquids or from sharp items that may be dropped or kicked. Shoes worn in the operating room (OR) should provide protection from fluids and accidentally dropped items. Clogs that have closed toes and heels are available for purchase and provide the same comfort advantages as those with open heels and toes. It is unlikely that clogs are less safe than any other footwear.

1.3.6.2.5 Home laundering:

Laundering of attire in a home laundry is not recommended. Attire becomes contaminated with microorganisms during wear and taking soiled attire home may spread contamination to the home environment. There are several problems with home-laundered surgical attire. In hospital-approved laundry facilities, conditions are monitored to meet specified standards. Linen may be washed in either hot or warm water, but there are defined concentrations of chemical additives that are used and monitored during the laundering process that are not possible at home. Clothing should be protected from possible contaminants. Unlike home laundry facilities, hospitals and hospital-approved facilities have processes in place to meet this requirement. If the scrub suit is contaminated with blood or other potentially infectious materials, the suit should be considered contaminated laundry that has to be handled according to Universal Precautions. Home laundering is not appropriate because laundry conditions cannot be controlled. Laundry is one link in the larger, potential chain
of cross contamination in the home. Pathogens of potential concern can survive
the wash cycle of today’s home laundry process.
Microorganisms that survive the wash cycle may be transferred from fabric to
fabric in the wash, from the surfaces of the washer to other fabrics in the next
load, and to human hands from wet laundry.
Microorganisms can survive today’s laundry process.
There are certain groups within the overall population that are at increased risk
of serious illness as a result of exposure to pathogenic microorganisms. There
are also certain situations in the home in which the risk of exposure to
pathogenic microbes is increased (e.g., when a household member is shedding
an infectious agent). Various factors affect the inactivation of pathogens during
the laundry process, including water temperature, the type of washing product
used, and drying time. With the use of a sanitizing detergent in the wash, the
risk of human exposure to laundry-borne pathogenic bacteria may be reduced
significantly when compared with the use of a nonsanitizing detergent.
The risk for cross-contamination via household laundry was clearly
demonstrated after an outbreak of *Staphylococcus aureus* skin infect ion among
families sharing laundry facilities.
Hygiene failures in home and communal laundry practices can result in the
cross-contamination of both viral and bacterial pathogens among different items
of domestic laundry. Changes in household laundry practices (e.g., lower wash
temperature, the use of a lower volume of water, and a reduction in the use of
sodium hypochlorite additives) as a result of environmental and economic
pressures may have had a negative impact on laundry hygiene ensurance.
Laundered fabrics may have a lower potential for contamination from the
presence of microorganisms but the possibility of cross- contamination via the
hands to other surfaces and to food still exists.
The healthcare worker (HCW) may believe that normal laundering produces
clean clothes, but this does not necessarily translate to *bacteriologically clean*,
and the detergent used may have a wide range of efficacy in reducing the
bacteria on contaminated cloth. Good laundering practices may include the
segregation of clothing items that may be at risk of contamination from other laundry items, as well as the use of a sanitizer.

### 1.3.6.3 Summary of standard precautions:

In 1996, the Center for Disease Control and Prevention (CDC) issued Standard Precautions directed to health-care facilities and personnel for the purpose of prevention of and transmission of infectious diseases. These guidelines were initially prompted by the HIV/AIDS emergence, but are applicable to all infectious diseases encountered in the health care system.

Universal Precautions, previously established, listing measures to safely deal with blood products, bodily fluids (including vaginal secretions and seminal fluid), was incorporated into Standard Precautions.

Patients and health-care givers are presumed to be potentially infectious or susceptible to infection. The practice of hand washing, utilization of gloves, masks, facial shields, gowns, cleansing of patient care equipment, environmental control, linen processing, occupational health and bloodborne pathogens, and patient placement considerations are addressed. By observing these measures, the spread of pathogenic microorganisms can be controlled or limited. (Goldman, Maxine 2008)

#### 1.3.6.3.1 Hand washing:

For more than 100 years, research has shown that proper hand washing is the most important way to reduce the spread of infections in health care settings

**POLICY:**

Hand hygiene is generally considered the single most important procedure for preventing healthcare-associated infections. Antiseptics control or kill microorganisms contaminating skin and other superficial tissues and are sometimes composed of the same chemicals that are used for disinfection of inanimate objects. Although antiseptics and other hand-hygiene agents do not sterilize the skin, they can reduce microbial contamination depending on the type and the amount of contamination, the agent used, the presence of residual activity, and the hand-hygiene technique followed.
**Hand hygiene:**

When hands are visibly dirty or contaminated with proteinaceous material or are visibly soiled with blood or other body fluids, wash hands with either a non-antimicrobial soap and water or an antimicrobial soap and water.

A. Turn on water to a comfortable warm temperature.

B. Moisten hands with soap and water and make a heavy lather.

C. Wash well under running water for a minimum of 15 seconds, using a rotary motion and friction.

D. Rinse hands well under running water.

E. Turn off faucet with paper towel and discard.

F. Dry hands with a clean paper towel and discard.

**Waterless hand-hygiene products:**

If hands are not visibly soiled, use an alcohol-based hand rub for routinely decontaminating hands in all clinical situations:

- When decontaminating hands with an alcohol-based hand rub, apply product to palm of one hand and rub hands together, covering all surfaces of hands and fingers, until hands are dry.

- Follow the manufacturer’s recommendations regarding the volume of product to use.

- Waterless hand wash stations should be strategically placed to be used as an adjunct to soap and water hand wash. Note: Flammability of product is an issue. Check with state and local fire guidelines before placement and bulk storage.

**Appropriate times for staff to wash hands:**

- Immediately after arriving at work

- Before and after examining each client

- After touching anything that might be contaminated

- After handling specimens

- After using the toilet or latrine

- Before putting on gloves

- After removing gloves
When you touching body fluids
Before leaving work

Kinds of hand washing

Routine hand washing with plain soap and running water:
This is appropriate in most situations.
Steps of Routine hand washing:
- Wet hands with running water
- Rub hands together with soap, make sure you rub all parts of your hands
- Vigorously weave fingers
- Rinse hands under a stream of clean running water until all soap is gone.
- Dry hands with clean personal towel or Air Dry

Washing with antiseptic and running water
This is appropriate before invasive procedures (inserting central venous catheter, spinal tap, etc) and before contact with clients at high risk of infection (newborn, immunosuppressed clients, etc)

An alcohol hand rubs
This kills or inhibits microorganisms, but does not remove microorganisms or soil. Alcohol hand rub is used when washing with soap and water is not possible or practical-but only if hands are not visibly dirty because using alcohol alone tends to dry the skin, it is best to use an alcohol rub solution by adding together 2ml of glycerin, propylene glycol, or sorbitol and 100 ml of 60-90% alcohol.
To use an alcohol hand rub solution: pure 3-5 ml of an alcohol hand rub solution is placed in to the palm of your hand and put hands together until they are dry

Hand washing tip:
- Keep bar soap on a rack to allow drainage
- Always use running water – avoid dipping or washing hands in a basin of standing water.
- Use small bars of soap, or cut large ones in to small pieces.
- Always use a clean towel or air-dry your hands.(Perry christine. 2007)
The six golden rules to improve compliance in hand hygiene:

- Select an alcohol-based hand rub which has a good skin tolerance and is acceptable to health care workers to use.
- The hand rub shall be easily available. Wall dispensers near the patient and pocket bottles may well help.
- Implement teaching and promotion of hand hygiene, which has been shown to be very effective.
- Create a hospital budget which covers all costs involved with preventable nosocomial infection.
- Get senior staff to set a good example in order to motivate junior staff, because negligence in hand hygiene appears to correlate with the number of professional years.
- Have the patient–staff ratio well balanced. It has been shown that staff shortage decreases hand hygiene compliance. (Kampf, G 2004)

1.3.6.3.2 Gloves
Gloves protect both clients and staff by acting as a barrier against infectious microorganisms. Staff should wear gloves whenever they expect that their hands will come in contact with a client blood or tissue. Staff should also wear gloves when ever their hands may come in contact with medical waste

Kinds of gloves
Surgical gloves:
These are used when their will be contact with the blood stream or with tissue under the skin (for example surgical procedure, pelvic examination for women in labor etc.)

Single-use exam gloves:
These are used when their will be contact with the intact mucous membrane or where the primary purpose of gloving is to reduce the provider risk of exposure. These gloves should be thrown out after one use

Utility or heavy-duty household gloves:
These are used for handling contaminated items. Handling medical or chemical waste and performing housekeeping activities
Gloving steps:
- Always wash utility gloves before you take the gloves off your hands.
- Always wash your hands after removing any type of gloves.
- Never reuse disposable gloves.
- If possible, use disposable surgical gloves, since it is difficult to properly process reusable gloves. (Perry Christine. 2007)

**Surgical gloves:** wear sterile or high level disinfected surgical gloves for any procedure where your hands will come in contact with a client blood stream or tissue under the skin. It is important to put on and remove the gloves correctly.

Gloves become contaminated:
- If you touch outside of the glove with your bare hand
- If you touch anything that is not sterile or high level disinfected while wearing the gloves.
- If you hold your gloves hands below the level of your waist.
- If either glove develops hole, tear, or puncture.

**Putting on surgical gloves:**
Surgical gloves are cuffed to make it easier to put them on without contaminating them. When putting on surgical gloves, remember the first glove should be picked up by the cuff, the second glove should then be touched only by the other glove.

Remember that the outside of the glove package is not sterile. If you will open the outer package of glove yourself, do so before you perform a surgical scrub.

**Steps of putting on surgical gloves:**
- Prepare large, clean, dry area for opening the package of glove either open the outer glove package and then perform a surgical scrub or ask someone else to open the package of glove for you.
- Open the inner glove wrapper exposing the cuff gloves with the palms up.
- Pickup the first glove by the cuff touching only the inside portion of the cuff (the inside is the side that will be touching your skin when the gloves is on)
– While holding the cuff in one hand slip your other hand in to the glove (pointing the finger of glove toward the floor will keep the fingers open) be careful not to touch anything and hold the glove above your waist level.
– Pickup the second glove by sliding the fingers of the glove hand under the cuff of the second glove. Be careful not to contaminate the glove hand with ungloved hand as the second is being put on.
– Put the second glove on the ungloved hand by maintaining a steady pull through the cuff. Adjust the glove finger and cuff until the glove fit comfortably.

Removing contaminated surgical gloves:

As you remove the gloves, do not allow the outside surfaces of the glove to come in contact with your skin. Avoid letting the glove snap, as this may cause contaminate splashes in to your eyes or mouth or on to your skin or other people in the area.

Remove used gloves before touching any thing:

Countertops, faucets, and pens and pencil are frequently contaminated because health care workers touch them while wearing used gloves.

Steps of removing surgical gloves:

– Rinse gloved hands in a basin of decontamination solution to remove blood or other body fluids
– Grab one glove near the cuff and pull it partway off. The glove will turn inside out. Keep the first glove partially on before removing the second on to protect you from touching the outside of a glove with your bare hand.
– Leaving the first glove over your fingers grasp the second glove near the glove and pull it partway off. Keep the second glove partially on.
– Pull off the two gloves at the same time being careful to touch only the inside surface of the glove with your bare hand.
– If the gloves are disposable or are not intact, dispose of them immediately. If they are to be processed or reused, decontaminate them
before processing wash hand immediately after gloves are removed, since tiny holes or tears in gloves may leave you at risk of exposure to contaminated fluids.

**SOME DOS AND DON’TS ABOUT GLOVES**

Do wear the correct size glove, particularly surgical gloves. A poorly fitting glove can limit your ability to perform the task and may be damaged (torn or cut) more easily.

Do change surgical gloves periodically during long cases as the protective effect of latex rubber gloves decreases with time and in apparent tears may occur.

Do keep fingernails trimmed moderately short (less than 3 mm or 1/8 inch beyond the finger tip) to reduce the risk of tears.

Do pull gloves up over cuffs of gown (if worn) to protect the wrists.

Do use water-soluble (nonfat-containing) hand lotions and moisturizers often to prevent hands from drying, cracking and chapping due to frequent handwashing and gloving.

Don’t use oil-based hand lotions or creams, because they will damage latex rubber surgical and examination gloves.

Don’t use hand lotions and moisturizers that are very fragrant (perfumed) as they irritate the skin under gloves.

Don’t store gloves in areas where there are extremes in temperature (e.g., in the sun, or near a heater, air conditioner, ultraviolet light, fluorescent light or X-ray machines). These conditions may damage the gloves (cause breakdown of the material they are made of), thus reducing their effectiveness as a barrier.

**1.3.6.3 Aseptic technique**

Aseptic technique refers to the practice performed just before or during a clinical or surgical procedure to reduce the client’s risk of infections by reducing the likelihood that microorganisms will inter area of the body where they can cause infection. **Surgical aseptic techniques are** designed to create such an environment by controlling the four main sources of infectious organisms the patient, surgical staff, equipment and operating room environment. Although the
patient is often the source of surgical infections, the other three sources are important and should not be overlooked.

Specific techniques required to establish and maintain surgical asepsis and make the surgical environment safer include the following:

Patient considerations: skin cleaning pre-operatively, skin antisepsis and wound covering.

Surgical staff considerations: hand hygiene (hand washing and/or hand rub and hand rubbing with waterless, alcohol-based antiseptic agents); use and removal of gloves and gowns.

**Aseptic technique includes:**
- Using barriers (surgical attire)
- Surgical scrub and gloving
- Client preparation
- Establishing and maintaining a sterile field.
- Using good surgical technique.
- Creating a safer surgical/procedure area

### 1.3.6.3.3.1 Surgical scrub

Scrubbing reduces the client’s risk of infection in case surgical gloves develop holes or tears. Warm, moist condition in side gloves promotes the growth the microorganisms. Performing surgical scrub with an antiseptic before gloving removes or kills many microorganisms, and also helps prevent this growth.

**Steps of surgical scrub:**
- Remove all jewelry on your hand and wrists.
- Adjust the water to a warm temperature and wet your hands and forearms thoroughly.
- Clean under each finger nail with a stick or brush. It is important for all surgical staff to keep their finger nails short.
- Holding your hands up above the level of elbow, apply the antiseptic. Using a circular motion, begin at the finger tip of one hand and lather and wash between the fingers, continuing from finger tip to elbow. Repeat this
for the second hand and arm. Continue washing in this way for three to five minutes.

- Rinse each arm separately finger steps first, holding your hand above the level of your elbow.
- Using a sterile towel, dry your hands and arms-and from finger tip to elbow- using a different sites of the towel on each arm.
- Keep your hands above level of waist and do not touch anything before putting on surgical gloves.

Recent studies have shown that using a brush during surgical scrub provides no greater reduction of microorganisms on the hands than scrubbing with antiseptic alone. Surgical scrub may be performed using either a soft brush or sponge or using an antiseptic alone avoids using a hard brush which is not necessary and may irritate the skin.

**Alternatives methods of surgical scrub:**

Although the use of antiseptic for surgical scrub is recommended, an alternative method is necessary when surgical staff members are allergic to the available antiseptic solutions or when antiseptic are not available. Performing surgical scrub with soap and water, followed by an alcohol hand rub, can be used in place of antiseptics in these situations.

Ideally surgical scrub should be performed before every procedure. However, to prevent skin irritation from too frequent scrubbing in high volume setting, using 3-5 ml of alcohol hand rub solution between clients, rubbing your hands together until alcohol dries. Then scrub every hour or after every four clients, whichever comes first note that alcohol hand rub does not remove soil or organic material such as blood. If gloves are torn or punctured, or there is blood or other body fluids on your hands after you remove your gloves, a surgical scrub should be performed.

**1.3.6.3.3.2 Client preparation:**

Proper client preparation with antiseptic before a clinical or a surgical procedure is critical. Since bacteria from client skin or mucous membrane can cause infection. Shaving the surgical procedure site is no longer recommended
because it cause small nicks and break in the skin where bacteria can grow and multiply and can lead to increase risk of post procedure infection, hair around the surgical procedure site may be clipped very short if it interferes with the procedure. If the site must be shaved use antimicrobial soap and water or dry shave immediately before the procedure in the operating theater or procedure room.

**To properly prep a surgical/procedure site:**

- Wash the area with soap and water.
- Apply an antiseptic and gently scrub the skin in a circular motion, beginning in the center of the site and moving out, using sterile cotton balls, cotton wool, or gauze sponges held by a sponge forceps.

For the vagina, cervix, and other mucous membranes: Do not use alcohol or alcohol-based antiseptics on mucous membranes. Using sterile cotton balls, cotton wool, or gauze sponges held by a sponge forceps, apply an antiseptic liberally to the cervix and vagina before instrumentation of the uterus.

**1.3.6.3.3 About antiseptics:**

An antiseptic is a chemical agent used to reduce the number of microorganisms on skin and mucous membranes without causing damage or irritation. In addition to removing or killing microorganisms, antiseptics may also prevent the growth and development of some types of microorganisms.

Antiseptics are used for:

- Skin, cervical, or vaginal preparation before a clinical procedure
- Surgical scrub
- Hand washing in high-risk situation; such as before an invasive procedure or contact with a client at high risk of infection (e.g., a newborn or immunosuppressed client).

Antiseptics are not meant to be used on inanimate object, such as instruments and surfaces. Antiseptics are designed to be used for reducing or destroying microorganisms on the skin or mucous membranes without damaging these tissues. They usually do not have the same killing power as chemicals used for disinfection of inanimate objects. Never use antiseptic solution to disinfect
inanimate objects, such as instruments and reusable gloves, and never leave item such as pickup forceps, scissors, scalpel blades, and suture needles soaking in antiseptic solution.

**Preventing contamination of antiseptic solutions:**

Using contaminated solution can cause infection in client. Solutions become contaminated when:

- The water used to dilute a solution is contaminated.
- Containers in which the solution is placed are contaminated.
- Microorganisms from skin or objects contact the solution during use (such as when removing cotton ball from a solution for use in skin prep).
- The area in which solutions are prepared or used is not clean.

Proper handling will reduce the chances of contaminating antiseptics solutions. Pour solution into smaller containers for use during service delivery to avoid contaminating the stock container. Pour solution out of the container without touching the rim or the solution itself with your hands, a cotton swab, cloth or gauze. These can contaminate the entire container of solution.

Store solution in a cool dark area because direct light or excessive heat may reduce their strength making them more susceptible to contamination.

**Properties of Common Antiseptics**

Antiseptic vary between countries, and a variety of products are available throughout the world. This section notes the most common antiseptics and provides the trade names of commonly available products. In general these have been studied extensively and their effectiveness is known. The information here reflects the most up to date scientific studies available. If possible, use these antiseptic, since others may not have been properly studied and effectiveness may not be known.

**Iodophors**, such as povidone iodine (e.g., betadine), contain iodine in a complex from making them relatively nonirritating and nontoxic.

- Antimicrobial spectrum: Effective against a range of microorganisms.
- Advantages: Less irritating to the skin than iodine; can be used on mucous membranes.
- Disadvantages: Effectiveness is moderately reduced by blood or other organic material.

- Usage: Recommended for surgical scrub and client preparation, and is the best antiseptic for use in the genital area, vagina, and cervix. Effective 1-2 minutes after application; for optimal effectiveness, wait several minutes after application. Use full strength; do not dilute.

- Comments: Iodophors are distinctly different from iodine. Iodophors are sudsy; iodine is not. Chlorhexidine gluconate (e.g., hibtane, hibidens, hibiscrub); chlorhexidine gluconate with cetrimide (e.g., Salvon)

- Antimicrobial spectrum: Effective against a range of microorganisms, but has a minimal effect on tuberculosis and fungi.

- Advantages: Good, persistent effect; remains effective for at least six hours after being applied. Effectiveness is not reduced by organic material.

- Disadvantages: On rare occasions, products containing chlorhexidine have been reported to cause irritation, especially when used in the genital area. Effectiveness can be reduced by hard water; hand creams, and natural soaps.

- Usage: Recommended for surgical scrub and skin prep preparations without cetrimide are preferable while products containing chlorhexidine are ideal for surgical scrub and skin preparation. They may cause irritation if used in the genital area vagina or cervix, chlorhexidine is the best alternative if an iodophor is available.

