Wound Care Updates Including possible Complications and Wound Infections

A wound is considered to be a break in the continuity of body structures which is caused by injury, trauma, violence, tear, cut or puncture to the skin and / or surgery to tissues. It can also be a blunt force trauma that causes a contusion considered a closed wound. Pathology specifically refers to a sharp injury that damages the dermis of the skin. When treating a non-surgically created wound, tetanus prophylaxis should be considered if patient has not been previously immunized with tetanus immune globulin. Wounds involve the skin, which is considered a large sensory organ that interacts with the environment, and sends signals to the brain about touch, pain, vibration and position.

The skin is the largest organ of the body covering approximately 3,000 square inches on the average person and weighs approximately six pounds. The skin protects us from infection (bacterial) and chemical invasions, radiation, extreme temperatures (hot and cold) and is the primary body system affected by pressure injuries. There are two layers of skin that cover the body, the epidermis and the dermis.

The “epidermis” is the outermost layer of skin and is very active, with new skin cells being formed and gradually shedding the outer most layer of skin that consists mainly, of non-living cells. There are many different kinds of epidermis cells. These cells include:

- Keratinocytes: Are the main skin cell that we see. These cells begin where the epidermis and the dermis meet. As they mature, they rise to the surface of the skin and are eventually shed. Keratinocytes are any of the cells that synthesize keratin, which is a durable protein polymer only found in the epithelial cells. These cells provide structural strength to skin, hair and nails.
The fibrous protein maybe either hard or soft. The epidermis has no blood supply, so it receives its nutrition from the underlying dermis.

- Melanocytes: contain the pigment and provide coloration to the skin and are responsible for absorbing radiation and protecting against the damage of ultraviolet radiation. They are found in the epidermis of the skin.
- Langerhan cells: are created in the bone marrow and migrate to the surface of the skin to help fight infection. Langerhan cells are the structural origination of the fibrous tissue of the skin and form natural cleavage lines that are present throughout the body. An example of this would be the creases of the palm. These creases in surgery are used to guide the surgeon’s decision on where to cut to allow them to make smaller parallel incisions. These scars will be much smaller when healing, compared to those that are made at right angles to those lines.
- Merkel cells: are specialized skin cells that help with sensing light touch. These cells are located on the tips of fingers and toes, but are in other specialized area as well.

The “dermis” is the deeper layer of skin that lies directly under the epidermis and is the true skin. Depending on its location, the dermis can be 15 to 40 times thicker than the epidermis. It has two layers Papillary and the reticular that are responsible for supporting the dermis:

- The papillary dermis is a thin layer of tissue just beneath the epidermis, and contains capillary blood vessels and a few elastic and collagen fibers.
- The deeper reticular dermis contains large bundles of collagen and elastic fibers that run parallel to the skin surface. The collagen and elastic fibers are responsible for helping the skin to resist injury from shearing or other types of trauma, and allow the skin to return to its resting state after being stretched or compressed. This is the layer where hair follicles, sweat glands and sebaceous glands are found.

The corium dermis is composed of fibrous connective tissue made of collagen and elastin. “Corium dermis” contains numerous capillaries, lymphatics and nerve
endings. This layer contains hair follicles and their smooth muscle fibers, sebaceous glands, sweat glands and their ducts.

- Capillaries are the minute blood vessels, approximately 0.008mm in diameter that connects the ends of the smallest veins.
- Lymphatic is a system that includes all lymph vessels that collect tissue fluid and return it to the blood.
- Nerve endings are the termination of a nerve fiber (axon or dendrite) in a peripheral (away from the center of the body) structure.
- Hair follicles are a cylindrical invagination of the epidermis that a keratinized thread like outgrowth from the skin of mammals.
- Smooth muscle fiber lacks cross striations on the fibers. Its action is involuntary.
- Sebaceous glands are oil secreting (sebum) holocrine glands of the skin, and can open into a hair follicle.
- Sweat glands (and ducts) are simple coiled glands found on all body surfaces except the margin of the lips, glans penis and inner surface of the prepuce. Sweat allows the skin to cool by evaporation.

Subcutaneous fat tissue underlies the layers of epidermis and dermis to provide extra cushioning for the skin. Beneath this layer are the muscle and bone.
Open wounds can be classified by how the wound was caused. The chances of infection in these wounds increase if they are exposed to standing water, soil or sand, ocean water or sea life. Any wound exposed to feces, soil or saliva should be evaluated by a health care professional. This includes animal or human bites because of the high rates of infection. In the case of animal bites there may be the need to consider a rabies immunization considering the animal involved. Deeper wounds require medical attention to prevent infection and loss of function due to damage to underlying structures including muscle, tendons, arteries, nerves or bone.

The types of open wounds are:

- **Abrasions**: considered a superficial wound referenced by the topmost layer of skin (the epidermis) is scraped. Skidding across a rough surface often causes abrasions.

- **Lacerations**: irregular tear-like wounds are often caused by blunt trauma. These incisions or lacerations might be stellate (irregular) or linear (regular).

- **Incisions are incised wounds**: created by a sharp-edged object. In surgery this would be a scalpel, however it could be a razor or a splinter of glass.

- **Puncture wounds**: are caused by an object that punctures the skin. An example would be stepping on a nail or sewing needle. Puncture wounds can carry a bit of clothing, shoe or dirt into this wound and can result in infection.

- **Penetrating wounds**: are caused when an object like a knife penetrates the skin.

- **Pressure sores (bed sores), or decubitus**: can develop when there is a lack of blood supply to the skin caused by chronic pressure on an area of the skin. It could be a person who is confined to sitting for long periods of time in a chair or wheel chair, bedridden, or who had a cast on. It can happen to a person with diabetes, peripheral vascular disease or malnutrition, which all increases the risk of pressure sores.
Gunshot wounds: are caused by a bullet when it is projected into the body. This situation may cause one or two wounds, depending on whether or not there is an exitus wound from the bullet.

Closed wounds can be just as dangerous as open wounds. The types of closed wounds are:

- Contusion: is a traumatic injury, creating a bruise caused by a blunt force blow to the skin, causing injury to the tissue below the skin. A contusion or bruise is a blood vessel that is broken while the skin remains intact. Signs and symptoms are pain, discoloration swelling and inflammation.
- Hematoma: is a blood vessel that is damaged and the blood has now collected under the skin. This collection of blood usually becomes clotted and confined.
- Crush injury: is caused by large amounts of force applied to an area for a long period of time. It involves compression of extremities or other body parts that causes muscle swelling and/or neurological disturbances in the affected areas of the body. This is usually a localized problem. Crush injury can cause both compartment syndrome and crush syndrome.
  - Crush syndrome: Is a traumatic muscle compression injury but with systemic manifestations, such as major shock and renal failure due to rhabdomyolysis (sometimes fatal) from the destruction of muscle due to the crushing of the skeletal muscle. This is a systemic problem is caused by the effects of prolonged muscle compression.

Compartment syndrome untreated could lead to muscle necrosis and leakage of muscle cells. Could become crush syndrome, but is not typical when an independent injury only involves the large muscle mass with prolonged compression usually one to six hours and has compromised blood circulation. This increases the possibility for leakage of muscles cells into the blood stream, creating a situation leading up to kidney failure. This type of injury may need
surgical intervention. Crush injuries are more likely to become infected than wounds from a cut.

**Wound Classifications**

A wound falls into two categories, either partial thickness or full thickness.

- A partial thickness wound includes destruction of epidermis and dermis. It is usually painful and pink. There will be no yellow tissue visible in this wound.
- A full thickness wound includes destruction of the epidermis, dermis, subcutaneous and/or deeper.

All wounds are classified based upon healing times.

- An acute wound will usually heal in a timely manner and uncomplicated manner. This process generally takes less than 12 weeks.
- A chronic wound does not heal in a timely manner and takes greater than 12 weeks to heal.

When documenting a wound, be clear on the location and side, then measure from edge to edge for the size. Make sure to include the length x width x depth measuring in centimeters. Documentation should also include wound color. Examples of wound color descriptions can range from erythema (red) meaning infection or inflammation, to white, which usually means moisture is present. The skin color blue could mean poor blood flow or purple, which might indicate trauma. Try to document the proper temperature, ranging from cool to hot. Wound texture should also be documented when describing a deeper wound. Document if the wound is firm or hard, or has edema present at the wound site. Also document if the wound has tunneled.

Necrotic tissue is non-viable tissue, where there is no blood supply and the tissue has died. This tissue will begin to slough; it might be yellow, green or grey in color. There could be eschar present and may present as black, brown or grey. This is usually darker and thicker. This area might even have the feel of being harder than the surrounding tissue.
Wound Care

Wound care is any technique that enhances the healing of skin abrasions, blisters, cracks, craters, infections, lacerations, rupture injuries, punctures, penetrating wounds, necrosis, and/or ulcers. Wound healing or cicatrization (healing by scar formation) is when the skin (or other organ tissues) can repair itself after an injury. Once an injury occurs to the skin or underlying tissues the healing process begins immediately. It is important for nurses to have a working knowledge of the general characteristics of the skin, its functions, and the changes that skin will go through as a patient grows older. This includes from pediatrics to geriatrics when doing a total skin assessment.

Wound care involves:

- Local care to the skin which includes debridement and an appropriate dressing.
- Positioning needs to be addressed in a manner to protect the affected body part to avoid excessive pressure on the wound.
- Appropriate application of compression (not too tight) or application of medicated bandage(s).
- When needed treatment of edema or lymphedema (an abnormal accumulation of tissue fluid in the interstitial spaces).
- If infection is present, treat appropriately.
- Check blood glucose levels and if needed start optimization of nutrition.
- Keep affected limb elevated using supports and cushions.
- Try to maximize the blood flow and oxygen levels to help affected area.

Wound healing is divided into three or four phases that are sequential yet overlap.

1. Hemostasis: This phase is not always addressed as a phase; however it is the first step to healing a wound.
2. Inflammatory: Most wounds will have some type of inflammation. When the blood comes in contact with collagen it triggers blood platelets to secrete inflammatory factors.

3. Proliferative: The process of making replacement cells.

4. Remodeling: Is the reconstruction of a part of the body that is needed to repair the part that has been injured.

This process is a biochemical event that takes place once the skin is injured. Within minutes, the injury platelets (thrombocytes) arrive at the injury site to form a fibrin clot. This clot which is an extracellular matrix providing structural support for cellular attachment will stop the bleeding. The speed at which this injury will begin healing could depend on other patient issues. If a blood vessel is injured and the cell membrane is ruptured it will release inflammatory factors like thromboxane (an unstable compound synthesized in platelets and other cells from prostaglandin, PGH₂. It acts to aggregate platelets, is a potent vasoconstrictor, and mediates inflammation), and Prostaglandins (biologically active, carbon-20, unsaturated fatty acids that are autacoids: (local, short – range hormones that are formed rapidly, act in an immediate area and then decay or are destroyed by enzymes). These factors cause the vessel to spasm preventing blood loss, as well as to collecting inflammatory cells and factors in the area. This vasoconstriction lasts five to ten minutes and is followed by vasodilation, a widening of the blood vessels, which peaks about twenty minutes or so post wound trauma.

The main factor involved in causing vasodilation is histamine (C₅H₉N₃ a substance produced from amino acid histamine which cause dilation of the blood vessels, increased secretion of acid by the stomach, smooth muscle constriction, tissue swelling). Histamine also causes blood vessels to become porous, allowing tissue to become edematous because proteins from the blood stream leak into the extravascular space, increasing osmolar (concentration of a solution) load and draws water into the area. This increased porosity of blood vessels also facilitates the entry of inflammatory cells like leukocytes into the wound site from the bloodstream.
During the inflammation phase, debris and bacteria are phagocytosed and removed. Also during this phase, factors are released that cause the migration and division of cells. Phagocytosis is a three stage process in which neutrophils, monocytes and macrophages engulf and destroy microorganisms, other foreign antigens, and cell debris. These substances must be covered with opsonin, to initiate the binding. The first stage is phagocytosis. In the second stage the particle is engulfed and enclosed in a vacuole. During the third stage, the phagosome (a membrane bound vacuole) merges with lysosomes whose enzymes destroy the engulfed particle.

The proliferative phase also begins while the inflammation phase is occurring. This phase is characterized by angiogenesis (the development of blood vessels) from vascular endothelial cells. Fibroblasts grow and form a new, provisional extracellular matrix (ECM) by excreting collagen and fibronectin. Concurrently, re-epithelialization of the epidermis occurs, in which the epithelial cells proliferate and “crawl” atop the wound bed, providing cover for the new tissue.

This wound itself is made smaller by the action of myofibroblasts gripping the edges of the wound and mimicking smooth muscle cells by contracting. When the cells are no longer needed they undergo apoptosis (a programmed cell death; genetic lifespan of cells).

In the remodeling phase, collagen is remodeled and realigned along tension lines and cells that are no longer needed are removed by apoptosis.

This phase is a complex and fragile time. This phase is susceptible to failure and interruption leading to non-healing chronic wounds. Factors that may contribute to this interruption may include diabetes, venous or arterial disease, old age, and infection.

**Polymorphonuclear neutrophils**

Polymorphonuclear means possessing a nucleus consisting of several parts, or lobes, connected by fine strands. Neutrophils are a granular white blood cell, the
most common type of white blood cells. This cell is responsible for much of the body’s protection against infection. They play a primary role in the inflammation phase, and are readily attracted to foreign antigens and destroy them by phagocytosis.

Within an hour of the injury, the polymorphonuclear neutrophils (PMS) arrive at the wound site and become the predominant cells in the wound for the first two days after the injury occurs. They are greatest in number on the second day. They are attracted to the site by fibronectin, growth factors and substances such as kinins (a group of polypeptides).

**Macrophages**

Macrophages are essential for wound healing. They replace the PMNs as the predominant cells in the wound by day two. They are attracted to the site by growth factors released by the platelets and other cells. Monocytes from the bloodstream enter the area through blood vessel walls. Monocytes peak in the wound around a day and a half after the injury. Once at the wound site, monocytes mature into macrophages. The spleen contains about half of the body’s monocytes ready to be sent to the injured tissue.

Macrophage’s main goal is to phagocytize bacteria and damaged tissue; they also are the body’s own way of debriding the wound of damaged tissue by releasing proteases. Macrophages are stimulated by the low oxygen content of their surroundings to produce factors that induce and speed angiogenesis. Macrophages also stimulate cells that re-epithelialize the wound, create granulation tissue, and lay down a new extracellular matrix.

**Decline of inflammatory phase**

As the inflammation dies down, fewer inflammatory factors are secreted, existing ones are broken down, and neutrophils and macrophages decrease in numbers at the wound site. This is end of the inflammatory phase.
This phase plays a big part of fighting infections, clearing debris and inducing the proliferation phase. This phase is a necessary part of the healing process. If this phase lasts too long it can lead to more tissue damage, so it is also important to reduce inflammation in therapeutic settings. Make sure the wound is clear of dirt or other objects, since this can extend the inflammatory phase which can lead to a chronic wound issue.

**Proliferative phase**

About two to three days after the injury, fibroblasts (any cells from which connective tissue develops; they produce collagen, elastin, and reticular protein fibers) begin make their way into the wound site, before the inflammatory phase ends.

**Angiogenesis**

This might also be called the neovascularization, this process of angiogenesis occurs concurrently with fibroblast proliferation when the endothelial cells migrate to the area of the wound. Since this process of fibroblasts and epithelial cells requires oxygen and nutrients, angiogenesis is required for the other stages of wound healing, including the epidermal and fibroblast migration. This tissue often has the appearance of looking red (erythematous) because of the presence of capillaries.

The stem cells of the endothelial cells that have originated from the parts of uninjured blood vessels develop pseudopodia and push through the EMC and into the wound site to produce new blood vessels.

**Fibroplasia and granulation tissue formation**

At the time of angiogenesis, fibroblasts begin accumulating in the wound site. Fibroblasts arrive at the wound site two to five days after the wound injury and at the end of the inflammatory phase. Fibroblasts peek at one to two weeks post
injury and are the main cell in the wound by the end of that first week. They lay down a collagen matrix in the wound site. They later add collagen which they adhere to for migration. This process ends two to four weeks post wound.

Granulation now becomes the rudimentary tissue, and begins to appear in the wound even during the inflammatory phase and continues growing until the wound bed is covered. Granulation tissue consists of new blood vessels, fibroblasts, inflammatory cells, endothelial cells, myoblasts, components of a new, and provisional extracellular matrix (ECM). The provisional EMC is different than in the composition from the ECM in normal tissue and its components originate from fibroblasts. The components included in this matrix are fibronectin (opsonic proteins), collagen, glycosaminoglycan (a complex polysaccharide), elastin, glycoproteins and proteoglycans. The main components include hyaluronan (hyaluronic acid) and fibronectin with these creating a very hydrant matrix and facilitate cell migration. This matrix will be replaced with an EMC that resembles in the matrix found in non – injured tissue.

**Collagen deposition**

Fibroblasts’ most important job is the production of collagen deposition, because it increases the strength of the wound. Cells that are involved in the inflammation process for the connective tissue construction attach, grow and differentiate on the collagen matrix laid down by the fibroblasts.

At the end of the granulation phase, fibroblasts begin to commit apoptosis, converting granulation tissue from an environment rich in cells, to one that consists mainly of collagen.

**Epithelialization**

Epithelialization is the process of granulation tissue growing over an open wound. Re-epithelialization phase takes place as the epithelial cells migrate across the new tissue to form a barrier between the wound and the environment. Basal keratinocytes from the wound edges and dermal appendages such as hair follicles,
sweat glands and sebaceous (oil) glands are the main cells responsible for the epithelialization phase of the wound healing. These cells move in a sheet across the wound site and proliferate at its edges, ceasing movement when they meet in the middle. These cells result in a scar, and neither sweat glands nor hair follicles form.

If the base membrane is not breached, the epithelial cells are replaced within three days of division; then upward migration of the cells in the stratum basale begins in the same fashion that occurs in uninjured skin. If the base membrane is ruined at the wound site then migration may only happen from the wound edges.

**Contraction**

Contraction happens during the wound healing process. If this continues too long, then it can lead to loss of function and disfigurement. It starts about a week after healing begins, when fibroblasts have become myoblasts in full thickness wounds. Contraction peaks between five to fifteen days post wound. This can last for several weeks, and continues even after wound is re-epithelialized.

**Maturation and remodeling**

Maturation phase has begun when the levels of collagen production and degradation equalize. During this phase, Type III collagen is replaced by Type I collagen. This phase may vary depending on the size of the wound and if it was an open or a closed wound. The tensile strength of the wound increases usually to 50% by three months. As activity around the wound decreases the scar will start to lose its red appearance as blood vessels are no longer needed and removed by apoptosis.

**Growth factors**

Here is a chart that gives an overview of the involvement of growth factors in wound healing:
<table>
<thead>
<tr>
<th>Growth Factor</th>
<th>Abbreviation</th>
<th>Main Origins</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epidermal growth factor</td>
<td>EGF</td>
<td>Activated macrophages Salivary Glands Keratinocytes</td>
<td>Keratinocyte &amp; Fibroblast mitogen Keratinocyte migration Granulation tissue formation</td>
</tr>
<tr>
<td>Transforming growth factor-α</td>
<td>TFG-α</td>
<td>Activated macrophages T-lymphocytes Keratinocytes</td>
<td>Hepatocyte &amp; epithelial cell proliferation Expression of antimicrobial peptides Expression of chemotactic cytokines</td>
</tr>
<tr>
<td>Hepatocyte growth factor</td>
<td>HGF</td>
<td>Mesenchymal cells</td>
<td>Epithelial &amp; endothelial cell proliferation Hepatocyte motility</td>
</tr>
<tr>
<td>Vascular endothelial G.F.</td>
<td>VEGF</td>
<td>Mesenchymal cells</td>
<td>Vascular permeability Endothelial cell proliferation</td>
</tr>
<tr>
<td>Platelet deprived growth Factor</td>
<td>PDGF</td>
<td>Platelets Macrophages Endothelial cells Smooth muscle cells Keratinocytes</td>
<td>Granulocyte, macrophages, fibroblast &amp; smooth muscle cell chemotaxis Granulocyte, macrophage &amp; fibroblast activation Fibroblast, endothelial cell &amp; smooth muscle cell proliferation Matrix metalloproteinase, fibronectin &amp; hyaluronan production Angiogenesis Wound remodeling Integrin expression regulation</td>
</tr>
<tr>
<td>Fibroblast growth factor 1 and 2</td>
<td>FGF-1,-2</td>
<td>Macrophages Mast cells T-lymphocytes Endothelial cells Fibroblasts</td>
<td>Fibroblast chemotaxis Fibroblast &amp; keratinocyte proliferation Keratinocyte migration Angiogenesis Wound contraction Matrix (collagen fibers) deposition</td>
</tr>
<tr>
<td>Transforming growth factor-β</td>
<td>TGF-β</td>
<td>Platelets T-lymphocytes Macrophages Endothelial Cells Keratinocytes Smooth muscle cells Fibroblasts</td>
<td>Granulocyte, macrophage, lymphocyte, fibroblast, &amp; smooth muscle cell chemotaxis TIMP synthesis Angiogenesis Fibroplasia Matrix metalloproteinase production inhibition Keratinocyte proliferation</td>
</tr>
<tr>
<td>Keratinocyte growth factor</td>
<td>KGF</td>
<td>Keratinocyte</td>
<td>Keratinocyte migration, proliferation &amp; differentiation</td>
</tr>
</tbody>
</table>

*Growth Factor (G.F.) Chart 1 of 9:
Complication of wound healing

Major complications are:

1. Deficient Scar Formation: Resulting in wound dehiscence or Rupture of the wound due to inadequate formation of granulation tissue.
2. Excessive Scar formation: Hypertrophic scar, keloid, desmoid.
4. Deficient Contraction (in skin graft) or excessive contraction (in burns).
5. Others: Dystrophic calcification, pigmentary changes, painful scars, incisional hernia, etc.

Keep in mind the different types of skin as we grow older:

Fetal skin has increased amounts of hyaluronic acid (a viscous fluid carbohydrate present in connective, epithelial and neural tissue. One of the chief components of extracellular matrix) associated with fetal scar-less healing. Neonatal skin is more permeable due to immature stratum corneum (the outer most horny layer of the epidermis). During the first two weeks of life, infants have thinner skin and nails, and epidermal stripping can occur easily. Elderly skin has a 50% reduction in cell turnover rate in the stratum corneum and a 20% reduction in the dermal thickness.

Surgical Wound Classification

The purpose of surgical wound classifications is to determine the potential for surgical wound infection. The definition of a:

A. Clean wound is a non-traumatic, uninfected operative wound in which the respiratory tract, alimentary tract, genitourinary tract, or oropharyngeal tract are not entered. Clean wounds are elective, primarily closed, and un-drained wounds. Also known as Class I.
B. Clean Contaminated wounds are operative wounds in which the respiratory tract, alimentary tract, genitourinary tract, or oropharyngeal tract are
entered in a controlled manner, without unusual contamination, wounds which are mechanically drained, and fractures. Also known as class II.

C. Contaminated wounds include open, fresh traumatic wounds, operation with a major break in sterile technique (e.g., open cardiac massage) and incisions encountering acute, non-purulent inflammation. Also known as class III.

D. Dirty and infected wounds include old traumatic wounds and those involving clinical infection or perforated viscera. The very definition of this classification suggests that the organisms causing postoperative infection are present in the operative field before the operation even starts. Also known as class IV.

Examples of this are:

| Class I | Operative wound clean | Non-traumatic
| Clean | Non-traumatic | No inflammation encountered 
| Clean | No break in surgical technique, Gastrointestinal surgery (without spillage): | Appendectomy, Gallbladder, biliary tracts without infected bile 
| Contaminated | Respiratory (ENT) surgery: | Tonsillectomy, Sinus Surgery 
| | Genitourinary Surgery: | Urology surgeries, Vagina entered 
| | Alimentary surgery: | The digestive system 
| | | Examples: Thoracic procedures (except mediastinoscopy I, Inflammation / foreign body III, Infected IV) 
| | | GI procedures 
| | | GYN procedures 
| Class I | Operative wound clean | Vascular procedures 
| | Contaminated | Thoracic procedures (except mediastinoscopy I, Inflammation / foreign body III, Infected IV) 
| | | GI procedures 
| | | GYN procedures 
| Class I | Operative wound clean | Orthopedic surgeries 
| | Contaminated | Eye Surgeries 

Examples:
<table>
<thead>
<tr>
<th>Fractures</th>
<th>Fractures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Class III</strong>&lt;br&gt;Contaminated</td>
<td>Major break in technique (rips in gloves with puncture of the skin, Persistent coughing and sneezing in to the mask)&lt;br&gt;Gross spillage from the gastrointestinal tract&lt;br&gt;Traumatic wound, fresh&lt;br&gt;Entrance of the genitourinary in presence of infected urine&lt;br&gt;Entrance of the Biliary tracts in presence of infected bile&lt;br&gt;Pins present that pierce skin (like external-fixators for removal)</td>
</tr>
<tr>
<td><strong>Class IV</strong>&lt;br&gt;Dirty and infected</td>
<td>Acute bacterial infection and inflammation encountered, without pus&lt;br&gt;Puss is always a IV&lt;br&gt;Transection of “clean” tissue for the purpose of surgical access to a collection of pus&lt;br&gt;Perforated viscus (any internal organ enclosed within a cavity such as abdomen) encountered&lt;br&gt;Traumatic wound with retained devitalized tissue, foreign bodies, fecal contamination and / or delayed treatment from a dirty source</td>
</tr>
</tbody>
</table>

Chart 2 of 9:

These wound classes are a reflection of the probability of an infection and wounds should be classified at the end of a surgical procedure. The debriefing is a perfect time to address the wound class and should be documented in charting.
Proper Wound Care

Proper wound care is important and necessary to prevent infection. Before starting wound care the most important first step is to always wash ones hands with soap and (clean) water. Avoid touching a wound and use disposable gloves while treating a wound. Sterile gloves may be appropriate in some situations.

Remove obstructive jewelry and clothing from the injured body part. It will also be important to assure there are no other associated injuries, and to promote healing of the wound. An additional goal would also be to have good cosmetic result after the wound has completely healed.

When is it appropriate to seek medical care for a wound? Most wounds can be treated at home with routine first aid including a thorough washing with tap water, possibly antibacterial ointment and a dressing to prevent infection. Here are some reasons to seek medical care for a wound.

- If a wound is due to significant force or trauma since there is a possibility of other injuries as well.
- If bleeding cannot be stopped with persistent pressure and elevation of the effected limb. Bleeding should usually stop within 10 minutes.
- If there is a possibility that the wound would need stiches to repair the injury. Most facial wounds may need to be examined and repaired for cosmetic reasons for example, the lip. Any wounds around, or if they affect, the eye.
- If a wound is caused by a bite, either animal or human. Leave bites open, this will stop bacteria from being trapped, leading to infection.
- If the wound is very dirty and it cannot be cleared of the debris.
- If there is evidence of infection including increased pain, redness, swelling or pus at the wound.
- It is always important to make sure tetanus immunizations are up to date, if not a booster is recommended within 48 hours. If the patient has never had a tetanus injection it would be important to give immediately.
If a wound needs medical care then the health care professional will make sure there are no associated injuries with the wound, and that the risk of infection is minimized. An example of this would be a patient that falls and hits their chin; they may be at risk for a jaw fracture.

When working with a patient it is important to get a clear history around the injury. The mechanism of injury could affect how care is provided. Other important influences of care would be if the patient has diabetes, poor circulation, on dialysis, or taking medications that would compromise their immune system putting them at a higher risk for infection. The time from when the injury occurred to the time treatment was sought is also a consideration. The longer a wound is open the higher the risk of infection.

Lacerations of the extremities including legs, arms, feet, and hands may involve tendons, nerves, and arteries. Assessing their function is an important part of treating an injury, to see if further workup is needed.

Primary wound closures: As a health care provider our first step is to clean the wound, and explore the area for foreign bodies. This is the time when assessment for underlying structure damage can take place. If no underlying issues are discovered, and if the wound is not too old, it may be closed with sutures, staples or surgical glue.

Wounds can be closed using sutures, staples or surgical glue. Other wound dressing might include tegaderm or hydrogel to promote healing instead of suturing the elderly due to very fragile skin that is difficult to repair.

Antibiotics maybe prescribed to prevent infection if a wound involves an animal or human bite (which may also need to go to surgery), wounds exposed to bodies of water like rivers, lakes or any contaminated water, or significantly “dirty” wounds. Antibiotics may also be prescribed if underlying structures are involved.
Other risk factors that influence wound healing are:

- Respiratory problems
- Atherosclerosis
- Coronary artery disease
- Peripheral vascular disease
- Congestive heart failure
- Malignancies
- Anemia
- HIV / AIDS
- End – stage renal disease
- Thyroid disease

**Things we can do to prevent wounds**

In the health care setting, when working with our patients there are things that we can do to help prevent pressure ulcers (sores). Pressure ulcers alone are a significant complication of hospital patients, and leads to high treatment cost ranging from $2,000 to $70,000 per wound. This does not compare to the human cost of a non-healing wound.

In the inpatient side of health care, patients positioning can play a very important role in preventing pressure ulcers (sores). Not only does pressure create ulcers but so can friction, shear forces and moisture can combine to produce pressure ulcers and occasionally necrosis. If not treated immediately and vigorously, the ulcer can go from a simple red patch to erosion into the subcutaneous tissues, eventually reaching to muscle or bone. Deep ulcers often become infected with bacteria and can lead to being gangrene.