- Comments: The concentration of chlorhexidine in products with the name Savlon may vary from one country to another: Savlon products containing at least 4% chlorhexidine are appropriate for use as antiseptics Savlon products containing less than 4% chlorhexidine in an alcohol base are also adequate, but should not be used on mucous membranes

**Iodine tincture of iodine (iodine and alcohol)**

- Antimicrobial spectrum: effective against a range of microorganism
Advantages: fast acting
Disadvantages: can cause skin irritation Effectiveness is markedly reduced by blood or other organic material
Usage: Too irritating for routine use in surgical scrub or for on mucous membranes. Because of potential irritation when used for skin prep iodine must be allowed to dry and then removed from the skin with alcohol.

**Alcohol (60% - 90% ethyl or isopropyl)**
- Antimicrobial spectrum: Effective against a range of microorganisms
- Advantages: Kills microorganism rapidly. Most Effective in reducing microorganisms Effectiveness is moderately reduced by organic material
- Disadvantages: Has a drying effect on skin Cannot be used on mucous membranes
Usage: cannot be used when skin is dirty; wash the area before applying it must dry completely to be effective
- Comments: 60% - 70% strength is most effective because alcohol must be diluted for optimal effectiveness and it is also less drying to skin.

**Para-chloro-meta-xylenol, PCMX chloroxylenol (all three also known as Dettol)**
- Antimicrobial spectrum: Fairly effective against most microorganisms
- Advantages: has a persistent effect over several hours Activity is only minimally reduced by blood or other organic material
- Disadvantages: less effective than chlohexidine and iodophors
Comments: Not recommended for routine use Antiseptic PCMX preparation containing alcohol should not be used on mucous membranes Disinfectant preparations should not be used as antiseptics

**1.3.6.3.3.4 Establishing and maintaining a sterile field:**
A sterile field is created by placing sterile towels or surgical drapes around the surgical procedure site a sterile field should also be established on the stand that will hold sterile instruments and other items needed during the procedure
Item below the level of the draped client are outside the field and are not sterile
a gowned and gloved provider’s sterile area extend from the chest to the level of
the sterile field sleeves are sterile from 5 cm above the elbow to the cuff
To maintain sterile field:

- Allow only sterile items and persons within the sterile field
- Do not contaminate item when opening dispensing or transferring them
- Consider any sterile item that has been penetrated (cut, wet or torn) to be
  non sterile
- Never set up a sterile field near a door or an open window
- When in doubt about whether or not an item is still sterile, consider it to
  be contaminated

1.3.6.3.5 Good Surgical technique:
Meticulous attention to bleeding and gentle tissue handling during surgical and
clinical procedures can help reduce the risk of infection; post procedure
infections are more likely to occur in tissue that has been damaged due to rough
or excessive manipulation during surgery or when there is excessive bleeding
(because the tissue is then more susceptible to invasion by microorganism)
The use of prophylactic antibiotics (giving antibiotics before a procedure to
prevent infection from developing) does not take the place of good infection
prevention. In general, prophylactic antibiotics may be indicated in contaminated
or clean contaminated surgical, in those involving implementation of a foreign
body, or when the client is severely immunosuppressed.
Prophylactic antibiotics are often prescribed in appropriately (e.g. when they are
not effective against microorganism likely to cause infection) or given at the
wrong time in relation to the procedure (e.g. when given post operatively in state
of pre-or intraoperatively) thus decreasing the likelihood that they will have any
effect.

1.3.6.4 Creating a safer surgical procedure area:
The operating room is clearly one of the most hazardous environments in the
healthcare delivery system.
By definition, surgery is invasive. Instruments that are designed to penetrate patients’ tissue can just as easily injure the provider. Blood is everywhere. Speed is essential.

Preventing infections following an operation is a complex process that begins in the operating room by preparing and maintaining a safe environment for performing the surgery.

### 1.3.6.5 Equipment and room preparation considerations:
Traffic flow and activity patterns as well as housekeeping practices and decontamination, cleaning and either sterilization or high-level disinfection of instruments, gloves and other items
Environmental considerations: maintaining an aseptic operating field and using safer operating practices and techniques
Antisepsis Process of reducing the number of microorganisms on skin, mucous membranes or other body tissue by applying an antimicrobial

### 1.3.6.6 SAFE HANDLING OF NEEDLES AND SYRINGES
The operating room has special characteristics that increase the chance of accidents. For example, staff often use and pass sharp instruments without looking or letting the other person know what they are doing. The workspace is confined and the ability to see what is going on in the operative field for some members of the team (scrub nurse or assistant) may be poor. There is, moreover, the need for speed and the added stress of anxiety, fatigue, frustration and occasionally even anger. Finally, there is the fact that exposure to blood often occurs without the person’s knowledge, usually not until the gloves are removed at the end of the procedure, which prolongs the duration of exposure, the fact that fingers are frequently the site of minor scratches and cut further increase the risk of infection with bloodborne pathogens.

The vast majority of sharps injuries in hospitals occur in the operating room, and most are due to scalpel and suture-needle injuries, which is not surprising given that these are the two most frequently used sharps during operations. Many other items can also cause sharps injuries and glove tears resulting in exposure to blood. Some of the most important are:
- Hypodermic needles
- Wire sutures
- Laparoscopy and surgical drain trocars
- Orthopedic drill bits, screws, pins, wires and saws
- Needle point cautery tips
- Skin hooks and towel clips
- Sharp-pointed scissors and sharp-tipped mosquito forceps
- Dissecting forceps

**Scalpel injuries most often occur when:**
- Putting on and taking off the disposable blade
- Passing the scalpel hand to hand between team members
- Cutting (e.g., in using fingers to hold or spread tissue or cutting toward the fingers of the surgeon or assistant)
- Before and after using the scalpel: leaving it on the operative field, dropping it on your own or the assistant’s foot, and reaching for scalpels sliding off the drapes
- Placing the scalpel in an over-filled sharps container or a poorly located container

**Suture needle injuries most often occur when:**
- Loading or repositioning it in the needle holder
- Passing the needle hand to hand between team members
- Suturing: using fingers to hold tissue or to guide the needle, sewing toward the surgeon or assistant and holding back other tissues by the surgeon or assistant
- Tying with the needle still attached or left on the operative field
- Before and after using the needle: leaving it on the operative field, dropping it on your own or the assistant’s foot, and reaching for suture needles or needles loaded in the needle holder sliding off the drapes
- Placing needles in an over-filled sharps container or a poorly located container
Almost all of these injuries can be easily avoided and with little expense.

For example:

- Use a small Mayo forceps (not fingers) when holding the scalpel blade, when putting it on or taking it off or loading the suture needle.
- (Alternatively, use disposable scalpels with a permanent blade that cannot be removed.)
- Always use tissue forceps, not fingers, to hold tissue when using a scalpel or suturing.
- Use a “hands-free” technique to pass or transfer sharps (scalpel, needles and sharp-tipped scissors) by establishing a Safe or Neutral Zone in the operative field.
- Always remove sharps from the field immediately after use.
- Make sure that sharps containers are replaced when they are only three-quarters full and place containers as close to where sharps are being used as conveniently possible (i.e., within arm’s reach).

1.3.6.7 Surgical Instruments

A safer method of passing sharp instruments (scalpels, suture needles and sharp scissors) during surgery, called the “hands-free” technique, has recently been recommended. This technique for sharps is inexpensive, simple to use, and ensures that the surgeon, assistant or scrub nurse never touches the same instrument at the same time.

Instruments processing:

Proper processing is critical for reducing infection transmission during clinical or surgical procedure. Correct handling and processing reduce staff risk of infection.

The steps of instruments processing:

There are four steps to processing instruments and other items used during clinical or surgical procedure:

Decontamination:

Decontamination is the first step in processing soiled surgical instruments, surgical gloves and other items. It is important, before cleaning, to
decontaminate these items by placing them in a 0.5% chlorine solution for 10 minutes. This step rapidly inactivates HBV, HCV and HIV and makes the items safer to handle by personnel who clean them.

Chlorine solutions made from sodium hypochlorite generally are the least expensive and the most rapid acting and effective products to use for decontamination, but other agents can also be used such as 70% ethyl or isopropyl alcohol and 0.5–3% phenolic compounds. If no disinfectants are available for decontamination, extreme care must be taken when handling and cleaning sharps (e.g., suture needles, scissors and scalpel blades).

Check concentration (% concentrate) of the chlorine product you are using. Determine total parts water needed using Table 10-1 or the formula below.

Total Parts (TP) water =% Dilute ×% Concentrate

(WHO, 1989) recommends 0.5% chlorine solution for decontaminating instruments and surfaces before cleaning because potable (clean) tap water often is not available for making the solution. In addition, because of the potentially high load of microorganisms and/or other organic material (blood or other body fluids) on soiled items, using a 0.5% solution for decontamination provides a wider margin of safety. For HLD, a 0.1% chlorine solution can be prepared provided boiled and filtered (if necessary) water is used for dilution, and the items have been thoroughly cleaned and rinsed.

Use a plastic container for decontamination to help prevent:

- dulling of sharps (e.g., scissors) due to contact with metal containers
- Rusting of instruments due to a chemical reaction (electrolysis) that can occur between two different metals (i.e., the instrument and container) when placed in water.
- Do not soak metal instruments that are electroplated (i.e., not 100% stainless steel) even in plain water for more than an hour because rusting will occur.

After decontamination, instruments should be rinsed immediately with cool water to remove visible organic material before being thoroughly cleaned.
For example, some healthcare facilities now keep two buckets in the procedure areas or operating rooms, one filled with 0.5% chlorine solution and one with water, so that the instruments can be placed in the water after soaking in the chlorine solution for 10 minutes. Although this will help to prevent corrosion, even leaving the instruments in plain water for more than 1 hour can lead to rusting.

Hypodermic needles and syringes that are to be disposed of should be decontaminated, placed in a puncture-resistant sharps container and, when the container is three-quarters full, burned, encapsulated or buried. If syringes (and needles) are to be reused, however, they should be thoroughly washed and rinsed after decontamination. Because it is the contaminated needle that primarily is responsible for injuries, it is recommended that only the syringe, but not the needle, be processed for reuse. Doing this is safer than processing both the needle and the syringe. Furthermore; it reduces costs and creates less contaminated waste than disposing of both.

Large surfaces, such as pelvic examination or operating tables that may have come in contact with blood and body fluids should be decontaminated.

Wiping with a suitable disinfectant such as 0.5% chlorine solution before reuse or when visibly contaminated is an easy, inexpensive way to decontaminate these large surfaces.

Cleaning:
Cleaning is important because:

- It is an effective way to reduce the number of microorganisms, especially endospores that cause tetanus, on soiled instruments and equipment.

Cleaning Steps:
Wear gloves while cleaning instruments and equipment. (Thick household or utility 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.

Note: Even when wearing heavy-duty utility gloves, care should be taken to prevent needle sticks or cuts when washing sharps.
- Wear protective eyewear (plastic visors, face shields, goggles or glasses) and a plastic apron, if available, while cleaning instruments and equipment to minimize the risk of splashing contaminated fluids into the eyes and onto the body. To prevent splashing keep the items being washed under the surface of the water.

- Instruments should be washed with a soft brush (an old toothbrush works well) in soapy water. Particular attention should be paid to instruments with teeth, joints or screws where organic material can collect. After cleaning, instruments should be rinsed with clean water to remove soap residue that can interfere with chemical disinfectants used for high-level disinfection or sterilization.

- Syringes (glass or plastic) when reused should be disassembled only after decontamination and cleaned with soapy water. They then should be thoroughly rinsed (three times) with clean water to remove the soap by expelling the water through the syringe into another container (to prevent contaminating the rinse water), and then dried.

**Note:** If an item cannot be cleaned, it cannot be reused and should be discarded.

Rubber or plastic tubing, such as nasogastic suction tubing for newborns, should be reused only if it can be thoroughly cleaned, rinsed and dried.

- Oral or rectal thermometers should never be mixed even after cleaning. Keep them in separate containers.

Operative endoscopes (e.g., laparoscopes) must be carefully cleaned because improper cleaning is a common cause of mechanical problems as well as transmission of infections to the next patient. 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 helps protect the person cleaning by inactivating many microorganisms including HIV.) Then completely disassemble the laparoscope and place in warm water containing a nonabrasive soap.
Clean all surfaces with a soft brush. 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, the trocar and cannula. After cleaning, laparoscopes should be rinsed three times with clean water to remove all soap residues. Excess water should be removed before proceeding with chemical sterilization or high-level disinfection so as not to dilute the chemical solution.

Savlon should not be used for final processing of laparoscopes because it is not a high-level disinfectant and, furthermore, may cloud the lens.

To be effective, sterilization requires time, contact, temperature and, with steam sterilization under high pressure. The effectiveness of any method of sterilization is also dependent upon four other factors:

- The type of microorganism present. Some microorganisms are very difficult to kill. Others die easily. Note: Although rinsing an item with alcohol and then igniting it with a match (flaming) sometimes is suggested as a method of sterilization, it is not effective!
- The number of microorganisms present. It is much easier to kill one organism than many.
- The amount and type of organic material that protects the microorganisms. Blood or tissue remaining on poorly cleaned instruments acts as a shield to microorganisms during the sterilization process.
- The number of cracks and crevices on an instrument that might harbor microorganisms. Microorganisms collect in, and are protected by, scratches, cracks and crevices such as the serrated jaws of tissue forceps.

Finally, without thorough cleaning, which removes any organic matter remaining on the instruments that could protect microorganisms during the sterilization process, sterilization cannot be assured, even with longer sterilization times.

**METHODS OF HEAT STERILIZATION**

High-pressure, saturated steam uses an autoclave, or dry heat using an oven, are the most common and readily available methods used for sterilization.
High-pressure steam sterilization is an effective method of sterilization but is the most difficult to do correctly. It is generally the method of choice for sterilizing instruments and other items used in healthcare facilities. Where electricity is a problem, instruments can be sterilized in a non electric steam sterilizer using kerosene or other fuel as a heat source.

Dry-heat sterilizers (ovens) are good in humid climates but need a continuous 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—it will melt other substances.

**Standard Conditions for Heat Sterilization:**

Steam sterilization (Gravity): 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. Or at a higher temperature of 132°C (270°F), pressure should be 30lbs/in2; 15 minutes for wrapped items.

Allow all items to dry before removing them from the sterilizer.

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

**Dry heat:**

- 170°C (340°F) for 1 hour (total cycle time—placing instruments in oven, heating to 170°C, timing for 1 hour, and then cooling—is from 2–2.5 hours), or

- 160°C (320°F) for 2 hours (total cycle time is from 3–3.5 hours).

Remember:

- Exposure time begins only after the sterilizer has reached the target temperature.

- Do not overload the sterilizer. (Leave at least 7.5 cm [3 inches] between the items and walls of sterilizer.) Overloading alters heat convection and increases the time required to sterilize.
**Sterilization by steam:**

**General Principles:**
Steam is an effective sterilant for two reasons. Firstly, 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 (dry) 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 oven is operated at a much higher temperature. Steam, especially under pressure, carries thermal energy to the potatoes very quickly, while hot air does so very slowly. Secondly, steam is an effective sterilant because any resistant, protective outer layer of the microorganisms can be softened by the steam, allowing coagulation (similar to cooking an egg white) of the sensitive inner portions of the microorganism. Certain types of contaminants, however, especially greasy or oily materials, can protect microorganisms against the effects of steam, thus hindering the process of sterilization. This reemphasizes the need for thorough cleaning of objects before sterilization.

**Requirements:**
Steam sterilization requires four conditions: adequate contact, sufficiently high temperature, correct time and sufficient moisture. Although 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 are discussed, in order of their importance in ensuring complete sterilization by steam.

**Advantages:**
- Most commonly used effective method of sterilization.
- Sterilization cycle time is shorter than with dry heat or chemical sterilants.

**Disadvantages:**
Requires a continuous source of heat (wood fuel, kerosene or electricity)
- Requires equipment (steam sterilizer), which must be expertly maintained to keep it in working condition.
- Requires strict adherence to time, temperature and pressure settings.
- Difficult to produce dry packs because breaks in procedure are common (e.g., not allowing items to dry before removing, especially in hot, humid climates).
- Repeated sterilization cycles can cause pitting and dulling of cutting edges of instruments (i.e., scissors).
- Plastic items cannot withstand high temperatures. Instructions (Steam Sterilizer)

STEP one: Decontaminate, clean and dry all instruments and other items to be sterilized.

Step two: 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.

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

Step four: Arrange packs in the chamber to allow free circulation and penetration of steam to all surfaces.

Step five: When using a steam sterilizer, it is best to wrap clean instruments or other clean items in a double thickness of muslin or newsprint. (Unwrapped instruments must be used immediately after removal from the sterilizer, unless kept in a covered, sterile container.)

If using a pressure cooker or kerosene-powered (non electric) gravity displacement steam sterilizer, bring the water to a boil and let steam escape from the pressure valve; then turn down heat, but keep steam coming out of the pressure valve.

Step six: Sterilize at 121°C (250°F) for 30 minutes for wrapped items, 20 minutes for unwrapped items; time with a clock.

Step seven: Wait 20 to 30 minutes (or until the pressure gauge reads zero) to permit the sterilizer to cool sufficiently. Then open the lid or door to allow steam to escape. Allow instrument packs to dry completely before removal, which may take up to 30 minutes. (Wet 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 they are removed from the steam sterilizer chamber. If using rigid containers (e.g., drums), close the gaskets.

Step eight: To prevent condensation, when removing the packs from the chamber, place sterile trays and packs on a surface padded with paper or fabric.

Step nine: After sterilizing, items wrapped in cloth or paper are considered sterile as long as the pack remains clean, dry (including no water stains) and intact. Unwrapped items must be used immediately or stored in covered, sterile containers.

**STERILIZATION BY DRY HEAT:**

When available, dry heat is a practical way to sterilize needles and other instruments. A convection oven with an insulated stainless steel chamber and perforated shelving to allow the circulation of hot air is recommended, but dry-heat sterilization can be achieved with a simple oven as long as a thermometer is used to verify the temperature inside the oven.

Effectiveness Dry-heat sterilization is accomplished by thermal (heat) conduction. Initially, heat is absorbed by the exterior surface of an item and then passed to the next layer. Eventually, the entire object reaches the temperature needed for sterilization. Death of microorganisms occurs with dry heat by a process of slow destruction of protein. Dry-heat sterilization takes longer than steam sterilization, because the moisture in the steam sterilization process significantly speeds up the penetration of heat and shortens the time needed to kill microorganisms.

**Advantages**

- Effective method, as dry heat by conduction reaches all surfaces of instruments, even for instruments that cannot be disassembled.
- Fewer problems with dulling of cutting edges.
- Leaves no chemical residue.
- Eliminates “wet pack” problems in humid climates.
Disadvantages
- Plastic and rubber items cannot be dry-heat sterilized because temperatures used (160–170°C) are too high for these materials.
- Dry heat penetrates materials slowly and unevenly.
- Requires oven and continuous source of electricity.

Instructions
(Dry Heat Oven)
To ensure correct operation, consult specific operating instructions supplied by the oven's manufacturer.
Step one: Decontaminate, clean and dry all instruments and other items to be sterilized.
Step two: If desired, wrap instruments in aluminum foil or place in a metal container with a tight-fitting, closed lid. Wrapping helps prevent recontamination prior to use. Hypodermic or suture needles should be placed in glass tubes with cotton stoppers.
Step three: Place loose (unwrapped) instruments in metal containers or on trays in the oven and heat to desired temperature.
Step four: After the desired temperature is reached, begin timing. The following temperature/time ratios are recommended:
170°C (340°F) 60 minutes
160°C (320°F) 120 minutes
150°C (300°F) 150 minutes
140°C (285°F) 180 minutes
121°C (250°F) overnight
Depending on the temperature selected, the total cycle time (preheating, sterilization time and cool down) will range from about 2.5 hours at 170°C to more than 8 hours at 121°C.
STEP 5: After cooling, remove packs and/or metal containers and store. Loose items should be removed with sterile forceps/pickups and used immediately or placed in a sterile container with a tight-fitting lid.
CHEMICAL STERILIZATION:
An alternative to high-pressure steam or dry-heat sterilization is chemical sterilization (often called “cold sterilization”). If objects need to be sterilized, but using high-pressure steam or dry-heat sterilization would damage them or equipment is not available (or operational), they can be chemically sterilized.