The Agency for Health Care Policy and Research defines a pressure ulcer as any lesion caused by unrelieved pressure that results in damage to underlying tissue. As a result of the tissue compression combined with inadequate
perfusion, damage may be observed immediately (e.g. reddened appearance of skin) or may not appear until several days after the tissue is exposed to unrelieved pressure. These pressure ulcers typically occur in patients who are chair or bed bound. Patients with sensory and mobility deficits (e.g. patients with spinal cord injury, stroke, or coma); malnourished, peripheral vascular disease, hospitalized elderly patients; nursing home residents are all at risk. Some evidence also suggests that incontinence is also a risk factor.

Maintaining clean skin and moisturizing frequently can protect skin integrity. Make sure to clean patient with warm water and a gentle soap. Always avoid hot water and scrubbing the patient. Use soft cloths and always pat the skin, do not rub.

The most common skin sites for break-down is over bony prominences including the sacrum, and the trochanters (the bony prominence below the neck of the femur), the heels, the lateral malleoli (the bony protuberance on both sides of the ankle joint), shoulder blades, ischial tuberosities (hip), occiput (back part of skull), ear lobes, elbows, and iliac crest.

Even short periods of time may produce a condition known as reactive hyperemia (i.e., reddened skin that develops after the arrest and subsequent restoration of the blood supply to a body part). Reactive hyperemia resolves without treatment and is differentiated easily from pressure injuries by noting that the reddened skin are blanches under fingertip pressure. These reddened skin areas usually fade within one half to three fourth of the length of the time that pressure was applied. For example, a reactive hyperemia lesion noted after two hours of immobility in a surgical position should disappear within one to one and a half hours after the surgery.

Pressure ulcer formations are categorized in stages, depending on the degree of tissue damage. Treatment is customized to the stage of ulcer development.
Staging ulcers:

**Stage I:** Intact skin is reddened and does not blanch (non-blanchable redness) to fingertip pressure of a localized area usually over a bony prominence. Darkly pigmented skin may not have visible blanching however its color may differ from the surrounding area. This area may be painful, firm, soft, warmer or colder to adjacent tissue. This lesion signifies the beginning of pressure injury.

Signs of a deep tissue injury may be the affected area appears purple or maroon in a localized area of discolored intact skin or blood filled blister due to damage of the underlying soft tissue from pressure and/or shear. The area may be preceded by tissue that is painful, firm, mushy, boggy, warmer or colder as compared to adjacent tissue. Deep tissue may be difficult to detect in individuals with dark skin tones. Evolution may include a thin blister over a dark wound bed. The wound may further evolve and become covered by thin eschar (dead matter that is cast off from the surface of the skin, and if often crusty or scabbed). Evolution may be rapid exposing additional layers of tissue even with optimal treatment.

Dressing choices: (primary dressing)

- No dressing
- Moisture barriers
- Skin Sealant
- Transparent adhesive

**Stage II:** Skin is abraded (chafed, roughen or removed), blistered, has shallow craters or open ulcer with a red pink wound bed. In this stage the area may present as an intact or open / ruptured serum – filled blister. Further description of this stage the area may present as shiny or dry shallow ulcer without slough or bruising which would indicate suspected deep tissue injury. This stage should not be used to describe skin tears, tape burns, perineal dermatitis, maceration (waste / wear away) or excoriation (abrasion). This
stage is characterized by partial-thickness skin loss involving the epidermis and dermis.

Dressing choices: (primary dressing)

- Hydrocolloid every 3 days and as necessary
- Adhesive foam every 3 days and as necessary
- Baza protect if dressing does not adhere

**Stage III:** Deep craters are present with or without undermining and tunneling deep sinus tract in the tissues. Full-thickness skin loss occurs and may extend down to, but not through underlying fascia. No bone, tendons or muscle will be exposed. Further description of a stage III pressure ulcer varies by anatomical location, since the nose, ear, occiput and malleolus do not have subcutaneous tissue and stage III ulcers can be shallow. In contrast, areas of significant adiposity (fatty) can develop extremely deep stage III pressure ulcers and in this case Bone or tendons may not be visible or directly palpable.

Dressing choices: (primary dressing) Minimum drainage 0 – 25% exudate

- Moist saline / gauze cover 3 time daily
- Or Solosite gel / gauze everyday
- Or Hydrocolloid everyday & as necessary
- Wound consult

Moderate to heavy drainage 25 – 100% exudate: (packing dressing)

- Barely moist saline gauze three times daily
- Or Calcium alginate / gauze every other day and as necessary
- Wounds not requiring packing foam every three days and as necessary
- Wound consultant: Evaluation for Wound VAC

**Stage IV:** Includes extensive damage to the muscle, bone, and supporting structures develops, tunneling and undermining, deep sinus tracts may be present. Slough or eschar may be present on some parts of the wound. The
depth of a stage IV pressure ulcer varies and can extend into muscle and / or supporting structures (e.g., fascia, tendon, or joint capsule) making osteomyelitis possible. Exposed bone and tendon are visible or directly palpable.

Dressing choices: Keep dry and stable until perfusion established. MD / Wound consult.

- No adhesive to skin!
- Approximate skin flap with steri strips
- Apply Bacitracin / Telfa or nonadhesive or cover with Vaseline gauze
- Secure dressing with conform gauze

**Unstageable:** Full thickness tissue loss in which the base of the ulcer is covered by slough (yellow, tan, gray, green, or brown) and / or eschar (tan, brown, or black) in the wound bed. Until enough slough or eschar is removed to expose the base of the wound, the true depth, and therefore staging may not be determined until this process happens. Stable (dry, adherent, intact without erythema or fluctuance) eschar on the heels serves as “the body’s natural (biological) cover” and should not be removed. Erythema is reddening of skin and fluctuance is a wavy impulse felt during palpation and is produced by the vibration of body fluid. Fluctuance is an indication of presence of pus in a bacterial infection. The skin overlying the pus remains red; touching the area produces a soft boggy feel. This boggy feeling is fluctuance.

The first skin assessment should be completed using Braden Risk Assessment scale. This Assessment tool helps to set a patient’s degree of risk for developing a pressure ulcer. All patients will receive a full body assessment of their skin condition upon an admission, at point of entry into a facility, every shift once admitted, and at the time of discharge. This includes assessing areas where orthotic or other external devices may come in contact with patient’s skin and cause pressure unless removal is contraindicated. Any pressure ulcer findings
need to be documented immediately in the medical records. It is also a good idea to take a picture of the ulcer at the start of admission.

Reporting of stage III and stage IV pressure ulcers, acquired after admission, is required under SB 1301 – Adverse Event Reporting which applies to acute care hospitals, acute psychiatric hospitals and specialty care hospitals which was effective July 1st, 2007. This excludes progression of stage II to stage III if documented on admission this is where a picture may come in to play after admission.

Routinely assess and document the patient’s RISK for development of pressure ulcers whenever there is a change in the patient’s condition including a transfer to a higher level of care, or level of sensory perception.

When a patient enters through an Emergency Room (ER) they will go through a Medical Screening Examination (MSE) includes screening skin assessment. For patients at a higher risk for pressure ulcers complete skin assessment may be required as part of the emergency room departments visit.

It is important to note that “inclusive criteria for complete assessment” includes:

- ED patients who are not ambulatory (gurney or wheelchair bound) and do not meet exclusionary criteria below.
- ED patients who are incontinent.
- Patients who are admitted (inpatient, operating room or 23 hour stay).
- Patients who transferred from a SNF or ECF or waiting transfer to SNF ECF.
- Patients admitted to the ED with a chronic alteration in mental status (who may not be able to articulate skin issues)
- Patients with moderate or severe dependent edema and do not meet exclusionary criteria below.

Patients’ meeting the screening criteria above should be assessed (MSE /ESI) by patient’s primary RN and a complete skin assessment should be completed. The
skin assessment includes the RN visualizing the skin for evidence of pressure – induced skin redness or ulceration, anteriorly and posteriorly.

Exclusion criteria for complete skin assessment would be:

- Patients with minor illnesses / injuries (sore throats, limb lacerations, URI symptoms etc.)
- Instable patients who are in “critical condition”. Complete skin assessment may be deferred until the inpatient admission. Observed problems or ulcers should be documented in the nursing record and noted during the hand off of the patient.

For ED patients where complete skin assessment is indicated by inclusionary of exclusionary criteria above, the assessment must be documented as having been done, whether or not pressure ulcer exists. This includes assessing areas where orthotic or other external devices may come in contact with a patient’s skin and cause pressure unless contra-indicated.

Photographing pressure ulcers may be required by Medical Center Local policy and procedure. Photographs, when taken, should include the date, time and patient’s insurance or admission number.

Pressure ulcer documentation should include:

- The location which may be charted on a body map.
- Size, height and width, depth if applicable.
- Color such as yellow, necrotic, beefy pink, dry black eschar, non-blanchable erythema on intact skin, etc.
- Document presence of erythema over bony prominences if applicable.

For all patients in the ED awaiting a hospital bed will receive the inpatient assessment through the process and timeline description of the hospital policies and procedures. The presence of pressure ulcers or risk factors may be a consideration in prioritizing a patient for bed placement for the ED patients
awaiting a bed in the hospital. This information should be communicated to the manager or designee for the shift.

ER patients (can be used for inpatients) the **S.K.I.N. Bundle** an acronym for 4 Key interventions can be used. When implemented, “S.K.I.N.” can simultaneously provide synergistic effect which promotes the desired outcome of maintaining skin integrity. S = surfaces, K = keep turning, Incontinence / moisture and N = nutrition.

**S:** Support surface for pressure redistribution: Sensory perception &/or mobility Braden sub-score less than or equal to 2. Do not use “donut” type devices. Use pressure relieving pads on operating tables and other pressure relieving positioning devices as necessary to relieve anticipated pressure during surgical procedures.

**K:** Keep turning and repositioning including mobilizing: Sensory perception, mobility, and / or friction / shear Braden sub – score less than or equal to two. The plan would be to systematically reposition the immobile patient at least every two hours around the clock while in bed including on specialty beds and pressure redistribution mattresses, and at least every hour when seated in a chair. Apply appropriate surface to chair. This would be true for a patient in an inpatient setting.

Position patient using 30 degree lateral side to side shifts in position. Avoid the 90 degree side lying position, because of the increased pressure directly over the trochanter. Supplement full-body repositioning with minor shifts in weight to redistribute pressure points. Use pillows or foam wedges in order to maintain a position. Have an overhead trapeze on the bed whenever possible to allow the patient ability to assist in moving themselves.

Avoid positioning directly on the trochanter (hip) or on any surface with an existing pressure ulcer.

Teach and encourage the patient to shift weight every 15 minutes while in a chair and frequently while in bed unless medically contraindicated. Limit the time in a
chair to one hour or less at a time. If at-risk patient needs to sit longer, physician’s orders may be required, within the different facilities and states. This may also require frequent nursing assessment and intervention as needed, and require very clear and detailed documentation. A physical therapy referral may be needed where appropriate.

Use pillows, foam wedges or gel pads to prevent direct contact with surfaces or other bony prominences where needed. Suspend heels using pillows and place pillows lengthwise beneath the calves, or use commercial suspension devices when available. Keep linens clean, dry and wrinkle free.

Avoid massage over bony prominences. Maintain 30 degrees or less, limiting the amount of time the head is elevated at a higher elevation. Use teamwork and patient mobility to help with patients to transfer in bed. Avoid shearing and friction by lifting not dragging the patient. Do not use friction linens, for example towels or bath blankets to move a patient. Friction reducing devices may include equipment such as a SLIPP mat or Hover mat.

Use moisturizing creams, lubricants, or protective transparent film to also protect the skin from injury.

I: Minimize or eliminate moisture (moisture Braden sub – score less than or equal to 3): Try to eliminate the source of moisture. Assess and treat for reversible cause(s) of incontinence. Check incontinent patients every one to two hours to meet elimination needs, while offering a bedpan, commode or toilet. Use absorbent incontinent pads on bed.

Use (adult) incontinent briefs on patients when ambulation or during rehabilitation activities. Use brief when the patient is sitting up in a chair during meal time. When traveling to another department or facility with communication to the receiving department and / or the person responsible for checking and changing the patient if needed.
When possible utilize a containment device such as an external catheter, retracted penis pouch, or fecal incontinence collector. Cleanse after each incontinent episode, pat dry, and apply a thin film of moisture barrier ointment.

Evaluate the patient’s incontinence device regularly if a foley catheter or alternative indwelling fecal system is used. Evaluate for skin barriers and / or pouching if the patient has drainage from drains, tubes or wounds. Protect the wound site with skin barriers or sealants on peri-wound skin when applying and changing dressings as needed.

Protect fragile skin using minimal friction, washing the patient’s skin with a mild skin cleaner using warm water, rather than hot water. Moisturize the patient’s skin as needed to minimize environmental factors that can dry the skin. This could include heating or cooling (pads), blankets or ice packs.

Avoid unnecessary adhesives; utilize netting or gauze wraps rather than tape on fragile skin. Consider other means rather than tape to secure dressings for fragile skins. Carefully remove prep solutions and blood from the patient’s skin around dressings and anywhere they are visible including under the patient. Ensure that the patient is on clean and dry linen on gurney or bed at the end of a surgical procedure.

**N**: Optimize nutritional and hydration status (Nutrition Braden sub – scale less than or equal to two. Initiate and follow recommendations of the nutritional services consult. Monitor pre-albumin levels and avoid prolonged NPO status. Monitor food and fluid intake. Assist with feeding and fluids as necessary. Make sure the patient chews food completely before swallowing. Always offer the patients something to drink in between meals or with snacks. Make sure the patients are weighed on arrival so that weight can be monitored throughout inpatient stay.

Patient hand-off should include patient’s risk assessment and skin appearance including integrity. This is a very important part of nursing documentation for
hand-off including shift, departmental change or transfer to other services including home health, hospice and specialized nursing facility (SNF).

Document all pressure ulcer risk assessment and prevention interventions in the medical record. Risk assessment should be documented on the shift assessment section of charting using the Braden Scale. Assess each parameter bases on the patient’s current condition, except nutrition, which is the “usual food intake pattern”. Score total automatically and if the facility used the SKIN bundle cascades for any patient with the risk score of 18 or less. If the facility uses the SKIN bundle identify at risk breakdown and make sure to document the risk specific interventions used.

Educate the patient and caregivers on appropriate skin care regimen based on the skin assessment and Braden scale scores. Include the discharge planner and/or social worker if appropriate. If appropriate, a Home Health referral may be initiated for open ulcer treatment especially if there will not be a caregiver.

The prevention of hospital acquired pressure ulcers is a high priority for all facilities and a requirement for Medicare and Medical reimbursement. The opportunities to prevent, as well as appropriate management and heal acquired pressure ulcers are addressed in this course.

Remember the Braden Scale scores are completed on admission, daily (including day of discharge), within 8 hours of surgery, and whenever the condition of a patient changes related to sensory perception, moisture, activity, mobility, nutrition, friction and / or shear. Initiate the Pressure Ulcer Prevention Protocol for any patient scoring ≤ 18. Patients that are older than 65 years experience pressure ulcers more frequently.

Perioperative skin risk assessment is done at the time of admission to the perioperative area (pre-op), unless the patient is an inpatient. The initial skin assessment is done using the Braden Scale and documented in the admission area of charting. The OR RN must be notified of any patient with a Braden score of 18 or
less, before the patient is moved to the OR. If the patient is an inpatient, the patient’s skin is inspected for any sign of skin breakdown that is not already documented in the patient’s medical record.

Exclusion criteria may include:

- Ambulatory patients’ for procedures of less than two-hour duration.
- Unstable patients’ (critical condition). Complete skin assessment may be deferred until the inpatient admission. Observed problems or ulcers should be documented in the nurses charting and noted during the hand off.

For all patients with existing pressure ulcers or skin areas of concern, photos will be taken and attached to the medical record prior to surgery. Be sure to date the photos and add the patient’s name and medical record number.

As part of the patients handoff to PACU, ICU, or other patient care areas (including change of shift), discuss the potential for pressure development during the procedure and measures taken to prevent the pressure.

Describe the patient’s position in the OR and potential pressure areas.

Describe any signs and symptoms of pressure noted at the end of the surgical procedure and whether the signs and symptoms were present on admission or developed during the surgical stay. Describe the appearance of the skin over all bony prominences or other areas of pressure after the patient was moved to the gurney or transport bed.

See Braden Scale on next page below:
# Braden Risk Assessment Scale

**Instructions:**

1. Assess patient’s risk to skin breakdown.
2. To calculate a Braden Score, choose the appropriate score from each category and total them.
3. If a category score falls between two numbers, choose the lower score.
4. Calculate a Braden Score upon admission and every 24 hours afterward and document on the patient care flow sheet.
5. If score is 18 or lower, initiate recommended interventions for each category.

<table>
<thead>
<tr>
<th>Sensory Perception: Ability to respond meaningfully to pressure related discomfort.</th>
<th>Braden Category</th>
<th>Braden Score: 1</th>
<th>Braden Score: 2</th>
<th>Braden Score: 3</th>
<th>Braden Score: 4</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completely limited: Unresponsive (does not moan, flinch or gasp) To painful stimuli, die to diminished level of consciousness or sedation, OR, Limited ability to feel pain over most of body surface</td>
<td></td>
<td>Very limited: Responds only to painful stimuli. Cannot communicate discomfort except by moaning or restlessness. OR has sensory impairment, which limits the ability to feel pain or discomfort over ½ of the body.</td>
<td>Slightly limited: Responds to verbal commands but cannot always communicate discomfort or need to be turned. OR Has sensory impairment, which limits ability to feel pain or discomfort in 1 or 2 extremities.</td>
<td>No limitation: Responds to verbal commands. Has no sensory deficit, which would</td>
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<tr>
<td>Moister: Degree to which skin is exposed to moisture.</td>
<td>Constantly Moist: Skin is kept moist almost constantly by perspiration, urine, etc. Dampness is detected every time patient is moved or turned</td>
<td>Moist: Skin is often but not always moist. Linen must be changed at least once a shift.</td>
<td>Occasionally Moist: Skin is occasionally moist, requiring an extra linen change approximately one a day.</td>
<td>Rarely Moist: Skin is usually dry: linen requires Changing only at routine intervals.</td>
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<tr>
<td>Activity: Degree of Physical activity.</td>
<td>Bedfast Confined to bed.</td>
<td>Chair Fast: Ability to walk severely limited or nonexistent. Cannot bear own weight and/or must be assisted into chair or wheelchair.</td>
<td>Walks Occasionally: During the day but for very short distances, with or without assistance. Spends majority of each shift in bed or chair.</td>
<td>Walks Frequently: Walks outside the room at least twice A day and inside the room at least once Every 2 hours during waking hours.</td>
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<tr>
<td>Mobility: Ability to change and control body position.</td>
<td>Completely Immobile: Does not make even slight changes in body or extremity position without assistance.</td>
<td>Very Limited: Makes occasional slight changes in body or extremity position but unable to make frequent or significant change independently.</td>
<td>Slightly Limited: Makes frequent though slight changes in body or extremity position independently.</td>
<td>No Limitations: Makes major and frequent changes in Position without assistance</td>
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<tr>
<td>Nutrition: Usual food Intake pattern.</td>
<td>Very Poor: Never eats a complete meal. Rarely eats more that ¾ of any food offered. Eats 2 servings or less of protein (meat or dairy products) per day. Takes fluids poorly. Does not take a liquid dietary supplement. OR Is NPO and/or maintained on clear liquids or IV for more than 5 days.</td>
<td>Probably Inadequate: Rarely eats a complete meal. Generally eats only about ¾ of any food offered. Protein intake includes only 3 servings or meat or dairy products per day. Occasionally will take a dietary supplement. OR Receives less than optimum amount of liquid diet or tube feeding.</td>
<td>Adequate: Eats over ¾ of most meals. Eats a total of 4 servings of protein (meat and dairy products) each day. Occasionally will refuse a meal, but will usually take a supplement if ordered. OR Is on tube feeding or TPN regimen, which probably meets most nutritional needs.</td>
<td>Excellent: Eats most of every meal. Never refuses a meal. Usually eats a total of 4 or more servings Of meat and dairy products. Occasionally Eats between meals. Does not require supplements.</td>
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<tr>
<td>Friction and Shear</td>
<td>Problem: Requires moderate to maximum assistance in moving. Complete lifting without sliding against sheets is impossible. Frequently slides Down in bed or chair, requiring frequent repositioning with maximum assistance. Spasticity, contractions or agitation lead to almost constant friction.</td>
<td>Potential Problem: Moves feely or requires minimum assistance. During a move, skin probably slides to some extent against the sheets, chair, restraints or other devices. Maintains relatively good position in chair or bed most of the time but occasionally slides down.</td>
<td>No apparent problem: Moves in bed and in chair independently and has sufficient muscle strength to lift up completely during move. Maintains good position in bed or chair at all times.</td>
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<tr>
<td>Braden Category</td>
<td>Braden Score: 1</td>
<td>Braden Score: 2</td>
<td>Braden Score: 3</td>
<td>Braden Score: 4</td>
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<td>Sensory Perception</td>
<td>Completely Limited Skin Assessment and inspection q shift. Surface: Access for specialty mattress or bed. Use bed cradle under linen. Use pillows between the knees and boney prominences to avoid direct contact.</td>
<td>Very limited Surface: assess for specialty mattress or bed. Use bed cradle under linen.</td>
<td>Slightly limited</td>
<td>No limitation Encourage patient to report pain over boney prominences, No intervention required.</td>
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<tr>
<td>Activity *Use lifts and hover mats with positioning.</td>
<td>Bedfast: Skin assessment and inspection q shift. Position prone if appropriate. Position with pillows to elevate pressure points off of the bed.</td>
<td>Chair fast: Provide trapeze. Consider postural alignment, weight distribution, balance, stability, and pressure relief when positioning individual in chair or wheelchair. Provide appropriate seating surface. Instruct patient to reposition q 15-30 minutes when in chair. Pad boney prominences with foam wedges, rolled blankets or towels. Consider physical therapy consult (done by MD)</td>
<td>Walks Occasionally: Provide structured mobility plan. Consider physical therapy consult (done by MD)</td>
<td>Walks Frequently: Encourage ambulatory outside the room at least bid. No interventions required.</td>
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<tr>
<td>Mobility *Use lift and hover mats with positioning.</td>
<td>Completely Immobile: Skin assessment and inspection q shift. Turn q 1-2 hours. Post turning schedule. Frequent small shifts of body weight.</td>
<td>Very Limited: Turn q 2 hours. Post turning schedule.</td>
<td>Slightly Limited: Ensure Patient turns q 2 hours.</td>
<td>No Limitations: Encourage ambulating outside the room at least bid. No interventions required.</td>
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<tr>
<td>Nutrition</td>
<td>Very Poor: Skin assessment and inspect q shift. Nutrition consult, Offer Nutrition Supplements Monitor Nutritional intake if NPO for &gt; 24 hours, discuss plan with MD</td>
<td>Probably Inadequate: Nutrition consult, Offer Nutritional Supplements, Monitor Nutritional intake, Small frequent meals, If NPO for &gt; 24 hours, discuss plan with MD.</td>
<td>Adequate: Nutrition consult (if patient has a wound.) Monitor nutritional intake, Offer Nutritional Supplements (if patient has a wound.) Encourage family to bring favorite foods. If NPO for &gt; 24 hours, discuss plan with MD.</td>
<td>Excellent: Nutrition consult (it patient has a wound.) Out of bed for all meals. Provide food choices. Offer Nutritional Supplements (if patient has a wound.) If NPO for &gt; 24 hours, discuss plan with MD.</td>
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<tr>
<td>Friction and Shear *Use lifts and hover mats with positioning.</td>
<td>Problem: Skin assessment and inspection q shift. Minimum of 2 people + draw sheet to patient up in bed. Keep bed linens clean, dry and wrinkle-free. Apply transparent dressing or elbow / heel protectors to intact skin over elbows and heels. Elevate head of bed as little as possible and for as little time as possible.</td>
<td>Potential Problem: Keep bed lines clean, dry and wrinkle-free. Avoid massaging pressure points. Apply transparent dressing or elbow / heel protectors to intact skin over elbows and heels.</td>
<td>No apparent Problem: Keep bed linens clean, dry and wrinkle-free.</td>
<td>Chart 4 of 9</td>
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</tbody>
</table>
### Modified Braden Q Scale (for Pediatric Use)

**Mobility**
1. Completely immobile: Does not make even slight changes or in body or extremity without assistance.
2. Very limited: Makes occasional slight changes in or extremity position but unable to completely turn self independently.
3. Slightly limited: Makes frequent though slight changes in body or extremity position independently.
4. No Limitations: Makes major and frequent changes in position without assistance.

**Activity**
1. Bedfast: Confined to bed
2. Chairfast: Ability to walk severely limited or non-existent. Cannot bear own weight and / or must be assisted into chair or wheelchair
3. Walks occasionally: Walks occasionally during day, but for very short distances, with or without assistance. Spends majority of each shift in bed or chair.
4. All patients too young to ambulate: OR walks frequently: Walks outside the room at least twice a day and inside room at least once every 2 hours during waking hours.

**Sensory**
1. Completely limited: Unresponsive (does not moan, flinch, or grasp) to painful stimuli due to diminished level of consciousness or sedation, OR, limited ability to feel pain over most of the body surface
2. Very limited: Responds to only painful stimuli, Cannot communicate discomfort except by moaning or restlessness; OR, has sensory impairment that limits the ability to feel pain or discomfort over half of body.
3. Slightly limited: Responds to verbal commands, but cannot always communicate discomfort of need to be tuned OR, has some sensory impairment that limits ability to feel pain or discomfort in one or two extremities
4. No Impairment: Responds to verbal commands. Has no sensory deficit that would limit ability to feel or communicate pain or discomfort.

**Moisture**
1. Constantly moist: Skin is kept moist almost constantly by perspiration, urine, drainage, etc. Sampness is detected every time patient is moved or turned.
2. Very moist: Skin is often, but not always, moist. Linen must be changed at least every 8 hours.
3. Occasionally moist: Skin is occasionally moist, requiring linen change every 12 hours.
4. Rarely moist: Skin is usually dry, routine diaper changes; linen only requires changing every 24 hours.

**Friction & Shear**
1. Significant problem: Spasticity, contracture, itching or agitation leads to almost constant thrashing & friction
2. Very moist: Skin is often, but not always moist. Linen must be changed at least every 8 hours.
3. Potential problem: Moves feebly or requires minimum assistance. During a move skin probably slides to some extent against sheets, chair, restraints, or other devices. Maintains relative good position in chair or bed most of the time but occasionally slides down.
4. No apparent problem: Able to completely lift patient during position change, moves in bed and in chair independently & has sufficient muscle strength to lift up completely during move. Maintains good position in bed or chair at all times. *(Occurs when skin and adjacent bony surface slide across on another)*

**Nutrition**
1. Very Poor: NPO and/or maintained on clear liquids, or IVs for more than 5 days OR albumin <2.5mg/dl
2. Inadequate: is on liquid diet or tube feedings/TPN, which provide inadequate calories and minerals for age OR albumin <3 mg/dl OR rarely eats a complete meal and generally eats only about half of any food offered. Protein intake includes only 2 servings of meat or dairy products per day. Takes fluids poorly. Does not take liquid dietary supplements
3. Adequate: is on tube feedings or TPN, which provide adequate calories & minerals for age OR eats over ½ of most meals. Eats a total of 4 servings of protein (meat, dairy products) each day. Occasionally will refuse a meal, but will usually take a supplement if offered.
4. Excellent: Is on a normal diet providing adequate calories for age. For example eats most of every meal. Never refuses a meal. Usually eats a total of 4 or more servings of meat and dairy products. Occasionally eats between meals. Does not require supplementation.

**Tissue**
1. Extremely compromised: Hypotensive (MAP <50mm hg; <40 in a new born. Or Patient does not Physiologically tolerate position changes.
2. Compromised: Nonmotensive oxygen saturation may be < 95%; hemoglobin may be <10 mg/dl; capillary refill may be > 2 seconds; Serum pH is < 7.40.
3. Adequate: Normotensive oxygen saturation may be <95% hemoglobin may be < 10mg/dl; capillary refill may be >2 seconds; serum pH is normal.
4. Excellent: Normotensive, oxygen saturation > 95% normal hgb; capillary refill < 2 seconds

*Braden Q Scale for children <5 years – Adult Braden Scale for children > 5 years*
When considering what position to put a patient in, think of one of the standard positions. There are five standard positions:

1. **Supine**: In this position the patient is lying flat on their back with their face upward.
2. **Prone**: In this position the patient is lying horizontal with face and front side downward on the bed.
3. **Lateral**: In this position the patient will be on their side. In the operating room the patient will be placed with the affected / surgical side up.
4. **Sitting**: Usually a patient will be in a chair when in this position. However in the operating room this means the patient’s head of the bed is raised; the bottom of the bed is lowered so the patient appears to be in a lounge chair sitting. The “beach chair” positioner may also be used; however a leg rest may be used instead of lowering the legs.
5. **Lithotomy**: In this position the patient is on their back with their legs flexed and usually placed in some type of stirrup to hold this position. The legs and thighs are abducted. The lower part of the bed is taken off and lowered for access to the patient.

These positions can be modified according to each patient’s needs. In the operating room the position maybe modified according to the surgeons preferences, surgical approach, and patients’ physiologic requirements. Keep in mind the patient’s functions of his or her vital systems and their physical condition.