Some high-level disinfectants will kill endospores after prolonged (10–24 hour) exposure. Common disinfectants that can be used for chemical sterilization include glutaraldehydes and formaldehyde. Sterilization takes place by soaking for at least 10 hours in 2–4% glutaraldehyde solution or at least 24 hours in 8% formaldehyde. Glutaraldehydes, such as Cidex, are often in short supply and very expensive, but they are the only practical sterilants for some instruments, such as laparoscopes, which cannot be heated. Both glutaraldehydes and formaldehyde require special handling and leave a residue on treated instruments; therefore, rinsing with sterile water is essential if the item must be kept sterile. Also, if not rinsed off, this residue can interfere (cause sticking) with the sliding parts of the laparoscope and cloud the lens.

Although formaldehyde is less expensive than glutaraldehydes, it is also more irritating to the skin, eyes and respiratory tract and is classified as a potential carcinogen. When using glutaraldehydes or formaldehyde, wear gloves to avoid skin contact, wear eyewear to protect from splashes, limit exposure time and use both chemicals only in well ventilated areas.

As items are unwrapped after chemical sterilization, they should be transported and stored in a covered, sterile container.

**Advantages**
- Glutaraldehydes and formaldehyde solutions are not readily inactivated by organic materials.
- Both can be used for items that will not tolerate heat sterilization such as laparoscopes.
- Formaldehyde solutions can be used for up to 14 days (replace sooner if cloudy); some glutaraldehydes can be used for up to 28 days. (Check the manufacturers’ instructions.)
Disadvantages

- Glutaraldehydes and formaldehyde are chemicals that cause skin irritation; therefore, all equipment soaked in either solution must be thoroughly rinsed with sterile water after soaking.
- Because glutaraldehydes work best at room temperature, chemical sterilization cannot be assured in cold environments (temperatures less than 20° C/68° F), even with prolonged soaking.
- Glutaraldehydes are expensive.
- Vapors from formaldehyde (classified as a potential carcinogen), and to a lesser degree glutaraldehydes, are irritating to the skin, eyes and respiratory tract. Wear gloves and eyewear, limit exposure time and use both chemicals only in well-ventilated areas.
- Formaldehyde cannot be mixed with chlorine or chlorinated water because a dangerous gas (bis-chloromethyl-ether) is produced.

Instructions

(Chemical Sterilization)

Step one: Decontaminate, clean and dry all instruments and other items to be sterilized.

Step two: Completely submerge items in a clean container filled with the chemical solution and place the lid on the container.

Step three: Allow items to soak:
  - Ten hours in a glutaraldehyde (check specific product instructions), or
  - At least 24 hours in 8% formaldehyde.

Step four: Remove objects from the solution with sterile forceps; rinse all Note: Ideally, three surfaces three times in sterile water and air dry. Separate (sequential) rinse containers should be used.

Step five: Store objects in a sterile container with a tight-fitting lid if they will not be used immediately.

MONITORING STERILIZATION PROCEDURES

Sterilization procedures can be monitored routinely using a combination of biological, chemical and mechanical indicators as parameters.
Biological Indicators  Monitoring the sterilization process with reliable biological indicators at regular intervals is strongly recommended. Measurements should be performed with a biological indicator that employs spores of established resistance in a known population.

The biological indicator types and different monitoring requirements:

- Steam sterilizers: Bacillus stearothermophilus, weekly and as needed
- Dry-heat sterilizers: Bacillus subtilis, weekly and as needed

**Sterilization**

Chemical indicators include indicator tape or labels, which monitor time, temperature and pressure for steam sterilization, and time and temperature for dry-heat sterilization. These indicators should be used on the inside and outside of each package or container.

External indicators are used to verify that items have been exposed to the correct conditions of the sterilization process and that the specific pack has been sterilized. Internal indicators are placed inside a pack or container in the area most difficult for the sterilization agent to reach (i.e., the middle of a linen pack). This is the indicator that tells if the item has been sterilized.

Chemical indicators, such as heat sensitive tape or glass vials containing pellets that melt at certain temperatures for a given time, do not guarantee that sterilization has been achieved. They do, however, indicate whether mechanical or procedural problems in the sterilization process have occurred.

Mechanical Indicators for sterilizers provide a visible record of the time, temperature and pressure for that sterilization cycle. This is usually a printout or graph from the sterilizer, or it can be a log of time, temperature and pressure kept by the person responsible for the sterilization process that day.

**STORAGE**

All sterile items should be stored in an area and manner whereby the packs or containers will be protected from dust, dirt, moisture, animals and insects. This storage area is best located next to or connected to where sterilization occurs, in a separate enclosed area with limited access that is used just to store
sterile and clean patient care supplies. In smaller facilities, this area may be just a room off the Central Supply Department or in the operating unit.

- Keep the storage area clean, dry, dust-free and lint-free.
- Control temperature and humidity (approximate temperature 24°C and relative humidity <70%) when possible.
- Packs and containers with sterile (or high-level disinfected) items should be stored 20–25 cm (8–10 inches) off the floor, 45–50 cm (18–20 inches) from the ceiling and 15–20 cm (6–8 inches) from an outside wall.
- Do not use cardboard boxes for storage. Cardboard boxes shed dust and debris and may harbor insects.

Note: Sterile packs will not remain sterile unless properly stored.

- Date and rotate the supplies (first in/first out). This process serves as a reminder, but does not guarantee sterility of the packs.
- Distribute sterile and high-level disinfected items from this area. Shelf Life

The shelf life of an item (i.e., how long items can be considered sterile) after sterilization is event-related. The item remains sterile until something causes the package or container to become contaminated—time elapsed since sterilization is not the determining factor. An event can be a tear or worn area in the wrapping, the package becoming wet or anything else that will enable microorganisms to enter the package or container. These events can occur at any time.

Therefore the shelf life of sterilization depends on the following factors:

- Quality of the wrapper or container
- Number of times a package is handled before use
- Number of people who have handled the package
- Whether the package is stored on open or closed shelves
- Condition of storage area (e.g., humidity and cleanliness)
- Use of plastic dust covers and method of sealing.

Most packages are contaminated as a direct result of frequent or improper handling or storage.

To make sure items remain sterile until you need them:
Prevent events that can contaminate sterile packs, and
- Protect them by placing them in plastic covers (bags).

Before using any sterile item, look at the package to make sure the wrapper is intact, the seal unbroken and is clean and dry (as well as having no water stains), then you can be reasonably sure it is sterile regardless of when it was sterilized. In some healthcare facilities where replacement of supplies is limited and the cloth used for wrapping is of poor quality, time as a limiting factor also serves as a safety margin. If plastic covers (bags) are unavailable for the sterilized items, limiting the shelf life to a specific length of time (e.g., 1 month) may be a reasonable decision as long as the pack remains dry and intact.

**Disinfection**

Disinfection is a process that eliminates many or all pathogenic microorganisms with the exception of bacterial spores, from inanimate objects and surfaces. In contrast, sterilization is a process that destroys all forms of microbial life, including spores, from inanimate objects and surfaces.

Factors shown to affect disinfection effectiveness are:
- Previous cleaning of the object
- Type and level of microbial contamination
- Concentration and exposure time to the germicide
- Physical configuration of the object (e.g., contains crevices, hinges, lumens)
- Temperature and pH of the disinfection process

Bacterial spores are the most resistant pathogens to germicides, followed, in descending order, by mycobacteria nonlipid or small viruses, fungi, vegetative bacteria, and lipid or medium-sized viruses.

**Items Classifications**

Patient care items are classified into three categories according to the nature of the items, the manner in which they are to be used, and the degree of risk of infection involved in their use.
**Critical Items**

Critical items present a high risk of infection if contaminated with any microorganisms, including bacterial spores. These items enter the sterile tissues or vascular system of the body or will have blood flowing through them. Sterilization is required for critical items. Examples of critical items are surgical instruments, implants, needles, some endoscopy accessories (biopsy forceps, cytology brushes), catheters (vascular and urinary), laparoscopes and arthroscopes, and some dental instruments.

**Semicritical Items**

Semicritical items are those that contact mucous membranes or non intact skin. These items should minimally receive high level disinfection (HLD) before use. Semicritical devices contaminated with the hepatitis B virus (HBV), human immunodeficiency virus (HIV), or Mycobacterium tuberculosis should receive a minimum of HLD. Semicritical items may also be sterilized. Some semicritical items (hydrotherapy tanks and thermometers) may require only intermediate level disinfection (ILD), which inactivates M. tuberculosis, vegetative bacteria, and most viruses and fungi but not necessarily bacterial spores. Examples of semicritical items are gastrointestinal endoscopes, bronchoscopes, laryngoscopes, endotracheal tubes, respiratory and reusable anesthesia equipment, dialyzers, transducers, diaphragm-fitting rings, tonometers, thermometers, and hydrotherapy tanks if used on patients with nonintact skin (e.g., burn patients).

**Noncritical Items**

Noncritical items come in contact with intact skin (not mucous membranes). Sterility is not critical because intact skin is an effective barrier to most microorganisms. Noncritical items should receive ILD or low-level disinfection (LLD) or cleaning. Examples of noncritical items are stethoscopes; blood pressure and tourniquet cuffs; electrocardiogram leads; bedpans; linens; and environmental surfaces such as tabletops, bedside stands, furniture, and floors.
Levels of Disinfection

**High Level Disinfection:**
HLD is a process that eliminates all microorganisms except large populations of bacterial endospores. HLD is achieved by immersing an item for a specified period in a chemical agent that has been cleared by the U.S. Food and Drug Administration (FDA) as a disinfectant or sterilant. Some high level disinfectants can, with prolonged contact, be classified as sterilants. HLD is used with semicritical and some critical items.

**Intermediate-Level Disinfection:**
ILD inactivates vegetative bacteria, including mycobacteria, most viruses, and fungi, but not necessarily bacterial spores. ILD is used for some semicritical items, and also some noncritical items. ILD is achieved by immersion in a specified chemical agent or by surface disinfection.

**Low Level Disinfection:**
LLD used on noncritical items, kills most vegetative bacteria and some viruses and fungi, but not tubercle bacilli or bacterial spores. LLD is accomplished by surface cleaning, disinfection, by washing or cleaning an item using specific chemical agents. (Weston, Debbie 2008).

**High level disinfection by boiling:**
Boiling in water is an effective, practical way to high-level disinfect instruments and other items. Although boiling instruments in water for 20 minutes will kill all vegetative forms of bacteria, viruses (including HBV, HCV and HIV), yeasts and fungi, boiling will not kill all endospores reliably.

**Instructions for HLD by boiling:**
Step one: Decontaminate and clean all instruments and other items to be high level disinfected.
Step two: If possible, completely immerse items in the water.2 Adjust the water level so that there is at least 2.5 cm (1 inch) of water above the instruments. In addition, make sure all bowls and containers to be boiled are full of water. For example, empty bowls that turn bottom side up and float to the surface contain air pockets.
Step three: Close lid over pan and bring water to a gentle, rolling boil. (Boiling too vigorously wastes fuel, rapidly evaporates the water and may damage delicate [or sharp] instruments or other items.)

Step four: Start timer. In the HLD log, note time on the clock and record the time when rolling boil begins.

Step five: Boil all items for 20 minutes.

Remember: A gentle rolling boil is sufficient and will prevent instruments or other items from being bounced around and possibly damaged by striking other instruments or the side walls of the boiling pot.

**Boiling Steps:**
- Always boil for 20 minutes in a pot with a lid.
- Start timing when the water begins to boil.
- Metal instruments should be completely covered with water during boiling.
- Do not add anything to the pot after timing begins.

Step six: After boiling for 20 minutes, remove objects with previously high level disinfected forceps. Never leave boiled instruments in water that 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.

Step seven: Use instruments and other items immediately or, with high-level disinfected forceps or gloves, place objects in a high-level disinfected container with a tight-fitting cover. Once the instruments are dry, if any pooled water remains in the bottom of the container, remove the dry items and place them in another high-level disinfected container that is dry and can be tightly covered.

Protecting the Life of Instruments That Are Frequently Boiled

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

A study documented that the interior temperature of a plastic cannula floating on the surface of boiling water reaches a temperature of 96–98°C in less than 1 minute. Therefore, for items that float (e.g., syringes, plastic MVA cannulae or...
rubber items), it is not necessary that they be fully covered by the water to achieve HLD if the pot is covered with a lid.

Step one: Boil the water for 10 minutes at the beginning of each day before use. (This precipitates much of the lime salt in the water on to the walls of the boiling pot before objects are added.)

Step two: Use the same water throughout the day, adding only enough to keep the surface at least 1 inch above the instruments to be high-level disinfected. (Frequent draining and replacing the water, and boiling too vigorously, increase the risk of lime deposits on instruments.)

Step three: Drain and clean the boiler or pot at the end of each day to remove lime deposits.

High level disinfection by steaming:
Steaming surgical gloves has been used as the final step in processing gloves for many years in Indonesia and other parts of Southeast Asia. In 1994, a study by McIntosh et al confirmed the effectiveness of this process.

Effectiveness of moist heat:
Essentially all vegetative forms of bacteria are killed by moist heat at temperatures of 60–75°C within 10 minutes. Hepatitis B virus, which is one of the most difficult viruses to kill, is inactivated in 10 minutes when heated to 80°C. In contrast, although many types of spores are killed when boiled at 99.5°C for 15 to 20 minutes, Clostridium tetani spores are quite heat-resistant and can even survive boiling for up to 90 minutes.

The highest temperature that boiling water or low-pressure steam 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 or steam items to be high-level disinfected for a minimum of 20 minutes. This provides a margin of safety for variations in altitudes up to 5,500 meters (18,000 ft), and at the same time eliminates the risk of infection from some, but not all, endospores.

High level disinfection using chemicals:
Although a number of disinfectants are commercially available in most countries, four disinfectants chlorine, glutaraldehydes, formaldehyde and
peroxide are routinely used as high-level disinfectants. These chemicals can achieve high-level disinfection if the items being disinfected are thoroughly cleaned before immersion. A high-level disinfectant should be selected for use based on the characteristics of the items to be disinfected, the physical area (i.e., is it well ventilated) and the skills of personnel available to do the procedure.

**Key Steps in Chemical High-Level Disinfection:**
- Decontaminate instruments and other items that may have been contaminated with blood and body fluids, and thoroughly clean and dry them before placing them in the disinfectant solution.
- Completely immerse all items in the high-level disinfectant.
- Soak for 20 minutes.
- Remove items using high-level disinfected or sterile forceps or gloves.
- Rinse well with boiled and filtered (if necessary) water three times and air dry.
- Use promptly or store in a dry, high-level disinfected, covered container.
  - 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**
- Glass containers may be washed with soap, rinsed, dried and reused. Alternatively, thoroughly rinse glass containers (at least two times) with water and dispose of by burying.
- Plastic containers used for toxic substances such as glutaraldehydes or formaldehyde should be rinsed (at least three times) with water and disposed of by burning or burying.

**Disposal of Used Chemicals:**
Carefully pour wastes down a utility sink drain or into a flushable toilet and rinse or flush with water. Liquid wastes can also be poured into a latrine.
Avoid splashing. Rinse the toilet or sink carefully and thoroughly with water to remove residual wastes.

To further prevent them from being misused, put a hole in each container before disposal so that water or other liquids cannot be carried in it.

**The major advantages and disadvantages of high-level disinfectants are:**

*Note:* Chemical HLD of hypodermic needles and syringes is not recommended, because chemical residues, which may remain even after repeated rinsing with boiled water, may interfere with the action of medications being injected.

Chlorine solutions are fast acting, very effective against HBV, HCV and HIV/AIDS, inexpensive and readily available.

A major disadvantage is that concentrated chlorine solutions (>0.5%) can corrode metals; however, stainless steel and plated instruments can be safely high-level disinfected in 0.1% chlorine solution by soaking in a plastic container for up to 20 minutes. For HLD, the 0.1% chlorine solution should be made using boiled water, which has been filtered if the tap water is cloudy. Prior to soaking, the items should have been thoroughly cleaned, rinsed and dried.

Problems from discoloration can be decreased if items are rinsed with boiled water and dried promptly. Although chlorine solutions for HLD may deteriorate if left standing uncovered or stored in a clear (transparent) container, fresh solutions for HLD need to be made only if the solution is visibly cloudy.

*Note:* Using the lower chlorine concentration (0.1%) is just as effective and will extend the useful life of the instruments.

Glutaraldehydes are less irritating than formaldehyde, but staff and clients still need to be protected from the fumes when mixing and using these solutions. Staff should wear gloves and protective eyewear to avoid skin contact, protect eyes from splashes, limit exposure time and use only in a well-ventilated area.

**1.3.6.8 DESIGNING SAFER OPERATIONS**

Using the least dangerous instrument or device that will effectively accomplish the task while at the same time minimizing risks to the patient and surgical team should be a goal of any operation. Simple things, such as a brief pre-op discussion of how sharps will be handled by the surgeon, assistant or scrub
nurse, can be very helpful. Better still is for the surgical team to review how to make each step in the operation safer, from securing the towel drapes around the proposed incision with nonperforating towel clips to using blunt-tipped needles for closure of all layers except the skin. Surgeons and assistants are most often stuck by hypodermic needles during procedures. Cleaning staff are most often stuck by needles when washing soiled instruments. Housekeeping staff are most often stuck by needles when disposing of infectious waste material.

Safety Steps for Using Hypodermic Needles and Syringes

- Use each needle and syringe only once.
- Do not disassemble the needle and syringe after use.
- Do not recap, bend or break needles prior to disposal.
- Decontaminate the needle and syringe prior to disposal.
- Dispose of the needle and syringe in a puncture-resistant container.

1.3.6.9 Safe Practices in the Operating Room

If the needle must be recapped, use the “one-handed” recap method:

- First, place the needle cap on a firm, flat surface; then remove hand.
- Next, with one hand holding the syringe, use the needle to “scoop” up the cap.
- With the cap now covering the needle tip, turn the syringe upright (vertical) so the needle and syringe are pointing toward the ceiling.
- Finally, using the forefinger and thumb of your other hand, grasp the cap just above its open end and push the cap firmly down onto the hub (the place where the needle joins the syringe under the cap).

Safety Tip for Using a Needle and Syringe for Multiple Injections in the Operating Room

If a hypodermic needle must be used for multiple injections during a surgical procedure, one option for preventing accidents between uses is as follows:

- Roll a sterile towel into a tube shape.
- Stick the needle into the towel between uses.

1.3.6.10 How to Withdraw Medication from a Sterile Multi dose Bottle
- Wipe the top of the bottle with a cotton swab soaked in 60–90% alcohol or other locally available disinfectant. Allow it to dry.
- If using a new disposable needle and syringe, open the sterile pack.
- If using a sterile or high-level disinfected syringe, remove it from the covered container using dry, sterile or high-level disinfected forceps.
- Note: Do not leave a needle inserted in the rubber stopper of a multi dose bottle. This practice provides a direct route for microorganisms, including HIV, to enter the bottle and contaminate the fluid between each use.
- Attach the needle to the syringe.
- Remove the needle cap and insert the needle tip until it touches the bottom of the bottle.
- After filling the syringe, withdraw both the needle and syringe from the bottle.

1.3.6.11 Housekeeping:
Housekeeping refers to the general cleaning of hospitals and clinics, including the floors, walls, and certain types of equipment, tables and other surfaces.

The purpose of general housekeeping is to:
- reduce the number of microorganisms that may come in contact with patients, visitors, staff and the community; and
- Provide a clean and pleasant atmosphere for patients and staff.

Most areas in hospitals and clinics are low-risk, such as waiting rooms and administrative offices, and can be cleaned using only soap and water. In high-risk areas where heavy contamination is expected, such as toilets and latrines, or for blood or body fluid spills, a disinfectant such as 0.5% chlorine or 1% phenol should be added to the cleaning solution (SEARO 1988). Using a disinfectant in addition to soap and water is also recommended in other high-risk areas such as operating rooms, pre- and postoperative recovery areas and intensive care units (ICUs).
In addition, patient rooms, especially those items that might be touched barehanded by patients and staff, should be cleaned using a disinfectant solution to minimize the risk of infection. For example, McFarland et al (1989) found that when patients who did not have Clostridium difficile were admitted to a room previously occupied by a patient with C. difficile, the risk for the new patient increased several fold—even though staff were correctly using precautions to prevent cross-contamination.