**Positioning**

Positioning is used throughout the health care area. Each patient may have special positioning needs whether they are having a procedure in the clinic, procedure room, emergency room, labor and delivery (including caesarian sections), or operating room. Even if they are in an inpatient setting they may also have special positioning needs and here are some considerations for all areas. Before
positioning or repositioning a patient, make sure all the materials needed for a position specific position are available. It is everyone’s responsibility to protect our patients from harm while positioning, and it is the nurse’s responsibility to make sure a patient is positioned correctly so that the pressure points are protected. Consider each body system when planning the patient’s position to prevent pressure, crushing, pinching, obstruction, or stretching. Proper body alignment is also important. This is also true when positioning a patient for any surgical procedure.

In procedure and operating rooms it is the circulating nurse who is responsible for placing the patient in a surgical position, with the guidance from the anesthesia provider and the surgeon. The anesthesia provider has the final work on positioning when the patient’s physiologic status and monitoring are in question.

There are always special considerations that need to be made. In complex cases positioning for example obese patients, the plan of care may include additional help in lifting and/or positioning the patient. Special devices or positioning aids may be necessary. The weight tolerance of the mechanism and mechanism of all beds and gurneys must be considered. To avoid questions or confusion, the weight tolerance should always be clearly labeled on all beds and gurneys.

**Supine**

Supine position is used for the majority of all procedures. When positioned in supine, the patient is placed on his or her back on the bed (including the operating or procedural room). The patient lies flat on his or her back with arms secured at the sides with the lifting sheet, and palms are extended along the side of body in their natural resting position. The elbows may be protected with plastic sleds, if needed use eggcreate for more padding. A patient’s arms in surgery may be placed and secured on arm boards. Additional eggcreate may be needed to support the arms.
An important consideration is the patient’s spinal column should be in a straight line with his or her legs parallel on the bed. A safety belt is placed across the thighs 2 inches above the knees. A pillow maybe used for the head, if not appropriate a small positioning pad (donut, etc.) may be used instead. Positioning pads may be needed under the popliteal area to relieve pressure on the spine as needed. The heels may need a gel pad, donut or pillow to protect them from pressure. The feet must not be in prolonged plantar flexion, or nerve stretch injury could result. To prevent footdrop, the soles may be supported by a pillow or padded footboard. This is also true of inpatients that are not able to move their own feet, for example recent stroke victims.

Footdrop may result in dragging of foot or toes while walking. This can be seen in patients who have had an injury to the nerve causing paralysis, or weakness in the nerves supplying the anterior tibial muscles creating plantar flexion.

Positioners:

- Headrest
- Pillow or other padding to place beneath the patient’s lower legs to reduce lower back strain.
- Roll or wedge to elevate patient’s right flank if patient is pregnant or morbidly obese.
- Extra-long draw sheet for tucking patients arms at sides during procedures or padded arms boards.
- Padded perineal post, if using a fracture table.

**Prone**

When positioned prone, the patient is placed face down on the bed. When the prone position is used, the patient’s arms are along his or her sides. If sequential devices are to be used they should be placed before the patient is moved. This should be verified in the timeout prior to a surgical procedure. The patient’s body
is rotated as if rolling a log; a team of at least four to six people is needed to maintain body alignment during this transfer.

Chest rolls or bolsters are placed on the bed in the area where the chest will rest. They will be placed under the axilla along the sides of the chest from the clavicles to the iliac crests. The chest rolls and bolsters raise the weight of the body from the abdomen and thorax. The weight of the abdomen will fall away from the diaphragm and thorax, keeping pressure off of the vena cava and abdominal aorta.

Keeping the weight off of this area facilitates respirations, although vital capacity and cardiac index are reduced. It is important to evaluate if a patient is able to tolerate this position for the amount of time the procedure will last.

Important considerations for patient’s in this position; for a woman, the breasts should be moved laterally to reduce the pressure on them. Male genitalia should be free from pressure. Pendulous skin folds should not be crimped under the patient in any manner.

The patients’ arms may lay supported along the sides of the body, with the palms up or inward. The patient’s arms might also be placed on arms boards with the up towards the patient’s head in what appears to be 90 degree angles.

The patient’s head can be turned to one side or positioned face down on a padded donut to prevent pressure on the ears, eyes, and face. If a patient is under general anesthesia, clearance of the airway must be ensured. A serious complication of the prone position is blindness, which can be caused by ischemia of the vascular system of the eye. If a patient is to be intubated for general anesthesia, it will be completed on the locked gurney in the supine position first. All direction from this point will be given by the anesthesia provider.

A pillow or padding under the anterior aspect of the ankles and the dorsa of the feet prevents pressure on the toes and elevates the feet to aid venous return. Do not permit the patients’ toes to extend beyond the foot of the bed. Donuts under the knees prevent pressure on the patellae. The safety belt is placed over the
calves to prevent flexion of the lower legs. Care is taken not to compress the lower legs. An additional belt can be positioned over the posterior thighs as an added precaution.

Positioners:
- Chest rolls, padding for arms if tucked or arm boards, pillows for knees and lower legs.
- Padding or positioning aid under patient’s ankles to maintain foot extension.
- In surgical procedures use table-length mattress overlay. May need to be shorter length if using accessory headrest parts.
- Prone headrest. May need extra padding if using accessory headrest adapter.

Lateral

The lateral position is when the patient is positioned on his or her left or right side. Pillows are usually needed for this position. For lateral positioning, in the operating or procedure rooms the bed is left flat. In the right lateral position, the patient lies on the right side with the left side up (for left-sided procedure) and the left lateral position exposes the right side. If the patient is to be medicated and/or intubated prior to a procedure, this is completed in the supine position and then the patient is turned to the affected side.

The patient is turned by no fewer than four people to maintain body alignment and achieve stability. The patient’s back is drawn to the edge of the operating / procedure room bed. The knee of the lower led is flexed slightly to prove stabilization, and the upper leg is flexed slightly to provide counterbalance. The flexed knees may require padding to prevent pressure and shearing force. In addition, a large soft pillow is placed lengthwise between the legs to take the pressure off the upper hip and the lower leg, therefore, preventing circulatory complication and pressure on the perineal nerve. The ankle and foot of the upper
leg should be supported to prevent footdrop. Boney prominences should be padded.

The patient’s arms may be placed on a padded double arm board, with the lower arm palm up and the upper arm slightly flexed with the palm down. Blood pressure should be measured from the lower arm. As an alternative, the upper arm can be positioned on a padded Mayo stand. A water bag or pressure reduction pad under the axilla protects neurovascular structures. The shoulders should be in alignment.

The patient’s head is in cervical alignment with the spine. The head should be supported on a small pillow between shoulder and neck to prevent stretching the neck and brachial plexus and to maintain a patent airway.

Many more patients are having spinal anesthesia for hip surgeries; this is also a consideration when positioning a patient. When a peg board is used for lateral position, make sure to have extra blankets and foam available for the pegs. If possible, use a gel pad over the peg board and use that for protection when placing the patient in lateral position. Blankets may be placed around the lower flexed leg with a blanket over the top of the lower leg with either a strap or 3 inch tape to secure the leg. A smaller arm positioner with padding may be used for the upper arm while the patient sleeps during the procedure.

If a bean bag is used to position a patient, remember to have the bean bag hooked up to suction with tubing and a connector prior to positioning the patient. Once the patient is moved to the lateral position it is much easier to inflate the bean bag while holding the patient.

Positioners:

- Head rest and axillary roll.
- Padding for opposing knees and heels. Roll or padded bean bag device to maintain or stabilize position.
Padding for arms. During surgical procedures padded arm board for patient’s dependent arm and padding for the upper arm. May support the upper arm on padded or elevated padded arm board.

For surgical procedures table-length mattress overlay.

**Sitting Position (Modified Fowler)**

In the sitting position, the back of the bed is elevated to a vertical plane, a foot board is placed perpendicular on the bed to support the patient’s feet, and the patient is placed over the break in the operating room bed if used. The shoulders and torso should be supported with body straps but not so tightly that respirations and circulation are impeded.

Pressure points are padded to reduce the risk of sciatic nerve damage. The flexed arms rest on a large pillow, on an adjusted table that is in front of the patient.

The head is seated forward in a cranial headrest, shoulder table attachment or resting on the bed. A padded footboard may be placed to maintain the patient’s feet in an upright position and deter sliding down on the bed.

A positioning system that may assist in the fowlers or beach chair position is a lift-assisted beach chair. These chairs can offer an unobstructed posterior access to the shoulder when a back panel can be removed. These chairs attach to the rails of the operating room table after the head of the bed is removed. Usually the foot of the table is removed to shorten the table. These chairs usually can accommodate up to 500 lbs. They may come with a foam pad to lift the legs off of the bed.

When using these chairs a universal head restraint (usually disposable) will be used to secure the head. Other surgical procedures that can take advantage of this type of positioner would be:

- Rotator cuff repair
Bankart repair: A repair of an avulsion injury of the anterior capsule and labrum of the glenoid rim of the gleno-humeral joint. This allows for shoulder dislocations and anterior instability.

Total Shoulder Replacement
Clavicle repair
Sub-acromial Decompression

Areas that may be affected by pressure injuries include the patient’s occiput, scapulae, back of the knee, coccyx, ischial tuberosities, and calcaneous. Positioning injuries can occur to the patient’s supra-scapular, ulnar, sciatic, perineal, and anterior tibial nerves as a result of inadequate padding and improper body alignment. Another potential sequel of the sitting position is the increased likelihood of air embolism due to negative venous pressure in the patient’s head and neck. If using skull pins, air can enter through the sites and through open venous channels and sinuses in the exposed brain. One advantage of the sitting position is the positive effect on the patient’s respiratory system. Lung excursion and diaphragmatic activity are facilitated by the unrestricted movements of the thoracic cavity.

Positioners: (more supplies for surgical positions)

- Sitting headrest, Head fixation devices need all components and should be padded in areas of patient contact.
- Padding for arms and extra-long draw sheet to assist with securing arms across patient’s chest. Extra padding beneath buttocks if patient is thin.
- Padding for lower legs and heels.
- Padded foot board to prevent plantar flexion
- Table-length mattress overlay. May need to be shorter length if head fixation devices are attached to operating room bed.
**Lithotomy:**

Lithotomy position is a term used when the patient lies with his or her legs abducted and elevated in stirrup devices attached to the bed for medical exams or surgical procedures that involve the pelvis and lower abdomen. The patient’s buttocks rest and align the break between the body and leg section if using an operating room table. For perineum examinations the patient is positioned at the edge of the examination bed. If using a GYN procedure bed, the buttocks are slid to the edge of the bed and legs placed in stirrups. A padded metal bootboard is used as an OR bed extension so the patient’s legs do not extend over the foot of the operating bed before placing the legs in the upright position. This position is used for the benefits that it allows for the doctor’s perspective.

This position has had references in the oldest of medical documents including versions of the Hippocratic Oath. This position is named after the ancient surgical position procedure for removing kidney stones, gall stones and bladder stones via the perineum.

If not using an exam table with these attachments being a part of the bed, then attach the stirrups securely to the sides of the bed rail at the level of the patient’s upper thighs. They are adjusted at equal height on both sides and are an appropriate height for the length of the patient’s legs to maintain symmetry when the patient is positioned. If the patient is anesthetized, the safety belt is removed and the patient’s legs are raised simultaneously by two people. Each person grasps the sole of the foot in one hand and supports the calf at the knee area with the other. The knees are flexed, and the legs and feet are placed inside the stirrup. For sling or candy cane stirrups, the feet are placed in the fabric slings of the stirrups at a 90 degree angle to the abdomen, One padded loop stirrup encircles the sole; the other padded loop goes around the ankle.

A simultaneous movement as the knees are flexed is essential to avoid straining the lower back. If the patient’s legs are properly placed, undue abduction and external rotation are avoided; the leg or ankle must not touch the metal stirrup.
Padding is placed as necessary. If the legs are put in stirrups before being medicated or induction of anesthesia, the patient can identify discomfort and pressure on the back of the legs.

After the patient’s legs are placed in the stirrups, the lower section of the mattress is removed and the lower section of the operating bed is lowered. The buttocks must not extend beyond the edge of the operating bed, which would strain the lumbosacral muscles and ligaments as the weight of the body rests on the sacrum.

The patient’s hands should not extend along the operating bed, where they could be injured during manipulation of the operating room bed. Bilateral arms may be extended at side or ticked to the side.

This position is used for vaginal exams and births including reproductive organs, rectal (gastrointestinal systems) exams and also urology exams and cases. At the conclusion of a procedure the leg section of the bed is raised and the lower section of the mattress is replaced. The patient’s legs are removed simultaneously from the stirrups and lowered slowly to prevent hypotension as blood re-enters the legs and leaves the torso. To prevent wide abduction of the thighs, the legs are fully extended and brought together as they are lifted from the stirrups.

Circulating blood volume may be depleted when the patient’s legs are lowered to the bed at the end of the procedure and blood is diverted quickly to the patient’s peripheral circulation. Gravitational forces return approximately 500 to 800 ml of blood to the patient’s legs which deplete the circulating volume and decrease the patient’s blood pressure. Slow simultaneous positioning of the patient’s legs at beginning and end of the procedure allows the body to adjust to shifting blood volumes. In addition, lowering and raising both legs simultaneously prevents possible hip dislocation or lumbar muscle strain.

Keep in mind the post exam physical and emotional risks of being in this position for a long period of time. Patients have stated they have had more pain from being in this position for a long period of time than from the surgery itself. Studies have
found the relationship between prolonged surgical procedures with the lithotomy position and a circulatory complication known as “compartment syndrome”. This is caused from the limited tissue space and increased pressure from this position causing nerve injury to the femoral or perineal nerves.

Positioners:

- Short mattress overlay if entire procedure is performed in lithotomy position.
- Full-length mattress overlay if any portion of procedure is performed in supine of prone.
- May need to secure full-length mattress overlay to operating room bed to prevent shifting when foot of OR bed is lowered.
- Headrest. Padding for arm boards and extra-long draw sheet if arms are tucked. Additional padding around hands.
- If patient’s arms are tucked, the hands must not contact metal parts of the OR bed or be located near bed break.
- Padding for ankle strap stirrups, knee crutch stirrups, and surface of stirrups in contact with patient’s skin.

Position devices must be customized for each patient’s needs. The terms overlay, headrest, padding, and rolls refer to positioning devices that are composed of viscoelastic dry polymer, silicone gels, or high-density convoluted foam. Rolls are composed of pressure-reducing materials that are able to support positioning needs preferable to towel or rolled sheets.

<table>
<thead>
<tr>
<th>Body Areas That Need Consideration During Positioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supine Position</td>
</tr>
<tr>
<td>Occiput</td>
</tr>
<tr>
<td>Heels</td>
</tr>
<tr>
<td>Elbows</td>
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<tr>
<td>Sacrum</td>
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<td></td>
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</tbody>
</table>

Chart 6 of 9:
**Respiratory considerations** include unhindered diaphragmatic movement and a patent airway that is essential for maintaining respiratory function, preventing hypoxia and in surgery facilitating induction by inhalation. Chest excursion is a concern because inspiration expands the chest interiorly. Some positions limit the amount of mechanical excursion of the chest. Some hypoxia is always present in a horizontal position because the anteroposterior (from front to rear) diameter of the ribcage and abdomen decreases. The tidal volume, the functional residual capacity of air moved by a single breath, is reduced by as much as one-third when a patient lies down, because the diaphragm shifts cephalad (toward the head). Therefore, there should be no constriction around the neck or chest.

Patients have additional compromise if they are obese, smoke or have pulmonary disease.

**Circulatory** considerations include adequate arterial circulation for maintaining blood pressure, perfuse tissues with oxygen, facilitating venous return, and preventing thrombus formation. Occlusion and pressure on the peripheral blood vessels should be avoided. Body support and restraining straps must not be fastened to tightly. Some drugs cause constriction or dilation of blood vessels, which further complicate positioning.

**Peripheral Nerve** considerations from prolonged pressure on/or stretching of the peripheral nerves can result in injuries that range from sensory and motor loss to paralysis and wasting. The extremities, as well as the body, should be well supported as all times. The most common sites of injury are the divisions of the brachial plexus and the ulnar, radial, perineal, and facial nerves; the axons may be stretched or disrupted, because of the extremes of position of the head and arm greater than 90 degrees can easily injure the brachial plexus. In the operating room if the patient is positioned improperly the ulnar, radial, and peroneal nerves may be compressed against the stirrups or the operating room bed.

Arthroscopy leg holders and tourniquets can cause crushing or transected nerve injury. Femoral nerve injury can be caused by retractors during pelvic procedures.
Sciatic nerve injury may be caused by tissue retraction during hip surgery or extremes of lithotomy position. Facial nerve injury may result from a head strap that is too tight or from manually elevating the mandible too vigorously to maintain an airway.

**Musculoskeletal** considerations include a strain on muscle groups resulting in injury or needless discomfort. If a patient’s head is extended for a prolonged time, the patient may suffer more pain from resulting stiff neck than from a surgical wound. Care should be taken to never hyperextend a joint, which not only causes pain, but may also contribute to permanent injury to an extremity. Elderly or debilitated patients with osteoporosis or other bone disease may suffer fractures.

When turning a patient, always keep the spine in alignment by grasping the shoulder girdle and hip in a log rolling fashion. Do not turn or elevate a patient by grasping only a hip and twisting the spine.

**Soft tissue** considerations included making sure the body weight is distributed evenly. This is an important consideration over bony prominences when weight is concentrated over these areas and can cause skin pressure ulcers and deep tissue injury. These areas should be protected from constant external pressure against hard surfaces, particularly in patients who are thin and underweight. In addition, tissue that is subjected to prolonged mechanical pressure (e.g., a fold I the skin under an obese or malnourished) will not be adequately perfused. Wrinkled sheets and the edges of positioning device under the patient can cause pressure on the skin. Foam pads are not adequate to relieve pressure, because they compress and do not alternate pressure. Towels and sheet rolls do not relieve pressure because they are unyielding to the patient’s body weight. Gel pads are preferred and positioning devices should maintain normal capillary interface pressure of 23 to 32 mm HG or less to prevent pressure injuries.

Pressure injuries in surgery are more likely to be in surgical procedures that last one hour or longer. During lengthy procedures, the head and other body parts should be repositioned if possible. Patients who are debilitated, poorly nourished
and diabetic are at particularly high risk for pressure ulcers and alopecia (permanent bald spots from pressure).

After positioning the patient in surgery, protect the linen on the OR bed from moisture during the prep. Protect the bed from irrigation and other fluids during the surgical procedure to maintain dry linen in contact with the patient. Manage excessive moisture that can macerate skin including excess wound exudates, perspiration and diaphoresis.

The contributing effects of gravity in pressure injuries can be illustrated by making a fist with each hand, aligning the fists at the knuckles, and pressing them firmly together. This exercise becomes uncomfortable within seconds, but the pressure exerted by opposing fists is extremely mild compared to the pressure experienced by the human body on a procedure room or operating room bed.

During positioning or repositioning in the operating room, lift, roll or use devices to move the patient that help to avoid shear or friction forces. Positioning or repositioning may require lifting devices, additional people, wide draw sheets, etc.

<table>
<thead>
<tr>
<th>Complications Caused By Improper Positioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homodynamic instability or orthostatic (erect) position</td>
</tr>
<tr>
<td>Poor ventilation by thoracic compression</td>
</tr>
<tr>
<td>Peripheral nerve injury caused by compression or stretch</td>
</tr>
<tr>
<td>Tissue damage from crush or shearing force</td>
</tr>
<tr>
<td>Ischemia of hair-bearing scalp, causing bald spots</td>
</tr>
<tr>
<td>Compartment syndrome</td>
</tr>
<tr>
<td>Pressure necrosis</td>
</tr>
<tr>
<td>Digit amputation in table bends</td>
</tr>
<tr>
<td>Blindness from optic nerve ischemia</td>
</tr>
<tr>
<td>Corneal abrasion</td>
</tr>
<tr>
<td>Ischemic limb from arterial occlusion</td>
</tr>
<tr>
<td>Venous emboli</td>
</tr>
<tr>
<td>Vertebral injury</td>
</tr>
<tr>
<td>Panic attacks and feelings of claustrophobia in awake patients during procedures</td>
</tr>
</tbody>
</table>

Chart 7 of 9:
There is always a potential for complication from improper positioning and pressure being placed on structures below the skin. Here are a few examples:

<table>
<thead>
<tr>
<th>Nerve Group / Area Affected and Symptoms</th>
<th>Potential Causes</th>
<th>Correct Position</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brachial Plexus:</strong> (Arm); Shoulder to arm pain, arm flaccidity, numbness, limited ROM, tenderness in supraclavicular area that involves entire arm.</td>
<td>Issues to the arm abducted more than 90 degrees. Arm sags and is abducted and / or rotated externally.</td>
<td>Adduct patient’s arm less than 90 degrees. Use padded arm boards with locking mechanisms. If arm is tucked by side, pad as necessary and secure to avoid slipping off OR bed or mattress edges.</td>
</tr>
<tr>
<td>Shoulder; shoulder pain</td>
<td>Shoulder braces are to medial or lateral with arm abducted.</td>
<td>Place well-padded shoulder braces over acromioclavicular joints’</td>
</tr>
<tr>
<td>Neck and head, partial sensation loss with spotty paralysis</td>
<td>Allowing the patient’s head to rotate and / or dorsal extension and lateral flexation of patients head to opposite side.</td>
<td>Do not allow patient’s head to rotate. Secure patient’s head in neutral position as much as possible. If using tape to secure head cover skin first.</td>
</tr>
<tr>
<td><strong>Suprascapular nerve:</strong> (Shoulder) Pain localizes to posterior and lateral aspects of the affected shoulder.</td>
<td>Forced abduction of arm across the chest. Facing downside arm ventrally and medially with shoulder circumducted.</td>
<td>Do not forcefully abduct or tightly secure patient’s arm across chest. Stabilize patient placed in lateral position.</td>
</tr>
<tr>
<td><strong>Circumflex nerve:</strong> (Arm) inability to abduct arm, sensation loss over upper half of lateral aspect of affected arm.</td>
<td>Arms abducted 90 degrees that are allowed to press against the vertical bars of anesthesia screen.</td>
<td>Place sufficient padding against the patient’s arm and the anesthesia screen of retractor posts.</td>
</tr>
<tr>
<td><strong>Radial nerve:</strong>(Arm / Wrist) weak grip on ulnar side of fist or inability to oppose or abduct fifth finger. Weak flexion of fourth and fifth fingers.</td>
<td>Arm extended on arm board with forearm pronated. Arms folded too tightly over abdomen or chest, with elbows flexed greater than 90 degrees.</td>
<td>Supinate patient’s forearms. Do not forcefully restrain arms. Flex elbow 90 degrees or less.</td>
</tr>
<tr>
<td>Impaired adduction / abduction of medial four digits</td>
<td>Arms secured too tightly at sides with inadequate padding at elbow.</td>
<td>Place sufficient padding at elbows.</td>
</tr>
<tr>
<td>“Claw – like “ hand</td>
<td>Elbows were allowed to slip off mattress or edge of OR bed.</td>
<td>Extend draw sheet above the elbows and tuck between patient and the mattress of OR bed.</td>
</tr>
<tr>
<td><strong>Obturator:</strong> Weakness or paralysis of adductors of the thigh.</td>
<td>Extreme flexion of the thigh at the hip.</td>
<td>Minimize flexion of patient’s hip.</td>
</tr>
<tr>
<td><strong>Sciatic Patathesia:</strong> Muscles below the knees.</td>
<td>Emaciated patient supine or sitting on inadequate padded bed or OR bed.</td>
<td>Generously pad bed beneath the patient’s buttocks.</td>
</tr>
<tr>
<td><strong>Numbness:</strong> Of lateral half of calf and most of foot.</td>
<td>Legs positioned straight while in sitting position.</td>
<td>Flex the Patients knees and flex the OR bed in the operating room.</td>
</tr>
<tr>
<td><strong>Foot Drop:</strong> Foot hangs instead of 90 degree angle.</td>
<td>Thighs and lower legs externally rotated with knees extended.</td>
<td>Minimally rotate patient’s thighs and flex patient’s knees.</td>
</tr>
<tr>
<td><strong>Common Peroneal:</strong> Foot drop. This nerve courses around the head of the fibula at the tibia condyles after penetrating various facial planes.</td>
<td>Stirrups</td>
<td>Lithotomy stirrups.</td>
</tr>
<tr>
<td><strong>Loss of dorsal extension of toes:</strong></td>
<td>Hard Knee rolls</td>
<td>Use soft knee rolls when padding.</td>
</tr>
<tr>
<td><strong>Anterior Tibial:</strong> Foot drop</td>
<td>Patient’s feet are plantar flexed.</td>
<td>Use foot board when patient is placed in sitting position or steep reverse Trendelenburg’s. Place pillow or soft roll under ankles to maintain extension when patient is in prone position.</td>
</tr>
<tr>
<td><strong>Posterior Tibial:</strong> Weak plantar flexion of foot, sensory deficit of sole, toes, lateral aspect of foot; and paresthesia of posterior calf.</td>
<td>Knee crutch stirrups supporting posterior aspect of patient’s knees.</td>
<td>Use generous padding under the knees. Avoid use of knee crutch stirrups for long surgical procedures.</td>
</tr>
<tr>
<td><strong>Lateral Femoral Cutaneous:</strong> Anesthesia on the lower lateral, anterior aspect of the thigh.</td>
<td>Thigh compresses by hard support bolsters in flexed prone position.</td>
<td>Place adequate padding between bolsters and patient’s thighs.</td>
</tr>
<tr>
<td><strong>Pudendal:</strong> Loss of perineal sensation and fecal incontinence.</td>
<td>Traction of legs against inadequately padded perineal post for the fracture table.</td>
<td>Place adequate padding between perineal post and patient’s perineum.</td>
</tr>
</tbody>
</table>

Now that the process of proper positioning has been explained, it is only one piece of a larger puzzle. It is important to look at the process of keeping a wound from acquiring an infection from all aspects of nursing. Using and keeping items that come in contact with a wound sterile are extremely important. Understanding this process is even more important.

Before we can discuss aseptic technique, it is important to understand why it is important to start with items that are sterile and how this process works. A dressing change should be performed with sterile items and aseptic technique to ensure a patient does not get an infection in their wound no matter where the origin. This process may start in the clinic or in the emergency room and continue to the patient’s room or departmental procedure room.
Sterilization including instrumentation

There are many regulatory requirements for sterilization, including federal, state and professional associations that guide our practice in situations where instruments or supplies need to be sterilized. The following agencies play a prominent role in sterilization: the Centers for Medicare and Medicaid Services (CMS), the Departments of Public Health (DPH) and the Joint Commission Accreditation Hospitals (JCAHO) now known as “The Joint Commission”. The Occupational Safety and Health Administration (OSHA) and U.S. Food and Drug Administration (FDA) also have roles in the sterile environment.

Professional associations include: the Association for Advancement of Medical Instrumentation (AAMI), which consists of over 100 technical committees and working groups that produce standards and recommended practices with technical information for medical devices. AAMI has been involved in standards approved on an international level with international technical committees. The American National Standards Institute (ANSI), who represents national consensus, approves many American national standards.

The Association for Operating Room Nurses (AORN) is also very involved with the policies and procedures of handling and sterilization of instrumentation. With the increase of ambulatory surgical centers, procedure rooms (clinics and ER), and labor and delivery operating rooms all nurses are increasingly responsible for the processing of and sterilization of instrumentation and supplies. It is extremely important for all staff who will deal with any type of sterile items to be familiar with the methods of sterilization available in each facility. All sterile items have been sterilized in some manner and it is important to understand the sterilization process. Even supplies that arrive already sterile should be checked to make sure they are not outdated and that packaging is still intact prior to use.

Nurses topped the Gallup Honesty and Ethics of Professionals survey for the 13th consecutive year for 2012. Nurses ranked highest at 85% among all professionals. This poll measures Americans perception of honesty and ethical standards. In all
aspects of nursing, patients expect nurses to keep them safe. Everyone must advocate for the patient to keep them safe. It is everyone’s responsibility not only in the perioperative setting, but all areas where procedures are performed.

Surgical site infections are considered a “never event”. This includes all procedure rooms including clinics procedure rooms, ER procedure rooms, and labor and delivery operating rooms, in general where ever a procedure is performed. A procedure could even happen on the floor or ICU, and could be as small as a dressing change.

In 2003, the Joint Commission produced the Surgical Care Improvement Project (SCIP), this identified core measures to decrease surgical site infection rates. CMS has implemented nonpayment for adverse events and conditions “not present on admission”. CMS also has the ability to hand out severe punishment, including the immediate closure of a facility. Not only is infection or disease a life-or-death situation for patients, it also has become a life-or-death situation for hospitals and surgery centers.

The SCIPS core measures that the Joint Commission and CMS produced together on infections, is to decrease the number of surgical site infection rates. SCIP measures collected data based on these implementations to show improvement in preventing these types of infections. This information is available to patients’, which allows them options for choosing their health care provider based of these SCIP measures.

According to Society for Healthcare Epidemiology of America (SHEA), approximately 500,000 surgical site infections (SSI) occur every year in the United States. This is a cost of $10 billion annually. Every patient with an SSI has an additional seven to ten day hospital stay with additional pain and suffering. Each patient with an SSI may face additional surgeries including irrigation and debridement (I&D), and possible removal of implants with placement of antibiotics. When evaluating the morbidity of patients with SSI’s, it was found that
77% of the deaths of the patients’ with SSI’s were directly related to their infection.

Even though processing of surgical instrumentation is a team effort, it is the nurses (including LVNs and LPNs) who are responsible for being the patient advocates. Everyone who comes in contact with a sterile item is part of the checks and balances system to prevent a patient from being contaminated by unsterile instruments or other unsterile items.

However, in the O.R. setting, it is the nurse who is held responsible for monitoring all aspects of aseptic technique, including monitoring the sterility of instruments and devices. It is everyone’s responsibility to check packages for being outdated or compromised before being opened on to a sterile field or used for a patient’s care, including dressing changes.

**What is Sterilization?**

Sterilization is the process that eliminates or kills all forms of life, including transmissible agents. Sterilization removes and destroys all microorganisms from an object. These agents include fungi, bacteria, viruses, spore forms, parasites, etc. Sterilization can happen in many ways including heat - the most common form - and also chemical, irradiation, high pressure, and filtration. Sterilization definition also includes disabling or destruction of infectious proteins such as prions related to Transmissible Spongiform Encephalopathies (TES).

The history of sterilization can be traced back to the times of ancient Rome. Back then, medical instruments were put through flame (heat) sterilization. Aristotle, a famed philosopher, recommended to Alexander the Great, King of Macedonia, that he should boil the water before giving it to his troops. In the following reference, AORN talks about sterilization in biblical times when God instructed Moses: “anything else that can withstand fire must be put through the fire, and then it will be clean. But it must also be purified with the water of cleansing. And
whatever cannot withstand fire must be put through that water.” This helps to prove that even back then; they understood the concept of clean and sterile.

Today, our main focus is on preventing wound infections. With the increase in antibiotic resistance, and with more and more bacteria being discovered, we really must increase the focus of our practice to prevent these types of infections. Health care-associated infections (HAIs) are infections that patients’ acquire during the course of receiving healthcare treatment for other conditions. These infections related to medical care can be devastating and even deadly. Approximately 1 out of every 20 hospitalized patients’ will contract an HAI according to the CDC. The cost has been estimated up to 120 billion dollars annually with at least 70% of the infections being preventable. It is estimated that HAIs lead to approximately 60,000 to 90,000 deaths in the United States. The most common infections are urinary tract infections, bloodstream infections, pneumonia, and surgical site infections. There is now zero tolerance for infections and it includes every single person involved in these environments to fight it.

These facilities include outpatient surgery centers, long-term care facilities, rehabilitation centers, and community clinics.

Healthcare-associated infections (HAI) are infections caused by a wide variety of common and unusual bacteria, fungi and viruses during the course of receiving medical care. Let’s review some of the bacteria that are the cause of serious life threatening situations in the inpatient care facilities.

Bacteria are one-celled organisms without a true nucleus or cell organelles, belonging to the kingdom Procaryotae (Monera). The cytoplasm is surrounded by a ridged wall composed of carbohydrates and other chemicals that provide the basis for gram stain. Bacteria can either be gram positive or negative. Millions of nonpathogenic bacteria live on human skin. These bacteria are considered normal flora. Bacteria that cause disease are called pathogens. Bacteria reproduce by binary fission; however, some bacteria can exchange genetic material.
Bacteria can be one of three shapes, spherical or ovoid which occur in single cells or pairs, rod-shaped which are called bacilli, or spiral bacteria which are rigid. What makes bacteria dangerous is its ability to mutate. The environment dictates those changes based on beneficial mutations which have survival value. Hand hygiene (washing, cleaning nails) is the most important action that health care workers can do to prevent the spread of infection. Health care associated infections account for an estimated 1.7 million infections and 99,000 associated deaths each year, with 32% UTIs, 22% SSIs, 15% pneumonia, and 14% blood stream infections, according to AORN. According to the Associated Professional Infection Control Committee (APIC) economic survey of associated health care infection for 2009, there were 100,000 deaths in the U.S. with a cost of $20 billion to the nation’s health care system.

We will address surgical site infections a little later, let us review other contaminates that are killed in the sterilization process:

**Fungi**

Fungi are in the kingdom of organisms that include yeast, molds and mushrooms. Fungi grow as single cells like in yeast. They can also grow in multicellular filamentous colonies such as in molds or mushroom. Fungi do not contain chlorophyll so they are saprophytic or parasitic, which means they obtain most of their food from dead organic material.

Most fungi are not pathogenic and are part of the body’s normal flora. Fungi that cause disease come from a group of fungi called Fungi Imperfecti. In patients’ with AIDS or Immunosuppressive drug therapy, Fungi are a source or opportunistic infections that cause death.

**Spores**

Spores are cell produced by fungi for reproduction. Spores may remain dormant, yet viable, for months. Pathogenic spores are usually inhaled rather than ingested. A spore can also be a resistant cell produced by bacteria that can withstand
extreme heat, cold or dehydration. These spores can remain viable for decades. Spore-forming bacteria include Tetanus, botulism, and gas gangrene. Spores can be destroyed by steam under pressure (autoclave).

**Virus**

A virus is a pathogen composed of a nucleic acid within a protein shell, which can grow and reproduce after infecting a host cell. More than 400 types of viruses that cause illness are known. All of them can attach to cell membranes, enter the cytoplasm, and take over the cells function. Once they take over the cells function they can reproduce their parts, and assemble themselves into mature forms capable of infecting other cells. Death can be associated with many viruses.

A few of the most virulent viruses known are hemorrhagic fever, which has been in the news recently, and Ebola virus. Viruses that cause tumors or malignant neoplasms are Epstein-Barr virus, Hepatitis B virus, Papilloma virus, and Human herpes virus 8.

The sterile environment makes surgery a unique area. Surgery has become a fast paced process with new and more complex equipment. This makes it even more important that staff remain educated and up- to-date with new techniques. We have to make split second decisions that will affect our patients’ for the rest of their lives, be it positive or negative.

The process starts the minute an instrument is purchased. All instruments must be washed and checked for proper function even before being put into circulation. It sounds trivial, but all staff must know and follow manufacturer’s instructions and understand that those instructions might change, and they need to be updated with each new product received. Patient safety is at risk every time instructions are not followed.

Perioperative nurses and surgical technologists should also receive the same information as sterile processing department (SPD) with all new equipment when it comes to processing. When possible, facilities should form a sterilization
committee that can review and give staff recommendations on how to deal with complex issues. It should consist of OR and SPD staff, so it is well represented within the perioperative group. This group can also come up with ideas for verification and documentation of the cleaning process and can follow, if applicable, the manufacturers test procedures.

The perioperative environment includes an SPD. They are a huge part of our patient safety goals. So let’s start with the cleaning process, which begins with the dirty instruments in decontamination room. These items might also come from the clinic i.e., vaginal speculums, suture removal kits to be reprocessed. Labor and delivery may send over their delivery kits and Cesarean section sets, and if they perform emergency hysterectomies those sets as well. L & D nurses roles have expanded and become perioperative nurses while in their surgical environment and fall under the same regulations as operating room nurses while performing these surgical procedures.

The first step is an extremely important one. Instruments should not be returned to SPD covered with dried blood and bioburden. AORN addressed the issue by stating: “You can clean without sterilizing, but you can’t sterilize without cleaning.” They call this a simple but important concept. However, we are discovering it is not so simple. Surgical cases themselves have increased in speed because of innovation of new equipment and systems. It has become harder to stay ahead of the surgeons in some cases, let alone try to keep instruments clean. However, it is still a very important step that is being missed in some operating rooms and we need to get back to basics. Make sure to spray all instrumentation with a pre-soak solution that starts to break down the bioburden as soon as it hits the instruments.

Part of the communication that should happen between the scrub personnel (including OB techs) and decontamination personnel is proper sorting of instruments being returned for processing. You must clearly identify any instrument or devise that is not properly functioning to be sent out for repair. Make sure all sharps are separated for SPD protection with all disposables thrown
away in proper containers. If your facility has a reprocessing program, make sure to deposit disposable equipment (trocars, scissors, graspers, etc.) for reprocessing in proper containers.

If your facility uses an instrument enzyme cleaner, try to put it on instruments before leaving the procedure room or OR If you are not able to accomplish this in the procedure room or OR, try to do this for the SPD staff before leaving the decontamination area. If the instrumentation is coming from a different area when delivered communicate this to the SPD staff.

**Cleaning and Care of Surgical Instruments and Powered Equipment**

Newly purchased instruments or equipment, items returned from repair, and loaner or consignment instrumentation should always be cleaned and inspected for proper function prior to sterilization. It is extremely important to remember this step. It can be a dangerous shortcut, because it can lead to surgical infections. Never believe or trust that another facility has accomplished this task without witnessing it yourself. This will keep our patients safer.

Complex instruments can be hard to clean without manufactures instructions. Have those instructions available to the staff, as they can be copied and laminated to keep them cleaner, and are able to be wiped down with disinfectant. This is important for those instruments that come back to the OR not properly processed.

Again, it is extremely important to remember instruments or devises with bioburden cannot be disinfected or sterilized. Blood or body fluids that have been allowed to dry on the surface or on the inside of an instrument, especially cannulated items, could possibly lead to transmission of infections. Blood, tissue, and mucous is extremely difficult to remove when it is allowed to dry on instruments and this increases cleaning time dramatically. That’s why it is so important to keep instruments clean of “gross soil” during surgical procedures. Remember during the surgical case to have a basin of sterile water and a soaked
sponge to wipe or submerge instruments that need to be cleaned while the case is in progress. Cleaning should begin as soon as possible after an instrument is used. Pre-cleaning and sorting begins in the O.R. at the sterile field with the scrub personnel, keeping instruments free of gross soil.

Remember to never use saline for this process because it can damage instruments due to pitting, which could also harbor contaminates. Saline also causes rust and corrosion, which shortens the life of instruments. It is important to flush instruments that could have blood or material inside of them. An example would be a suction tip that could have blood clots on the inside from a really bloody case. To prevent aerosolization, staff should flush instruments below the surface of water. Aerosolization could suspend particles of matter in the air which could be inhaled. This could cause the person to be exposed to whatever the patient had by breathing this in including cancer cells.

Keeping instruments clean during a surgical case also assists central processing in the cleaning process. In turn, they are able to get instruments back into circulation fast, since flashing is the exception, in which we will discuss later.

When separating instruments for processing after a surgical case, remember to put the lightweight instruments on top of the heavier instruments, this helps to protect the lighter instruments. If this is not possible, separate them into different containers. It is important to reduce the risk of staff injuries and instrument damage.

Make sure to communicate to the decontamination staff if this set or specialty instruments will be needed back. This is important to communicate so there are no delays in reprocessing of the higher priority instrumentation. This could end up costing the facility because of delays in a patient’s surgery.

Cleaning itself should be done manually or mechanically, this includes washing by hand and rinsing thoroughly. For delicate instruments, please refer to manuals for proper cleaning methods. Instrumentation with lumens must be cleaned with the
proper size brush to remove debris from inside. Power and electrical equipment should also be manually cleaned since it cannot be immersed.

Cleaning defined by AAMI is the removal of contamination from an item to the extent necessary for further processing or for the intended use. AAMI notes: “Cleaning consists of removal, usually with detergent and water, of adherent soil (e.g., blood, protein, and other debris) from the surfaces, crevices, serrations, joints and lumens of instruments, devices and equipment by manual or mechanical process that prepare the items for safe handling or further decontamination.”

Mechanical decontamination includes ultrasonic cleaners, washer-decontaminators, washer-sterilizers, ultrasonic cleaners and cart washers. Always use manufactures recommendations and never overload these machines, they must be able to do the job correctly for ensuring patient safety. It is also important to remember to run your manual cleaners through your mechanical decontaminator daily to keep them clean for the next use.

Cleaning is the most important step to breaking the chain in disease transmission. Make sure to take apart instruments for the cleaning process that have multiple parts. Pay special attention to reamers and biopsy forceps where tissue can be trapped.

**Tray Assembly**

Once the instrumentation has gone through its terminal cleaning process then it is on to the tray assembly area.

Before assembly of instrument trays, and after cleaning and decontamination, it is important for instruments to be inspected. This is another check for instruments that may need further cleaning or sent out for repair. Devices at this time should also be checked to see if they are functioning correctly. Make sure that these work areas are equipped with lighted magnifiers. This allows staff to see if there are breaks in insulated equipment or other concerns. While following the recipe sheet for each tray, make sure to organize the tray in a way that the sterilant can come
in contact with all exposed surfaces. Steam must be able to touch all surfaces of each instrument. Place integrating indicators in the center of the tray. When using a multilevel tray, place integrating indicators in opposite corners of each level of instruments.

The standard has not changed on the weight of sets; it is still set at 25 lbs. With specialty loaner sets coming and going out of a facility, those sets weighing more than the standard 25 pounds should be flagged and documented in the patient’s chart; if one of those sets are used on the patient for better tracking, in case of infection. The possibility of sterility compromise is greater with these complex heavier sets.

**Types of sterilization**

There are many types of sterilization as well as many different sterilizers. All sterilizers are considered Class II medical devices and are required to follow guidelines for manufacturing and submission to the FDA prior to being marketed for sale.

There are two types of steam sterilization that are often used in operating rooms.

The first one is the gravity displacement type sterilizer. This sterilizer works by the chamber, filling with hot steam and as the chamber fills, the pressure pushes the air down the drain. This sterilizer is slowly being replaced with the Pre-Vac sterilizer. You will find these types of sterilizers in an OR substerile room within the OR. These types of sterilizers are not only used in hospitals, they are also used in outpatient clinics and dental offices as well.

In a Pre-vac sterilizer or dynamic air removal sterilizer, a vacuum pump pulls the air out prior to the hot steam entering the chamber. These machines operate at a higher temperature than a gravity sterilizer. Not only creating a more efficient and rapid cycle because of the higher temperature 270-275 degrees, but hopefully less air pockets, creating greater opportunity for all instrumentation exposure to the hot steam. Always use a Bowie-Dick biologic test pack to ensure the machine is
working correctly daily. The proper way to do this test is in an empty chamber. The test pack should be run for 3.5 to 4 minutes at 270 to 275 degrees Fahrenheit; make sure to document this result in the sterilization records. If the test fails, repeat the test. If it fails a second time, report the information to a supervisor for possible retesting or servicing. Again, this information will be present to the surveyors’ when they come through on their visits.

Use both of these machines according to manufacturer’s recommendations. It is also important to have proper documentation in place and have it set up according to The Joint Commission and Centers for Medicare and Medicaid Services (CMS) guidelines so that your facility is prepared for their visit. Documentation is extremely important with flash sterilization since the recommendation is to “Never Flash”. Be very clear as to the reason for flashing since both agencies will want an explanation as to why an item was flashed. And also include who was notified as to why the item was flashed.

When documentation is done for sterilization monitoring of loads, it is important to document the following:

- Lot number
- Contents of the load
- Exposure time and temperature
- Operator Identification
- Results of Bowie-Dick Testing
- Results of biologic testing including the chemical indicators

These records will help with recalls to be able to trace where the instrumentation may be and where it possibly was used. The number allows the retrieval process to be done efficiently.

Load time should be done according to manufactures recommendations for the machines that your facility is using. Dry times for packaged instruments depending on the loads can be from 30 minutes to two hours. The bigger and heavier the load, the longer the cooling time should be.
Flashing of Instruments

Flashing is a clear focus for the Joint Commission and CMS. Flash sterilization should NEVER be a substitute for sufficient instrument inventory. This is a topic of issue with OR’s with decreasing budgets.

The American National Standards Institute (ANSI)/AAMI, AORN, The Association for Practitioners in infection Control (APIC), and the CDC have set guidelines for flashing. Flashing should only occur when an instrument is contaminated (dropped, contaminated wrapper, or chemical indicator failure) as is a “one of a kind” instrument and only in an emergency.

The most important concern when it comes to flashing is the cleaning and preparation process used on these instruments before being sterilized. The concern is that bioburden and soiled instruments be completely cleaned from the instrument to ensure proper sterilization. OSHA defines decontamination as use of physical or chemical means to remove, inactivate or destroy blood-borne pathogens on a surface to the point where they are no longer capable of transmitting infectious particles. This process renders the item safe for handling, use or disposal.

It is recommended that only trays that have been approved for flash sterilization by the FDA be used to sterilize the item in for safe, easy transport, and low burn risk to staff.

There are several options to prevent burns; the most common are special gloves or towels. Once the item is removed from the flash sterilizer, the concern would be to have a reduced risk of contamination or damage during transport. Once in the room, the next concern is presentation to the sterile field. The recommendation is that the tray NEVER be placed on a nonsterile surface. It should be placed on a sterile impervious drape separate from the back table.

Do not forget your documentation. The sterilizer printout should be reviewed and initialed with room number. The flash log should be filled out with clear reason for
flashing and who was notified (manager or charge nurse). Also, complete charting with which sterilizer was used, load number, what was sterilized and did it meet parameters.

Other concerns that address the containers themselves:

1. Are they cleaned, checked and maintained on a daily basis according to manufactures instructions?
2. The ability of staff to tell the difference between flash sterilizer containers and containers used for regular sterilization.
3. Flash containers should be opened immediately, item delivered, not stored for later use.

Remember, the instruments that have been flashed are hot. Take precautions not to burn the patient. Cool the instrument before use. Cool sterile water from a designated refrigerator is one way of quickly cooling an instrument.

If the scrub person must transport an item from the sterilizer to the room, the Circulating Nurse must direct traffic and the scrub personnel MUST be aware of their surroundings during transport.

It is also recommended by AORN that a facility policy and procedure be developed with periop management and the infection control department with the objective of ensuring the best practice possible for aseptic transfer within the physical constraints of the facility.

**Ethylene Oxide**

Ethylene Oxide is another form of sterilization that has been around since the 1950s and can be used for heat and/or moister sensitive items. All instruments and tubing must be completely dry for this process. This is a very effective process with a very low temperature. At the end of the sterilization cycle, the load must be aerated before they can be used. Ethylene Oxide, however, is a strong poison to
humans, and chronic exposure has been known to cause cancer, reproductive effects, mutagenic changes, neurotoxicity, and sensitization according to OSHA with their update as of April, 2009. Under the Clean Air Act, the first chlorofluorocarbons were phased out, which were part of the mixture for ethylene oxide sterilizers. These chlorofluorocarbons were linked to destruction of the earth’s ozone layer. OSHA also regulates the acceptable vapor levels of ETO due to exposure being an occupational hazard. This has pushed development of other alternative technologies for low temperature sterilization in the health care setting.

**Paracetic Acid**

Paracetic acid for hospital use came in 1985, although at the time it had been recognized for its disinfection and sterilization properties for over 100 years. Paracetic acid is considered a “just in time” process. Instruments must be moisture tolerant since this is a liquid process. If the item is left in the sterilizer, it is only considered sterile up to two hours. This process is usually used for scopes, light cords, and cameras. The FDA has cleared a new version of steris called the Steris System1E.

**Hydrogen Peroxide Gas plasma**

Low temperature sterilization can also be achieved with hydrogen peroxide gas plasma which was patented in 1987. This was not available in the U.S. till 1993. This process does not require aeration because the by-products are oxygen and water. Gas plasmas are generated in an enclosed chamber under deep vacuum using radio frequency or microwave energy to excite the gas molecules and produce charged particles. Many of these molecules are free radicals. A free radical is an atom with an unpaired electron and is highly reactive. This process requires very specific lumen size regulations. Again, load must be completely dry before starting the cycle. The biological indicator is Bacillus atrophaeus spores. This process has the ability to inactivate a broad range of microorganisms, including resistant bacterial spores.
Ozone

Ozone can also be used for terminal sterilization of heat and moisture sensitive instruments by oxidation. This technology came on board in 2003. Ozone cycles last four to five hours. Ozone has lumen restrictions as well.

Vaporized Hydrogen Peroxide

Vaporized Hydrogen Peroxide is the newest method of low-temperature sterilization. Again, there are some restrictions on lumen length and diameter.

It is the perioperative nurses’ responsibility to have a basic understanding of various types of quality control for sterilized instruments. These should include the mechanical controls such as graphs and printouts. Make sure to understand what you are reading and how to document those items. Also, understand the chemical controls such as indicators, integrators, autoclave tape, pouch dots, container arrows or breakaway lock. Know the difference between each of the colors prior to sterilization and the colors they should turn when a load should be sterile. Biologic controls need to be incubated and read. Understand that parameters have been met for that load to be sterile. It is also everyone’s responsibility to know the steps to follow if an indicator has not turned correctly.

All sterile processing equipment must be properly maintained with preventative maintenance. This should be done on a routine basis to keep equipment working properly to prevent failures. Proper maintenance records should be kept up to date as well.

Moving to the Operating Room

Your case is picked and you are ready to start your case. You spread everything out as you are checking the physician preference card to make sure you have everything needed for this case. A tray is opened and moisture is found, at this point, the tray should be considered contaminated. Moisture can act as a route
with wicking action to allow microorganisms to be drawn into the package via any paper area. You should take steps to document that the tray in contaminated and central processing must be notified to start the recall process.

As you open the sterile items for your case, you must inspect all items for integrity (no tears or holes) and ALWAYS check the expiration date. Outdated supplies can also play a role in infections. Just handling a product can create an environment in which the packaging could be compromised and contamination could occur.

**Things that can affect package sterility:**

- Improper humidity, temperature and air exchange. When certain items require specific levels, monitoring must occur and logs may be required.
- How items are stored: Wire racks must be lined properly to protect packaging. Do not aggressively remove sets from racks.
- Moisture from spills or being placed close to a sink area.
- Inadequate air exchanges taking place in sterile areas.
- Airborne contaminates from things like lint from linen or dust.
- Placement of sterile supplies in high traffic areas. Unsterile items laid or placed on sterile packages. Example: sweaty lead aprons on sterile sets.

**Best practice:** When opening paper items, put the wrapper up to an O.R. spot light to check for holes. This takes only a moment and is an easy way to check for holes.

See **IMAGE #1** below. This is an example of the how holes can be detected. There are actually two holes and they have been outlined in black. You can see the light pass through them:
**IMAGE #1**

Picture 2 of 7:

**IMAGE #1** is from a Synthes 4.0 cannulated screw set. However, this does not just occur with orthopedics.

Below in **IMAGE #2** is a picture of an Adkins Pedi Strut. It is a little harder to see. This item actually had three holes in the packaging.

**IMAGE #2**

Picture 3 of 7:
When you turn a wrapper slightly, you can see the light reflecting through these holes and know that it has been compromised.

There are items that can be purchased to help to try and keep the trays safe from creating holes in wrappers. An example of one type of item is in IMAGE #3 below.

**IMAGE #3**

![](image3.png)

Picture 4 of 7:

The tray in IMAGE #4 below is off the wrapper, which could also help in the drying process. Towels can also be used to protect the corners if these items are not available.
This helps with sets that are heavy and close to the 25 pound limit.

Peel pouches easily get holes in them from handling, and from being put away in an over stocked bin. Just packaging some of the instruments that have sharp points, for example; scissors, gelpis or forceps can easily create holes in packaging. If you are seeing consistent holes in packaging, other packaging options may be needed. Peel packs can also be held up to the light for inspection. If an instrument is opened to the scrub personnel, it should not be placed on the back table until the package is inspected by the circulating nurse.

Nothing should be brought to the back table until sets are checked for sterility. This means checking the indicator before being brought to the table. A turned indicator does not always mean a set is sterile. Indicators can change if left in a sterilizer for an extended period of time, even if the load is not initiated. Usually these indicators will be a lot lighter in color. If you see this, it should be questioned. Make sure the indicator has turned completely. This is also why it is important to check all chemical indicators, including the tape. Make sure the correct indicator is in the correct package. An example of this would be a Sterrad indicator in a steam sterilized package. Correct indicators must be used for the right load.
During the case, care of the instruments is extremely important to the decontamination process. At all times, keep instruments free of gross blood and debris. This is accomplished with a basin of water and a water soaked sponge throughout the surgical case. At the end of the case, sort instrument appropriately and secure all sharps for everyone’s protection, as well as protecting the instruments. When possible, use enzyme cleaner to start the decontamination process prior to leaving the OR suite.

After entering the decontamination area, give a hand-off report to the staff in decontamination. Point out what instruments will need to be turned over for the following cases. Point out any broken instruments that need to be sent out for repair. Remind the staff of where sharps are located. Dispose of sharps in sharps container and deposit any items that may be recycled in correct containers.

**Loaner Instruments**

With any loaner tray, there usually are implants that follow these instruments. Each facility should set up a tracking system and have quality control procedures in place; this includes inpatient and outpatient facilities. Facilities will be held responsible for lost instruments. When possible, loaner trays should be brought in the day before surgery. This is to allow time for policy and procedure to be followed when preparing trays for sterilization. If loaner equipment arrives wrapped, consider it unsterile and break it down to be reprocessed.

A management system of loaner instruments reduces lost instruments and helps to ensure that decontamination and sterilization have been done correctly with communication involving vendors. Make sure to follow all manufactures’ recommendations when cleaning and sterilizing another company’s instrumentation. Sterile processing should maintain records, which should include when instruments were received. Additionally, the time instruments were received, the person checking in the instruments, the sets brought in, document
any missing instruments and copies of manufactures instructions. It helps if venders have “count sheets” of their sets, if they do not request them.

The Association for the Advancement of Medical Instrumentation recommends a maximum weight of 25 pounds for loaner sets. This weight is to include the weight of the container the instruments are in. This weight makes it difficult to determine the correct drying time to ensure sterility of these sets.

Another problem with heavy instrument sets is that they are difficult for the staff to lift. This can cause injury to not only SPD staff, but O.R. staff as well. Many injuries are reported due to the lifting of heavy instrument sets.

Each facility should address a return protocol in their policy. It is important for staff to know how instruments should be cleaned and decontaminated before being returned to the vendor. These policies should be strictly enforced.

**Implants**

According to the FDA, an implant is a device that is placed into a surgically or naturally formed cavity of the human body and is intended to remain there for 30 days or more. In order to protect public health, the FDA may determine that devices placed in subjects for shorter periods are also implants. Implants should NEVER be flashed sterilized per recommendations from the CDC, the Joint Commission, AORN and AAMI. Infections that involve implants are much harder to treat and often lead to more surgeries. In some cases, the implants have to be removed and antibiotic cement is used as spacers or in place of the implant until the patient is infection free. In worse cases, patients die from the infections. Implants are foreign bodies and they increase the risk of surgical site infections (SSI).

If an implant must be flashed, a biological indicator must accompany the implant and all proper paperwork should be sent to sterile processing. The biological should be read at one hour and at two hours, with results communicated to the
circulator in the room. If the surgical case is finished and staff has left the building, report the results to the manager or charge nurse. If the results from this biological are positive, notify the surgeon and infection control immediately.

AAMI recommends a dedicated exception log and form to facilitate dedicated detailed information related to this event. The information should include detailed information of the reason for premature release of the implant for fully traceable information to the patient. This information should include:

- Patient name
- Implant prematurely released
- Surgeon
- Reason for premature release
- What could have prevented premature release of this implant

Sterilization loads with implants should only be released by an experienced person at the end of a sterilization cycle. This person should strictly review all information pertaining to this load including monitors and printouts. When possible, this load should be quarantined until the biological is read and the results are negative.

Monitoring of each load should include:

- The physical monitoring of each load
- Label every package with an external process indicator a Class One
- Place an internal Class One indicator inside each package
- Monitor with a process challenge devices (Biological indicator)
- Evaluate all quality control measures and data at conclusion of the sterilization cycle.
- Release loads only if all criteria for release are met, which should be performed by a knowledgeable, experienced professional.
Cleaning and processing of Anesthesia Equipment

If your facility does not have anesthesia technicians, it usually means the perioperative nurse is involved with the anesthesia equipment. Anesthesia equipment that comes in contact with mucous membranes should be sterilized or undergo high-level disinfection. It is also important for anesthesia techs or nurses to follow all manufacturers’ instructions for the products that are used. Whenever the anesthesia department purchases new blades, clean them before use and review the new products instructions.

The Perioperative Area Accountability

The Operating Room suite historically has been a place where no one wanted to venture and was usually passed over by surveyors. This is no longer true. In fact, the OR is now under the microscope. The Operating Room is a huge drain on financial recourses, and with public education and scrutiny, the OR must change to meet these needs. With the expansion of outpatient surgery centers and procedure rooms these areas also fall into this category. With educational TV and the internet, patients can watch the surgical process before they have their procedure and understand what should happen. This includes all areas of the hospital and community where procedures are performed. Patients have a much more defined expectation of how their care should be performed.

The Operating Room, whose double doors were closed to everyone, must now open them so everyone can look in and see how we are changing and meeting the needs of our patients’. We have to become more efficient and still protect our patients’ from harm. It has become a true balancing act, to give more with less. This now includes areas like labor and delivery with operating rooms. They also fall under the same rules as all other operating rooms and the standards set by each state.
The days of surveyors passing us by because we were out there on our own are long gone. With “wrong site” surgeries, “never events”, and increasing surgical site infections, we are in the forefront more than ever. The Joint Commission surveyors, as well as CMS investigators are here with the staff and asking a lot of questions. They are verifying that education is being done, and ensuring that quality improvement participation is indeed happening. This is why perfect documentation is also required.

The Joint Commission Surveyors are perfecting the tracer methodology with every survey. Direct observation and personal contact involved with that patient throughout the perioperative area is a newer experience for everyone. Even though the Joint Commission process is voluntary, it is a requirement for Medicare and Medicaid reimbursement. AORN thoroughly explains how each of these agencies can affect how a hospital or surgery center functions.

The FDA, established in 1906, regulates medical products and oversees medical devises; like being illegal to alter a medical device. The FDA also regulates the reuse of items that are labeled “single use only”.

The EPA and OSHA were each established in 1970. OSHA was established by the U.S. Department of Labor, and it works to ensure safe work places for the employee. If an employee does not follow the law, OSHA can invoke severe fines and endanger Joint Commission accreditation. The EPA maintains a central file of Material Safety Data Sheets (MSDS) and manufacturer’s instruction for storage and the use and disposal of all products. The hope is that facilities will keep their MSDS up to date and educate the staff so the hospital can remain in compliance with hazardous chemicals. In the perioperative setting, some of these chemicals would be used to clean, disinfect and sterilize the instruments for the OR and procedure rooms.