If the purpose of housekeeping as stated above is to be achieved, it is important that housekeeping staff be trained to perform their assigned tasks and are supervised on a regular basis. As part of their training, it is important that housekeeping staff:

Understand the risk of exposure to contaminated items and surfaces when performing environmental cleaning procedures; and

Follow recommended policies and guidelines, including the use of appropriate personal protective equipment (PPE).

The general principles for cleaning hospitals and clinics and other healthcare facilities are summarized as:

**General Principles of Cleaning:**

- Scrubbing (frictional cleaning) is the best way to physically remove dirt, debris and microorganisms.
- Cleaning is required prior to any disinfection process because dirt, debris and other materials can decrease the effectiveness of many chemical disinfectants.
- Cleaning products should be selected on the basis of their use, efficacy, safety and cost.
- Cleaning should always progress from the least soiled areas to the most soiled areas and from high to low areas, so that the dirtiest areas and debris that fall on the floor will be cleaned up last.
- Dry sweeping, mopping and dusting should be avoided to prevent dust, debris and microorganisms from getting into the air and landing on clean
surfaces. Airborne fungal spores are especially important as they can cause fatal infections in immunosuppressed patients.

- Mixing (dilution) instructions should be followed when using disinfectants. (Too much or too little water may reduce the effectiveness of disinfectants.)
- Cleaning methods and written cleaning schedules should be based on the type of surface, amount and type of soil present and the purpose of the area.
- Routine cleaning is necessary to maintain a standard of cleanliness. Schedules and procedures should be consistent and posted.

Definitions:

- **Cleaning solution**: Any combination of soap (or detergent) and water, with or without a chemical disinfectant, used to wash or wipe down environmental surfaces such as floors, chairs, bench tops, walls and ceilings.

- **Disinfectant**: Chemical that destroys or inactivates microorganisms. Disinfectants are classified as low-, intermediate- or high-level depending on their ability to kill or immobilize some (low- or intermediate-level) or all (high-level) microorganisms (but not all spores).

- **Disinfectant cleaning solution**: Products that are a combination of a detergent (soap) and a chemical disinfectant. Not all detergents and disinfectants are compatible. Several combinations are available commercially or can be prepared, such as alkaline detergents with chlorine compounds, alkaline detergents with quaternary ammonium compounds (QUATs) or other nonionic surfactants, and acid detergents with iodophors.

- **Environmental controls**: Standards specifying procedures to be followed for the routine care, cleaning and disinfection of environmental surfaces, beds, bedrails, bedside equipment and other frequently touched surfaces.

- **Environmental hygiene**: Process of maintaining a clean, healthy and pleasing patient and work environment.

- **Sanitizer**: Chemical that reduces the number of bacterial contaminants to safe levels on inanimate objects based on public health requirements (i.e., a
chemical that kills 99.999% of the specific test bacteria in 30 seconds under the conditions of the test).

— Soaps and detergents: (terms used interchangeably). Cleaning products (bar, liquid, leaflet or powder) that lower surface tension, thereby helping remove dirt, debris and transient microorganisms from hands. Plain soaps require friction (scrubbing) to mechanically remove microorganisms; antiseptic (antimicrobial) soaps kill or inhibit the growth of most microorganisms.

— Sterilants: Chemicals used to destroy all forms of microorganisms, including endospores. Most sterilants are also high-level disinfectants when used for a shorter period of time. Sterilants are used only on inanimate objects (e.g., surgical instruments) that are used in semicritical and critical areas (e.g., surgery). Sterilants are not meant to be used for cleaning environmental surfaces.

— Surfactant: Agent that reduces the surface tension of water or the tension at the interface between water and another liquid; a wetting agent found in many sterilants and disinfectants.

— Type of detergent: Commercial cleaning product (liquid or powder) they are composed of a hydrophilic (water-seeking) component and a lipophilic (fat-seeking) component and can be divided into four types: anionic, cationic, amphoteric and nonionic detergents.

How to select cleaning products:
Different types of cleaning products are available - liquid soaps and detergents, disinfectants, combinations (detergent and disinfectant) and sanitizers - and each type has different properties. An ideal cleaning product should accomplish the following:

- Suspension of fats (suspend fats in water)
- Specifications of fats (make fats water-soluble)
- Surfactation (decrease surface tension of water and allow greater penetration of the agent into the dirt or soil)
- Dispersion (break up of soil into small particles)
- Protein destruction (break up proteins)
- Softening the water (removal of calcium and magnesium)

When selecting a disinfectant or other cleaning product, consider the following factors:

- Intended use
- Efficacy
- Acceptability
- Safety
- Cost

In settings where resources are limited, it is important not to waste money on expensive cleaning products that are unnecessary. Where the volume of intended use is high, preparing cleaning solutions from bulk products should be considered. For smaller facilities, it may be necessary to purchase commercial products for use in cleaning high-risk areas, such as operating rooms, to ensure that cleaning meets the requirements for the area. What is important is that the decision as to what product(s) to buy or use is not left to chance. (Tietjen “et al”, 2003)

**Cleaning methods:**

In general, written schedules and procedures for cleaning in each specific area should be available and posted. Cleaning should start with the least soiled area and move to the most soiled area and from high to low surfaces.

**Common methods of cleaning are briefly described below:**

- Wet mopping: is the most common and preferred method to clean floors.
- Single-bucket (basin) technique: One bucket of cleaning solution is used. The solution must be changed when dirty. (The killing power of the cleaning product decreases with the increased load of soil and organic material present.)
- Double-bucket technique: Two different buckets are used, one containing a cleaning solution and the other containing rinse water. The mop is always rinsed and wrung out before it is dipped into the cleaning solution. The double-bucket technique extends the life of the cleaning
solution (fewer changes are required), saving both labor and material costs.

- Triple-bucket technique: The third bucket is used for wringing out the mop before rinsing, which extends the life of the rinse water.

- Flooding followed by wet vacuuming is recommended in the surgical suite, if possible. This process eliminates mopping, thus minimizing the spread of microorganisms. This method increases the contact time of disinfectants with the surface to be cleaned, but it is necessary to leave the floor wet for several minutes. (Flooding is best done at night or at times when foot traffic is minimal.)

- Dusting is most commonly used for cleaning walls, ceilings, doors, windows, furniture and other environmental surfaces.

- Clean clothes or mops are wet with cleaning solution contained in a basin or bucket. The double-bucket system minimizes the contamination of the cleaning solution.

- Dry dusting should be avoided and dust cloths and mops should never be shaken to avoid the spread of microorganisms.

- Dusting should be performed in a systematic way, using a starting point as a reference to ensure that all surfaces have been reached.

- When doing high dusting (ceiling tiles and walls), check for stains that may indicate possible leaks. (Leaks should be repaired as soon as possible because moist ceiling tiles provide a reservoir for fungal growth.)

- Dry vacuuming is only recommended for cleaning of carpets. (Tietjen “et al”, 2003)
Uses of personal protective equipments:
Lists the recommended PPE for use by housekeeping staff when performing the various tasks:

<table>
<thead>
<tr>
<th>TYPE OF PPE</th>
<th>WHEN USED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gloves (preferably household utility gloves)</td>
<td>Handling disinfectant cleaning solutions</td>
</tr>
<tr>
<td>Shoes that protect the feet from accidentally dropped items and blood and body fluids</td>
<td>Cleaning patient care areas</td>
</tr>
<tr>
<td>Plastic or rubber apron, mask and protective eyewear</td>
<td>Cleaning heavily contaminated areas</td>
</tr>
<tr>
<td></td>
<td>Handling soiled linen</td>
</tr>
<tr>
<td></td>
<td>Handling soiled items and instruments</td>
</tr>
<tr>
<td></td>
<td>Handling or disposing of waste</td>
</tr>
<tr>
<td></td>
<td>When spills or splashes are expected</td>
</tr>
</tbody>
</table>

Table (1.1)

Schedule and procedures for specific areas:
Housekeeping schedules should be planned, written and closely followed. Cleaning schedules should be developed according to the needs of each area.

- Walls, windows, ceilings and doors, including door handles: Spot clean 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.

- Chairs, lamps, tables, tabletops, beds, handrails, grab bars, lights, tops of doors and counters: Wipe daily and whenever visibly soiled with a damp cloth, containing disinfectant cleaning solution. A disinfectant should be used when contamination is present, such as for blood or other body fluid spills as described below.

- Non critical equipment (e.g., stethoscopes and blood pressure cuffs): Wipe daily and whenever visibly soiled with a damp cloth, detergent and water. If the equipment is visibly soiled with blood or other body fluids or the patient is under contact precautions, it should be cleaned and disinfected before it is reused.

- Floors: Clean floors frequently (daily and as needed) with a wet mop, detergent and water. A disinfectant should be used when
contamination is present, such as for blood or other body fluid spills as described below.

- Sinks: Scrub frequently (daily or more often as needed) with a separate mop, cloth or brush and a disinfectant cleaning solution. Rinse with water.
- Toilets and latrines: Scrub frequently (daily and more often as needed) with a separate mop, cloth or brush and a disinfectant cleaning solution.
- Patient rooms: Clean daily and after patient discharge, using the processes described above. The same cleaning process applies to rooms of patients who are under isolation precautions. Any cleaning equipment used in the rooms of patients under isolation precautions should be cleaned and disinfected before used in another room.
- Procedure rooms: Wipe horizontal surfaces, equipment and furniture used for the procedures with a disinfectant cleaning solution after each procedure and whenever visibly soiled. Clean blood or other body fluid spills as described below.
- Examination rooms: Wipe horizontal surfaces with a disinfectant cleaning solution after each procedure and whenever visibly soiled. Linen or paper on the examination table should be changed after each patient. Clean blood or other body fluid spills as described below.
- Laboratory: Wipe countertops with a disinfectant cleaning solution after each shift and whenever visibly soiled. Clean blood or other body fluid spills as described below.
- Curtains: Change and clean curtains according to the routine schedule and when visibly soiled.
- Carpets: Vacuum carpets daily in patient rooms or weekly in offices or conference rooms.
- Soiled linen: Collect soiled linen daily (or more often as needed) in closed, leak proof containers.
- Waste: Collect waste from all areas at least daily (or more frequently as needed). (Tietjen et al., 2003)

**Schedule and procedures for the operating room:**
At the beginning of each day, all flat (horizontal) surfaces (table, chairs, etc) should be wiped with a clean, lint-free moist cloth to remove dust and lint that may have collected overnight
- Total cleaning is not necessary between each case for surgical procedures.
- Total cleaning or terminal cleaning (mopping floors and scrubbing all surfaces from top to bottom) of the operating room should be done at the end of each day.

**Total Cleaning:**
Step one: Move covered decontamination buckets to the central supply or processing room. A clean bucket containing a fresh 0.5% chlorine solution, or other locally available and approved disinfectant, should be provided at the beginning of each day and after each case.
Step two: Remove covered contaminated waste container and replace it with a clean container. Arrange for burning (incineration) or burial as soon as possible.
Step three: Close and remove sharps containers when three quarters full.
Step four: Remove soiled linen in closed leak proof containers.
Step five: Soak a cloth in disinfectant cleaning solution and wipe down all surfaces, including counters, tabletops, sinks, lights, etc. Wash from top to bottom, so that any debris that 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.
- Chairs, lamps, sink 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 room table. Wipe with a 0.5% chlorine solution (or other approved disinfectant) to decontaminate. Then clean top, sides, base, legs and any accessories (e.g., leg stirrups) with a damp cloth and disinfectant cleaning solution.
− Floors. Clean with a wet mop using a disinfectant cleaning solution.
− Vents (heating or air conditioning). Wipe with a damp cloth, soap and water.

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

Spills: Clean spills with a 0.5% chlorine solution or other locally available and approved disinfectant (see below).
− Operating room bed: Wipe all surfaces and mattress pads with a disinfectant cleaning solution.
− Instrument tables (trolley and Mayo stand) and other flat surfaces: Wipe all flat surfaces that have come in immediate contact with a patient or body fluids with a disinfectant cleaning solution.
− Center of operating room surrounding the operating room bed. Mop with a disinfectant cleaning solution (if visibly soiled). Collect and remove all waste from the operating room in closed Leak proof containers.
− Sharps containers: Close and remove containers from the operating room when they are three quarters full.
− Containers with a 0.5% chlorine solution for decontamination. Remove covered containers with instruments from the operating room and replace them with clean containers with a fresh 0.5% chlorine solution.
− Soiled linen: Remove soiled linen in a leak proof, covered, waste containers.

**How to clean spills of blood and other body fluids:**

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

For small spills while wearing utility or examination gloves, remove visible material using a cloth soaked in a 0.5% chlorine solution, then wipe clean with a disinfectant cleaning solution.
- For large spills. While wearing gloves, flood the area with a 0.5% chlorine solution, mop up the solution and then clean as usual with detergent and water.

**How to clean soiled and contaminated cleaning equipments:**

Step one: Decontaminate cleaning equipment that has been contaminated with blood or body fluids by soaking it for 10 minutes in a 0.5% chlorine solution or other locally available and approved disinfectants.

Step two: Wash cleaning buckets, cloths, brushes and mops with detergent and water daily or sooner if visibly dirty.

Step three: Rinse in clean water.

Step four: Dry completely before reuse. (Wet cloths and mop heads are heavily contaminated with microorganisms.)

1.3.6.12 Waste management

**Background:**

Wastes from hospitals and healthcare facilities may be contaminated (Potentially infectious) or none contaminated. Approximately 85% of the general waste produced by hospitals and clinics is non contaminated waste and poses no infectious risk to persons who handle it. Examples of non contaminated waste include paper, trash, boxes, bottles, plastic containers and food. They can be disposed of by the usual methods or sent to the local landfill or dumpsite.

Some waste from healthcare facilities, however, is contaminated. If not disposed of properly, contaminated wastes may carry microorganisms that can infect the people who come in contact with the waste as well as the community at large. Contaminated wastes include blood, pus, urine, stool and other body fluids, as well as items that come in contact with them, such as used dressings. Wastes from operating rooms (human tissue, blood or blood soaked sponges, gauze or cotton) and laboratories (blood, feces, sputum, urine specimens and microbiological cultures) should be considered contaminated. Soiled medical devices or items that can inflict injury (e.g., used needles and scalpel blades) are capable of spreading blood borne diseases such as hepatitis B, hepatitis C and HIV, and are also considered contaminated waste.
Other types of waste that do not contain infectious agents, but are considered hazardous because of the potential harm they can cause to the environment include:

- Chemical and pharmaceutical residues (e.g., cans, bottles or boxes containing expired drugs and vaccines, laboratory reagents and disinfectants such as formaldehyde and glutaraldehydes, and organic solvents such as acetone and chloroform);
- Cytotoxic waste (e.g., drugs typically used in cancer chemotherapy);
- Waste with a high content of heavy metals (e.g., mercury from broken thermometers, blood pressure gauges or dentistry materials, and cadmium from discarded batteries); and
- Non recyclable and discarded pressurized containers (spray cans), that are hazardous if burned because they can explode. (Tietjen “et al”, 2003)

**Definitions:**

- Contaminated: State of having been actually or potentially in contact with microorganisms. As used in healthcare, the term generally refers to the presence of microorganisms that could be capable of producing disease or infection.
- Container: Vessel in which waste is placed for handling, transportation, storage and/or eventual disposal.
- Disposal: Intentional burial, deposit, discharge, dumping, placing or release of any waste material into or on air, land or water. Disposal is undertaken without the intention of retrieval.
- Encapsulation: Filling a sharps container that is three-quarters full with cement or clay, this, after hardening, can be disposed of safely in a landfill.
- Hazard: Intrinsic potential property or ability of any agent, equipment material or process that can cause harm.
- **Incineration**: Controlled burning of solid, liquid or gaseous combustible (burnable) wastes to produce gases and residues containing little or no burnable material.
- **Infectious waste**: The part of medical waste that is capable of causing infectious diseases.
- **Municipal waste**: General waste for collection by municipalities (e.g., local city or town authorities) generated mainly by households, commercial activities and street-sweeping.
- **Sanitary landfill**: Engineered method of disposing of solid waste on land in a manner that protects the environment (e.g., by spreading the waste in thin layers, compacting it to the smallest practical volume and then covering it with soil at the end of each working day).
- **Scavenging**: Manual sorting of solid waste at landfills and removal of usable material.
- **Segregation**: Systematic separation of solid waste into designated categories.
- **Sewerage**: System for the collection and transport of sewage, including conduits, pipes and pumping stations.
- **Sharps**: Hypodermic needles, suture needles, scalpel blades, scissors, wire sutures, broken glass or any object that can cause a puncture or cut.
- **Waste management**: All activities, administrative and operational (including transportation activities), involved in the handling, treatment, conditioning, storage and disposal of waste.

**The purpose of waste management is to:**
- Protect people who handle waste items from accidental injury,
- Prevent the spread of infection to healthcare workers who handle the waste,
- Prevent the spread of infection to the local community, and
- Safely dispose of hazardous materials (toxic chemicals and radioactive compounds).
Open piles of waste should be avoided because they:

- Are a risk to those who scavenge and unknowingly reuse contaminated items,
- Allow persons to accidentally step on sharp items and injure themselves,
- Produce foul odors, and
- Attract insects and animals.

**Disposal of Contaminated Waste:**

Proper disposal of contaminated waste may include:

- Pouring liquids or wet waste directly into a safe sewerage system.
- Incinerating (burning) items to destroy the item as well as any microorganisms. (This is the best method for disposal of contaminated waste. Burning also reduces the bulk volume of waste and ensures that the items are not scavenged and reused.
- Burying all contaminated wastes to prevent further handling.

Proper handling of contaminated waste minimizes the spread of infection to healthcare personnel and to the local community. Whenever possible, contaminated waste should be collected and transported to disposal sites in leak proof, covered waste containers.

- Use plastic or galvanized metal containers with tight-fitting covers for contaminated wastes. Many facilities now use colored plastic bags to alert handlers to the contents and to keep the general (none contaminated) waste separate from contaminated waste.

Use puncture-resistant sharps containers for all disposable sharps (sharps that will not be reused).

- Place waste containers close to where the waste is generated and where convenient for users (carrying waste from place to place increases the risk of infection for handlers). This is especially important for sharps, which carry the highest risk of injury for health workers and staff.
- Equipment that is used to hold and transport wastes must not be used for any other purpose in the clinic or hospital. (Contaminated waste containers should be marked as such.)
- Wash all waste containers with a disinfectant cleaning solution (0.5% chlorine solution plus soap) and rinse with water regularly.
- When possible, use separate containers for combustible and non-combustible wastes prior to disposal. This step 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.

Noncombustible (non-burnable) wastes include glass and metals.

Use personal protective equipment (PPE) when handling wastes (e.g., heavy-duty utility gloves and closed protective shoes).
- Wash hands or use a waterless, alcohol-based antiseptic hand rub after removing gloves when handling wastes.

Because most of the waste from healthcare facilities can be sent to a municipal landfill or dumpsite (the least expensive and easiest way to dispose of waste), it is important to train all healthcare workers, including physicians, to keep contaminated and non-contaminated waste separate. For example, throwing a hypodermic needle into a wastebasket in a patient’s room automatically makes that container hazardous for housekeeping staff to handle. And, if discovered, that wastebasket now needs to be handled and disposed of as contaminated waste.

**How to dispose sharps:**
Disposable sharp items (hypodermic needles, suture needles, razors and scalpel blades) require special handling because they are the items most likely to injure the healthcare workers who handle them as well as people in the community if these items go to the municipal landfill.

**Encapsulation**
Encapsulation is recommended as the easiest way to safely dispose of sharps. Sharps are collected in puncture-resistant and leak-proof containers. When the
container is three-quarters full, a material such as cement (mortar), plastic foam or clay is poured into the container until completely filled. After the material has hardened, the container is sealed and may be land filled, stored or buried. It is also possible to encapsulate chemical or pharmaceutical waste together with sharps (Tietjen Linda; Bossemeyer Débora; McIntosh Noel 2003).