The agencies roles in the healthcare industry are to keep workers and patients safe. How can these agencies affect your facility? Extreme consequences by these agencies can include immediate closure. CMS can reduce the amount of funding a
facility can receive. State and Federal agencies can levy fines for infractions of statutes/standards.

Each state has set a minimal standard and these standards must be followed by all licensed and non-licensed staff. When you become licensed you agree to follow all standards set by your state, not your facility. Each facility must follow the minimal standard set, and it is each licensed persons responsibility to know the states minimal standard.

Aseptic Technique

Aseptic technique is most strictly applied in the operating room because of the direct and often extensive disruption of skin and underlying tissue. However aseptic technique is used throughout the inpatient and outpatient setting. Aseptic technique helps to prevent or minimize postoperative or procedural infection.

The most common source of pathogens that cause surgical site infections is the patient. While microorganisms normally colonize parts in or on the human body without causing disease, infection may result when this endogenous flora is introduced to tissues exposed during surgical procedures. In order to reduce this risk, the patient is prepared or prepped by shaving hair from the surgical site; cleansing with a disinfectant containing such chemicals as iodine, alcohol, or chlorhexidine gluconate; and applying sterile drapes around the surgical site.

The dramatic reduction in the incidence of infectious disease that occurred during the late 1800s and 1900s resulted largely from the understanding that microorganisms cause disease and that they can be controlled through aseptic practices. Established control methods include use of physical agents, such as disinfectants, on agents outside the body; use of chemical agents, such as antiseptics, on inanimate objects and on the body surface; and use of chemotherapeutic agents, such as antibiotics, to combat microorganisms on body surfaces and inside the body.
The two major categories of aseptic practice are medical asepsis and surgical asepsis. Medical asepsis refers to measures taken to control and reduce the number of pathogens present. It is also known as “clean technique”. Measures used to prevent the spread of organisms from place to place include hand hygiene, gloving, gowning, and disinfecting to help contain microbial growth. Surgical asepsis refers to “sterile technique.” To be sterile, an object must be free of all microorganisms. Sterile technique is used to prevent the introduction of spread of pathogens from the environment into the patient. Sterile technique is employed when a body cavity is entered with an object that may damage the mucous membranes, when surgical procedures are performed, and when the patient’s immune system is already compromised. Procedures requiring sterile technique include insertion of IV catheters, injections, urinary catheterization, some irrigation of drainage tubes that enter sterile parts of the body, and all operative procedures.

For patients whose immune systems are compromised, certain procedures that normally would require clean technique should be performed using sterile technique. Examples of such patients include premature newborns, burns, transplant recipients, and patients receiving chemotherapy or radiation.

Medical asepsis includes all measures aimed at reducing the number or spread of microorganisms. Using barriers and cleaning and sterilization are important medical aseptic measures, but the most important of all is hand hygiene.
In all clinical settings, hand washing is an important step in asepsis. The “2012 Standards, Recommended Practices, and Guidelines” of the AORN, states that proper hand washing can be “the single most important measure to reduce the spread of microorganisms.” In general settings, hands are to be washed when visibly soiled, before and after contact with the patient, after contact with other potential sources of microorganisms, before invasive procedures, and after removal of gloves. Proper hand washing for most clinical settings involves removal of jewelry, avoidance of clothing contact with the sink, and a minimum of 10-15 seconds of hand scrubbing with soap, warm water, and vigorous friction.

All healthcare personnel and patients’ and their family members should learn proper hand washing techniques. Provide patients with material that explain the importance of washing their hands before and after toileting. Instruct all visitors to wash their hands before contact with patients and before leaving a patient’s room. If infection is to be controlled, the paramount importance of adequate hand washing cannot be stressed too often, no matter how unsophisticated it may seem.

From the 2010 CDC guidelines for hand hygiene in healthcare settings (Boyce & Pittet, 2010), recommended hand hygiene techniques including the following:

- When using alcohol-based products, apply product to the palm of one hand and rub both 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.
- If washing hands with soap and water, apply an amount of product recommended by the manufacturer to hands; rub hands together vigorously for at least 15 seconds, covering all surfaces of the hands and fingers. Rinse hands with water and dry thoroughly with a disposable towel. Use towel to turn off the faucet. Avoid hot water, to reduce the risk of dermatitis with repeated exposures.
A surgical scrub is performed by members of the surgical team who will come into contact with the sterile field or sterile instruments and equipment. This procedure requires use of a long-acting, powerful, antimicrobial soap on the hands and forearms for a longer period of time than used for typical hand washing. Institutional policy usually designates an acceptable minimum length of time requires; the CDC recommends at least two to five minutes of scrubbing. Thorough drying is essential, as moist surfaces invite the presence of pathogens. Contact with the faucet or other potential contaminants should be avoided. The faucet can be turned off with the use of a foot pedal. An important principle of aseptic technique is that fluid (a potential mode of pathogen transmission) flows in the direction of gravity. With this in mind, hands are held below elbows during the surgical scrub and above elbows following the surgical scrub. Despite this careful scrub, bare hands are always considered potential sources of infection.

As an infection control measure, hand-hygiene compliance by healthcare workers remains poor (Karabey, Ay, Derbertli, 2010). Some factors that contribute to poor compliance with hand hygiene (Katz, 2009) include:

- Lack of awareness of client care activities that require hand hygiene, such as performing routine and “clean” activities, including taking blood pressure or shaking hands with patients
- Common misperception that wearing gloves and gowns can substitute for hand hygiene
- Understaffing and high workloads
- Inaccessibility to sinks or dispensers for soap or alcohol-based cleanser
- Skin irritation and dryness

Studies have documented that easily accessible dispensers with an alcohol-based, waterless hand-hygiene antiseptic can lead to higher rates of hand washing by healthcare workers (Bischoff, Reynolds, 2002).

The CDC developed and implemented national guidelines for hand hygiene in 2002. Equipment necessary for hand hygiene (soap, running water, and paper
towels or waterless alcohol-based antiseptics) is inexpensive and should be available readily to all healthcare providers. High-risk areas, such as newborn nurseries, critical care, transplantation, and burn units; operative suites, may also require the use of antiseptic cleansing agents, such as nail files or sticks, and antiseptic-impregnated scrub brushes.

Health care professionals are recommended to wash their hands before and after every patient care contact. The use of gloves during patient care does not eliminate the need for hand hygiene. It is recommended to wash hands in the following situations:

- At the beginning and end of shift
- Before contact with patient
- Between contact with different patients
- Before and after contact with wounds, dressings, specimens, or bedclothes
- Before performing any invasive procedures
- Before administering medication
- After contact with any patient secretion or excretion
- Before and after using the bathroom
- After sneezing, coughing, or blowing your nose
- After removing gloves
- Before eating
- After picking your nose (This one is for my kids)

Sterile surgical clothing or protective devices such as gloves, faces, face masks, goggles, and transparent eye/face shields serve as barriers against microorganisms and are donned to maintain asepsis in the operating room. This practice includes covering facial hair, tucking hair out of sight, and removing jewelry or other dangling objects that may harbor unwanted organisms. This garb must be put on with deliberate care to avoid touching external, sterile surfaces with nonsterile objects including the skin. This ensures that potentially contaminated items such
as hands and clothing remain behind protective barriers, thus prohibiting inadvertent entry of microorganisms into sterile areas. Personnel assist the surgeon to don gloves and garb and arrange equipment to minimize the risk of contamination.

The concept of what is “essential” for asepsis remains controversial. Sellors et al. surveyed obstetric anesthetists in Australia to determine what practitioners believe to be “essential” aseptic precautions when inserting an epidural catheter for labor analgesia.

The hands of health care providers are the most common vehicle by which microorganisms are transmitted between patients. As a result, hand washing is considered to be the single most important technique in the prevention of cross-infection. Soap and water alone moves bacteria but is not effective at killing organisms. In contrast, full surgical scrub was believed necessary with an antiseptic solution. Antiseptic solution with an alcohol component or alcoholic solutions alone provide superior disinfection when compared with nonalcoholic antiseptic (povidone iodine, 4% chlorhexidine, hexachlorophene, and triclosan) or standard nonantimicrobial soaps. For example, a 1-minute hand rub with 60% isopropanol by volunteers who then put on surgical gloves has an immediate bacterial reduction lasting 3 hours, which is significantly greater than that resulting from the use of non-alcoholic antiseptics. Alcohols are rapidly germicidal when applied to the skin but have very little persistent activity. However, when combined with other antiseptic compounds, bacterial regrowth occurs at a significantly slower rate. Extended antimicrobial activity appears to be greatest for alcohol-based solutions containing 2% or 4% chlorhexidine gluconate, followed by hexachlorophene, triclosan, and the iodophors. Because hexachlorophene is absorbed into the blood after repeated use, it is seldom used as a surgical scrub. Of note, antiseptic solutions containing 60% to 95% alcohol appear to be most effective, with higher concentration being less potent because protein denaturization requires the presence of water.
Currently, in 2013, it is unclear whether or not the use of artificial nails or the length of natural fingernails contributes to an increased risk of hospital-related infections. Health care workers with artificial nails are more likely to harbor gram-negative pathogens on their hands and fingertips both before and after hand washing when compared with health care workers with natural fingernails alone. Studies have shown that the subungual region of the hand harbors high concentration of bacteria primarily coagulase 0 negative staphylococcus, gram-negative rods, corynebacteria, and yeast. At present, nail length does not appear to be a significant risk factor for either infectious complication or cross-contamination because the majority of bacterial growth occurs along the proximal 1 mm of nail adjacent to the subungual skin. The application of nail polish to artificial or natural-borne fingernails does not increase the number of bacteria recovered from the periungual region. However, chipped or poorly maintained nail polish may increase the number of transient microorganisms present.

The majority of respondents in the survey in table 1, (86%) indicated that removing wristwatches was essential, a view held by many infection-control experts. However, there was less agreement on the removal of rings, an issue that nearly divided the respondents equally. Higher microbial counts after hand washing have been bound in health care workers who prefer not to remove rings. Bertha suggested that this practice may place patients at higher risk for nosocomial infections. Finally, it is important to emphasize that proper hand washing techniques or other interventional procedures nut throughout the patient’s entire preoperative experience.

Although gloves may be considered a useful and important component of asepsis, they should only be regarded as a supplement to, not replacement for, hand washing. For example, Olsen and colleagues report possible microbial contamination of hands and transmission of infection despite gloves being worn. In this prospective investigation, quantitative hand cultures were obtained from 137 health care workers before and after contaminated patient care procedures (endotracheal tube care, digital rectal examinations, and routine dental
All health care workers wore single-use, nonsterile disposable latex vinyl gloves. External glove surfaces were also quantitatively cultures after each patient contact. Used gloves were then tested for leaks by using the American Society for Testing Material’s watertight test. Eighty-six (64%) of the 135 glove cultures had gram-negative rods or enterococci on the external surface after use and were therefore sources of potential hand contamination. Microbial contamination of the health care workers’ hand occurred in 11 (13%) of theses 86 events and was more frequent with vinyl (24%) versus latex gloves (2%). Although appropriate glove use prevented hand contamination in the vast majority of cases, 23% of hands were found to be contaminated after patient care when a glove leak occurs. The authors concluded that latex gloves, and to a lesser extent vinyl gloves, provide substantial protection to health care workers during hand contact with contaminated mucosal membranes. However, non-sterile gloves cannot reliably provide an impenetrable barrier between patient and health care provider and must therefore always be considered potential extrinsic infectious foci. At present, no investigation has examined the risk of microbial contamination or glove leaking with sterile surgical latex or neoprene gloves, Single-use sterile or disposable gloves should never be washed, re-sterilized, or disinfected, with new gloves being worn during each patient encounter.

Gowns are generally considered a means of preventing cross-contamination between patients by preventing infectious materials from coming into contact with the clothes of health care providers. Recent investigations have shown that the use of gowns did not reduce patient colonization, infection, or mortality rates in neonatal intensive care units. Furthermore, the universal use of gloves and gowns was found to be no better than the use of gloves alone in preventing colonization of vancomycin-resistant enterococci in medical intensive care units. However, there is currently insufficient data to make a definitive recommendation with regard to routine gown use within the operating room environment during regional blocks.
Donning sterile gloves requires specific technique so that the outer glove is not touched by the hand. A large cuff exposing the inner glove is created so that the glove may be grasped during donning. It is essential to avoid touching non-sterile items once sterile gloves are applied; the hands may be kept interlaced to avoid inadvertent contamination. Any break in the glove or touching the glove to a nonsterile surface requires immediate removal and application of new gloves.

Asepsis in the operating room or for other invasive procedures is also maintained by creating sterile surgical fields with drapes. Sterile drapes are sterilized linens placed on the patient or around the field to delineate sterile areas. Drapes or wrapped kits of equipment are opened in such a way that the contents do not touch non-sterile items or surfaces. Aspects of this method include opening the furthest areas of a package first, avoiding leaning over the contents, and preventing opened flaps from falling back onto contents.

The issue of wearing surgical masks during regional techniques has also received a tremendous amount of attention and controversy. Several clinicians contended that surgical masks are critical component of asepsis, whereas others argue their
use in not based on definitive scientific evidence. A British survey reports that 51% of practitioners do not routinely wear masks when performing central neuraxial block. This practice is supported by the work of Schweizer, who showed that surgical masks may significantly increase the amount of wound contamination. It is postulated that under these conditions, skin friction with the mask may release skin scales that carry a significant amount of bacterial contaminants. These findings were also confirmed by Orr, who reported a 50% decrease in wound infections when surgical face masks were not worn during procedures. However, this investigation is often criticized for its lack of controls. Tunevall subsequently performed a prospective, randomized investigation to examine whether or not the face mask significantly increased the amount of bacterial “fall-out” into the surgical wounds of 3,088 patients undergoing a variety of general surgical procedures. Postoperative infections were identified in 73 of 1,537 (4.7%) patients in which face masks were used and in 55 of 1,551 (3.5%) patient’s, in which no surgical face masks were worn, showing no added benefit of wearing masks during surgery. As a result, Tunevall suggested that the routine use of face masks be reconsidered if the intent is to protect the patient. However, he goes on to recommend that surgical masks may be worn if the intent is to protect operating room personnel against blood droplets or airborne infections originating from patient encounters.

In contrast to the investigations noted earlier, Pholops and colleagues showed that wearing a face mask results in a marked reduction in the bacterial contamination of a surface in close proximity to the upper airway. Bacterial colonies grew on more than 50% of agar plates 30cm away from providers who were speaking without a mask. A fresh mask barely abolished contamination, whereas a small increase did occur after 15 minutes of wear. Although this increase was statistically insignificant, it is advisable to wear a new face mask for each procedure or patient encounter. It should be kept in mind that organisms grow in the upper airway are of low pathogenicity and virulence. Therefore, the likelihood
of causing a wound infection in a patient with an intact immune system is extremely small.

Equipment and supplies also need careful attention. Medical equipment such as surgical instrumentation can be sterilized by chemical treatment, radiation, gas, or heat. Personnel can take steps to ensure sterility by assessing that sterile packages are dry and intact and checking sterility indicators such as dates or colored tape that changes color when sterile.

In the operating room, staff have assignments so that those who have undergone surgical scrub and donning of sterile garb are positioned closer to the patient. Only scrubbed personnel are allowed into the sterile field. Arms of scrubbed staff are to remain within the field at all times, and reaching below that level of the patient or turning away from the sterile field are considered breaches in asepsis.

Other “unscrubbed” staff members are assigned to the perimeter and remain on hand to obtain supplies, acquire assistance, and facilitate communication with outside personnel. Unscrubbed personnel may relay equipment to scrubbed personnel only in a way that preserves the sterile field. For example, an unscrubbed nurse may open a package of forceps in a sterile fashion so that he or she never touches the sterilized inside portion, the scrubbed staff, or the sterile field. The uncontaminated item may either be picked up by a scrubbed staff member or carefully placed on to the sterile field.

The environment contains potential hazards that may spread pathogens through movement, touch, or proximity. Interventions such as restricting traffic in the operating room, maintaining positive-pressure airflow (to prevent air from contaminated areas from entering the operating room), or using low-particle generating garb to help minimize environment hazards.

When beginning a surgically aseptic procedure, the nurse follows certain principles to ensure maintenance of asepsis. Failure to follow these principles places patients at risk for infection. The following principles are important:
1. A sterile object remains sterile only when touched by another sterile object. This principle guides the nurse in placement of sterile objects and how to handle them.
   a. Sterile touching sterile remains sterile; for example, sterile gloves or sterile forceps are used to handle objects on a sterile field.
   b. Sterile touching clean becomes contaminated; for example, if the tip of a syringe or other sterile object touches the surface of a clean disposable glove, the object is contaminated.
   c. Sterile touching contaminated becomes contaminated; for example, when the nurse touches a sterile object with an ungloved hand, the object is contaminated.
   d. Sterile state is questionable, for example, when you find a tear or break in the covering of a sterile object. Discard it regardless of whether the object itself appears untouched.

2. Only sterile objects may be placed on a sterile field. All items are properly sterilized before use. Sterile objects are kept in clean, dry storage areas. The package or container holding a sterile object must be intact and dry. A package that is torn, punctured, wet, or open is considered unsterile.

Other principles that are applied to maintain asepsis in the operating room include:

- All items in a sterile field must be sterile
- Sterile packages or fields are opened or created as close as possible to time of actual use.
- Moist areas are not considered sterile.
- Contaminated items must be removed immediately from the sterile field.
- Only areas that can be seen by the clinician are considered sterile (i.e., the back of the clinician is not sterile).
- Gowns are considered sterile only in the front, from chest to waist and from the hands to slightly above the elbow.
• Tables are considered sterile only at or above the level of the table.
• Non-sterile items should not cross above a sterile field.
• There should be no talking, laughing, coughing, or sneezing across a sterile field.
• Personnel with colds should avoid working while ill or apple a double mask.
• Edges of sterile areas or fields (generally the outer inch) are not considered sterile.
• When in doubt about sterility, discard the potentially contaminated item and begin again.
• A safe space or margin of safety is maintained between sterile and nonsterile objects and areas.
• When pouring fluids, onto the lip and inner cap of the pouring container is considered sterile; the pouring container should not touch the receiving container and splashing should be avoided.
• Tears in barriers and expired sterilization dates are considered breaks in sterility.

A key difference between the operating room and other clinical environments is that the operating area has high standards of asepsis at all times, while most other settings are not designed to meet such standards. While clinical areas outside of the operating room generally do not allow for the same strict level of asepsis, avoiding potential infection remains the goal in every clinical setting. Observation of medical aseptic practices will help to avoid nosocomial infections. The application of aseptic technique in such settings is termed medical asepsis or clean technique (rather than surgical asepsis or sterile technique required in the operating room).

Specific situations outside of the operating room require a strict application of aseptic technique. Some of these situations include:

• Wound care
• Drain removal and drain care
• Intravascular procedures
• Vaginal exams during labor
• Insertion of urinary catheters
• Respiratory suction

For example, a surgical dressing change at the bedside, though in a much less controlled environment than the operating room, will still involve thorough hand washing, use of gloves and other protective garb, creation of a sterile field, opening and introducing packages and fluids in such a way as to avoid contamination, and constant avoidance of contact with nonsterile items.

General habits that help to preserve a clean medical environment include:

• Safe removal of hazardous waste, i.e., prompt disposal of contaminated needles or blood-soaked bandages to containers reserved for such purposes
• Prevention of accumulation of bodily fluid drainage, i.e., regular checks and emptying of receptacles such as surgical drains or nosogastric suction containers
• Avoidance of backward drainage flow toward patient, i.e., keeping drainage tubing below patient level at all times
• Immediate clean-up of soiled or moist areas
• Labeling of all fluid containers with date, time, and timely disposal per institutional policy
• Maintaining seals on all fluids when not in use

The isolation unit is another clinical setting that requires a high level of attention to aseptic technique. Isolation is the use of physical separation and strict aseptic technique for a patient who either has a contagious disease or is immunocompromised. For the patient with a contagious disease, the goal of isolation is to prevent the spread of infection to others. In the case of respiratory infections (i.e., tuberculosis), the isolation room is especially designed with a negative pressure system that prevents airborne flow of pathogens outside the
room. The severely immunocompromised patient is placed in reverse isolation, where the goal is to avoid introducing any microorganisms to the patient. In these cases, attention to aseptic technique is especially important to avoid spread of infection in the hospital or injury of the patient unprotected by sufficient immune defenses. Entry and exit from the isolation unit involves careful hand washing, use of protective barriers like gowns and gloves, and care not to introduce or remove potentially contaminated items. Institutions supply specific guidelines that direct practices for different types of isolation, i.e., respiratory versus body fluid isolation precautions.

In a multidisciplinary setting, all personnel must constantly monitor their own movements and practices, those of others, and the status of the overall field to prevent inadvertent breaks in sterile or clean technique. It is expected that personnel will alert other staff when the field or objects are potentially contaminated. Health care workers can also promote asepsis by evaluating, creating, and periodically updating policies and procedures that relate to this principle.

Every individual is accountable for his or her own role in infection control. The patient should be considered an extension of the caregiver’s own body. The patient completely trusts the team to provide safe care and protection from infection. Assuring aseptic technique at all times is our solemn obligation, with moral implications!

**Possible wound infections:**

**Beta-Lactamase/ Extended-Spectrum Beta-Lactamases (ESBLs):**

Beta-lactamase are enzymes that are produced by some bacteria and are responsible for their resistance to beta-lactam antibiotics like penicillins, cephamsins and carbapenems (ertapenem). The two most common bacteria are Escherichia coli (E.coli) and Klebsiella pneumoniae.
Cephalosporins are common in their molecular structure to beta-lactamase; they both have four-atom rings, these are known as beta-lactam. The lactamase enzyme breaks open the ring which deactivates the molecule’s antibacterial properties.

Extended-Spectrum Beta-Lactamases (ESBLs) are enzymes that can be produced by bacteria, making them resistant to cephalosporins e.g. cefuroxime, cefotaxime, ceftriaxone and ceftazidime as well as monobactums e.g. aztreonam. Extended-spectrum is third generation antibiotics. These antibiotics are widely used in many hospitals. At this time they do not affect the cephamycins which are cefotetan or cefoxitin. They also do not affect carbapenems including meropenem or imipenem.

ESBLs were first described in the mid-1980s and were mostly found in Klebsiella species, mostly in hospitals and often in intensive care units usually with patients with illnesses that make them opportunistic for bacterial infections. At that time it was suggested that ESBLs, because of molecular analysis, may have derived from mutations. This problem was not a big issue at the time however now we have a new class of ESBL. The new class of ESBLs is called CTX-M enzymes, and is detected among Escherichia coli (E. coli) bacteria.

E. coli is able to resist Penicillins and cephalosporins. These CTX-M enzymes are rapidly expanding. This is not just simple cystitis, concern because it is found in most urinary tract infections. Missing the presence of ESBL could result in treatment failure. It is hard sometimes to detect these because they do have different activity levels.

Other types of infections are caused by E. coli, could lead to bacteremia a blood infection which could be life threatening. K. pneumonia causes bacterial pneumonia, or wound infections in addition to UTIs. Patients with weak immune systems, other illnesses, children and elderly are at risk.

The National Committee for Clinical Laboratory Standards (NCCLS) developed broth microdilution and disk diffusion screening tests. These tests have indicated
that cefpodoxime and ceftazidime show the highest sensitivity of ESBL. Another problem is some ESBLs contain β-lactamases that can mask ESBL production.

Beta-lactam antibiotics are used to treat a broad spectrum of Gram + and Gram- bacteria. Examples of the many different bacteria would be Enterobactoer, K. pneumonia, K. oxytoca, E. coli, Enterobacteriaceae (Salmonella), Proteus, Morganella, Mirabilis, Psuedomonas aeruginosa, Citobacter, andvSerratia, which all produce ESBLs.

**Methicillin Resistant Staphylococcus Aureus (MRSA):**

What is MRSA? It has been brought to the attention of many people, because it has been the subject of many news features lately. Why has MRSA been featured? Because of the spread of this “super disease” and new cases; Health care workers are more concerned than ever about its transmission process and getting it themselves.

Staphylococcus aureus is a common cause of healthcare associated infections reported to the National Healthcare Safety Network (NHSN). The percentages reported are Coagulase-negative staphylococci the leading infection is 15%, while Staphylococcus aureus is 14%. Staphylococcus Aureus is the most common cause of surgical site infections at 30% and causing ventilator associated pneumonia at 24%. Of all the healthcare associated S. aureus infections, it is suggested that 49-65% are caused by Methicillin resistant strains.

Methicillin Resistant Staphylococcus Aureus (MRSA): is a type of “staph” bacteria that does not react to certain beta-lactam antibiotics called antimicrobial-resistant and will normally cause skin infections. Bacteria are a one-celled organism without a true nucleus or cell organelles, belonging to the kingdom of procaryotae (Monera). Millions of non-pathogenic bacteria live on human skin and mucous membranes, these are called normal flora. Bacteria that cause disease are called pathogens. Bacteria, like all living things, undergo mutations. It is the environment that determines which mutations are beneficial to bacteria. Mutations may be
Beneficial to bacteria and may not be to humans, because mutation provides resistance to the potentially lethal effects of antibiotics against bacteria.

MRSA can cause other infections that CAN BE FATAL! MRSA occurs most frequently with patients who undergo invasive procedures. Examples are catheters or surgery and with patients who have weakened immune systems. MRSA in the healthcare setting commonly cause bloodstream infections, surgical site infections as well as pneumonia.

**History of Methicillin-resistance:**

Methicillin-resistance in S. aureus was first identified in the 1960s usually among hospitalized patients.

• Starting in 1974, MRSA infections accounted for about 2% of the total number of staph infections.

• By 1995 it was up to 22%; in 2004 it was 63%, one can see how it is increasing. The CDC estimates that each year approximately 27 million surgical procedures are performed.

• The CDC estimated 94,360 invasive MRSA cases occurred in the U.S. in 2005 and of these cases, 18,650 which means 20% were associated with death.

• In 2006-2007 MRSA is viewed as stabilizing at 56% after evaluation of this trend.

About 14% of all infections occurred in persons without obvious exposures to healthcare. The overall rates of disease were consistently highest among persons older than 65, black and also males.

MRSA is resistant to antibiotics including methicillin, oxacillin, penicillin and amoxicillin including cephalosporins (e.g., cephalexin). Since these strong drugs are no longer effective against MRSA, these infections are sometimes called multidrug resistant organisms (MDROs). According to the CDC high prevalence influences unfavorable antibiotic prescribing, this possibly could contribute to further spread of bacterial resistance.
MRSA is seen most frequently among patients who undergo invasive medical procedures or often occur with people who have weakened immune systems and are in hospitals and/or healthcare facilities. This includes nursing homes, dialysis centers and prisons. MRSA in healthcare settings commonly causes serious and potentially life threatening infections such as bloodstream infections, surgical site infections or pneumonia.

What is a surgical site infection?

An infection that occurs at the site of surgery within thirty days of an operation or within one year of an operation if a foreign body (e.g., artificial heart valve, joint or mesh) is implanted as part of the surgery. Most surgical site infections, approximately 70% are superficial infections which involve the skin only. The remaining, more serious infections may involve tissues under the skin, organs or implanted material.

An example of this would be orthopedic surgery, according to the CDC, who estimates approximately over 4 million orthopedic surgeries are performed each year and over 500,000 of these surgeries involve the knee. Typically depending on the type of surgery, less than 1% of most surgeries result in surgical site infection. Of these infected cases, 50% are caused by MRSA. You can watch these statistics at National Healthcare Safety Network’s annual update.

This infection spreads because of skin-to-skin contact, sharing or touching personal items from a person who has infected skin. MRSA can be spread from touching a surface or item that has been in contact with someone with MRSA. In the case of MRSA, patients who already have an MRSA infection or who carry the bacteria on their bodies but do not have any symptoms (Colonized) are the most common sources of transmission.
Colonization of MRSA:

Colonization of MRSA generally proceeds to infection and in this case colonization can be long lasting. This means it could last from months to years in some subpopulations.

MRSA infections that occur in otherwise healthy people who have not recently (usually within the last year) been in the hospital or had surgery are known as Community-associated MRSA infections (CA-MRSA). In the community at large, these infections are usually skin and soft tissue (SSTIs) infections such as pimples, furuncles (abscessed hair follicles or “boils”), Carbuncles (coalesced masses of furuncles), abscesses and other pus-filled lesions. The role of MRSA in cellulitis without abscess or purulent drainage is less clear since cultures are rarely obtained. However, these infections may also lead to more serious illness, such as pneumonia.

Major strides have been made in recent years to reduce the numbers of MRSA infections in healthcare settings.

**What to look for:**

When considering a patient has an MRSA infection, you will find skin with a red, swollen and painful area. This area of skin will be warm to the touch possibly full of puss or other drainage. Another symptom is the patient will also present with a fever.

The CDC encourages an MRSA in the differential diagnosis of SSTIs compatible with S. Aureus infections, especially those that are purulent (fluctuant or palpable fluid-filled cavity, yellow or white center, central point or “head” draining pus. It may be possible to aspirate pus with a syringe). A patient may present with a complaint of a “spider bite,” this should raise suspicion of a Staphylococcus aureus infection.
How is MRSA spread in the healthcare setting?

Although MRSA can come from the environment and be transmitted to people, the most common method of transmission is from person-to-person. The main mode of transmission in the healthcare setting is through healthcare workers’ hands. Health care worker’s hands may become contaminated with MRSA bacteria by contact with infected or colonized patients. If appropriate hand washing with soap and water or use of an alcohol-based hand rub is not performed, the bacteria can be spread from a healthcare worker who has come in contact with MRSA to a patient. It is also appropriate to ask all visitors to wash their hands before visiting patients. When possible it is best for patients if friends and relatives do not visit while a patient is ill.

Colonization means the growth of microorganisms, especially bacteria, in a particular body site. A patient who has acquired MRSA colonization during a hospital stay has increased risk for MRSA infections after discharge from the hospital or a transfer to a long term acute admission. These MRSA carriers can transmit the disease as the move through and across the healthcare facilities.

If appropriate hand washing with soap and water or using an alcohol-based hand sanitizer is not performed, the bacteria can be spread when the healthcare worker touches other patients.

Let’s discuss MRSA:

The expensive results of Antimicrobial Resistance bacteria, along with MRSA many significant infection-causing bacteria in the world are becoming resistant to most commonly prescribed antimicrobial antibiotics and treatments. In some cases this means no antibiotics are effective against these mutated “super” bacteria. However, at this time, MRSA for healthcare-associated treatment still exits.

People with antibiotic-resistant organisms like MRSA are more likely to have extended and more expensive hospital stays. These patients are at higher likelihood of serious complications and possible health serious issues resulting
from this infection. Extended treatments create a greater burden and expense to the healthcare system. Because of this issue, the CDC, State and Local health departments, and other health partners nationwide are collaborating to prevent MRSA infections in the healthcare settings.

Of the pathogens which are causing the antibiotic resistant infections, most strains are associated with MRSA infections and are usually caused by traditional strains associated within the healthcare community. However, the strains traditionally associated with the community transmission are now being identified in the healthcare system as well.

One test to know if you are dealing with MRSA is to culture patients who are suspected to have colonized or have MRSA. Cultures can be expensive to the facility; however, it is less costly that other tests and it is a common practice than labs are accustomed to using. It does however take 72 hours to identify if MRSA is present. Start treating patients as if they are positive while waiting for results. This way there is less chance of spreading if a patient is positive.

Another test is the Polymerase chain reaction test; this is a very fast way of testing patients. On the negative side it is very expensive. Additionally it is a more difficult test for lab personnel to perform. Another issue with this test is which body site to use; possible site are wounds, axillae and groin.

The CDC recommends testing patients who are in high risk areas like ICU, however anywhere in the facility would be appropriate.

Prevention and control are key to stopping infection. It is very important that Healthcare providers review frequently updated policies and procedures when dealing with MRSA.
Preventing MRSA:

There are ways to prevent infection in MRSA colonized patients’. The CDC calls these Core Prevention Strategies. Assessment of the staff for hand washing/hygiene practices. Implement contact precautions for patients’ with MRSA during hospital stay. Recognize previously colonized patients’. Rapidly reporting MRSA lab results and making sure to give this information during handoff reports. Provide MRSA education for all healthcare providers’, this includes all staff members who interact with patient’s care.

Hand hygiene is one of the most important parts of the prevention efforts. This prevents transmission of MRSA by the hands of healthcare care professionals. Make sure soap and water, as well as alcohol-based hand creams or gels are easily available to the entire staff including family and visitors. Educate not only health care professionals, but include the patient’s and their family. Watch how the health care providers put these practices into action. Make sure all employees are following policies and procedures correctly. Always do what the CDC calls “Just in time feedback” when staff members are not washing their hands according to policy.

Contact Precautions is another core prevention to put in place with someone with or suspected of MRSA. Use a gown and gloves prior to entering patient’s room. Remove the Personal protective equipment (PPE) prior to leaving a patient’s room to prevent spread. Put these patients’ in their own room or if confirmed MRSA put with another confirmed colonized/infected patient. Always use dedicated if possible disposable items, blood pressure cuffs and stethoscopes are examples. Leave the IV poles and pumps in the rooms for entire stay. These patients’ could be in the hospital for months.

Education is a huge part of the core prevention measure. Education helps improve adherence to hand hygiene by health care workers and patients, including family and friends. It also helps to improve interventions, including contact precautions. Understanding this problem helps to encourage behavioral change.
What can patients’ do to protect themselves? There are several things a patient can do to protect themselves from MRSA. It is important for patients to maintain a healthy weight. If a patient smokes, educate the importance of quitting at least 30 days prior to surgery. If a patient has diabetes, they should work with their doctor to keep blood sugar levels under control, especially prior to surgery. Make sure the patient takes a shower or bath prior to surgery, at least the day before. Make sure patients do not shave an area prior to surgery. Explain to the patient that hair may be clipped if necessary in surgery.

Patients’ can also ask that doctors make sure to use antibiotics correctly prior to and after their surgery. Patients need to be proactively involved with their care. They can watch to make sure staff is washing hands prior to touching them.

Decolonization therapy for MRSA carriers is one way to try and suppress or possibly eliminate colonization. This is the use of topical and/or systemic agents. This therapy may reduce risk of subsequent infections in MRSA carriers as well as decrease transmission. One of the problems with decolonization is determining which body parts to target, whether it is just the nares, or the whole body. Then the question is should intra-nasal mupirocin be used only, or just a chlorhexidine baths. The other option is to do both. There are also oral agents available now. The worry would be emergence of mupirocin resistance.

Prevention is our main goal when talking about MRSA, and prevention in surgery is an Operating Room nurses goal. Health care facilities should put prevention measures in place, which can affect surgical site infections. Active surveillance testing is one of the strategies used. Another more controversial method is chlorhexidine bathing. There are also impregnated prepackaged wash cloths that some surgeons are having patients use prior to surgery.

It is the operating and procedural room nurses responsibility to post contact precautions signs on doors when necessary. It is also extremely important to pass this information on to each other in our hand off reports and briefings. This information should be written on the OR room count boards for all staff entering.
the room to see. When possible, have the patients bed completely cleaned while a surgical case is in progress; make sure to communicate information about MRSA to environmental services personnel to wear protective equipment. Make sure to completely clean the patient of all body fluids before they leave the Operating Room suite.

Again, communicate all information to recovery room staff so that they are prepared to receive the patient appropriately attired and if possible separated from other recovery room patients. This will ensure we help prevent surgical site infection throughout the perioperative phase.

In all clinical settings, hand washing is an important step in asepsis. The “2012 Standards, Recommended Practices, and Guidelines” of the Association of Perioperative Registered Nurses (AORN) states that proper hand washing can be “the single most important measure to reduce the spread of microorganisms.” In general settings, hands are to be washed when visibly soiled, before and after contact with the patient, after contact with other potential sources of microorganisms, before invasive procedures, and after removal of gloves. Proper hand washing for most clinical settings involves removal of jewelry, avoidance of clothing contact with the sink, and a minimum of 10-15 seconds of hand scrubbing with soap, warm water, and vigorous friction.

All healthcare personnel, patients’ and their family members should learn proper hand washing techniques. Provide patients’ with material that explain the importance of washing their hands before and after toileting. Instruct all visitors to wash their hands before contact with a patient and before leaving a patient’s room. If infection is to be controlled, the paramount importance of adequate hand washing cannot be stressed too often, no matter how unsophisticated it may seem.

From the 2010 CDC guidelines for hand hygiene in healthcare settings (Boyce & Pittet, 2010), recommended hand hygiene techniques including the following:
• When using alcohol-based products, apply product to the palm of one hand and rub both 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.

• If washing hands with soap and water, apply an amount of product recommended by the manufacturer to hands; rub hands together vigorously for at least 15 seconds, covering all surfaces of the hands and fingers. Rinse hands with water and dry thoroughly with a disposable towel. Use towel to turn off the faucet. Avoid hot water, to reduce the risk of dermatitis with repeated exposures.

A surgical scrub is performed by members of the surgical team who will come into contact with the sterile field or sterile instruments and equipment. This procedure requires use of a long-acting, powerful, antimicrobial soap on the hands and forearms for a longer period of time than used for typical hand washing. Institutional policy usually designates an acceptable minimum length of time requires; the CDC recommends at least two to five minutes of scrubbing. Thorough drying is essential, as moist surfaces invite the presence of pathogens. Contact with the faucet or other potential contaminants should be avoided. The faucet can be turned off with the use of a foot pedal. An important principle of aseptic technique is that fluid (a potential mode of pathogen transmission) flows in the direction of gravity. With this in mind, hands are held below elbows during the surgical scrub and above elbows following the surgical scrub. Despite this careful scrub, bare hands are always considered potential sources of infection.

As an infection control measure, hand-hygiene compliance by healthcare workers remains poor (Karabey, Ay, Derbertli, 2010). Some factors that contribute to poor compliance with hand hygiene (Katz, 2009) include:

• Lack of awareness of client care activities that require hand hygiene, such as performing routine and “clean” activities, including taking blood pressure or shaking hands with patients.
- Common misperception that wearing gloves and gowns can substitute for hand hygiene
- Understaffing and high workloads
- Inaccessibility of sinks or dispensers for soap or alcohol-based cleanser
- Skin irritation and dryness

Studies have documented that easily accessible dispensers with an alcohol-based, waterless hand-hygiene antiseptic can lead to higher rates of hand washing by healthcare workers (Bischoff, Reynolds, 2002).

The CDC developed and implemented national guidelines for hand hygiene in 2002. Equipment necessary for hand hygiene (soap, running water, and paper towels or waterless alcohol-based antiseptics) is inexpensive and should be available readily to all healthcare providers. High-risk areas, such as newborn nurseries; critical care, transplantation, and burn units; and operative suites, may also require the use of antiseptic cleansing agents, nail files or sticks, and antiseptic-impregnated scrub brushes.

Health care professionals are recommended to wash their hands before and after every patient care contact. The use of gloves during patient care does not eliminate the need for hand hygiene. It is recommended to wash hands in the following situations:

- At the beginning and end of shift
- Before contact with patient
- Between contact with different patients
- Before and after contact with wounds, dressings, specimens, or bedclothes
- Before performing any invasive procedures
- Before administering medication
- After contact with any patient secretion or excretion
- Before and after using the bathroom
- After sneezing, coughing, or blowing your nose
• After removing gloves
• Before eating
• After picking your nose (This one is for my kids)

Sterile surgical clothing or protective devices such as gloves, faces, face masks, goggles, and transparent eye/face shields serve as barriers against microorganisms and are donned to maintain asepsis in the operating room. This practice includes covering facial hair, tucking hair out of sight, and removing jewelry or other dangling objects that may harbor unwanted organisms. This garb must be put on with deliberate care to avoid touching external, sterile surfaces with non-sterile objects including the skin. This ensures that potentially contaminated items such as hands and clothing remain behind protective barriers, thus prohibiting inadvertent entry of microorganisms into sterile areas. Personnel assist the surgeon to don gloves and garb and arrange equipment to minimize the risk of contamination.

The concept of what is “essential” for asepsis remains controversial. Obstetric anesthetists were surveyed in Australia to determine what practitioners believe to be “essential” aseptic precautions when inserting an epidural catheter for labor analgesia. Surprisingly, there was a wide variation in what was considered to be “essential”. These findings likely reflect the paucity of scientific evidence currently available to support, or refute, the efficacy of these aseptic precautions.

**Post-Surgical Infection Prevention:**

Once a patient is discharged, it is very important that the patient takes home this MRSA prevention information. Make sure they know that everyone is to wash their hands for at least 15 seconds every time. Keep hand sanitizer available at all times after surgery. Do not use sanitizer when hands are visibly soiled (dirty).

When educating a patient and patient’s family remind them it is important for everyone to wash their hands 15 seconds prior to fixing meals, and before eating these meals. Always wash hands after using the toilet, keeping this in mind do not share hand towels, use fresh linens. Wash hands after handling dirty clothes,
towels, and linens. Wash all items in contact with patient in hot water to kill any contaminates that could possibly present. Once home from surgery, the Patient should not share items such as razors, clothing or exercise equipment. Everything should be wiped down prior to use. Always keep wounds covered with clean, dry bandages. It is important to keep all shared items and surfaces clean for the surgical patient. These important precautions will help to keep the surgical patient from contacting MRSA after surgery.

**Group A Streptococcal (GAS) Disease:**

Group A Streptococcus (GAS) is a beta-hemolytic streptococci bacterium often found in the throat and on the skin. Some people may be carriers of streptococci in their throats and or skin and may never have any symptoms of illness. Most GAS infections are relatively mild illnesses. Examples include strep throat, pharyngitis, tonsillitis, sinusitis, otitis media and pneumonia. When thinking of skin issues they could include cellulitis, scarlet fever, erysipelas, necrotizing fasciitis and impetigo. Impetigo is a bacterial infection of the skin caused by streptococci or staphylococci and marked by a yellow-to-red, weeping and crusted or pustular lesion. These lesions are usually around the nose, mouth, and cheeks or on the extremities. There are several million cases of strep throat and impetigo reported each year. Group A Streptococcus infection may have immunologic sequelae such as rheumatic fever and acute glomerulonephritis.

Rheumatic fever can develop approximately 18 days after a bout of strep throat, and it can cause heart disease with or without joint pain. Syndenham shorea, a disorder where the muscles of the torso, arms and legs move involuntarily in a dancing or jerky manner can occur months later.

Occasionally these bacteria can cause severe and even life-threatening diseases including sepsis. When GAS disease is spread to parts of the body where this bacteria is normally not found it can become severe and life-threatening. Examples include when it’s found in places such as muscle, blood (bacteremia) or lungs.
When found in these places the infections are termed invasive GAS disease. There are about 9,000-11,500 reported cases of invasive GAS disease each year in the US.

There are two forms of this infection that are the most severe kinds of this disease. The first would be Toxic Shock Syndrome (TSS). TSS is related to tampon usage. The bacteria strains that caused exotoxin to be produced were Staphylococcus aureus and Group A Streptococci, which in turn caused TSS. TSS has also been linked with not only vaginal tampons, but has included contraceptive sponges, diaphragms and surgical wound packing. Approximately 10-15 percent of patients’ with invasive group A Streptococcal disease die from the infection. This relates to approximately 1,000 to 1,800 deaths annually.

This infection usually presents with a fever of 102° (38.9°C) or greater, Diffuse macular (flat), Erythematous rash, followed by 1 to 2 weeks of peeling of the skin. The peeling usually occurs in the palms of the hands and soles of the feet. The patients may have hypotension or orthostatic syncope.

Patients could have involvement in one of the three or more organ systems.

• When the gastrointestinal system is involved the patient may have vomiting or have diarrhea at the onset of the illness. If the Muscular system is involved, they may have severe myalgia (pain or tenderness).

• The mucous membrane may include any or all of these areas, the vagina, opharyngeal, or conjunctival. A patient may have Issues with hyperemia, unusual amount of blood in a part, including hepatic and hematological (platelet) problems.

• When the central nervous system is involved the patient may experience disorientation or alteration in consciousness without focal neurological signs when fever and hypotension are absent. Culture results are usually negative when taken from blood, throat and cerebrospinal fluid.

The second very serious form is Necrotizing Fasciitis most commonly known as “flesh eating disease” which is a rapidly aggressive spreading bacteria. Even
though it is the least common of this disease, it destroys muscle, fat and skin tissue.

Streptococcal toxic shock syndrome (STSS) results in rapid drop in blood pressure and Organs (e.g. kidney, liver and lungs) begin to fail. STSS is not the same as TSS, as it is a different bacteria. 25% of patients with Necrotizing Fasciitis and more than 35% with STSS die according to the CDC. Aggressive and early surgical intervention is often needed for a person with Necrotizing Fasciitis to remove the damaged tissue and to try and stop the disease spread. Amputation of limbs may occur.

GAS is spread through direct contact of persons who are infected. The Bacteria comes from the mucus of the nose or throat and from infected wounds or sore from an infected person’s skin. Patients who have strep throat or skin infections are most likely to spread the infection. However, a person may have the bacteria without any symptoms, but could still pass on the bacteria. When a patient is treated with antibiotics for 24 hours or longer, it usually eliminates the possibility of spreading bacteria. Always remember to reinforce with patients to always finish the entire course of antibiotics as directed.

Invasive Group A Streptococcal disease can get past a person’s defenses when they have sores or breaks in skin, and this allows the bacteria into the tissue. A person with chronic illness or an immune deficiency may allow Virulent strains to cause severe disease more so than in others.

Persons with cancer, diabetes, chronic heart or lung disease or those who use steroids or chemotherapy or have suppressed immune systems are at higher risk. Persons who have open wounds, surgical wounds, chicken pox, who are elderly, and those who have a history of alcohol or drug abuse are also at higher risk for this disease. Patients who are burn victims are also at very high risk. This disease may occur in patients who are otherwise healthy and have no known risk factors.
Once you have GAS infections, it can be treated with many different antibiotics. For STSS and Necrotizing Fasciitis, high doses of penicillin and clindamycin are recommended. Supported care in ICU also may be necessary.

How do we stop the spread of Group A Streptococcal infections? It can be as easy as washing ones hands. We at Cutting Edge CE will repeat this again and again within our material. Good hand washing practices helps to stop the spread of many diseases. Remind anyone who is coughing and sneezing to wash their hands often. Always wash your hands before preparing and eating foods. Persons with sore throats should be seen by a doctor to be tested for strep throat. If results are positive, stay home with treatment for at least 24 hours to prevent spreading.

All wounds should be watched for signs of infection and kept clean and dressed properly. Patients with strep throat but more often with GAS skin infections can also develop inflammation of the kidneys. This rarely happens in the United States because of prompt intervention. If signs of infection arise, seek medical attention immediately to prevent a GAS infection. At the time of surgery most patients receive a dose of antibiotics at the time of incision. Make sure to document this information correctly.

**Mycobacterium Tuberculosis:**

Tuberculosis (TB) is a bacteria that could have a class of its own, however, this lesson will just hit on some important points related to drug resistance. TB is a bacteria that attacks not only the lungs, but also kidneys, spine and brain. TB is spread through the air from one person to another. It is usually passed when an infected person coughs, sneezes, speaks or sings. According to the CDC, it cannot be spread by kissing or sharing a toothbrush.

Not every patient infected with TB becomes sick; in fact most people are able to fight off the TB bacteria from growing. This is called Latent TB Infection (LTBI). About 5 to 10% of patients’ with (LTBI), who do not receive treatment, will develop TB. TB is sometimes discovered through the tuberculin skin test or special TB blood
test. You could have the disease for years before it becomes active. If the TB bacteria are able to become active, possibly because of a weakened immune system, and then it begins to multiply, eventually the patient will become sick.

Extensively drug-resistant tuberculosis (XDR-TB) is caused by Mycobacterium Tuberculosis. XDR TB is a rare type of multidrug resistant tuberculosis (MDR TB). The first line of medication used to treat TB is Isoniazid and Rifampin, both are no longer effective against MDR TB. XDR TB is also resistant to the best second line medications including Fluroquinolones and at least three of the uninjectable drugs being Amikacin, Kanamycin, and Capreomycin. At this time, patients have bad outcomes due to less effective treatments.

Today, patients’ with weak immune systems are at higher risk of death once infected with TB. Symptoms of a patient with TB may be not feeling well with a bad cough that they may have had for more than three weeks. A patient may experience chest pain, weakness, fatigue, weight loss due to suppressed appetite, with possible chills and fever. Some patients may complain of night sweating. A patient may complain of coughing up phlegm possibly with blood. Symptoms will vary when a patient is affected in a different part of the body.

Persons that have these conditions including babies and young children are at greater risk:

1. HIV infected
2. Substance abuse
3. Silicosis: a form of pneumonoconiosis which are inhaled.
4. Diabetes mellitus
5. Severe kidney disease
6. Low body weight
7. Organ transplants
8. Head and neck cancer
9. Patients on corticosteroids or taking rheumatoid arthritis.
The CDC has a tremendous amount of information about TB, if more information is needed.

**Clostridium Difficile (C.Diff):**

Clostridium Difficile is a bacterium found in feces that causes diarrhea as well as other serious intestinal conditions such as pseudomembranous colitis. About 30% of people have C. Diff as one of the normal germs in their intestine that help digest food. Other diseases that result from C. Diff are serious intestinal conditions such as toxic megacolon and perforations of the colon, sepsis and death in rare cases. C. Diff is a spore-forming, gram-positive anaerobic bacillus that produces two exotoxins. It is a common cause of antibiotic-associated diarrhea.

Symptoms for C. Diff are watery diarrhea, at least three bowel movements per day for two or more days. Other symptoms are loss of appetite, fever, nausea, and abdominal pain or tenderness. Treatment for C. Diff is usually 10 days of antibiotics and has few side-effects. In some cases it may be necessary to have multiple treatments.

To test for C. Diff a stool culture can be done, although it is very difficult. Antigen detection can also be done, but it must be done in combination with toxin testing to verify diagnosis.

Patients in good health usually do not get C. Diff disease. Patients with other illnesses or conditions requiring prolonged antibiotics are at greater risk. The elderly or immunocompromised patients are also at greater risk of C. Diff. Patients who have had gastrointestinal surgery or intestinal manipulation is at greater risk. Patients usually become infected after coming in contact with items or surfaces contaminated with feces then touch their mouth or mucous membranes. Health care workers can spread the bacteria to other patients or contaminate surfaces if they do not wash their hands after contact with a patient’s contaminated feces.

A patient with C. Diff should be placed on contact precautions and their room should be cleaned regularly with disinfectants because surfaces harbor the
bacterium and is a source of contamination. If possible, place these patients in private rooms because of surface contamination of the C. Diff spores. It is recommended to clean with Hypochlorite-bases disinfectant for environmental surface disinfection.

Always wash hands with soap and water especially after using the restroom. Always wash hands prior to preparing or eating food. Alcohol-based disinfectants are not effective against C. Diff and should not be used to disinfect environmental surfaces.

Treatment options for C. Diff includes Metronidazole or oral Vacomycin, even with treatment, the patient may still remain colonized.

**Klebsiella Pneumoniae (K. Pneumonia):**

T.A. Edwin Klebs was a German Bacteriologist and American Pathologist (1834-1913). Klebs identified Klebsiella which is a genus of gram-negative, encapsulated bacilli of the family Enterobacteriaceae.

Edwin Klebs also demonstrated the presents of bacteria in wounds. K. pneumoniae is a species that may cause sinusitis, bronchitis or pneumonia.

Klebsiella pneumoniae in today’s healthcare setting has caused infections that include pneumonia, bloodstream infections, wound or surgical site infections and meningitis. Klebsiella is joining the list of bacteria that have developed antibiotic resistance.

Carbapenems is the most recent class of antibiotics that Klebsiella has formed resistance. When Klebsiella pneumoniae bacteria produce an enzyme known as carbapenemase, they are also known as KPC producing organisms or carvapenem-resistant Klebsiella pneumoniae (CRKP). Carbapenem antibiotics are often the last line of defense against gram-negative infections that are resistant to other antibiotics.
Vancomycin-Resistant Enterococci VRE:

Enterococci are often found in the environment. Enterococci is found in the intestines and in the genital tract in women. These bacteria may cause infections and the treatment for this is the antibiotic Vancomycin. Some Enterococci bacteria have become resistant to this Antibiotic. Most Enterococci infections are caused by Enterococcus Faecalis. Most Vancomycin-resistant Enterococci (VRE) infections occur in hospitals. VRE is also commonly encountered in nursing homes, and other long term care facilities.

The Types of infection that VRE can cause when colonized is urinary tract infection, wound infections and it can get into the blood stream for blood infections. VRE can live in humans quite often without ever causing disease. Enterococci account for approximately 110,000 UTI’S, 25,000 bacteremia, and 40,000 wound infections and 1,100 endocarditis cases in the U.S. annually.

As always, there are certain people who are at greater risk of being infected from VRE, and they are patients who have had antibiotic treatment with Vancomycin or a different antibiotic for a long period of time. Hospitalized patients who have been receiving antibiotic treatment for a long period of time are also susceptible.

Patients’ with weakened immune systems may be at greater risk, as well as cancer patients, transplants or ICU stays. Patients who have undergone abdominal or chest surgeries are at a higher risk. Patients who have some type of a medical device an example might be catheters or central lines. Patients who have colonized Enterococci are definitely at higher risk. Patients who have multiple hospitalizations are also included.

The CDC collected information that spanned from 2006-2007 and it indicated that 1 out of every 8 hospital infections were caused by Enterococci. Of these infections, 30% of those were VRE. VRE was most common in those with weakened immune systems.
Patients who have VRE present may never have any sign of it. If a patient does not have any symptoms, then they do not need treatment for the bacteria. There are other types of treatments besides Vancomycin which do work, however it may be harder to treat. A different antibiotic can be determined through lab testing. If a patient gets an infection because of a catheter, if the catheter is no longer needed, remove it. Patients with bladder infections may report frequent urination, burning when urinating or bladder spasms. Even so, removing the catheter may aid in getting rid of the infection as well.

VRE is a contact bacteria, this means it can be passed from person to person. VRE can also come from contaminated surfaces. The most effective way to stop the spread is washing ones hands and using contact precautions. Make sure to communicate this during hand off reports. It is very important that everyone dealing with a VRE patient is to be aware that the patient has VRE. Encourage the patient to tell all health care professionals they may come in contact with VRE. VRE is usually not spread through the air.

Remember to wash your hands thoroughly after using the bathroom. Bathrooms can be contaminated with VRE. If possible, patients with VRE may require their own bathroom. Always wash hands before preparing food. After dealing with a patient with VRE wash hands with soap and water, or use an alcohol-based hand rub. Wear personal protective equipment (PPE) when coming in contact with body fluids, stool or bandages. Always wash hands after removing gloves. Follow precautions as if a patient has signs of infection, they may be discontinued once signs are eliminated and patient can care for themselves without contaminating the immediate environment.

**Other Resistant Bacteria:**

*Burkholderia Cepacia (B. Cepacia)*: A group or “complex” bacteria which is found in water or soil and is often resistant to common antibiotics. It does not pose a
great risk to the healthy population. It is usually a problem for patients with weakened immune systems. Patients who have cystic fibrosis (CF) or chronic lung diseases are at higher risk. B. Cepacia pneumonia has been reported in patients who were exposed either by person-to-person contact, contaminated surfaces or devices, or just ordinary exposure to the environment.

(VANCOMYCIN-INTERMEDIATE) VISA/Vancomycin Resistant (VRSA): Are specific types of antimicrobial staph bacteria. Most staph is taken care of by Vancomycin; VISA and VRSA are no longer susceptible.

Streptococcus Pneumoniae disease: Resistant to more than one commonly used antibiotic. Invasive disease is usually caused by Pneumococci. S. Pneumoniae which causes 60,000 cases per year of the invasive disease. Risk groups include providers working at child care centers, and people who recently used antimicrobial agents and children.

Resistant Psudomonas Aeruginosa: Commonly found in soil or water. It enters the body through a cut or other breaks in the skin and potentially can become deadly. Mortality rate is 50% of infected patients, which can happen with burn patients, and patients with cystic fibrosis. It presents itself as other illness including UTIs, bone and joint infections.

Resistant E. Coli: Associated with GI infections and dehydration. Resistant E. Coli can come from animal feces. This strain causes approximately 3,000 deaths a year in the US.

Acinetobacter Baumannii: Also found in soil and water, but can be found on the skin on otherwise healthy people. This rarely occurs outside the health care setting. This bacteria most commonly occurs in ICU patients.

Once a patient is diagnosed with a wound infection, they will be placed on isolation.
**Multidrug resistant Organisms (MDRO’s):**

In 2010, reports surfaced about a disease causing bacteria that could “stand up and walk”. Bacteria are not new or more dangerous; they have always been around, and over the past few decades, it seems we have managed to control them. Now, we may be losing control. In the health care setting, it can be life threatening and very costly.

What are bacteria? Bacteria are one-celled organisms without a true nucleus or cell organelle that belong to the kingdom of Procaryotae (Monera). The cytoplasm allows for gram stain. Some bacteria produce polysaccharides or a polypeptides capsule, this inhibits phagocytosis by the white blood cells.

Phagocytosis means destruction or disinigration of phagocytes. Millions of these nonpathogenic bacteria live on human skin and mucous membrane, which are called normal flora. Bacteria that are capable of or cause disease are called pathogens. Pathogenic bacteria are disease-causing species, and compared to the millions of bacteria it is a very small portion of bacteria as a whole.

Bacteria have three principle forms; spherical (ovoid), rod-shaped or spiral. Bacteria mutates, like all living things. The environment determines the beneficial mutations which have the survival value.

Bacteria can also be placed into three groups based on their continued response to gaseous oxygen.

1. **Aerobic bacteria** thrive in the presence of oxygen and require it to grow.
2. **Aerobic bacteria** cannot tolerate gaseous oxygen; these bacteria live in places like under water deep sediment, or those that cause bacterial food poisoning.
3. **Facultative anaerobes** grow in the presence of oxygen but can also continue to grow without it.

Another way to classify bacteria is by how they obtain their energy. Heterotrophs break down complex organic material that they take in from the environment and decaying material including fermentation or respiration. The second group are
Autotrophs; they fix carbon dioxide to make their own food. This process can include light energy, or oxidation of nitrogen, sulfur, or other elements. Bacteria's most important role is to release nutrients back into the environment as well as cycling nitrogen.

When you look at the history of bacteria, awareness has been around for a very long time. Around 3500 B.C. the Sumerian doctors gave their patients beer soup mixed with snake skins and turtle shell for its healing powers. Babylonians’ used ointments made of frog bile and sour milk. Each of these contained a “like” antibiotic.

A patient whose wound becomes infected will be placed on isolation precautions.