**Disposal in the Procedure Area:**

Step one: Do not recap needles or disassemble needles and syringes.

Step two: After use, to decontaminate the assembled hypodermic needle and syringe, hold the needle tip under the surface of a 0.5% chlorine solution, fill the syringe with solution and push out (flush) three times (if the syringe and/or needle will be reprocessed, fill the syringe with 0.5% chlorine solution and soak for 10 minutes for decontamination).

Step three: Place assembled needles and syringes to be disposed of in a puncture-resistant sharps container such as a heavy cardboard box, plastic bottle or tin can with lid. The opening in the lid should be large enough that items can be easily dropped through it, but small enough that nothing can be removed from inside. (Old intravenous fluid bottles may also be used, but they can break.)

Step four: When the container is three-quarters full, it should be removed from the procedure area for disposal.

**Disposing of the Sharps Container:**

Step one: Wear heavy-duty utility gloves.

Step two: When the sharps container is three-quarters full it should be capped, plugged or taped tightly closed. Be sure that no sharp items are sticking out of

Step three: Dispose of the sharps container by burning, encapsulating or burying.

Step four: Remove utility gloves (wash daily or when visibly soiled, and dry).

Step five: Wash hands and dry them with a clean cloth or towel or air dry. (Alternatively, if hands are not visibly soiled, apply 5mL, about 1 teaspoonful, of an antiseptic hand rub and rub the solution vigorously into hands until dry.)
How to dispose liquid contaminated waste:
Liquid contaminated waste (e.g., human tissue, blood, feces, urine and other body fluids) requires special handling, because it may pose an infectious risk to healthcare workers who contact or handle the waste.

Step one: Wear PPE (utility gloves, protective eyewear and plastic apron)
Step two: Carefully pour wastes down a utility sink drain or into a flushable toilet and rinse the toilet or sink carefully and thoroughly with water to remove residual wastes. Avoid splashing.
Step three: If a sewage system doesn’t exist, dispose of liquids in a deep, covered hole, not into open drains.
Step four: Decontaminate specimen containers by placing them in a 0.5% chlorine solution for 10 minutes before washing them.
Step five: Remove utility gloves (wash daily or when visibly soiled and dry).
Step six: Wash and dry hands or use an antiseptic hand rub as described above.

Cholera epidemic in case of a cholera epidemic, hospital sewage must also be treated and disinfected. Vibro cholerae, the causative agent of cholera, is easily killed and does not require use of strong disinfectants. Buckets containing stools from patients with acute diarrhea may be disinfected by the addition of chlorine oxide powder or dehydrated lime oxide.

How to dispose solid contaminated wastes:
Solid contaminated waste (e.g., surgical specimens, used dressings and other items contaminated with blood and organic materials) may carry microorganisms.

Step one: Wear heavy-duty or utility gloves when handling and transporting solid wastes.
Step two: Dispose of solid wastes by placing them in a plastic or galvanized metal container with a tight-fitting cover.
Step three: Collect the waste containers on a regular basis and transport the burnable ones to the incinerator or area for burning.
Step four: Remove utility gloves (wash daily or when visibly soiled and dry).
Step five: Wash and dry hands or use an antiseptic hand rub as described above.

**Incineration:**
Incineration is a high-temperature process that reduces the volume and weight of waste. This process is usually selected to treat waste that cannot be recycled, reused or disposed of in a sanitary landfill or dumpsite.

**Types of Incinerators:**
Incinerators can range from extremely sophisticated, high-temperature ones to very basic units that operate at much lower temperatures. All types of incinerators, if operated properly, eliminate microorganisms from waste and reduce the waste to ashes.

**Four basic types of incinerators are used for treating waste:**
- Double-chamber, high-temperature incinerators are designed to burn infectious waste.
- Single-chamber, high-temperature incinerators are less expensive and are used when double-chamber incinerators are not affordable.
- Rotary kilns operate at high temperatures and are used for destroying cytotoxic substances and heat-resistant chemicals.
- Drum or brick (clay) incinerators operate at lower temperatures and are less effective, but can be made locally using readily available materials.

**Types of Waste That Should Not Be Incinerated:**
- Pressurized gas containers (aerosol cans)
- Large amounts of reactive chemical waste
- Silver salts and photographic or radiographic wastes
- Plastic containing polyvinyl chloride (blood bags, IV tubing or disposable syringes)
- Waste with high mercury or cadmium content, such as broken thermometers, used batteries and lead-lined wooden panels

**Open burning:** is not recommended because it is dangerous, unsightly and the wind will scatter the waste. If open burning must be done, burn in a small,
designated area, transport waste to the site just before burning and remain with the fire until it is out.

For healthcare facilities with limited resources and where high-temperature incinerators are not affordable, waste may be incinerated in a drum incinerator. A drum incinerator is the simplest form of single-chamber incinerator. It can be made inexpensively and is better than open burning. (Tietjen “et al”, 2003)

**1.3.6.13 Infection prevention practices applicable to multiple setting:**

In both ambulatory surgical and inpatient settings, the same major infection prevention concerns must be addressed and goals must be met: to protect the patients, HCWs, visitors, and others in the health-care environment and to deliver services in a timely, efficient, and cost-effective manner. Aseptic practices such as opening and setting up rooms and sterile fields, scrubbing, gowning, gloving, prepping the patient’s skin, wearing proper attire (depending on the procedure and its risks), and using SP should be faithfully followed and role modeled throughout the facility. Patient care during invasive procedures whether they occur in an ambulatory surgery facility or physician’s office; in an endoscopy and G-I, cardiac catheterization, or interventional radiology laboratory, should be based on the principles of aseptic technique delineated in related association guidelines current articles, national accreditation standards, and state regulations. (Tietjen Linda; Bossemeyer Débora; McIntosh Noel 2003).

**Ambulatory Surgery Centers**

The risk of nosocomial infection has been thought to be minimal in ambulatory surgical settings because of the short stay in the facility, the short duration of anesthesia, the “minor” nature of the surgical procedures, and the general good health of the patient. However, surgical site infections (SSIs) remain an important cause of morbidity, mortality, and excess hospital costs during the postoperative period when patients must be admitted to an acute care facility for treatment of SSIs. As the shift toward more ambulatory surgery continues and more procedures are performed on an out-patient basis, verification will be needed that high-quality services are being provided in same-day
surgery centers.
Although SSIs can develop from postoperative wound contamination, most infections result from introduction of bacteria into the wound during surgery. For this reason, the ambulatory surgical environment should adhere to and maintain standards similar to those promoted for inpatient ORs. The designated infection control practitioner and the surgical staff must ensure that the OR is safe and the principles of asepsis are maintained.
Ventilation requirements are similar to those needed in hospital surgical settings.
Traffic patterns should be planned that allow for even flow of traffic from the unrestricted area to semirestricted and restricted areas where special attire is required and surgical procedures are performed. The OR must be separate and segregated from the general office area (e.g., waiting rooms, examination rooms, physician offices, and staff lounge).
The following guidelines are based on accreditation standards for the ambulatory surgical setting:
Use of a steam autoclave is preferred where all instruments must be sterilized. Alternative methods can be chemical autoclave or gas (ethylene oxide [EtO]). Gas sterilizers must be vented, if appropriate for the specific sterilizer. High-level disinfection is used only for nonautoclavable equipment such as certain endoscopes.
A sterile field is routinely used and aseptic technique is maintained during and between procedures.
Proper scrub facilities are provided. If there is a sink in the OR proper, there must be a written policy to prevent its use for surgical scrubbing, during surgery, or to clean dirty instruments after surgery. The sink must be removed when remodeling is done. If there is one sink used both to clean dirty instruments and to scrub for surgery, there must be a written policy to clean and disinfect the sink prior to scrubbing.
Appropriate attire, consisting of scrub suit, cap or hair cover, gloves, operative gown, mask, and eye protection, is worn.
Maintenance and cleaning of the operating room should be done routinely, using appropriate germicides and a written protocol.

Patient screening should be done to identify patient risk factors such as hypertension, heart disease, obesity, and alcohol and drug use. A careful assessment can minimize unanticipated complications. The Accreditation Association of Ambulatory Health Care (AAAHC) notes that an appropriate and current history, including a list of current medications and dosages; a physical examination; and pertinent preoperative diagnostic studies should be incorporated into the patient’s medical record before surgery. Information gained during admission can reveal infection-related problems such as an elevated temperature. A chest x-ray could reveal asymptomatic TB or pneumonia.

Postoperative teaching should include the proper care of the incisional area, identification of possible signs of infection, procedures for home wound care, and appropriate communication lines should complications occur.

Employee health issues must be addressed in the ambulatory surgical setting. It cannot be assumed that a HCW in an ambulatory facility is at a lower risk of acquiring occupational, injury or disease than a HCW at an inpatient facility. Same-day surgery units should have a well-designed plan to safeguard employee health and safety. Accreditation criteria for ambulatory surgical settings include quality of care and quality improvement, which are necessary for maintaining a continuing emphasis on infection prevention. Required area designated infection control person and infection control processes. Often, in nonacute care organizations staffing numbers are insufficient to support a full-time infection control practitioner. Staff members may perform double duty as the head of an infection control program and as surgical staff, making it difficult to maintain surveillance, prevention, and control activities. Perhaps the most difficult infection control issue for ambulatory surgery is that of collecting data on surgical wound infections. Such confounding factors as surgeons’ nonvoluntary reporting of SSIs, patients’ inability to ascertain the nature of a wound infection, and the problem of many patients returning to their primary care physician rather than their surgeon make consistent and accurate reporting difficult. It is
critical that innovative and collaborative ways of detecting and reporting SSIs be implemented in ambulatory care facilities.

**Physicians’ Office-Based Surgery**

As practiced in office settings, infection prevention standards may vary from strict aseptic technique to a very low level of care where practically no sterile technique is practiced. Accreditation standards and recommended practices for environmental cleaning, sterilization, use of sterile technique, Universal Precautions (UP) and SP, attire, and waste management used in ambulatory surgical settings can and should be, followed for office-based surgery.

**The following infection control recommendations apply to office based surgery:**

- Building codes for licensed office-based ORs require that the ceiling be smooth and washable. Acoustic ceiling tile is not acceptable. Tile flooring must be sealed. Surfaces must be cleaned and disinfected on a predetermined schedule and whenever necessitated by exposure to contamination. There should be a minimum of one adequately sized OR that is used exclusively for surgery. A general treatment room is not adequate.
- Any opening to the outer air must be adequately controlled to prevent the entrance of insects. Adequate lighting, ventilation, and temperature must be provided and controlled.
- All premises must be kept neat and clean, and a cleaning schedule must be maintained that is adequate to prevent cross-contamination.
- Adequate space, equipment, and personnel must be provided for aseptic treatment and prevention of cross-contamination among patients.
- Hand care should include scrubbing of hands and wearing of gloves. Masks should be worn to protect the patient, surgeon, and surgical staff. Patients should not be exposed to spray from the mouths of surgical personnel; personnel should not be unnecessarily exposed to patients’ saliva droplets, which could contain viruses such as hepatitis B virus (HBV) and human immunodeficiency virus (HIV). Also, dermabrasion,
electrosurgery, and laser procedures can produce aerosols and droplets that can be inhaled without the protection of a mask. During dermabrasion, a cover gown is essential to protect personnel from the spray of skin squames.

- Surgical drapes should be used to isolate the surgical area following standard skin preparation. The drape should provide barrier and moisture protection though it may not cover the patient completely.
- Lasers may be used in a sterile surgical field. A sterile sleeve drape can cover the wand so that it can be handled by the surgeon without contaminating the sterile field. Photographs may be taken during the surgical procedure. This can be done without breaking sterile technique by having an assistant use a long focal lens to take close-up photos while standing away from the sterile field.

The American College of Surgeons recommends the following additional infection-control-related guidelines for office-based surgeries, including both major and minor procedures:

- Using an operative suite that includes separate areas for surgical instrumentation preparation and sterilization, and another for preparation and cleaning of used instruments and reusable materials.
- Having acceptable standards of cleanliness and sterility, and adequate sterilization of OR materials.
- Training all surgical personnel in basic aseptic techniques, isolation precautions, and the wearing of suitable surgical attire such as scrub suits, caps, masks, gowns, shoe coverings, and protective eye wear.
- Employing procedures to minimize the sources and cross transmission of infections, including adequate surveillance techniques.
- Using disposable items that are processed according to standard Occupational Safety and Health Administration (OSHA) regulations.
- Having a system for the proper identification, management, handling, transport, treatment, and disposition of hazardous materials and wastes, whether solid, liquid, or gas.
- Advising patients of continuity of care provided after surgery (e.g., discharge instructions).
- Adopting a quality assurance program that includes records of complications such as infections and resultant outcomes.

**Endoscopy and Gastrointestinal Laboratories**

Infections related to endoscopic procedures are caused by both endogenous and exogenous microbes. Infections caused by *endogenous* microbes develop when the microflora colonizing the mucosal surfaces of the G-I or respiratory tract gain access to the blood stream or other normally sterile body sites as a consequence of the procedure. Endoscopy related *exogenous* infections are caused by introduction of microbes transferred from patient to patient or from staff to patient by the endoscope or bronchoscope. The microorganisms may be gram-negative bacilli, mycobacteria fungi, parasites, or viruses. Examples of endogenous infections include cholangitis after the manipulation of an obstructed biliary tract and pneumonia resulting from aspiration of oral secretions in a sedated patient.

Ventilation requirements in endoscopy and G-I labs vary from those in other areas of the hospital or ambulatory surgical center. In the endoscopy and G-I departments, air movement from adjacent areas should be into the rooms with a minimum of 2 *air* exchanges of outside air per hour and a minimum of 6 total air exchanges per hour. There should be no recirculation of air by room units. In a bronchoscopy room, air movement should be into the room from outside areas with a minimum of 2 air exchanges of outside air per hour and a minimum of 12 total air exchanges per hour. Air should not be recirculated by room units. Air ventilation should conform to the latest Center for Disease Control and Prevention (CDC) guidelines for preventing the transmission of TB in healthcare facilities. Space used for cleaning and disinfection or sterilization should have adequate ventilation to exhaust toxic vapors and airborne pathogens. If large volumes of glutaraldehyde in basins are used, covers with tight-fitting lids should be used. Consideration should be given to the installation of an exhaust hood,
or ductless fume hood, with absorbents for the vapor and air systems that provide 7 to 15 air exchanges per hour.

Space considerations should include patient volume, traffic flow, and the types of endoscopic procedures (e.g., bronchoscopy, G-I endoscopy) performed. Space for the performance of procedures should be separate from the space used for cleaning and disinfection or sterilization of equipment. There should be designated sinks for hand washing and separate sinks for cleaning endoscopes. There must be adequate space for the storage of chemicals and sterilants, some of which have special handling requirements as hazardous materials. The areas should be designed so that the workflow can facilitate sound infection control practices (e.g., avoiding the co-mingling of contaminated with clean equipment. Storage cabinets or closets used for drying and storing clean endoscopes and accessories should be constructed of materials that can be easily cleaned. Endoscopes must not be stored in foam-lined cases because foam lining is impossible to clean should it become contaminated. Endoscopes should be stored in a manner that will protect the endoscope and minimize the potential for residual moisture accumulation. Cleaning and high-level disinfection (HLD) or sterilization of endoscopes and endoscopic accessories is a major infection prevention focus for the staff in any department or office where endoscopy is performed. Instruments that penetrate mucosal barriers, such as biopsy forceps, are considered critical items and must be sterilized before use. Cleaning and disinfection of the water bottle and connecting tubing may be difficult because these are often colonized with *Pseudomonas* spp. Both should be sterilized or receive HLD at least once daily. Sterile water is used to fill the bottle for endoscopic irrigation. One study showed no difference in infection rates when comparing the use of tap water with the use of sterile water for irrigation. Similar bacterial isolates were found in both tap and sterile water, and no measurable effect on clinical outcomes was found.

Procedure stretchers, x-ray tables and other noncritical equipment should be wiped down between uses with an Environmental Protection Agency (EPA) approved disinfectant.
The cleanup of splashes and spills of radiological contrast material, blood, or blood-contaminated body fluids should be done with EPA-approved disinfectants.

Endoscopic attachments (e.g., teaching heads, video attachments) should also be decontaminated. The effectiveness of all cleaning methods should be validated. Routine or frequent culturing of endoscopes is not recommended. However, the following infection control measures are advocated:

Maintaining a log for all endoscopic retrograde cholangiopancreatographies (ERCPs) (e.g., instrument used, date, and patient name).

Taking periodic, unscheduled cultures of endoscopes and related equipment, designating an individual to be responsible for seeing that national and manufacturers’ guidelines for cleaning and disinfection are complied with.

OSHRs Blood borne Pathogen Standard is followed to protect personnel from potentially infectious materials while cleaning and disinfecting equipment during and following procedures. The standard states that all surgical facilities should do the following:

**Develop an exposure control plan:**

Train all employees on occupational risks and methods to reduce risk of exposure to blood borne pathogens and hazardous chemicals. Label all chemicals. Employee training must include an explanation of the Hazard Communication Standard and identification of the hazards and their health effects. Employees must also know the location of the written hazard communication program and material safety data sheets (MSDSs). Employees should be instructed on safe work practices, how to detect and measure contaminants, the use of appropriate personnel protective gear, and be given an explanation of the labeling system. Employees should be aware of the hazards associated with the materials used and how to manage any spills that may occur.

Maintain records of employees’ training and medical evaluations.
Protect employees by implementing safe handling of sharp objects, specimens, contaminated laundry, and waste. In addition, all surgical facility personnel should do the following:

Perform thorough hand washing before, during, and after endoscopic procedures, even if gloves are worn. Use personal protective clothing and equipment. This includes the use of impervious gowns, gloves, masks, and eye protection. During cleaning of the endoscopes, wear gloves that are resistant to chemicals. Understand the risk of infection from Mycobacterium tuberculosis, HBV, HIV, herpes simplex, and enteric pathogens. Understand that the patient’s infectious status may be unknown at the time of the procedure. Hepatitis B vaccine must be made available to employees at no cost.

**Cardiac Catheterization Laboratories**

The availability of literature describing the frequency, prevention, and outcome of infections associated with cardiac catheterization is limited. This makes it difficult to direct infection control recommendations at specific techniques used in the cardiac catheterization laboratory. However, infection control guidelines related to the insertion, use, and maintenance of any central vascular device apply. These devices give direct access of microorganisms to the blood stream. It is critical that all precautions and guidelines for the prevention of SSIs be followed. These guidelines are similar to those suggested for procedures in other ambulatory surgical areas. Specific guidelines for the cardiac catheterization laboratory are as follows:

- Air movement should be out of the cardiac catheterization room to adjacent areas. There should be a minimum of 3 outside air exchanges per hour and a minimum of 15 total air exchanges per hour.
- Sterile equipment and solutions should be opened immediately before use in the room where they will be used. (Tietjen “et al”, 2003).

**1.3.6.14 Employee Health**

Surgical personnel are at risk for occupational exposure to many bloodborne diseases such as hepatitis B and C (HBV and HCV) and human
immunodeficiency virus (HIV). Exposure to tuberculosis (TB) is a possibility as well, as is exposure to other communicable diseases such as pertussis, varicella, rubella, and influenza. Ill personnel put their co-workers and patients at risk by coming to work with communicable diseases.

Following the basics of infection prevention and immunizations guidelines, using safe practices that protect the patient and the healthcare worker (HCW) by avoiding exposure and preventing risk to patients and self, is critical and cannot be overlooked or considered less important than other aspects of patient care. Following prevent ion guidelines is first and foremost an individual responsibility.

**Responsibilities:**

**Employer**

Responsibilities of the employer should include providing training programs that educate personnel about the principles of infection control and stressing individual responsibility for infection control, collaborating with the infection control department in monitoring and investigating potentially harmful infectious exposures and out- breaks among personnel, educating personnel about appropriate preventive measures for work-related illnesses and exposures, and containing costs by preventing infectious diseases that result in absenteeism and disability.

Employers must stay current with ever-changing regulations that set policy and protect employees (e.g., employers must follow the Occupational Safety and Health Administration’s [OSHA’s] recent compliance directives that emphasize the use of safer devices to prevent needle stick injuries and must provide hepatitis B vaccination at no cost to all HCWs. Specific policies should prevent HCWs from infecting patients and other HCWs and should cover management of job-related illness and exclusion of ill personnel from work and post-exposure prophylaxis when contact does occur. Policies should encourage personnel to report illnesses and exposures without fear of loss of wages, benefits) or job status.
Healthcare Workers

HCWs who give direct patient care should be familiar with agency policies intended to protect them. Responsibilities should include protecting themselves and others from infection by frequent hand-washing, keeping current on immunizations, and knowing how transmission can be prevented. HCWs should also be familiar with the latest information and agency policies regarding reporting of exposures and necessary follow-up care.

Immunizations:

Because of contact with patients or infective material from patients, HCWs are at risk for exposure to and possible transmission of vaccine-preventable diseases. Maintenance of immunity is an essential part of infection prevention and control programs. Consistent immunization programs could substantially reduce the number of susceptible HCWs and the accompanying risks for transmission of vaccine-preventable diseases in hospitals, physicians’ offices, nursing homes, schools, ambulatory care centers, and laboratories. All employees should be screened by way of history and/or serologic testing to document their immune status to diphtheria/tetanus, HBV (required by OSHA), rubeola, mumps, rubella, and varicella. Varicella immunization should be considered if the worker is nonimmune.

Vaccine Recommendations

The following vaccines are strongly recommended and should be offered to all HCWs:

Hepatitis B

Dose: 2 X 1 ml IM (deltoid) 4 weeks apart; third dose 5 months after second. Not contraindicated during pregnancy. Employers are required to make hepatitis B vaccine available to HCWs at no cost (22, p. 37). All personnel should be strongly encouraged to receive the hepatitis B vaccine because HBV presents the greatest risk of occupational disease. The risk for acquiring HBV from occupational exposures is dependent on the frequency of percutaneous and permucosal exposures to blood or body fluids containing blood. It should be noted this immunization does not protect against HCV.
**Influenza**
Dose: 0.5 ml IM (deltoid), annual single dose. Not contraindicated during pregnancy.
There is no evidence of maternal or fetal risk when this vaccine has been given to pregnant women with underlying conditions that render them at high risk for serious influenza complications. Admitting patients infected with influenza to hospitals has led to nosocomial transmission of the disease, including transmission from staff to other patients. Influenza vaccine is strongly recommended for HCWs and others in close contact with persons in high-risk groups.

**Rubella (German measles)**
Dose: 0.5 ml SC. Contraindicated during pregnancy and within 3 months of planned pregnancy. NOTE: HCWs should have documented evidence of having received live vaccine on or after their first birthday, or laboratory evidence of immunity.
Nosocomial rubella outbreaks involving both HCWs and patients have been reported. Although vaccination has decreased the overall risk for rubella transmission in all age groups in the United States by approximately 95%, the potential for transmission in hospitals and similar settings persists.

**Rubeola (measles)**
Dose: 0.5 ml SC; booster: 0.5 ml SC no less than 1 month after primary dose. Contraindicated during pregnancy.
All medical personnel beginning employment should have documentation of receipt of two doses of measles vaccine after their first birthday, or other evidence (e.g., physician diagnosed measles or serologic evidence of immunity). If no documentation exists, the vaccine should be given. The risk for measles infection in medical personnel is estimated to be thirteen times that of the general population.

**Mumps**
Dose: 0.05 ml SC. Contraindicated during pregnancy. Mumps transmission in medical settings has been reported nationwide. NOTE: If measles or rubella...
immunity is in question, it is best to give measles/mumps/rubella (MMR) vaccine.

**Varicella (chickenpox)**

Dose: First dose 0.5 ml SC; second dose 4 to 8 weeks after first dose, if age 1 3 years or older. Contraindicated during pregnancy.

Vaccination of susceptible HCWs is recommended. If seronegative and exposed, they can be furloughed. Sources of nosocomial transmission of varicella zoster virus have included patients, hospital staff, and visitors.

**Immunocompromised Healthcare Workers**

The degree of risk for developing infection in immunocompromised HCWs should be assessed by a physician who should consider the risk for exposure to a vaccine-preventable disease together with the risks and benefits of vaccination.

**1.3.6.15 POSTEXPOSURE RECOMMENDATIONS**

Infection control sources should be consulted and policies developed to assess exposures, evaluate risk of transmission, and implement steps to prevent further outbreaks.

Post-exposure work restrictions ranging from restriction of contact with high-risk patients to complete exclusion from duty are appropriate for HCWs who are not immune to certain vaccine-preventable diseases.

**Work exclusion recommendations:**

The following list provides work exclusion recommendations for ill HCWs. Illnesses not listed require that judgment and common sense be used so that patient and co-worker health is not compromised. Taking precautions and following work exclusion recommendations will protect patients as well as other HCWs.

Acute infection: HCWs with acute infections such as the flu, a , sore throat, or the common cold should not be permitted within patient care areas.

Skin conditions: Persons with cuts, burns, rashes, or skin lesions should not be assigned as a scrub person or handle sterile supplies (circulating nurse) because serum may seep from the open wound. Open skin lesions may
be portals of entry for contact with bloodborne pathogens. Agents used for hand washing or scrubbing that are chemical or physical irritants can exacerbate skin conditions. Persons with chronic skin conditions should seek medical care and take measures to prevent future outbreaks.

**Conjunctivitis:** Patient contact, as well as contact with patient environment, should be restricted until eye discharge ceases.

**Diarrheal disease:** Acute illness: patient contact should be restricted, as well as contact with patient environment and food handling until symptoms resolve.

Convalescent stage

**Salmonella:** HCWs should be restricted from care of high-risk patients. Local and state health authorities should be consulted regarding the need for negative stool cultures.

**Diphtheria:** HCWs should be excluded from duty until antimicrobial therapy is completed and two cultures taken 24 hours apart are negative.

**Enteroviral infections:** HCWs should be restricted from care of infants, neonates, and immunocompromised patients and their environments until symptoms resolve.

**Hepatitis A:** HCWs should be restricted from patient contact, as well as contact with patient environment and food handling, until 7 days following the onset of jaundice.

**Hepatitis B:** Depending on state regulations, there are no restrictions for persons who do not perform exposure-prone procedures (e.g., those during which reasonable anticipated skin, eye, mucous membrane, or parenteral contact with blood can occur). Infected persons should be restricted from performing exposure-prone procedures until hepatitis B antigen is negative.

**Hepatitis C:** No recommendation for restricting professional activities of HCWs infected with HCV. Those who are HCV positive should follow strict aseptic technique and Standard Precautions (SP), including appropriate use of handwashing and protective barriers and care in the use and disposal of needles and other sharp instruments.

**Herpes simplex:** Genital herpes: no restriction.
**Hand lesions:** HCWs should be restricted from patient contact and contact with patient environment until lesions heal.

**Rubeola:** HCWs with active disease should be excluded from duty until 7 days after the rash appears. Exposed HCWs should be excluded from work from day 5 after the first exposure through day 21 after last exposure, or 4 days after the rash appears.

**Meningococcal infections:** HCWs should be excluded from duty until 24 hours after start of effective therapy.

**Mumps:** HCWs with active disease should be excluded from duty until 9 days after onset of parotitis. HCWs that have been exposed should be excluded from duty from day 12 after first exposure through day 26 after last exposure, or until 9 days after onset of parotitis.

**Pertussis (whooping cough):** HCWs with active disease should be excluded from duty from beginning of catarrhal stage through third week after onset of paroxysms, or until 5 days after start of effective antimicrobial therapy. Symptomatic personnel should be excluded from duty until 5 days after start of effective antimicrobial therapy. No restriction for asymptomatic exposed HCWs. Prophylaxis is recommended.

**Rubella:** HCWs with active disease should be excluded from duty until 5 days after rash appears. Susceptible personnel who have been exposed should be excluded from duty from day 7 after first exposure through day 21 after last exposure.

**Tuberculosis:** HCWs with active pulmonary disease should be excluded from duty until proven noninfectious. Purified protein derivative (PPD) converter: no restriction.

**Varicella (chickenpox):** HCWs should be excluded from duty until all lesions are dry and crusted. Susceptible HCWs who have been exposed should be excluded from duty from day 10 after first exposure through day 21 (day 28 if varicella zoster immune globulin (VZIG) given) after last exposure.

**Shingles:** Healthy HCWs with localized lesions should be restricted from care of high risk patients (e.g., neonates, the elderly, and those who are
immunocompromised) until all lesions are dry and crusted. Susceptible HCWs who have been exposed should be restricted from patient contact from day 10 after first exposure through day 21 after last exposure (day 28 if VZ1G is given) or, if varicella occurs, until all lesions are dry and crusted.

**Viral respiratory infections acute, febrile:** HCWs should be screened for possible exclusion from the care of patients and contact with their environment if patients are at high risk for complications of influenza during community outbreak of respiratory syncytial virus and influenza.

**Staphylococcus aureus:** Factors related to S. aureus or methicillin-resistant S. aureus (MRSA) carriage and transmission are similar. The following recommendations relate to both. HCWs with active, draining lesions should be restricted from contact with patients and their environment or food handling until lesions have resolved. Carrier state: no restriction unless personnel are epidemiologically linked to transmission of the organism. MRSA-carrier personnel who are epidemiologically linked to transmission should be removed from direct patient care until treatment of the carrier is successful. HCWs are known to have a higher S. aureus carriage rate (50% to 90%) than the general population. S. aureus from the anterior nares can be transferred to skin and other body areas. Given a portal of entry (e.g., trauma to the skin or a surgical incision), S. aureus can cause infection. Eradication of nasal S. aureus carriage by the application of mupirocin often leads to elimination of the organism from other colonized body sites. However, nosocomial outbreaks have rarely been traced to a “shredder.” S. aureus strains that cause infection are transmitted from patient to patient from the hands of HCWs. The main mode of transmission of MRSA is via the hands, especially the hands of HCWs. Contamination can occur from colonized or infected patients; infected body sites of the personnel themselves; or by devices, items, or environmental surfaces contaminated with body fluids containing MRSA. Following SP should control the spread of MRSA in most instances. Culturing of personnel who are S. aureus carriers should not be undertaken unless an epidemiologic investigation and organism typing indicate that cross-transmission is occurring and that staff may be an important
reservoir. The nasal application of mupirocin to eradicate nasal carriage of S. aureus has been used to reduce the chances that the organism will spread from one individual to another. Resistance development to the drug was not observed among S. aureus isolates when a single 5-day course of mupirocin was used.

**Exposures to blood and other infectious substances:**

It has been estimated that 600,000 to 800,000 needle stick and percutaneous injuries occur annually. About half of these injuries go unreported. Some of these injuries expose workers to bloodborne pathogens that can cause infection.

**Procedure for Immediate Exposure**

Immediately following an exposure to blood:
- Needle sticks and cuts should be washed with soap and water.
- Splashes to the nose, mouth, or skin should be flushed with water.
- Eyes should be irrigated with clean water, saline, or sterile solution.
- Exposures should be reported promptly because post-exposure treatment may be recommended and, if so, should be started as soon as possible.

**The following are not recommended after exposure to blood:**
- The use of antiseptics and the squeezing of wounds, which have not been scientifically proven to reduce the risk of transmission of bloodborne pathogens.
- The use of a caustic agent such as bleach.

**Post-Exposure Follow-up for Needle sticks and Other Percutaneous Incidents:**

Any exposure incident should be reported immediately after exposure and management should be conducted by a licensed healthcare professional as soon as possible. Employers are required to document at a minimum the route of exposure and the circumstances under which the exposure incident occurred. Further documentation surrounding the incident allows identification and correction of hazards. It is helpful to document the following information:
- Engineering controls in use at the time
- Work practices followed at the time
- A description of the device
- A listing of protective equipment or clothing that was used at the time of the exposure incident
- Location of incident
- Procedure being performed
- The employee’s training.

**Post exposure prophylaxis:**
Most exposures do not result in infection. The risk of infection varies with the pathogen involved, the type of exposure, the amount of blood involved in the exposure, and the amount of virus in the patient’s blood at the time of exposure. The degree of risk also depends on the immune status of the worker, the severity of the exposure, and the availability and use of appropriate post-exposure prophylaxis (PEP).

**Human Immunodeficiency Virus**
PEP for exposure to HIV is recommended under certain circumstances. However, the drugs used for HIV post-exposure have many adverse side effects. Currently no vaccine exists to prevent HIV infection and no treatment exists to cure it. HIV PEP recommendations are determined by analysis of the type of exposure and the virulence of the exposure source. Post-exposure treatment should begin as soon as possible after exposure, preferably within 2 hours. Starting treatment 1 to 2 weeks after exposure may be considered if the exposure was significant.

The Public Health Service recommends a 4-week course of two drugs, zidovudine and lamivudine, for most HIV exposures, or zidovudine and lamivudine plus a protease inhibitor, indinavir or nelfinavir, for exposures that may pose a greater risk for transmitting HIV (such as those involving a larger volume of blood or a concern about drug-resistant HIV). Differences in side effects associated with the use of these two drugs may influence which is selected in a specific situation. Side effects include nausea, vomiting, diarrhea,
tiredness, and headache. Determining which drugs and how many drugs to use or when to change a treatment regimen is largely a matter of judgment.

**Hepatitis B Virus**

HBV rate of transmission to susceptible HCWs ranges from 6% to 30% after a single needlestick exposure to an HBV-infected patient. HCWs who have antibodies to HBV, either from vaccination or prior infection, are not at risk. If a susceptible worker is exposed to HBV, PEP with hepatitis B immune globulin and initiation of hepatitis B vaccine is more than 90% effective in preventing HBV infection. Administration of preexposure vaccination or PEP to workers can dramatically reduce this risk. Recommendations vary depending on the immune status of the HCW and the infectious status of the source patient.

**Hepatitis C Virus**

Currently, there is no recommended post-exposure treatment that will prevent HCV infection. Baseline antibody and liver enzyme tests should be done as soon as possible and again at 4 to 6 months after the exposure. Another test, hepatitis C virus ribonucleic acid (HCV RNA), may be recommended 4 to 6 weeks following exposure. (Tietjen “et al”, 2003).
1.3.7 PREVENTING SURGICAL SITE INFECTIONS

1.3.7.1 BACKGROUND

Since skin is normally colonized by a range of microorganisms that could cause infection, defining an SSI requires evidence of clinical signs and symptoms of infection rather than microbiological evidence alone. SSIs frequently only affect the superficial tissues, but some more serious infections affect the deeper tissues or other parts of the body manipulated during the procedure. The majority of SSIs become apparent within 30 days of an operative procedure and most often between the 5th and 10th postoperative days. However, where a prosthetic implant is used, SSIs affecting the deeper tissues may occur several months after the operation.

To reduce the risk of nosocomial SSIs in developing countries, a systematic but realistic approach must be applied with awareness that this risk is influenced by characteristics of the patient, the operation, the healthcare staff and the hospital. In theory, reducing risk is relatively simple and inexpensive, especially when compared to the cost of the infections themselves, but in practice it requires commitment at all levels of the healthcare system. And, as noted neither the basic problems responsible for the high nosocomial rates (i.e., lack of training, supervision, infrastructure and resources) nor the recommended solutions have changed over the past 10–20 years in most developing countries.

Infections that occur in the wound created by an invasive surgical procedure are generally referred to as surgical site infections (SSIs). SSIs are one of the most important causes of healthcare-associated infections (HCAIs). A prevalence survey undertaken in 2006 suggested that approximately 8% of patients in hospital in the UK have an HCAI. SSIs accounted for 14% of these infections and nearly 5% of patients who had undergone a surgical procedure were found to have developed an SSI.1 However, prevalence studies tend to underestimate SSI because many of these infections occur after the patient has been discharged from hospital. (SSI prevention and treatment 2008)
1.3.7.2 The CDC definition describes three levels of SSI:
Organ/Space SSI: any part of the body other than the incised body wall parts that were opened or handled during an operation. Surgical site infections (SSI) either an incisional or organ/space infection occurring within 30 days after an operation or within one year if an implant is present. As shown in Figure (1.3.6.1), incisional SSIs are further divided into superficial incisional (only involves skin and subcutaneous tissue) and deep incisional (involves deeper soft tissue, including fascia and muscle layers).

Patient has at least one of the following:

a. Purulent drainage from a drainage that is placed through a stab wound into the organ/space.

b. Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space.

c. An abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation, or by histopathologic or radiologic examination.

d. Diagnosis of an organ/space SSI by a surgeon or attending physician. (Mayhall CG. 2004)

Figure 1.6 Cross-sections of Abdominal Wall Showing CDC Classifications of Surgical Site Infection
Table (1.2) the surgical wound classification system includes four categories:

<table>
<thead>
<tr>
<th>Wound class</th>
<th>Definition</th>
<th>Example</th>
<th>Reminder</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Class I Clean</strong></td>
<td>* Operative wound clean</td>
<td>* Vascular Procedures</td>
<td>* Any wound open for drainage II (except total hip/knee)</td>
</tr>
<tr>
<td></td>
<td>* Non-traumatic, with no inflammation encountered</td>
<td>* Neurological procedures (inflamed II, infected III)</td>
<td>* Removing old implants (wires, pins, etc…)</td>
</tr>
<tr>
<td></td>
<td>* No break in technique</td>
<td>* Endocrine procedures</td>
<td>* Re-operation at the same site</td>
</tr>
<tr>
<td></td>
<td>* Respiratory, gastrointestinal and genito-urinary tracts not entered</td>
<td>* Eye surgery (inflamed II, foreign body III, infected III)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>* Caesarean Section, elective, no pre-rupture of membranes or trial of labor</td>
<td>* Orthopedic procedures (unless: trauma III, old wound IV, amputation II)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Penile prosthesis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Skin (mastectomy, lumpectomy, lesions, lipoma, cosmetic, I&amp;D IV, old wounds III, inflamed III, infected IV)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Exploratory Lap (no bowel involvement II)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Miscellaneous procedures (lymph node excision/Bx unless inflamed III or infected IV, splenectomy, tenckhoff cath unless replacement II)</td>
<td></td>
</tr>
<tr>
<td><strong>Class II clean contaminated</strong></td>
<td>* Operative wound clean-contaminated</td>
<td>* Thoracic procedures (except mediastinoscopy I, inflammation III, infected IV, foreign body III)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>* Non-traumatic wound with minor break in technique</td>
<td>* GI procedures (including: laparoscopy, colonoscopy, gastroscopy) (gross spillage III, acute inflammation III, fresh accidental wound III) (litis III, Lithiasis II)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>* Gastrointestinal, respiratory or genito-urinary tracts entered without significant spillage</td>
<td>* GU procedures (infected III)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>* Includes:</td>
<td>* Ear surgery (infected III)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>* Transaction of appendix or choledystic duct in the absence of infected bile or urine</td>
<td>* Nose/Oropharynx procedures (infected IV)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>* Hysterectomy</td>
<td>* GYN procedures (Oophorectomy I, inflamed III, infected IV)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>* Caesarean Section, emergency involving pre-rupture of membranes and/or trial of labor</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Class III Contaminated</strong></td>
<td>* Operative wound contaminated</td>
<td>* Inflammation</td>
<td>* Foreign bodies in a wound (bullets, etc…)</td>
</tr>
<tr>
<td></td>
<td>* Fresh traumatic wound from clean source</td>
<td>* Gross spillage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>* Operative wound with a major break in technique</td>
<td>* Fresh accidental wound</td>
<td></td>
</tr>
<tr>
<td></td>
<td>* Gross spillage from the gastrointestinal tract</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>* Entrance into the genitourinary or biliary tracts</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>* When infected urine or bile is present Incision encountering acute non-purulent inflammation</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Class IV Dirty</strong></td>
<td>* Operative wound dirty</td>
<td>* Infected</td>
<td></td>
</tr>
</tbody>
</table>
1.3.7.3 EPIDEMIOLOGY AND MICROBIOLOGY

Among surgical patients, SSIs are the most common nosocomial infection, accounting for about a third of all such infections. In most studies about two thirds of these can be classified as superficial incisional, while the remaining involve either organs or spaces entered during surgery or are deep incisional SSIs. On average, having an SSI increases a patient’s hospital stay by 7–10 days, with organ/space and deep incisional SSIs accounting for the longest stays and highest costs.