Isolation

Each facility or organization will have its own policies and procedures when dealing with isolation.

Isolation is the physical separation of individuals (patients) with certain infections from other people as a precaution to prevent the transmission of an infection or disease. Using up to date information and our understanding of how infections are transmitted isolation policies and practices can minimize transmission in a clinical, ambulatory (outpatient), or hospital setting.

The CDC (Centers for Disease Control) and HICPAC (Hospital Infection Control Practice) have defined guidelines for hospital-based infection precautions.

The CDC uses standard precautions as the recommended guideline to reduce the spread of infections in hospitals. Many, if not most of these precautions, should also apply to outpatient and clinical settings. These precautions are hand washing and wearing personal protective equipment (PPE) including gloves, mask, eye protection and gown. In the hospital setting, there are usually two levels of
precautions. The first level is **standard precautions**, and the second is **transmission-based precautions**.

Standard Precaution combines the major features of universal precautions and body substance isolation. Standard precautions are based on the principle that all blood, body fluids, secretions (except sweat), skin that is not intact, and mucous membranes may contain infectious transmissible agents. All patients are treated equally and should be treated as potentially infected. It should not matter if they have a suspected or confirmed infection and/or disease, all patients should be treated as if they have been infected.

Standard isolation precautions not only should be used on all patients but any room contamination and should include:

- Gloves: to anticipate contacts with all body substances including blood, body fluids, mucous membranes, secretions and excretions.
- Eye protection, masks and gowns **must** be worn if splashing of body substances is a possibility.
- Hands and other contaminated skin surfaces should be washed thoroughly and immediately if accidentally contaminated by body substances.
- Patient supplies or medications that come in contact with the floor or other potentially contaminated surfaces must be disposed of or disinfected appropriately. It is extremely important that the environmental services ensure consistent environmental cleaning and disinfection with focus on restrooms even when they do not appear to be soiled.

Transmission-based isolation should not only include standard isolation precautions, but will be used on patients with suspected or known infections requiring special isolation precautions. The infection control department of each facility should provide guidance on the appropriate isolation to be used on each patient.
Not only should patients be treated as if they have been infected, but also all equipment that has come in contact with that patient, this includes direct and not direct contact. All infection control practices should be applied during the health care delivery.

The practice of universal blood and body fluid Precautions was introduced in 1985. In 1987, the practice of universal precautions was adjusted based on the rules of body substance isolation. In 1991, the bloodborne pathogens standard precautions recommended by the CDC were mandated by OSHA for all workers in the U.S. health care settings. In 1996, both practices were replaced by the latest approach know as standard precautions (health care). Body substance Isolation (BSI) goes further than universal precautions. These recommendations began with the AIDS outbreak. This practice was to help employees of health care systems.

The CDC estimated that nearly 600,000 percutaneous injuries annually in the U.S. involved contaminated sharps. Congress passed the needle stick safety and prevention act directing OSHA to revise the bloodborne pathogen standard. That revision was published January 18, 2001 and became effective April 18, 2001.

It is within the role/scope of physicians’, physician assistants’, nurse practitioners’, nursing staff and infection control practitioners’ to place patients appropriately and order transmission-based special isolation precautions. It is everyone’s responsibility to comply with isolation precautions and everyone’s (all employed staff) to tactfully call on all observed infractions to the attention of the non-compliant staff.

The quality of care should not be compromised by isolation precautions.

There are two broad categories of pathogens and they are bloodborne (body fluids) and airborne. This is the pre-hospital curriculum for hospital providers and firefighters. These precautions should be in place when dealing with; blood, feces, urine, preseminal fluid, semen, vaginal secretions, cervical mucus, vomitus, sputum, mucous, nasal secretions, phlegm, saliva, secretions, colostrum, amniotic
fluid, blood from the umbilical cord, breast milk, synovial fluid, cerebrospinal fluid, peritoneal fluid, pleural fluid, and marrow. Sweat is not included as a secretion.

When dealing with these bodily fluids, one should use a hospital gown (plastic or sterile), medical gloves (sterile or unsterile), shoe (type depending on exposure), surgical mask, including N95 respirators up to actual surgical hoods, safety glasses, shields and surgical masks with shields.

Transmission based precautions may be needed in addition to standard precautions for patients suspected or known to harbor certain infections.

**Modes of transmission**

The portal of exit provides a means for the microorganism to leave the source. Sputum, emesis, stool, urine, blood, wound drainage, or secretions from genitals all permit microorganisms to exit the source. Animal discharge or blood organisms carried by mosquitoes also can provide a means of escape.

Mode of transmission refers to the way in which the organism moves or is carried from the source’s portal of exit. The five main routes of transmission are contact, vehicle, droplet, airborne, and vector borne.

Contact transmission is the most frequent of transmitting infections in healthcare facilities. Contact transmission is by direct or indirect contact.

Direct contact involves body-surface-to-body-surface contact, causing the physical transfer of organisms between an infected or colonized person and a susceptible host. Healthcare personnel can transfer organisms to patients during care such as bathing, dressing changes, and insertion of invasive devices. Direct transfer also may occur between two patients, with one acting as the source and the other as the host. Indirect contact occurs when a susceptible host is exposed to a contaminated object, such as a dressing, needle, or surgical instrument.

Vehicle transmission involves the transfer of microorganisms by way of vehicle or contaminated items that transmit pathogens. Food can carry salmonella and
water can carry legionella. Drugs can carry bacteria from contaminated infusion supplies and blood can carry hepatitis and HIV.

Droplet transmission occurs when mucous membranes of the nose, mouth, or conjunctiva are exposed to secretions of an infected person who is coughing, sneezing, or talking. Droplets do not remain suspended in the air for very long and seldom travel more than 3 feet; thus, transmission is not via the airborne route.

Airborne transmission occurs when fine particles are suspended in the air for a long time or when dust particles contain pathogens. Air currents widely disperse organisms, which can be inhaled by or deposited on the skin of a susceptible host.

Vectors can be biologic or mechanical. Biologic vectors are living creatures that carry pathogens, such as rats, insects, or birds. Transmission by biologic vectors is of great concern in tropical areas, where mosquitoes transmit diseases such as malaria. Mechanical vectors are inanimate objects that are contaminated with infected body fluids. Central line catheters, which are used for medication, blood draws, and total parenteral nutrition (TPN), and ventilators, are examples of mechanical vectors. Contaminated needles and syringes shared by intravenous (IV) drug users are also examples of mechanical vectors. Both hepatitis B and HIV are commonly spread in this manner.

The portal of entry permits the organism to gain entrance into the host. Pathogens can enter susceptible hosts through body orifices such as the mouth, nose, ears, vagina, or urethra. Breaks in the skin or mucous membranes from wounds or abrasions increase opportunities for organisms to enter the host. The practice of placing tubes for long-term IV or gastric feedings and drainage of body cavities further increases the number of potential routes of entry into the body, thus increasing the risk of infection. Central venous access devices (CVAD) account for approximately 250,000 catheter-related bloodstream infections a year in the United States (Rosenthal, 2006).
A host is a person whose own body defense mechanisms, when exposed, cannot withstand the invasion of pathogens. The body has numerous defense mechanisms that naturally resist entry and multiplication of pathogens. When infectious disease occurs in a human, the agent of infection has overcome the body’s ability to resist infection. A primary focus of nursing practice is to identifying patients whose defenses may be compromised and working to enhance their defense.

The types of isolation in addition to standard universal precaution/body substance isolation are:

**Airborne Transmission:** which requires negative air room pressure; this is to eliminate disease being pushed outside of the room from positive pressure inside the room. When you think of Airborne you think of Tuberculosis.

- Strict (disease spread by airborne and contact routes)
- Respiratory

**Droplet transmission:** includes diseases such as mumps, rubella, and influenza pertussis.

- Droplet/Pediatric Respiratory

**Contact Transmission:** Can be direct or indirect contact with skin or contaminated surfaces. This can also include vomitus and feces.

- Enteric (pertinent to small intestine)
- Vancomycin / Antibiotic Resistant

The type of isolation used is based on how the disease or infection can be spread from one person to another. Make sure to read the sign posted at the door or bedside to understand the isolation being used on a particular patient. These signs indicate which personal protective equipment (PPE) must be used before entering
the room and before initiating any personal care. When possible, an isolation station should be set up in each room in preparation for isolation precautions.

Many hospitals are using a system called **category-specific isolation** to protect people from bacteria infecting a given patient. This system is supposed to be an easier system for staff to understand these categories. This system breaks isolation down into five categories:

1. Strict Isolation
2. Respiratory Isolation
3. Wound and Skin Precaution
4. Enteric Precautions
5. Blood/Body fluid precautions

There are other additional categories of isolation that can be used in any system that a health care system chooses to use. Isolation is also used also to protect patients who have immune suppressed systems. Compromised host precaution is one category because they are susceptible to contracting an infection. Two other terms that may be used are protective isolation or transmission-based isolation precautions.

Hand washing provides all individuals with increased safety. This includes all inpatient and outpatient units caring for patients with isolation precautions. This means anyone who comes in contact with this patient or patient’s room.

All isolations should be used in conjunction with standard universal/body substance precautions. These standards include always using gloves, mask and gowns. Depending on the situation the gloves and gowns might be sterile.

**Make sure to place appropriate isolation sign on patient’s door!!**

Once an isolation type has been assigned to a patient it is the nursing departments responsibility to educate the patient and the patients family on hand hygiene, respiratory etiquette and isolation procedures.
Visitors shall be instructed and supervised by nursing personnel in proper isolation techniques.

**Contact and Contact Plus Isolation and Precautions**

Patients with highly transmissible or microbiological microorganisms will be isolated appropriately to prevent the spread of disease. Contact and contact plus isolation precautions are designed to reduce the transmission of highly transmissible or epidemiologically important microorganisms. This would include inpatient and outpatient settings as well as anyone who comes into contact with this patient.

These patients should be placed in private rooms. Everyone should don gloves and impervious gown upon entering the room and at all times while in a contact isolation room. Change gloves and gown when having contact with infective material. Remove gloves and gown before leaving the room. **Always perform hand hygiene immediately!!** Ensure that hands/clothing/skin do not touch potentially contaminated environmental surfaces or items in the patients room.

Contact happens with mutual touching or apposition (placing together, or bringing into proximity) of two bodies. Direct contact is the transmission of a communicable disease from the host to a healthy person.

Indirect contact is transmission of a communicable disease in any medium between the host and the susceptible person. The medium might be hands of a health care worker, medical supplies, clothing, contaminated food or water.

**Contact precautions may be used for the following diseases:**

- Diphtheria (cutaneous): a skin infection, usually at the site of a wound, caused by C. diphtheria, usually in humid tropical regions or with poor sanitation.

- Herpes simplex virus (neonatal or mucocutaneous severe)
• Impetigo: a bacterial infection of the skin caused by streptococci or staphylococci which is usually yellow to red and weeping with crusted or pustular lesions. Impetigo can develop after trauma.

• Major (non-contained) abscesses, cellulitis, decubitis

• Multi-drug resistant organisms: this includes both infected and colonized patients. Examples are methicillin resistant staphylococcus aureus (MRSA), vancomycin resistant enterococcus (VRE), and extended spectrum beta lactamase (ESBL). A patient with a history of MRSA, VRE, or ESBL will remain on isolation usually for their entire hospital stay and possibly future admissions.

• Pediculosis: Infestation of lice, usually causing scalp infection. This may develop a secondary bacterial infection. Therapies modify frequently due to the resistance of lice, current therapies and toxicities to medications.

• Respiratory syncytial virus (RSV), parainfluenza virus or enteroviral infections in infants and young children: Virtually all children in U.S. have been infected by age 6. This is a group of viruses that cause upper respiratory infections, especially children.

• SARS (Severe acute respiratory syndrome): A highly contagious, potentially lethal viral respiratory illness first diagnosed in China in 2002. Radiograph (x-ray) compatible with pneumonia. Instances without pneumonia are considered moderate infections.

• Scabies: Contagious infestation of the skin with the itch mite.

• Smallpox: An acute, highly contagious, and frequently fatal viral illness caused by the variola virus. Patients are usually present with influenza-like symptoms, including high fever.

• Staphylococcal furunculosis in infants and young children, usually involving boils.
• Staphylococcal scaled skin syndrome: A scald is deeper than a burn from dry heat and this is the infection of the syndrome.

• Viral/hemorrhagic conjunctivitis

• Viral hemorrhagic fever: Ebola, Lassa fever, Marburg Virus: Sporadic outbreaks in Africa, widespread bleeding into many organs and fever similar to Lassa, and Marburg as well as Congo-Crimean viral hemorrhagic fevers.

• Zoster: Herpes

**Contact Plus Precautions:** includes using bleach (wipes) for these patients’ rooms. Use the bleach wipes for the following diseases:

• Clostridium Difficile, Norovirus, Acute diarrhea disease illness:

• Patients with a history of being positive for Clostridium difficile are to remain on contact plus precautions for an extended amount of time. Usually the time frame is three months after the last positive culture.

With contact plus precautions, perform hand hygiene with soap and water after PPE removal. Use bleach wipes on all equipment.

Make sure to clean patient-care items, bedside equipment and frequently touched surfaces daily. Try to use single-use item only.

Single-use items can include blood pressure cuffs (BP Cuffs), stethoscopes, and thermometers. **Do not share** any equipment with any other patients! If you must share make sure all equipment is thoroughly cleaned and disinfected.

If ambulating a patient in a shared hallway, use transportation isolation policy if one is available. Make sure to don gloves and impervious gown when ambulating a patient in the hallway.
When a contact precautions patient is transferred, make sure to notify the receiving area that the patient has a disease transmittable by direct hand or skin to skin contact. Make sure the receiving nurse knows of any area of potential drainage. Wrap a clean blanket or sheet around patient, with care not to contaminate the outside of the blanket or sheet. Personnel should wear gown and gloves if body substance is anticipated.

Make sure to have the wheelchair or gurney, disinfected prior to the use for another patient and always perform hand hygiene after dealing with a contact precautions patient. Remember even your uniform can become contaminated.

**Airborne Isolation Precautions: (Respiratory Isolation)**

The purpose of Airborne Isolation is to help appropriately prevent the spread of confirmed or suspected airborne diseases. This precaution is designed to reduce the transmission of microorganisms by airborne droplet nuclei or dust particles containing the infectious agents. These infectious agents can remain suspended in the air, which can be dispersed by air currents. Environmental health and safety usually are responsible for respiratory protection programs.

**Airborne Isolation precautions can be used for the following diseases:**

- **Avian Influenza (Bird flu):** Influenza A virus that primarily infects birds and poultry, and may occasionally cause a febrile illness in human beings. Symptoms include cough, muscle aches, sore throat and headache. Viral pneumonia or acute respiratory distress syndrome can be seen in severe cases. A pandemic of type H5N1 avian influenza killed millions of people worldwide in the early 20th century. Influenza A is responsible for about 65% of cases, Influenza B about 35%, Influenza C causes such a small amount it’s not even accounted for.

- **Measles (Rubeola; reddish):** A highly communicable disease caused by the rubeola virus. Symptoms include fever, general malaise, sneezing, nasal congestion, brassy cough, conjunctivitis, spots on the buccal mucosa (Koplik’s
spots) and maculopapular eruption over entire body. An episode of measles almost means permanent immunity.

- Monkeypox: A poxviral illness clinically similar to smallpox. The same vaccination is used for monkeypox exposure as is smallpox.

- Novel or unknown pathogens to be discovered.

- Pulmonary, laryngeal and draining extrapulmonary lesion.

- SARS (Severe Acute Respiratory Syndrome): A highly contagious, potentially lethal viral respiratory illness first diagnosed in China November 2002. Usually presents a fever greater than 100.4°F, cough, difficulty breathing and hypoxia. This can be consistent with pneumonia findings in x-rays.

- Smallpox/Variola (pustule): An acute, highly contagious viral infection that can be frequently be fatal. Smallpox is caused by the Variola virus.

- Tuberculosis/ (M. Tuberculosis):

- Varicella (a tiny spot), Chickenpox, and disseminated Herpes Zoster: An acute infectious disease usually seen in children under age 15, caused by varicella-Zoster virus. It is usually described as a dew drop on a rose petal pattern, scattered in clusters (“crops”) over the trunk of the body. It also includes the face, scalp, upper extremities, and sometimes the thighs. It is transmitted by respiratory droplets that contain infectious particles. Direct contact can also spread the virus.

When dealing with airborne isolation precautions, assure patients are placed into private rooms with special ventilation; the ventilation systems in these rooms should be negative pressure. Make sure no one enters these rooms that may be susceptible to measles or varicella, which can be identified by negative antibody titer.
All persons entering a patient’s room should use a N95, HEPA, or PAPR respirator mask. In some cases a hood may also be worn when necessary. Another standard precaution may be to gown and glove before entering patient’s room.

Transport patients for essential studies or purposes **ONLY**. Limit the movement and transportation of patient. When possible do procedures in patient’s room. Notify receiving departments when a patient is on airborne precautions. If a patient is wearing a surgical mask during transportation and infectious skin lesions are covered, health care staff does not need to wear a mask or respirator.

When a patient has skin lesions related to varicells, smallpox, or draining lesions caused by M. tuberculosis, always cover these areas prior to transportation to prevent aerosolization.

It is a **nurses responsibility** to notify engineering immediately to assure that the negative pressure ventilation system and the alarm systems are working correctly. It usually is the engineering departments’ responsibility to monitor the negative pressure in that room daily.

Patients on airborne precautions are usually brought straight to the operating room, they bypass Preop. The positive pressure is turned off by engineering prior to the patient being brought down from their hospital room so that the OR is ready. Depending on the hospitals policy, once the surgical case is complete, the OR might remain empty for a specific amount of time prior to the positive pressure being turned back on. Hospital policy may affect when a surgical suit is cleaned depending on if the policy requires the room to be vacant for period of time. If the room is grossly bloody, be sure to spray gross blood with a pretreatment so it does not dry; making it harder for environmental services (EVS) to clean the room.

Also verify whether this should be a terminally cleaned room or not, prior to the next case. The new standard as of approximately 2010 is all operating rooms should be terminally cleaned every night.
Once the room is cleaned, make sure to call engineering to turn on the positive pressure. Make sure all doors to the operating room are closed. If the hospital's policy states to wait a certain amount of time prior to using this room, make sure to document the time the operating rooms positive pressure was turned back on.

When possible try to make these airborne precaution cases the last case of the day. Making these cases the last of the day helps make it easier to follow hospital policy without delaying the following cases.

**Droplet Isolation Precautions:**

The purpose helps to prevent the confirmed or suspected disease spread from droplet transmissions. Droplet precautions include coughing, sneezing, talking and when procedures are performed. Transmission usually is from close contact from the source, this is less than three feet.

**Droplet Isolation is used for the following diseases:**

- Adenovirus, in infants and young children: Includes any double-stranded DNA viruses that can cause upper respiratory tract infections. A large number of these viruses have been isolated.

- Diphtheria (Pharyngeal): A rare toxin-mediated bacterial infection marked by patchy grayish-green membrane over the tonsils, uvula, soft palate, and posterior pharynx. It can happen in skin, conjunctiva, ears, GI and urinary tracts. The bacteria that causes Corynebacterium diphtheria is considered an airborne droplet. The Diphtheria toxoid in the U.S. has made the incidence of the disease rare.

- Haemophilus influenza type B, including meningitis, pneumonia, epiglottitis, and sepsis: Haemophilus is a genus of the gram-negative, nonmotile bacilli; some of these bacteria are normal flora of the upper respiratory tract, while others cause serious illness. Haemophilus influenza type B is a vaccine preventable cause of
meningitis. In children, it can cause epiglottitis, pneumonia, septic arthritis, and cellulitis.

Meningitis: The inflammation of the membranes of the spinal cord or brain. Usually, but not always caused by an infectious illness. Bacterial meningitis is a medical emergency and must be treated immediately. Meningitis is fatal in about 10% to 40% of the cases, even with immediate treatment. In about 10% of these cases, there is neurological injury in patients who do survive. This disease in adults is usually caused by Streptococcus pneumoniae or Neisseria menigitidis, although other microbes could also be responsible.

Pneumonia: An inflammation of the lungs, usually due to infection caused by either bacterium, viruses or pathogenic organisms. This term usually means an infectious disease. Pulmonary inflammation due to other reasons is called pneumonitis. In the U.S. alone, about 4,500,000 cases of pneumonia happen each year and is the sixth most common cause of death due to infectious disease. Pneumonia presents with fever, chills, shaking chills, pleuritic chest pain, coughing, and prostration. The most important symptom is difficulty breathing, with shortness of breath which may require supplemental oxygen. Unfortunately, these symptoms are not universal and a patient may present with mild symptoms. Treatment is based on gram stain of sputum and x-rays.

- Influenza: An acute contagious respiratory infection which presents with fever, headache, muscle aches and pains, chills, prostration (lying with body extended possibly face down), runny nose, watery eyes, cough, and sore throat. Influenza usually, but not always, strikes during the winter. Influenza can also be fatal, up to an estimated 36,000 deaths annually in the U.S. Vaccinations are available during the “flu” season.

- Meningococcal disease, including meningitis, pneumonia, and sepsis: Meningococcal is a caused by various serogroups of Neiseria meningitides which is a gram-negative diplococcus.
• Parvovirus B19: We will address in more in depth later. Referred to as the “fifth disease” and is not related to the animal parvovirus.

• Pertussis (whooping cough): is a contagious disease with a 7-to-10 day incubation period. Symptoms are paroxysmal (repeatedly without warning) coughing; vomiting that follows the cough, and a whooping inspiration. It is caused by a nonmobile gram-negative bacillus (Bordetaella pertussis). Immunization against pertussis is available and mandatory for school entrance in some states.

• Plague (yersinia Pestis): A any widespread contagious disease associated with a high death rate. The natural host for usually yersinia pestis is ground squirrels, wild rodents and rats; the vector is the rat flea. Symptoms for the plague are high fever, restlessness, confusion, prostration, delirium, shock and coma. In the U.S., about 15 cases of plague are reported per year and are usually in the western and southwestern regions. If treated immediately plague is rarely fatal, however in U.S. about 1 in 7 die because of delayed diagnosis and treatment.

• Rubella: A mild, highly infectious viral disease only in humans, historically in children. The vaccine has made the disease rare among vaccinated children and young adults. Rubella is contracted through nasopharyngeal secretions, blood, urine and stool.

• Streptococcal Pharyngitis, pneumonia, or scarlet fever in infants and young children: Streptococcal Pharyngitis is a common bacterial infection of the throat and tonsils especially in children between 5 and 15 years of age. Symptoms are usually fever, sore throat, painful swallowing, exudates (fluid or solid debris concentration) on tonsils, and swollen anterior cervical lymph nodes. Caused by Group A beta-hemolytic streptococci, which could lead to rheumatic fever and post streptococcal glomerulonephritis.

Scarlet Fever: An acute contagious disease presenting with Pharyngitis and a pimply red rash. Its cause is Group A beta-hemolytic streptococcus from any one of more than 40 strains, and usually affects children 3 to 15 years of age.
Symptoms are pharynx and tonsils are swollen and red with exudates, Fever, chills, vomiting, abdominal pain, and malaise. The tongue can be white initially with red swollen papilla, and after about five days the white disappears creating a “strawberry” red tongue. A red pinpoint rash appears on trunk then spreads out within 12 hours of fever that blanches with pressure and feels like sand paper.

With Haemophilus influenza and meningococcal disease, most hospital policies require isolation for 24 hours with the appropriate antibiotic before being removed from isolation.

Patients under droplet isolation precautions should have private rooms unless other patients have the same microorganism. If patients are placed in the same room, make sure they are physically separated to limit contact. Make sure to keep patients room door closed at all times. When dealing with these patients make sure to wear a surgical mask when within 3 feet of the patient. Make sure to change the surgical mask with each new encounter.

When cohorting patients, make sure patients are provided with a safe environment and in accordance with hospital infection control precaution policies. A daily assessment of each patient’s isolation status should be completed daily to determine if reassignment of rooms is necessary.

Limit the movement of these patients. When the need for transportation arises, place a mask on the patient. Make sure to notify the receiving department of droplet isolation.

Patients in the periop setting including Preop, OR and PACU as well as emergency department and X-ray should all follow the same precautions.

**Remember** when considering patient room assignment, the recommendation would be;

- A private room should be assigned to patients who require airborne and droplet precautions. An exception would be during periods of significant influx of infectious disease patients who have consistent symptoms (SARS, Influenza).
• A private room is highly recommended for patients with contact isolation. Always try to keep patients physically separated. Make sure patients who contaminate the environment with body fluids and do not assist in maintaining appropriate hygiene are not cohorted.

• Applicable microorganisms for cohorting include: MRSA, VRE, and Clostridium difficile as long as the patient is no longer incontinent and can maintain appropriate hygiene. Cohorting applies to patients colonized or “previously identified” with the previous admission and without current infection.

Contraindications to cohorting per The Centers for Disease Prevention and Control (CDC) is; whenever possible do not place a patient colonized with MRSA and/or VRE in a room with someone with an indwelling catheter, an invasive line, pressure ulcers or other functional disabilities that may prevent compliance with contact precautions. This also includes patients who are confused, who may wander out of bed and contaminate a roommates part of the room.

**Enteric Precautions:** recognized by some facilities and is dealing with direct contact with gastrointestinal secretions, vomitus and feces.

This is a possible route for pathogens to be transmitted through contact. Always use a private room for pediatric patients because it is so difficult for them to remain in their own beds.

There are also categories of isolation that protects the immune suppressed patient. This category is sometimes called the **compromised host precaution**. An example of this is:

**Neutropenic Precautions:** An abnormally small amount of neutrophils. In this case the patient is extremely susceptible to infections. They must have a private room, and strict hand hygiene (including nails) must be enforced. Visitors must be
restricted!! Usually the neutrophil count (ANC) is <500-1000/mm3. Neutrophils are the most common white blood cell (WBC).

These patients cannot have unwashed fresh fruits and vegetables, raw eggs or yogurt. They also cannot have flowers or plants. Avoid all sources of stagnant water, in the hospital examples of this would be denture cups or irrigation containers.

Below is a chart to address the type and duration of precautions needed for each individual infection. The codes for this chart are:

- A: Airborne Precautions
- C: Contact Precautions
- D: Droplet Precautions
- S: Standard Precaution

Whenever A, C, or D are used make sure to also use S

All rooms will be cleaned the same using universal precautions. Air borne precaution room will require per hospital policy (usually 30 min) before discharge cleaning will be allowed. Room will be cleaned using hypochlorite solutions (bleach) to clean room. Bleach wipes have also been recommended when an area need to be clean in between regular environmental room cleaning.

It is important to know and to report the conditions and diseases to the Public Health Department of your state. For instance in California, you can access the public health department described in Title 17, California Code of Regulations (CCR) §2500, §2593, §2641-2643 and §2800-2812 reportable Diseases and conditions and other appropriate state, local and federal regulations.

Each facility will have a policy for dealing with contaminated equipment. It will address that all equipment must be handled and transported in a manner to
prevent transmission or potentially infectious substance. Equipment can be contaminated and still appear to be clean, this is important to remember.

Equipment should be handled in such a way to prevent potential infectious contact to healthcare or environmental workers. Noncritical equipment should be cleaned and disinfected before use on a different patient.

Biohazardous equipment in its normal use could be contaminated with blood or other potentially infectious materials, therefore, it should be treated as such. It should be cleaned according to infection control policies based on a cleaning, disinfection and sterilization policy.

A few machines to think of that would fall into this category would be a suction D&C machine, dialysis machine, cell saver, and anesthesia equipment. If parts of these machines or equipment cannot be cleaned for whatever reason the machine should be tagged with an international Biohazard symbol. Personnel maintaining or repairing equipment should follow Universal/Standard precautions and wear appropriate personal protective equipment (PPE).

When talking about wound care, it is important to discuss general charting examples for ulcer documentation. When assessing a wound, keep in mind that proper documentation is necessary for medical, legal and reimbursement reasons. When charting a wound, always make sure to include:

- Vital signs: Temperature, pulse, respirations and blood pressure.
- Dressings: If a patient has dressings on, are they intact? Are they wet, dry, loose, clean or dirty.
- Strikethrough: Is there drainage on the outside of the dressing.
- Location: Foot, leg, thigh, sacrum, elbow, shoulder; right or left, dorsal, plantar, medial, lateral, anterior, posterior, etc.
- Size: This includes length, width, and depth, remember to measure in centimeters. A sterile cotton tip applicator to measure depth. Do not cross contaminate wounds by using the same gloves, instruments, measuring
devices, or other objects from wound to wound. If there are previous measurements, has the wound improved, deteriorating or is it remaining the same size.