Organisms associated with SSIs vary with the type of procedure and the anatomic location of the operation. *Staphylococcus aureus*, enterococcus species and *Escherichia coli* are the three most frequently isolated pathogens. An increasing number of SSIs are caused by antimicrobial-resistant pathogens, and the incidence of fungal SSIs has risen significantly in the last decade in part because of the dramatic increase in the number of HIV/AIDS patients. For most SSIs, the source of the pathogen(s) comes from the patient’s skin, mucous membranes or bowel and rarely from another infected site in the body (endogenous sources). Exogenous sources of SSI pathogens are occasionally responsible. These include:

Organisms from members of the surgical team (e.g., hands, nose or other body parts);
Contaminated surfaces in the operating room, even the air; and
Contaminated instruments, surgical gloves or other items used in the surgery.
Exogenous organisms are primarily aerobic staphylococci or streptococci species (with the exception of tetanus endospores). Although fungi are widely present in the environment, they rarely cause SSIs. The mechanisms by which microorganisms infect tissue and produce disease are complex and incompletely understood. For example, some pathogens may contain or produce toxins and other substances that increase their ability to invade a patient’s tissue, produce damage or survive in the tissue.

1.3.7.4 Pathogenesis:

By the end of an operation, bacteria and other microorganisms contaminate all surgical wounds, but only a small number of patients actually develop a clinical infection. Infection does not develop in most patients because their defense mechanisms effectively eliminate the contaminating organisms at the surgical site. Whether a potential infection occurs depends on several factors, with the most important being:

- Number of bacteria entering the wound;
- Type and virulence (ability to cause infection) of the bacteria;
- Host defense mechanisms (e.g., effectiveness of inflammatory response and status of the immune system); and external factors, such as being in the hospital several days before surgery or the operation lasting more than 4 hours.

Two factors that can help minimize the number of organisms entering the wound are the skill and experience of the surgeon and use of good surgical technique. Both are important because if a surgical site is contaminated with more than 105 (100,000) organisms per gram of tissue, the risk of SSI is markedly increased. The dose required for infection can be even lower, however, if foreign material is present at the site (e.g., only 102 or about 100 staphylococci are enough if silk suture is used for closure or to control bleeding) (James and MacLeod 1961).

While the type and virulence of the bacteria cannot be controlled, the other factors can to a large extent. For example, tissue injury caused by making the wound incision triggers a chain of events, called the inflammatory response, that take place even before bacterial contamination occurs. The effectiveness of the inflammatory response to mobilize patient defense mechanisms (e.g., activation
of various types of white blood cells that contain and destroy the bacteria before infection can occur) depends to large extent on the patient’s general health, age, obesity, smoking, some chronic diseases and the status of the immune system.

Patient and Operation Characteristics That May Influence the Risk of Developing a Surgical Site Infection

Patient:

- Nutritional status, poor
- Diabetes, uncontrolled
- Smoking or use of other tobacco products
- Obesity
- Coexistent infections at a remote body site
- Colonization with microorganisms
- Altered immune response (HIV/AIDS and chronic corticosteroid use)
- Length of preoperative stay

Operation:

- Preoperative shaving
- Preoperative skin prep
- Duration of operation
- Antimicrobial prophylaxis
- Operating room ventilation
- Instrument processing (cleaning, HLD or sterilization)
- Foreign material in the surgical site
- Surgical drains

Surgical technique:

- Poor hemostasis
- Failure to obliterate dead space
- Tissue trauma
1.3.7.5 Reducing the risk of surgical site infections:

In 1999, CDC issued guidelines for reducing the risk of SSIs based on existing scientific data, theoretical rationale and applicability. A copy of these recommendations, including the strength of the scientific information, because these recommendations are intended to be used in US healthcare facilities, administrators and health professional staff in developing countries will need to carefully review, accept or modify them according to what is possible, practical and doable within their resource setting. While the vast majority of these recommendations are applicable and doable even in limited resource settings, some are not. For example, recommendations regarding Intraoperative Operating Room Ventilation that require positive-pressure ventilation, provision of 15 air exchanges per hour and filtration of all air (fresh or recirculated). Other recommendations that may need to be modified, depending on available resources and the nature of the surgical procedure, include instrument sterilization recommendations and the use of sterile surgical attire and drapes that are fluid-resistant.

In addition, some factors that may affect the risk of infection have either not been studied or the results of existing studies are inconclusive (e.g., members of the surgical team wearing nail polish). As a consequence, for these factors either no recommendation is provided in the guidelines or they are not dealt with at all. A few of the most notable omissions include whether or not to:

- Limit traffic flow (i.e., the number of people in the operating room) during surgery;
- Wear soiled surgical clothing from case to case; perform more than one operation in the same room, including the use of shared personnel;
- Cover a clean incision closed at surgery beyond 48 hours; or advise the patient to bath or shower after surgery without a dressing.

For most of these, standard practice would advise against doing them.

With regard to care of the incision, it is generally believed that postoperative care has only minimal effect on the risk of SSIs. This belief is based on the assumption that wounds begin to heal immediately and after 48 hours do not to require a dressing or will not become infected by showering or bathing. This
assumption, however, may not be valid, especially in limited-resource settings where hygiene is poor and the quality of tap water is questionable or frankly contaminated.

1.3.7.6 Other Factors

**Prolonged preoperative hospitalization** exposes patients to hospital flora, including multidrug-resistant organisms. Completing presurgical evaluations and correcting underlying conditions before admission to a hospital decreases this risk. Also, performing elective surgery, where feasible, in ambulatory surgery centers rather than acute care hospitals decreases the risk of exposure to hospital flora.

**Preoperative hair removal** should be avoided if it is unnecessary. If hair must be removed, clip it with scissors just before the surgery. Shaving is a proven risk factor for SSIs.

**Wide prepping of the proposed incision site** with antiseptic solution preoperatively helps keep microorganisms from migrating into the wound if the site towels or drapes become wet during surgery.

**Good surgical technique** minimizes tissue trauma, controls bleeding, eliminates dead space, removes dead tissue and foreign bodies, uses minimal suture and maintains adequate blood supply and oxygenation. Specifically, it is important to:

- Handle soft tissue gently to avoid crushing that can result in tissue death (necrosis);
- Use electrocautery sparingly to control bleeding because it leaves behind dead tissue that is more likely to become infected;
- Use absorbable suture whenever possible because permanent suture, especially silk suture, reduces the number of bacteria necessary to cause infection and use closed suction drains that exit through a separate stab wound to help prevent accumulation of tissue fluid in the dependent portion of the wound. Preventing this is especially important in obese patients and may reduce SSIs. (Passive drains, such a Penrose drain, exiting through the bottom of the incision should not be used.)
Increased length of surgical procedures is associated with increased risk of SSIs. It is estimated that the infection rate nearly doubles with each hour of surgery

Prompt discharge postoperatively, provided patients are able to return to homecare, reduces the risk of infection as well. These factors, coupled with the experience and skill of the surgeon and assistant, are known to reduce the risk of SSIs.

Hospital acquired infections are not only an important cause of morbidity and mortality but also cause severe economic burden throughout the world. Risk of these infections is further increased when patients are exposed to invasive procedures. Breach in intact skin and mucosal lining after surgeries provide opportunity to nosocomial pathogens to invade the internal milieu of the body.

Surgical site infections (SSI) are a real problem to the surgeons and are considered as major infection control concern across the world.2-4 In the United States, every year SSI develops in 2%-5% of patients, resulting in at least 500,000 infections, 3.7 million excess hospital days and $1.6 billion in extra hospital charges.

Surveillance of these infections is a vital step as it provides an insight into the magnitude of problem and hence helps the authorities to take radical measures and therefore curtail these infections. (Tietjen "et al", 2003).
Chapter two
2. Methodology

2.1. Study Design
This was a cross-sectional interventional study with application of guidelines for Infection Control and prevention in the Operating Room (Neuro and Cardiothoracic) at Elsha'ab hospital – Khartoum, characterized by being:

- A health Facility based prospective study
- A quantitative evaluation (observation/check list audit)
- An interventional training of the target group with development of guidelines, strategies and surveillance sheet.

2.2. Study Area and Period
Elsha'ab Teaching Hospital was built by donation of the World Health Organization and under the supervision of Dr. Mamoun Hassan Sharif and Zainal Abidin Ibrahim and the opening was in the year 1959
In 1982, the first intensive cardiac care established composed of one room and two beds only.
In 1983, Professor Daoud Mustafa founded the department of neurology and in the year 1982 the Heart Foundation was established by the efforts of some cardiologists, with funding from the Organization of Islamic Dawa. The institution had a major role in the development of the hospital with the introduction of modern equipment such as the echo of the heart and ECG. Also it built a diagnostic cardiac catheterization department for which work stopped due to lack of maintenance and spare parts but was re-opened in 2007. In 1989, emergency department for cardiac and chest disease established.

The hospital building consists of:

- Five separate two floors buildings consisting of the wards and intensive care units.
- Emergency building complex departments, clinics.
- Operations Complex building and the department of cardiac catheterization.
- Administration building including administration offices and the Department of Quality control and the offices of specialists, statistics, accounts and training center and library.
- Heart Foundation Building.
- Building for human resources.

The hospital Contains seven ICUs and 10 wards and 13 private rooms.
Total capacity of ICUs is 49 beds
Total capacity of wards is 204 beds

2.3. Study Population
- Doctors including Surgeons
- Anesthesiologists
- Theatre nurses and surgical technologist
- Anesthesia technicians
- Supporting staff (Porters and Cleaners)

2.4. Variables under Study:
- Knowledge, attitude and practices of Surgeons, anesthesiologists, theatre nurses, surgical technologist, anesthesia technologist and porters about:
- Existing infection control structures (Committee & units)
- Disease transmission
- Hand washing and Proper use of gloves
- Instrument processing (decontamination, cleaning, sterilization and high-level disinfection, and storage)
- Use and disposal of needles and other sharps
- Waste disposal
- Housekeeping
- Surgical scrub and surgical attire (gowns, caps, masks…etc.)

2.5. Sampling and sample
- Comprehensive sampling with total coverage of all theatre team and intensive care units
2.6. Methods of data collection:
- Structured questionnaire
- Observation and check list,
- Surgical site infection surveillances sheet
- Pre and post training tests
- In depth interview (I.C. committee, head surgeon, theatre supervisor)

2.7. Data analysis & interpretation:
- SPSS used for entry, cleaning and analysis of data

2.8. Ethical consideration
- The participants’ consent was obtained
- Integrity of the research process was ensured by using of appropriate checks and balances throughout
- The privacy of participants was protected to the maximum degree possible.
- Prevented and minimizes harm, and/or promotes good to all research participants
- written permission from relevant ethical committees was obtained
Chapter Three
3. Results

The questionnaire covered socio-demographic and current working unit of the respondents, implementation of UP, attendance to UP training, perceived barriers for UP implementation.

The questionnaire was completed by 126 HCWs including 28 Theater nurse and surgical technologist, 11 Anesthesia personnel, 35 supporting staff (Cleaners and porter) 20 surgeons, 32 ICU nurse 35% of which had four years work experiences.

About 46% of respondents Said that the hands washing facilities were equipped with antiseptic some times

Most of the staff (55%) didn't receive any type of training about infection prevention.

With regards to the practice of hand washing and appropriate time of practice among study group, almost all the staff practiced hand washing when touching body fluids after each procedure but fewer (33%) of them practiced hand washing when leaving the work and when arriving at work (24% only).

Regarding practice of hand washing and appropriate time of practice among the study group almost all of the respondents (95%) wash their hands only when they touched body fluid and less (24%) when arriving at work and (35%) when leaving work. About half of the staff (49%) said the obstacles to practicing hand washing at the appropriate time was they were busy

In practicing the steps of instruments processing among nurses and technicians (43%) only said they did the first step which is decontamination
Regarding practices of waste disposal guidelines only (9%) used utility gloves.

Regarding practice of sharp injury prevention guidelines few used utility gloves when dealing with sharps

Regarding type of gloves used by nurses and technicians to clean instruments most of them (95%) used surgical gloves and none used utility gloves

Regarding types of gloves used by cleaner for cleaning the majority (65%) used single gloves and few (4%) used heavy duty gloves

Regarding training about infection prevention and control (55%) didn't receive any type of training about infection control and prevention but (91%) had theoretical lectures only.

Regarding obstacles to improving Infection prevention practices (53%) said that was because of inadequate supplies and lack of equipment and space.
3.1 Results of questionnaire analysis

Table 3.1.1 Distribution of study group by job title

<table>
<thead>
<tr>
<th>Job Title</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theater nurse</td>
<td>3</td>
<td>2.4</td>
<td>2.4</td>
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<tr>
<td>Surgical technologist</td>
<td>25</td>
<td>19.8</td>
<td>19.8</td>
</tr>
<tr>
<td>Anesthesia technologist</td>
<td>8</td>
<td>6.3</td>
<td>6.3</td>
</tr>
<tr>
<td>Anesthesiologist</td>
<td>3</td>
<td>2.4</td>
<td>2.4</td>
</tr>
<tr>
<td>Cleaner</td>
<td>27</td>
<td>21.4</td>
<td>21.4</td>
</tr>
<tr>
<td>Porter</td>
<td>8</td>
<td>6.3</td>
<td>6.3</td>
</tr>
<tr>
<td>Surgeon</td>
<td>20</td>
<td>15.9</td>
<td>15.9</td>
</tr>
<tr>
<td>ICU Nurse</td>
<td>32</td>
<td>25.4</td>
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</tr>
<tr>
<td>Total</td>
<td>126</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Figure 3.1.1 Easy accesses to attires
Figure 3.1.2 Hand washing facilities equipped with antiseptic solution

Figure 3.1.3 Practice of hand washing and appropriate time of practice among study group
Figure 3.1.4 Obstacles to Practice of hand washing and appropriate time of practice among study group

Figure 3.1.5 practicing the steps of instruments processing among nurses and technicians
Figure 3.1.6 Practices of waste disposal guidelines

Figure 3.1.7 Practices of sharp injury prevention guidelines
Figure 3.1.8 Type of gloves used to clean (reprocessing) instruments

Figure 3.1.9 Types of gloves used by cleaners for cleaning
Figure 3.1.10 Training about infection prevention and control

91%

4% 5%

Lectures  Seminar  Training course

Figure 3.1.11 Types of training among those who had attended training

Figure 3.1.12 Obstacles to Improving Infection Prevention Practices

26%  21%  53%

Lack of knowledge  Resistance to changing old habits  Inadequate supplies, equipment, and space
3.2 Surgical Site Infections (SSIs) Surveillance

**Results:** In the first year the total number of cases operated upon in the cardiothoracic department were two hundred and twenty five cases, one hundred and forty eight were clean contaminated and contaminated cases, and seventy seven clean procedures (operation). The infection rate among clean operations was (18%) there were thirty seven (16%) from the total cases who developed surgical site infections: fourteen clean wounds (38%) and twenty three clean contaminated wounds (62%). Infection among thoracotomy procedures was the highest (seventeen patients) MVR (eight patients) and decortications (four patients) by type of operation (procedure).

Of the 225 patients, 10 patients (4%) were known to be infected with blood borne disease, (seven HBV, two HCV and one HIV)

In the Second year the total cases operated upon in cardiothoracic department were two hundred and seven cases, one hundred and twenty five were clean contaminated and contaminated cases, and eighty two had clean procedures (operation). The infection rate among clean operations was (11%).

Of the 207 patients, 11 patients (5%) were known to be infected by a blood borne disease, (seven HBV, two HCV and one HIV)
Table (3.2.1) incidence of SSIs

<table>
<thead>
<tr>
<th>Types of operations</th>
<th>First Year</th>
<th>Second year</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Developed</td>
<td>No</td>
<td>Developed</td>
</tr>
<tr>
<td>Clean procedures</td>
<td>14</td>
<td>63</td>
<td>9</td>
</tr>
<tr>
<td>Clean contaminated / contaminated procedures</td>
<td>23</td>
<td>125</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td>37</td>
<td>188</td>
<td>29</td>
</tr>
</tbody>
</table>

Figure (3.2.1)

Incidence of SSIs Among post Cardiothoracic Surgery patients during the study period

- First year: 16% developed SSIs, 84% did not develop SSIs
- Second year: 14% developed SSIs, 86% did not develop SSIs

P-value = 0.050
Figure (3.2.2)

Incidence of SSIs Among post Cardiothoracic Surgery patients during the study period by type of wound

Figure (3.2.3)

Incidence of blood borne diseases among patients who had cardiothoracic surgeries

P-value=0.051
Chapter Four
4.1 Discussion

It is important to improve the knowledge, attitude and practice (KAP) of healthcare workers (HCWs) toward infection prevention and control and proper application of infection prevention guidelines and adherence to universal precautions (UP) standards. While there is a growing awareness of the seriousness of HIV, as well as hepatitis C, and how they are acquired in the workplace, many healthcare staff do not perceive themselves to be at risk. Moreover, even those that do perceive the risk do not regularly use protective equipment such as gloves, or other practices (e.g., hand washing). The result of the study indicates that the majority of staff cannot access eye wear and aprons and all HCWs and cleaner cannot access utility gloves. Despite this and a universally favorable attitude, we found that adherence to UP was reported as low by most health care workers (HCWs). In order to develop evidence based tailor made interventions and reduce risks, it is important to improve the knowledge and attitude of HCW to occupational blood-borne exposure. Comprehensive understanding and favorable attitudes to occupational risk will enhance adherence to UP standards. This study also challenges the concerned department management to remedy the short supply of personal protective equipments (PPE) and to develop strategies allowing staff to work safely in a high stress / urgent response setting.

Regarding the compliance with proper and frequent hand washing by HCWs and the availability of hand hygiene facilities by observation there were inadequate and inconveniently located hand hygiene facilities. Hand washing
sinks were with hand taps. No elbow, wrist, sensor, mixer, foot-operated taps were available, except in the operation theatre. There were no wall-mounted paper towels or foot operated waste bins with lids at each hand washing area. We believe the availability of such facilities will encourage proper and frequent hand washing.

The study indicates that most of the study group (76%) don’t usually wash their hands on arrival at work place and before leaving it (65%), and healthcare workers who wear gloves while treating patients are much less likely to clean their hands before and after patient contact. From the point of view of infection prevention, hand hygiene practices (hand washing and surgical hand scrubbing) are intended to prevent hand borne infections by removing dirt and debris and inhibiting or killing microorganisms on skin. This includes not only most of the organisms acquired through contact with patients and the environment, but also some of the permanent ones that live in the deeper layers of the skin.

Our observation shown that the design of ICU and ward don’t facilitate the appropriate area of hand washing; it has been shown that all the hand-washing sinks are close to a toilet and can be considered to be the leading cause of infections.

Glove use was appropriate for situations when contact with body fluids is anticipated or when patients are to be managed with contact precautions. However, use of gloves should not be considered a substitute for effective hand hygiene practices taking place before and after patient contact. Although gloves can reduce the number of germs transmitted to the hands, germs can
sometimes still get through latex. However, it is well practiced after examining clients, when touching body fluid and before leaving the work place. This corresponds with a study, done by Larson and Kretzer, which reviewed 37 other studies published between 1989 and 1994 on hand washing compliance by healthcare workers and revealed, among other things, hand washing occurred only in 50% of patients contact. (Weston, Debbie 2008).

In comparison with a study done to monitor and observe the adherence to the hand washing technique and compliance of health care workers pre and post procedures during routine patient care at a teaching hospital in Bahrain, the study reported here found that compliance to hand washing was quite poor. The result of observation by infection control staff found that 43.3 % did hand washing (medical or surgical) properly according to the manual and 56% did not, hand washing carried before and after removing gloves in 43% while 56% did not. Hand washing is done before and after each procedure, before 16% and after 83%. (Abass, Fatima 2007).

Low staff compliance with hand hygiene practices remains a major problem in most healthcare settings worldwide. Indeed, when appropriate methodology is used to assess compliance, it rarely exceeds (30%). (WHO 2006) and this present the argument that a strong effort is needed to fight this problem.

The Key reasons given for not washing hands according to recommended guidelines include lack of time, limited access to sinks and running water, frequent hand washing irritates the hands, and perception that peers and supervisors do not perform hand washing as recommended.
Several seminars and lectures for health care workers should be done in a regular manner to explain the importance of hand washing. Posters depicting good hand washing technique should be distributed to all departments and hung over clinical hand basins and alcohol hand rubs should be applied as recommended by the CDC to improve the compliance of health care workers.

The study revealed that there was no system available for waste disposal at the hospital. Healthcare workers would put all the waste in one type of container, including sharp waste. The containers were collected through at the hospital and then transferred outside the institute in public waste containers. The absence of such a system will lead to accidental needle stick injuries especially since most of the staff, and especially cleaners, don’t use heavy duty gloves when dealing with waste. Such practice will also put all the visitors and community at risks of infection.

We suggest that health care workers should be involved in waste collection with segregation of waste and use red bags for the collection of infectious waste and a black ones for general waste with the use of puncture-proof high-density plastic containers fitted with covers for collection of sharps distributed all over the hospital and for internal collection and storage of medical waste for final disposables.

One of the important problems the study found was the absence of a central sterilization unit, the surgical instruments and wraps are sterilized in the operating area. The limited area and space will affect the instrument processing steps. Establishing an independent center for sterilization is needed.
The results of this study indicate that no training or improvement program concerning infection control or prevention is being conducted in order to improve the practice of infection prevention. (55%) of HCWs and supporting staff didn't receive any type of training about infection control and prevention and of those who did (91%) had theoretical lectures only.

We believe that the study results demonstrate that training gave participants an adequate knowledge of infection control practices as well as promoting positive attitudes concerning implementation and use of infection prevention practices. There is no doubt that all the participants are now attempting to put improved infection prevention practices into place. Yet, the challenge remains to sustain infection prevention practices and avoid the return to previously observed inadequate practices and habits.

In comparison with previous studies it has been estimated that in developed countries up to 10% of hospitalized patients develop infections year. Not only is there a substantial cost to healthcare systems, but some healthcare associated infections (HCIAs) can be fatal. Since the majority of HCIAs are preventable, reducing HCIAs is now considered to be an integral part of patient safety and quality of care provided by all healthcare institutions worldwide. (N. Damani. Nizam 2012)

Infection prevention practices are crucial to the safety of health workers, individuals obtaining health care and the communities in which they live. Even with limited staff, equipment, and funds, health care facilities in the developing
world can fight deadly diseases such as HIV infection and hepatitis B by following some simple, cost-effective procedures.

Exposure to blood-borne infections (BBI) poses a serious risk to health care workers (HCWs). WHO estimates that 40%-65% of hepatitis B virus (HBV) and hepatitis C virus (HCV) and 2.5% of HIV infections in HCWs are occupationally acquired, and 90% of occupational exposures occur in developing countries (WHO 2005). The absences of structured infection control committees and an active infection control officer and infection control nurse leads to absences of direct audit and the basic improvement measures of infection prevention and control practices and low compliance with the guidelines and thus no infection surveillances.

There is strong need to activate the role of the infection control nurse as a member of a well structured infection control committee.

The infection control committee should be involved in planning, monitoring, evaluating, updating, and educating and setting general infection control policy and provides input into specific infection control issues. It will also help to standardize infection control procedures throughout the facility so that the same level of care is provided in all departments.

This study demonstrates a decrease in infection rates with the implementation of a comprehensive educational and training in infection control program.

The surveillance of incidence rates is essential to outbreak investigation, and one of our study objectives was to assess the effect of the interventional program on the incidence of postoperative infections. We found that there was
no surveillance program in the hospital. Absence of such a program has a number of consequences since it is a secondary measurement tool for the effort of infection prevention and control practice. The study done by (Boroumand, M. Ali 2007) was a briefly reported the most important activities at Tehran Heart Center’s infection control committee and reflect the importance of a well designed regular surveillance program. They stated that the second priority of that committee in the last year was the issue of outbreaks in March and April, which coincided with the yearly holidays in their country. The first impression was that, because of the long duration of the holidays and possible hurry in evacuation of wards, the quality of patient care was reduced. With regards to this hypothesis, ICC significantly increased both supervision on intensive care units (ICUs) and proper education of the nurses and physicians. After this supervision & retraining measures, the rate of postoperative infection was significantly reduced and no further outbreak was observed in the last year. The Study on the Efficacy of Nosocomial Infection Control (SENIC) showed that a well-organized surveillance and infection control programs that included feedback of infection rates to surgeons were associated with significant reductions in surgical site infection. (Health Protection Agency 2007). So a surveillance tool for the incidence rates was prepared.

We found that the rate of all cardiothoracic SSIs was (16%) in the first year and (14%) in the second year. Over the same period, the rate of SSIs among clean procedures decreased from (14%) to (11%). This reflects the outcome of
implementation of comprehensive education and training infection control program.

We found that the overall infection rate is high as compared with other countries Kashmir (Mustafa A, Bukhari A, Kakru DK, Tabish SA, Qadri GJ. 2004)(11.3%) and (Razavi SM, Ibrahimpur M, Kashani AS, Jafarian A. 2005), U.S.A (2.6%) and European countries (2.5%)( eaper DJ, van Goor H, Reilly J, et al. 2004) and lower than that reported in Iran (17.4%).

Standardizing the stages of preoperative preparation of patients for surgery with the use of clippers should replace routine shaving the night before surgery. Appropriate a septic technique and use of personal protective equipment, instrument processing in a central sterilization unit; besides a surveillance program all these will help in fighting the high rate of surgical site infection.

It was not only important to develop initial action plans, but the follow up of success and challenges with all participants in the final training sessions was helpful in identifying where further program efforts should be focused to support infection prevention activities depending on departmental strategies.

Based on the above, we believe that the project goal has been met. We plan to continue to place emphasis upon infection prevention practices with the hope of developing the outcome of ongoing and consistent infection prevention practice.
4.2 Conclusion

This study focused on situation analysis and then measuring the effectiveness of training of HCWs to improve Infection Control practices in the operating room at Elshaab Hospital in Khartoum. Four major areas (environment cleanliness, hand-washing facilities and compliance, waste disposal, cleaning and decontamination of instruments) were focused on during training and follow-up periods. It was found that infection control practices improved after education and on-site practical training of the participants.

In conclusion surgical site infections in post cardiothoracic surgeries were found to be high. Staff are at risk of infections (especially blood borne diseases)

The study concludes that there is

- Lack of an infection prevention practice among the study group regarding the importance and time of Hand Washing.
- Nurses and supporting staff (cleaner and porters) ignore the Importance of Utility or heavy-duty house hold gloves.
- The proper handling and disposal of medical waste and the guidelines for disposal of medical waste and sharps were not correctly followed neither by nurses nor supporting staff (cleaner and porters). And thus prevention of sharps Injuries was a real hazard.

There were main obstacles to improving infection prevention practices:

- Lack of training and clear guidelines
- Inadequate supplies, equipment, space and washing facilities
- Resistance to changing old habits
- Low staff compliance with hand hygiene practices remains a major problem in most healthcare settings.

It is clear that much work needs to be done to enhance and improve the education and training to improve practice and behavior toward infection prevention and control.

We observed significant reductions in SSI rates of clean surgery procedures following implementation of a comprehensive infection control program. These differences remained significant when adjusted for potential confounding co-variables so the decrease in infection rates reflected the success of the implementation of a comprehensive educational and training about infection prevention and control program.
4.3 Recommendations

The study recommends the following:

- There needs to be a review of clinical governance to support greater adherence of individual clinicians to IC policies and procedures. This should consider components of the clinical governance framework, including credenti-

- Hospitals should support IC programs with staff dedicated to infection control and adequate access to expertise in infectious diseases, microbiology, pathology and epidemiological services.

- Hospitals should provide structural resources to support the ICP including effective data collection, analysis and reporting systems.

- The scope of practice of the ICP should reflect the education and training of the ICP in relation to expected roles and responsibilities.

- It is recommended that there be a national approach to developing curricula for infection control post graduate courses.

- There is strong need to activate the role of infection control nurse as a member of a well structured infection control committee.

- Setting up of a Control of Infection Committee including infection control to assess the efficacy of the regular preventive measures used in hospital.
- There is a strong need for a training approach that seeks to achieve continuous improvement in performance through motivation, modeling, practice, constructive feedback and gradual transfer of skills.
- All staff must be given adequate and regular orientation in infection prevention because the contribution of everybody is important especially cleaners.
- Joint effort and more research about infection prevention practice
- Educational schools should maximize the opportunities for multi disciplinary learning on infection control.
- Provision of the minimal facilities and utilities needed (e.g. for hand washing and proper waste disposal)
- Provision of written instructions, posters and guidelines.
References

Abass, Fatima. Hands washing. Eighth congress of the international federation of infection control (IFIC), Europa Congress Centre Budapest, Hungary (October 18–21, 2007).


Boroumand, M. Ali. Brief report of most important activities of Tehran Heart Center’s infection control committee. Eighth congress of the international federation of infection control (IFIC), Europa Congress Centre Budapest, Hungary (October 18–21, 2007)


Joint Commission Resources (2010). The Nurse’s Role in Infection Prevention and Control. Oakbrook Terrace/US.

Kamal, Letimad, Ibrahim. Application of infection prevention and control measures to reduce maternal sepsis in obstetrics and gynecological teaching hospital Wad Medani. 3rd scientific conference of the scientific society of Arab nursing faculties on quality nursing education and services, Khartoum 20th - 22nd December 2011.


Mohamed, Fatima, hamid. Theatre nurse compliance with standard infection control. 3rd scientific conference of the scientific society of Arab nursing
faculties on quality nursing education and services, Khartoum 20th -22nd December 2011.


Tietjen Linda; Bossemeyer Débora; McIntosh Noel (2003). Infection Prevention Guidelines for Healthcare Facilities with Limited Resources, JHPIEGO Corporation. Chapter 6 and 8


Appendix

Glossary

Colonization: Used to describe microorganisms present without host interfering or interaction.

Colonization, infection, disease: Relatively few anatomic sites (e.g. brain, blood, bone. Heart, vascular system) are sterile. Bacteria found throughout the body usually provide beneficial normal flora to compete with potential pathogens and to facilitate digestion, or to work in another way by symbiotically with the host.

Communicable disease: A disease that is directly or indirectly transmitted from man to man or from animal to man or from environment (through water, food, air, dust, or soil) to man or animal.

Contamination: The presence of an infectious agent on a body surface or on clothes, beddings, toys, surgical instruments, dressing or other articles or substance like water milk and food. Contamination on body surface does not imply a carrier state.

Incubation period: Time between contact and onset of signs and symptoms

Infection: The successful invasion of a microorganism in the tissue of host (man or animal) and its establishment and growth (multiplication or development).

Infectious disease: A disease resulting from an infectious agent

Infestation: The presence of an animal parasite in or on the human body.

Latency: Time interval after primary infection when a micro organism lives within the host without producing clinical evidence.

Iatrogenic disease: An adverse consequence of preventive, diagnostic, or therapeutic regimen or procedure resulting from an activity of a healthy care provider and causing impairment disability or death.

Methicillin/resistant staphylococci coccus aureas (MRSA): Staphylococcus aureas bacterium not susceptible to extended. Penicillin antibiotic formulas, such as methcillin. Nosocomial infection: Infection acquired in hospital that was not present or incubating at the time of hospital admission.

Opportunistic infection: A disease occurring by an infectious agent taking the opportunity of a defective immune system of a host. Examples of such agents are herpes simplex cytomegalovirus toxoplasma gondii, M. tuberculosis, pneumocytis, carnii. Opportunistic infections are very common in AIDS.
Pollution: Presence of offensive but not necessarily infectious matter in the environment

Standard precaution: Strategy of assuming all patients may carry infection agents and using appropriate barrier precaution for all health care worker patients interaction

Vancomycin resistant staphylococcus aureas VRSA: Staphylococcus aureus bacterium that is not susceptible to vancomycin

Virulence: Degree of pathogenicity of an organism
Application of infection Prevention and Control
In Operating Theatres of Elsha’ab Hospital – an Interventional Study-
Khartoum, Sudan (2009-2011)

* Checklist *

Hospital name:

1. Does your hospital have an Infection Control Committee (ICC)?
   □ Yes □ No

2. If yes, please mark which individuals, and number, that are part of your Infection Control Committee:
   □ Hospital Epidemiologist ____
   □ Hospital Administration ____
   □ Surgeon ____
   □ ICU Specialist ____
   □ Infection Control Nurse ____
   □ Infectious Disease Physician ____
   □ Medical Microbiologist ____
   □ Pharmacist ____
   □ Maintenance Staff ____
   □ Public Health Doctor ____
   □ Occupational Health ____

3. Does the (Infection Control Committee) ICC produce annual reports?
   □ Yes □ No

4. Does your hospital have access to: (check all that apply)
   □ Gloves ____
   □ Gowns ____
   □ Eye Protection ____
   □ Caps ____
   □ Masks ____
   □ Footwear protection ____
   □ Clean linens ____
   □ Clean cloth towels ____
   □ Alcohol-based hand rubs ____
☐ Paper towels ____
☐ Antiseptic Cleaning Solutions ____
☐ Disposable Drapes ____
0= NA  1= sometimes    2= always

5. Are hand-washing facilities equipped with disinfecting soap?
   ☐ Yes ☐ No

6. Is it mandatory for your health-care personnel to be vaccinated for Hepatitis B?
   ☐ Yes ☐ No

7. Does your hospital have central sterilization supplies department (CSSD)
   ☐ Yes ☐ No

8. Which types of sterilization methods you are practicing in the operating room? (check all that you apply)
   ☐ Boiling methods.
   ☐ Autoclaving.
   ☐ Dry heat
   ☐ Chemical disinfections
   ☐ Gas sterilization
   ☐ Others (please specify)
   ___________________________________________
   ___________________________________________

9. Does your hospital provide regular training for medical professionals about infection control and prevention?
   ☐ Yes ☐ No

10. Does your hospital have sharps boxes and biohazard collection containers?
    ☐ Yes ☐ No

11. Is your hospital obligated to have an Infection Control Committee?
    ☐ Yes ☐ No
Application of infection Prevention and Control
In Operating Theatres of Elsha’ab Hospital – an Interventional Study-
Khartoum, Sudan (2009-2011)

Questionnaire
*Do not write your name*

Respondent No (  )

1. Job title:
   □ Theater nurse □ Surgical technologist □ Anesthesia technologist
   □ Anesthesiologist □ Cleaner □ porter □ surgeon □ ICU Nurse

2. Qualifications:
   □ Primary □ Secondary □ Diploma □ B.Sc □ M.Sc □ PhD □ Other

3. Experiences in years:
   □ <1 year □ 1-2 years □ 2-3 years □ > 3 years

4. Sex:
   □ male □ female

5. Do you have easy access to: (check all that apply)
   □ Gloves ______ 
   □ Gowns ______ 
   □ Eye Protection ______ 
   □ Caps ______ 
   □ Masks ______ 
   □ Footwear protection ______ 
   □ Clean linens ______ 
   □ Clean cloth towels ______ 
   □ Alcohol-based hand rubs ______ 
   □ Paper towels ______ 
   □ Antiseptic Cleaning Solutions ______ 
   □ Disposable drapes ______ 

0= NA   1= sometimes   2= always

6. Are hand-washing facilities equipped with disinfecting soap?
   □ Yes □ No
7. When do you wash hands?
   □ After arriving at work
   □ Before each procedure
   □ After each procedure
   □ Before putting on gloves
   □ After removing gloves
   □ When you touch body fluids
   □ Others (please specify):

   ___________________________________________________
   ___________________________________________________

8. Why don’t people in your unit perform hand hygiene as often as they should?
   □ Too busy
   □ Supplies not accessible
   □ Forget
   □ Tired
   □ Don’t know importance
   □ Damages skin
   □ Others (please specify):

   ___________________________________________________
   ___________________________________________________

9. How do you process the instruments (check Steps that apply)
   □ Decontamination
   □ Cleaning
   □ HLD OR Sterilization
   □ Storage

10. What are the types of sterilization methods you are practicing in the operating room? (check all that you apply)
    □ Boiling methods.
    □ Autoclaving.
    □ Dry heat
    □ Chemical disinfections
    □ Gas sterilization
    □ Others (please specify):

    ___________________________________________________
    ___________________________________________________

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11. What are the Guidelines for Disposal of Medical Waste? (check all that you apply)
   □ Use washable leak-proof containers
   □ Keep containers in convenient places
   □ Empty containers daily or when three-quarters full
   □ Always dispose of medical waste correctly
   □ Wear utility gloves and shoes
   □ Wash the gloves and your hands afterwards

12. How often do you maintain the sterile field in the operating room?
   □ Weekly
   □ twice weekly
   □ Monthly
   □ occasionally
   □ Others (please specify: ________________________

13. What are the measures that you use to prevent Sharps Injuries? (check all that you apply)
   □ None or one hand recapping
   □ Sharp proof containers
   □ Utility gloves to process sharps
   □ Safe zone, kidney dish
   □ Others (please specify: ________________________

14. What type of gloves do you use for cleaning (Instruments)?
   □ Single use gloves
   □ Surgical gloves
   □ Heavy duty gloves

15. What are the common used disinfectants in your department?
   □ Chlorine
   □ Glutaraldeyde (Cidex)
   □ Formaline
   □ Others (please specify: ________________________

16. What are the common antiseptics used for skin preparation in your department?
□ Chlorohexidine
□ Iodophors. Povidon iodine E.G. Betadine.
□ Alcohol.
□ Iodine.
□ Others (please specify: ____________________________

17. How would you sort the waste? (check all that you apply)
   □ General waste
   □ Hazardous chemical waste
   □ Medical waste
   □ No sorting

18. What are the Guidelines for disposal of Medical Waste? (check all that you apply)
   □ Use washable leak-proof containers
   □ Keep containers in convenient places
   □ Empty containers daily or when three quarters full
   □ Always dispose of medical waste correctly
   □ Wear utility gloves and shoes
   □ Wash the gloves and your hands afterward

19. Does your hospital provide training for medical professionals on infection control and prevention?
   □ Yes □ No

20. Which of the following have you attended in your health facility about infection prevention?
   □ Lectures
   □ Seminar
   □ Training course
   □ Others (please specify: ____________________________

21. What are the Obstacles to Improving Infection Prevention Practices?
   □ Lack of knowledge
   □ Resistance to changing old habits
   □ Inadequate supplies, equipment, and space
   □ Others (please specify: ____________________________

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Surgical site infection surveillance sheet prepared by: Mohamed Baheer Koko

Surgical site infection surveillance sheet front

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<th>Wound Classification</th>
<th>Date of Infection</th>
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Surgical Site Infections

(SSI) is an infection that develops within 30 days after an operation or within one year if an implant was placed and the infection appears to be related to the surgery. Post-operative SSIs are the most common healthcare-associated infection in surgical patients.

Surgical Site infections criteria

1. Purulent discharge
2. Organisms isolated from an aseptically collected culture of fluid or tissue
3. Displays at the site of incision any of the following signs and symptoms of infection:
   - Pain or tenderness
   - Localized swelling
   - Redness or heat
4. Diagnosis of superficial incision infection by operating Surgeon or Registrar

Wound classification

1. Clean wound
2. Clean contaminated wound
3. Contaminated wounds
4. Dirty or infected wounds

Surgical Site Infection Rate

<table>
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<th>No infection</th>
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Application of infection Prevention and Control
In Operating Theatres of Elsha’ab Hospital – an Interventional Study- Kartoum, Sudan (2009-2011)

Submitted by: Mohammed Basheer Koko Baraka
M.Sc.N
University of Medical Sciences and Technology

Submitted in Fulfillment of the Requirements for the Degree of Doctor of Philosophy in community health
Primary Health Care and Health Education Centre
Faculty of Medicine
University of Gezira

Training Manual
Infection Prevention and Control

Prepared by: Mohamed B. Koko

Supervisors:
Professor Ahmed Abdalla Mohamedani Ahmed
MBBS (Khartoum), DCP (London) & FRCPath. (United Kingdom)

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إشراف البروفيسور: أحمد عبد الله محمداني
الدكتور: أحمد سيد احمد السيد