- Tracking: This is defined as skin overhanging the wounds edges.
- Drainage: Is there drainage from the wound or on the contact layers of the dressing? What does it look like serous, purulent, bloody, clear, yellow or green? Does it appear thick? Yellow purulent drainage could indicate possible staphylococcus infection. Green drainage could indicate pseudomonas involvement. Estimate the amount of drainage present.
- Odor: Is there any odor coming from the wound? This can sometimes indicate the kind of organism that may be in the wound if it were infected. A foul odor almost fecal in scent could indicate gram negative bacteria. A more fruity smell could indicate that a staphylococcus organism may be present.
- Necrotic tissue: If it appears there is necrotic tissue present, and where it is located.
- Infection: Is the wound red, hot and swollen? Infection should assessed both clinically (vitals) and with lab work including WBC count and possibly a culture.
- Stage the ulcer: Remember do not reverse the stage a healing ulcer it is not recommended. If an ulcer had an original staging of a 4, and now it is being assessed at a later date, it should remain a 4.
- Classify non pressure ulcer – use Wagner classification for foot ulcers. Use “Full thickness” or “partial thickness” phrasing when documenting other types of ulcers. Wagner Classification is as follows”
  - Grade 0: pre-ulcerative lesion, healed ulcers, presence of bony deformity.
  - Grade 1: Superficial ulcer without subcutaneous tissue involvement.
  - Grade 2: Penetration through the subcutaneous tissue (may expose bone, tendon, ligament, or joint capsule).
  - Grade 3: Osteitis (inflammation of bone), abscess, or osteomyelitis (inflammation of bone and marrow).
o Grade 4: Gangrene of the forefoot
o Grade 5: Gangrene of the entire foot.
• Past treatments: Note any past treatment and changes in the products used during treatments.
• Current treatments: Document the type of irrigation, products and secondary dressing used during the dressing changes.
• Signature: Do not forget to sign the note.
• Follow up: Contact appropriate doctors, nurses, therapists or other health care professionals to discuss findings and if there is any deterioration. Document these events occurred and with whom include time and date.

Diabetic Foot
Diabetic Foot is a perfect example of how important wound care can be. Diabetes is a general term for this disease that means a marked excessive urination usually diabetes mellitus (DM).

According to the 2011 National Diabetes Fact Sheet from the Centers for Disease Control and Prevention (CDC), in the United States, a total of 25.8 million people, or 8.3% of the U.S. population, have diabetes. This includes 18.8 million diagnosed people and 7.0 million undiagnosed people.

• Age 20 years and older: 25.6 million or 11.3% of all people in this age group have diabetes.
• Age 65 years or older: 10.9 million or 26.9% of all people in this age group have diabetes.
• Men: 13.0 million or 11.8% of all men aged 20 years or older have diabetes.
• Women: 12.6 million or 10.8% of all women aged 20 years or older have diabetes.
• Non-Hispanic whites: 15.7 million or 10.2% of all non-Hispanic whites aged 20 years or older have diabetes.
• Non-Hispanic blacks: 4.9 million or 18.7% of all non-Hispanic blacks aged 20 years or older have diabetes.
• Younger than 20 years of age: About 215,000 people in this age group have diabetes (type 1 or type 2).

Sufficient data was not available to estimate the total prevalence for diabetes in other U.S. racial / ethnic minority populations.

For racial and ethnic differences in diagnosed diabetes on the national level is estimated from survey data taken by HIS NPIR. This includes data for approximately 1.9 million American Indians and Alaska Natives in the United States who receive health care from the HIS. Differences in diabetes prevalence by race/ethnicity are partially attributable to age differences. When they adjust for age it makes the results from racial/ethnic groups more comparable.

Data from 2009 HIS NPIRS indicates that 14.2% of American Indians and Alaska natives aged 20 years of older who received care from HIS had diagnosed diabetes. The regions varied from 5.5% among Alaskan Native adults to 33.5% among American Indian adults in southern Arizona.

Prediabetes among people aged 20 years or older, according to 2010 information from the CDC:

• Prediabetes is a condition in which individuals have a blood glucose or A1c levels higher than normal, but not high enough to be classified as diabetes. People with this condition have a higher risk for developing type 2 diabetes, heart disease and stroke.
• Studies have shown that people with prediabetes who lose weight and increase their physical activity can prevent or delay type 2 diabetes and in some cases return their blood glucose levels to normal.
Gestational diabetes in the United States can range from 2%-10% of the pregnancies. Immediately after pregnancy, 5%-10% of women with gestational diabetes are found to have diabetes, usually type 2.

Women who have had gestational diabetes have a 35% to 60% chance of developing diabetes in the next 10 – 20 years. New diagnostic criteria for gestational diabetes will increase the proportion of women diagnosed with gestational diabetes. Using these new diagnostic criteria, with an international multicenter study of gestational diabetes concluded 18% of the pregnancies were affected by gestational diabetes.

The estimated cost in the United States, direct and indirect is over $174 billion dollars. The direct cost is over $116 billion with over $58 billion related to disability, work loss and premature mortality.

Diabetes is the seventh leading cause of deaths in the United States. It is the leading cause of Kidney failure, non-traumatic lower-limb amputations and new cases of blindness among young adults.

**Diabetes mellitus (DM)** is a chronic metabolic disorder marked by hyperglycemia. This results either in failure of the pancreas to produce insulin (type 1 DM formally “juvenile onset” occurs usually in children) or from insulin resistance, with inadequate insulin secretion to sustain normal metabolism (type 2 DM). Either type of DM may damage blood vessels, nerves, kidneys, the retina, and in pregnancy, the developing fetus, and the placenta. Type 1 or insulin dependent DM has prevalence in just 0.3 to .04%. Type 2 DM (previously known as “adult onset” DM) has a prevalence in the general population of 6.6%. Type 2 DM primarily affects obese middle-aged people with sedentary lifestyles.

Type 1 DM when it occurs in children, these children are usually active and thin, now obese children are being diagnosed with Type 2 diabetes as well. Type 1 usually will present with an acute illness with dehydration and often diabetic ketoacidosis. Type 1 is caused by autoimmune destruction of the insulin-secreting
beta cells of the pancreas. The loss of these cells results in nearly complete insulin deficiency; without exogenous insulin, Type 1 DM and is extremely fatal.

Type 2 DM is often asymptomatic in its early years and therefore not easily understood. It results partly from decreased sensitivity of muscle cells to insulin-mediated glucose uptake and partly from a relative decrease in pancreatic insulin secretion.

It is important to teach a diabetic patient to recognize symptoms of low blood sugar (e.g., confusion, sweats, and palpitations) as well as those for high blood sugar (e.g., polyuria and polydipsia). When either of these conditions result in hospitalization it is important to keep tract of vital signs, weight, fluid intake, urine output, and caloric intake while documenting everything correctly.

**Complications of diabetes:**

- Heart disease and strokes
- Hypertension
- Blindness and eye problems
- Dental disease
- Complication of pregnancy
- Kidney disease
- Nervous system disease
- Amputations
- Other complications: biochemical imbalances, susceptible to other illnesses, mobility issues, and depression.

There are many issues that lead to foot wounds or diabetic related foot wounds. Comprehensive foot care programs, i.e., that include risk assessment, foot-care education and preventive therapy, treatment for foot problems, and referral to specialists, can reduce amputation rates by 45% to 85%.

Physicians are medical doctors (M.D.) or doctors of osteopathy (D.O.) who diagnose and treat diseases and conditions. From here doctors can specialize and
for feet there are podiatrists. Podiatrists have a doctoral degree in podiatric medicine, or medicine related to the foot. They are not trained nor licensed in treating conditions related to other body systems. Podiatrists treat anything from ankle injuries to infected toenails, and some are qualified to perform surgical procedures to repair the foot. In the case of a diabetic foot this may be the better option.

Patients with diabetes who have peripheral neuropathy with loss of protective sensation in their feet or foot deformities are at increased risk to develop foot ulcers and have amputations. Foot ulcers occur in about 15% of the people with diabetes. In the United States, more than 50,000 lower extremity amputations are done every year because of diabetic foot ulcers at a cost of more than $1.1 billion.

Foot ulcers, are the usual precursor to lower extremity amputations, occur three to six times more frequently than lower extremity amputations at an estimated average cost of more than $27,000 per ulcer.

Monofilament testing to screen patients with diabetes for loss of protective sensation in their feet is recommended to be done annually.

Patients with diabetes should be encouraged to inspect their feet daily and to report any problems they identify immediately. Patients with diabetes should also be asked to remove their shoes and socks for examination of their feet at all routine clinic appointments.

Peripheral neuropathy describes the damage to the nerves of the peripheral nervous system, which is a huge network of communication from the brain and spinal cord (central nervous system) to every other part of the body. This is either caused by diseases or trauma to the nerve(s) or side effect of systemic illness. The peripheral nerves also send sensory information back to the brain and spinal cord, for an example in this case that the feet may be cold. In the case of peripheral nerve damage there is interferes with the messages sent back to much because of distortion and the message may never be received.
The four patterns of peripheral neuropathy are:

- Polyneuropathy
- Mononeuropathy
- Mononeuritis multiplex
- Autonomic neuropathy

The most common form is (symmetrical) peripheral polyneuropathy, and it mainly affects the legs and feet. This process starts in both feet and gradually works its way up both legs. Polyneuropathy is often more serious and affects more areas of the body. These nerve fibers (individual cells that make up the nerve) are the most distant from the brain and the spinal cord malfunction first. There have been more than 100 types of peripheral neuropathy identified, each have its own characteristic set of symptoms, patterns of development, and prognosis.

Diabetic Neuropathy is the most common cause of this pattern. Many people with diabetic neuropathy experience this pattern of ascending nerve damage.

Neuritis is a general term for inflammation of a nerve, or the general inflammation of the peripheral nervous system.

Because of the different types of nerve damage each patient may experience different types of symptoms which include:

- Temporary numbness
- Tingling
- Prickling sensations (paresthesia)
- Burning pain (especially at night)
- Sensitivity to touch
- Muscle weakness or muscle wasting
- Paralysis
- Organ or gland dysfunction

Pain associated with this type of nerve damage may also be described as: burning, freezing, or electric-like sensations. Pain receptors in the skin can become over
sensitized and patients may feel severe pain (allodynia). An example of this would be patients who cannot even stand to have sheets on their feet.

Impaired function and symptoms depend on the type of nerves that have been damaged. These symptoms may be seen over a period of days, weeks or years. The good news is that studies have shown than in many of the cases of small fiber neuropathy with typical symptoms of tingling, pain and loss of sensation in the feet and hands due to glucose intolerance before diagnosis of diabetes and pre-diabetes. Such damage is often reversible, particularly in the early stages, with diet, exercise and weight loss.

Smaller sensory fibers without myelin sheaths transmit pain and temperature sensations. Damage to these fibers can interfere with the ability to feel pain and temperature. Patients may not be able to sense that they have been injured from a cut or that a wound is becoming infected. This loss of pain sensation is an extremely serious problem for patients with diabetes, and this loss of sensation has contributed to the high rate of lower limb amputations.

Diabetes Mellitus is characterized by chronically high blood glucose levels, leading from mild to severe forms of nervous system damage. Vascular damage and blood diseases may lead to a decrease in oxygen supply to peripheral nerves and quickly lead to serious damage or even death of nerve tissue. Microvascular disease is significant when the narrowing of the small arteries is involved. This problem cannot be fixed surgically and can lead to ulcerations.

A general physical exam and related test i.e., blood glucose test, may reveal the presence of a systemic disease causing the nerve damage.

A clinic visit could initiate an evaluation of the patient’s ability to register vibration, light touch, body position, temperature, and pain reveals sensory nerve damage. This test may also indicate whether small or large sensory nerve fibers are involved.

This is a perfect time to educate the patient to:
• Inspect their feet daily: Check for cuts, blisters, swelling or nail problems. If needed use a hand held magnifying mirror to look at the bottom of the feet. Make sure they know to take immediate action and call to make an appointment to be seen.
• Wash feet in lukewarm (never hot) water: Make sure to keep feet clean by washing them daily only in lukewarm water the same as you would use on a new born baby.
• Be gentle when using an object such as a soft washcloth or sponge. Do not use hard objects like a foot file or pumis stone. Pat or blot dry making sure to dry in between the toes.
• Moisturize feet, but not between the toes: using a moisturizer daily will help to keep dry skin from itching or cracking. Do not however moisturize between the toes this could promote fungal infection.
• Cut nails carefully: file the edges of a nail, don’t cut them to short. Cutting a nail to short could lead to an ingrown toe nail.
• Never trim corns or calluses: DO NOT DO “bathroom surgery” always have a patient make an appointment and let the doctor do that job.
• Always wear clean, dry socks: Have the patient change them not only daily, but also if they become damp or wet for any reason. Keep extra pairs of socks and shoes available if needed.
• Avoid the wrong type of socks: Avoid tight elastic bands (they can reduce circulation). Do not wear thick or bulky socks since they can fit poorly and irritate the skin.
• Wear socks to bed: if the patient’s feet get cold at night, have them wear socks. Never use a heating pad or hot water bottle to keep feet warm.
• Shake out shoes and inspect the inside before putting them on. For patients with diabetes they may not feel an object in their shoes that might cause them injury and create a wound.
• Keep feet warm and dry: Don’t get them wet in rain or snow. Always wear appropriate foot gear in bad weather.
• Never walk barefooted: Not even at home! It is easy to get a cut or scrape without even realizing it happened.
• Keep blood sugar levels under control: Make sure all directions are followed when it comes to staying within normal limits.
• Don’t smoke: Smoking restricts blood flow to the feet.
• Get periodic foot exams: This should be completed on all visits to the doctor and make sure to see the podiatrist if this is available to the patient.

Foot wear is an important role in keeping the patients feet safe from forming ulcers. Always remember:

- Firm heel counters for support and stability
- Rocker soles are designed to reduce pressure in the areas of the foot most susceptible to pain.
- High, wide toe box in the space of the toe area
- Removable insoles for fitting flexibility and the option for orthotics if necessary.

Strict control of blood glucose levels have been shown to reduce the neuropathic symptoms and help people with diabetic neuropathy and avoid further nerve damage.

In the case of mononeuropathies that are caused by compression or entrapment injuries, surgical intervention may be used.

Charcot foot deformity is a result of decreased sensation. People with “normal” feeling in their feet can immediately determine there is too much pressure in any one area of their foot and either adjusts their foot to relieve the pressure; or if available with a change shoes. Patients with neuropathy have lost the ability to feel this problem and even a blister can be the start of a huge problem for this patient. As a result, tissue ischemia necrosis may occur in the foot leading to plantar ulceration.
Microfractures can even occur in the bones of the feet and go unnoticed and untreated. If this happens then it can result in disfigurement, chronic swelling, and additional bony prominences further complicating the situation.

Once a diabetic patient has discovered a foot ulcer or wound then treatment becomes much more difficult. The patient usually starts in the emergency room to have the foot evaluated. While the patient is there the ER staff also must manage the Diabetes Mellitus using age specific guidelines and prioritize the following documentation.

1. Obtain vital signs including orthostatic as indicated by history. Note Kussmaul’s (very deep gasping) respirations or acetone on the patient’s breath.
2. Past medical history, medications, and allergies
3. Chief complaint in this case would be the foot ulceration. In addition to this the precipitating factors and associated symptoms such as pain, nausea, vomiting, diarrhea, dizziness, weakness, and other illnesses. Vomiting can become a very serious situation for diabetics.
4. Assessment including level of consciousness, respiratory effort, skin color, diaphoresis and neurologic deficits, pain level.
5. Patients in acute distress as indicated by completed assessment will be roomed immediately and the physician should be notified.

Interventions for blood glucose within the Patient’s normal range will be attained and maintained.

1. Determine if the patient’s airway is patent. Assess the quality of the patient’s reparations and document.
2. Place the patient on cardiac monitor as patient’s condition warrants.
3. Start IV as ordered by physician or according to Standardized Procedure of each facility.
4. Draw labs and blood sugar POCT per protocol or as ordered by physician. Use glucometer where appropriate and indicated. If the patient’s foot is infected a culture may be taken and delivered at the same time.

5. Administer medications and treatments as ordered by physician. Document patient’s response to medications. If a culture is needed for the foot, this should be accomplished before antibiotics are started.

6. Provide on-going patient assessment including decreased level of consciousness (LOC), nausea/vomiting, pain level, vital signs. Notify physician of significant changes in patient’s condition.

7. Provide oral nutrition as ordered by the physician. In the case of a patient who may need surgery, make sure they remain NPO, if they are not already.

8. Repeat vital signs as warranted by the patient’s condition and document.

If the patient’s wound has been evaluated and it is determined the patient will be discharged, make sure the patient and family (when indicated) will verbalize the understanding of the instructions given including the review of the disease process. Ensure the patient has received discharge and follow up instructions. Notify and utilize the diabetic nurse specialist where one is available.

A patient requiring admission will verbalize the reason for admission, including all circumstances. Make sure to explain the admission procedure as well. In the case of a diabetic ulcer, a patient may have or need a consultation from the podiatrist or orthopedic surgeon to decide if the wound needs to be further addressed. Depending on if the patient needs surgery and if they are NPO, the patient may or may not continue on to the pre-op area. If the Patient is not NPO, then the admission process would continue.

Once the diabetic patient becomes an inpatient the facilities diabetic care procedure will be instituted and usually includes:

A) The patient will attain and maintain a serum glucose, potassium, CO₂ value within normal lab/physician prescribed parameters during hospitalization. The nursing staff would monitor signs of
hypoglycemia and hypoglycemia: The nurses would monitor blood glucose greater than 350 milligrams per deciliter. It is preferred that patients be below 300 in order to proceed to surgery.

- Blurred vision
- Extreme thirst
- Polyuria (excessive secretion and discharge of urine)
- Confusion
- Hyperreflexia (an increased action of the flexes)
- Aphasia (absence or impairment of speech)
- Lethargy
- Coma

Monitor for signs and symptoms of hypoglycemia:

- Blood sugar or less than 70 milligrams per deciliter.
- Tachycardia
- Cool, clammy skin
- Diaphoresis
- Pale
- Irritability
- Jitteriness
- Confusion
- Lethargy
- Slurred speech
- In Coordination
- Mood swings

B) Implement measures to:

- Provide meals with 15-30 minutes after administration of rapid acting insulin.
- Provide snacks between meals and bedtime.
- Nutritional service referral where available.
- Treat hypoglycemia/hyperglycemia according to physician order.
Educate patient to report symptoms of hypoglycemia immediately.

C) Monitor blood glucose and chemistry, and report abnormal values to physician. Notify MD if the anion gap is greater than 12. An anion gap of greater than 12 usually indicates metabolic acidosis.

D) Implement measures to treat hypoglycemia:
   - If blood sugar goes to 70 or below, and the patient is conscious, give wither 4 oz. of regular apple or cranberry juice, DO NOT GIVE orange juice. 4 oz. of regular soda is appropriate. 8 oz. of milk, nonfat works fastest, 1 Tbsp. of honey or jelly, or 2-3 glucose tablets. Re-check blood glucose within 15-20 minutes.
   - If patient is unconscious or NPO, notify physician.

E) Subcutaneous insulin administration:
   - Administer insulin per physician orders including sliding scale.
   - When mixing, draw clear to cloudy.
   - DO NOT MIX THE FOLLOWING: Humulog insulin with any fast acting (i.e., regular) insulin. Do not mix lantus insulin with any other insulin. Do not mix animal and human insulin.
   - Only regular (Humulin R) can be given IV
   - Basal insulin’s (e.g., Lantus) must be given once daily at the same time each day (often at bedtime). Effects last for 24 hours.
   - Humulog insulin is very rapid acting. Feed patient immediately after administration. Patients should be observed for symptoms of hypoglycemia for one – two hours after administration. Do not give at night unless followed with food.

F) The rapid acting insulin’s (lispro and aspart), may be mixed with NPH, or Ultralente, however, the mixture should be used within 15 minutes.

G) Diabetic Ketoacidosis patients will have resolution with appropriate therapy.
H) Patient education is an important part of this process. Educate the patient, significant other and family to ensure they can communicate the understanding of signs, symptoms, and treatment of hyper/hypoglycemia.

I) High risk problem prone aspects of care:
- Patient will show no evidence of infection or sepsis.
- Monitor for signs and symptoms of infection.
- Give oral care once a shift and/or PRN.
- Patients are at high risk for skin integrity issues.
- Monitor for symptoms of delayed wound healing
- Obtain wound nurse consult for diabetic ulcers where available.
- Prevent injury due to neuropathy.

Once the patient becomes NPO and is within surgical blood sugar levels, patient will be sent to the Pre-op. When the patient reaches the pre-op again all checks will be put in place to make sure the patient is safe in this environment. They will be asked to wipe down with a pre-surgical wipe, to help with preventing bacterial growth.

At this point, it is extremely important that the surgeon has seen the patient and that the correct surgical foot has been marked and verified, before the patient is medicated. It is not unusual for a diabetic patient to have black toes on both feet. In some cases the non-surgical foot looks worse than the foot having surgery. The wrong surgery has been performed on diabetic patients, and the wrong foot has been amputated.

Once the patient is brought into the operating room, the time out will again verify the correct side and what the correct procedure will be completed. Verify the side including the physicians initials. The patient will be placed in the correct position, prepped and draped. Just prior to incision the correct side will again be announced prior to incision.
If an incision and drainage (I&D) is being performed, usually the area of infection is opened, cultures are taken and the infection is cleaned out as best as it can be. The wound is then irrigated and it may or may not be packed, then dressed to allow the infection to drain. The dressing is dry sterile sponges with bulky sterile dressing over the foot.

After a day or so of antibiotics and monitoring, the patient is then brought back to surgery for another I & D, and if the infection has cleared the wound will be closed.

If this process has progressed further, the patient may lose a toe(s), and the wound may or may not at this time require a wound vac (to be discussed later). Once the infection has been cleared as much as possible, the wound vac sponges maybe placed, secured and the wound vac turned on.

A partial amputation of the foot may be necessary to stop the infection if it was not caught quickly enough. Again the wound vac, maybe placed over ½ of the foot until the infection has cleared.

Make sure to check with surgeon, but always have power equipment available once the foot is open and examined, it may be needed.

Worse case would be that the infection has spread to the point that the foot would have to be entirely amputated. If the patient does not have tissue that is viable in the lower extremely/foot an orthopedic surgeon maybe called. If the amputation has vascular involvement and is high enough a vascular surgeon may need to perform the amputation.

It is not unusual to watch a patient go through this process of having many surgeries and end up having an amputation. This process could take years or happen over a short amount of time.
**Wound Vac Therapy or Negative pressure wound therapy:**

Negative Pressure Wound Therapy (NPWT) was developed in the 1990s by researchers at Wake Forest University School of Medicine, Winston-Salem, NC. This concept was based on the mechanic of physics. The application of controlled sub-atmospheric pressure caused mechanical stress to the tissues. Mitosis is stimulated, new vessels are formed, and the wound is drawn closed. The degree of pressure to the wounded tissue is small, but when all areas of the wound work together in an effort to close toward the center point, the negative pressure results in quicker healing and resolution. It is quite impressive.

The food and drug administration (FDA) approved the NPWT in March 1995 for the treatment of non-healing wounds. Its indications were expanded in January 2000 to include chronic, acute traumatic and sub-acute wounds, flaps and grafts.

How does the wound vac therapy help? Studies have shown the controlled negative pressure assists in wound healing by:

- Providing a moist, protective environment.
- Reduces the peripheral edema around the wound.
- Stimulates the circulation to the wound bed.
- Decreases bacterial colonization.
- Increases the rate of granulation tissue formation and epithelialization.

The Negative pressure machine (there are many to choose from) applies suction to the wound bed through a closed system. The sponge is cut and is placed on a clean wound bed in the shape of the wound. This should also include any tunnels and undermining areas. These sponges are open cell foam sponges. Once the sponge is in place add the tubing to the top of the sponge then secure with an adhesive clear drape. Make sure to pinch the clear drape around the tubing. This drape helps to provide the semi-occlusive environment that supports the moist wound healing. The drape is vapor permeable to facilitate gas exchange, which is an important part of treating infected wounds with anaerobic organisms that would normally thrive in an oxygen-depleted occlusive environment. The foam and drape also
protect the wound base from environmental contaminants and reduce the risk of friction or shear, enhancing the body’s ability to heal. Moist dressings have been a part of the wound healing process since the mid-1980s.

Once the clear drape is secured and the wound is completely sealed, hook the tubing up to the canister and turn the machine on. Watch for the sponge to collapse and there are no leaks. Watch to see if the machine makes it to the target pressure and that it is appropriate. If there are any leaks just add more clear drape may be added to the areas where there are air leaks. Once sealed the sponge should collapse and fill the entire wound bed. Fluid may start to be drawn to the machine. If needed, change the canister on the machine if it becomes full of fluids from the wound.

Peripheral edema and circulation are also addressed by these machines. The tissue surrounding a wound typically has localized buildup of interstitial (third-spacing) fluid. This fluid can mechanically compromise the circulation and lymphatic systems, impeding oxygen and nutrient delivery to the tissue and supporting inhibitory factors and bacterial growth. Studies have shown that wound fluid contains elements that delay wound healing by suppressing proliferation.

When using the NPWT machines, wound fluid is evacuated via a tubing system placed in or on the foam at one end and connected to a disposable canister which lives on the therapy unit. These machines remove that stagnant fluid and allow circulation to resume and the disposal of cellular waste via the lymphatic system to once again work correctly. Laser Doppler flow studies have verified decreased peripheral edema when the negative pressure has been used.

Bacterial colonization happens when microorganisms invade the tissue and infection is present. This is defined as organisms greater than $10^5$ per gram of tissue. The microorganisms begin to consume the nutrients and oxygen that would normally go to the new tissue to promote growth. These organisms also release enzymes that break down protein, which is an important component in wound healing process.
Granulation tissue is a mix of small blood vessels and connective tissue in the base of the wound. Studies have shown that granulation formation is enhanced by negative pressure by increased circulation.

**Indication and contraindication for the use of NPWT:**

Contraindications would be:

- Wounds with necrotic tissue, untreated osteomyelitis, fistulas to organs or body cavities, placement directly over exposed veins and arteries, or malignancy within the wound.
- Devitalized tissue: Wounds must be cleared of all devitalized tissue before NPWT placement. This would also include debridement of bone if osteomyelitis was present. Osteomyelitis should be treated with the proper antibiotics to clear the underlying infection.
- Fistulas that tract to organs should not have a NPWT placed. However if they do not tract to organs they have been placed with success. Chronic and newly created fistulas have been successfully closed with NPWT.
- Organs and exposed blood vessels should not be exposed to the porous sponge and suction.
- Malignancy is not an appropriate use for the NPWT.
- Malnutrition, untreated infection, or imminent death are situation when the NPWT should never be used.

Clinical consideration for indications of use, the main consideration would be the ability for the wound to heal.

Guidelines for use:

After the NPWT has been placed and it is time for a dressing change, it is important to:
Remove the NPWT gently, starting with the adhesive. It is recommended the adhesive dressing be gently lifted, not pulled from the skin. The pulling motion can cause stripping and irritation of the peri-wound skin. It is acceptable to use topical adhesive remover to aid in removing the drape. Once the drape is removed, the sponge should now be loosened from the wound bed. Sterile saline maybe used to help aid in this process. Aggressive granulation tissue growth may result in growth into the sponge. This may cause pain on removal of the sponge. The moistening of the sponge may lessen the discomfort and reduce the potential trauma to the fragile capillaries in the wound bed. If possible, it may be a good idea to medicate the patient prior to the dressing change.

Aggressively cleanse the wound and peri-wound area based on the guidelines on pressure ulcer treatment from the Agency for Health Care Policy and Research (AHCPR; now the Agency for Healthcare Research and Quality). The recommendation is wound cleaning with sterile saline solution under pressure of 4 to 15 pounds per square inch. Cleaning with each dressing change is important to remove the loose debris in the wound.

The wound should be debrided of necrotic tissue of applicable. This is to remove debris not only from the wound bed, but also sinus tracts or tunnels.

Select the appropriate foam dressing based on wound characteristics. The black polyurethane foam has larger pores than the other sponge choices and is considered to be more effective for stimulating granulation tissue including wound contraction. The white polyvinylalcohol (PVA) soft foam is denser with smaller pores and is generally recommended when growth of granulation tissue need to be somewhat restricted. White foam may also be used if a patient cannot tolerate the polyurethane foam due to pain. The PVA foam does require higher negative pressure, because of its higher density. Here are the foam choices recommended guidelines:
A combination of the polyurethane and PVA foam can be used in a wound, depending on the desired results. Make sure to select a kit that is appropriate for the size of wound to be filled.

This table lists the recommended guidelines for target pressures and cycles for different types of wounds. However, always consult physician for individual patient conditions and treatment protocols. Before starting device on the patient, also consult the user manual for verification of settings.

<table>
<thead>
<tr>
<th>Wound Type</th>
<th>Rationale for use</th>
<th>Initial Cycle</th>
<th>Subsequent Cycles</th>
<th>Target Pressure Polyurethane</th>
<th>Target Pressure Polyvinyl-alcohol</th>
<th>Dressing Change Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute/traumatic wound</td>
<td>Edema removal, wound contraction, granulation growth, protection from outside contaminants</td>
<td>Continuous for first 48 hours</td>
<td>Intermittent (5 min on/ 2 min off) for duration of therapy</td>
<td>125 mm Hg</td>
<td>125 – 175 mm Hg</td>
<td>Every 48 hours (every 12 hours with untreated infection)</td>
</tr>
<tr>
<td>Surgical wound dehiscence</td>
<td>Edema removal, wound contraction, granulation growth</td>
<td>Continuous for first 48 hours</td>
<td>Intermittent (5 min on/ 2 min off) for duration</td>
<td>125 mm Hg</td>
<td>125 – 175 mm Hg</td>
<td>Every 48 hours (every 12 hours)</td>
</tr>
<tr>
<td>Protection from outside contaminants</td>
<td>Of therapy</td>
<td>Hours with untreated infection</td>
<td></td>
<td></td>
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<tr>
<td>Meshed Graft</td>
<td>Edema removal, adhere graft to wound bed, protect against shearing forces</td>
<td>Continuous</td>
<td>Continuous for duration of therapy</td>
<td>75 – 125 mm Hg</td>
<td>125 mm Hg; titrate up for more drainage</td>
<td></td>
</tr>
<tr>
<td>Pressure ulcer</td>
<td>Granulation tissue growth, Edema removal, wound contraction, protect against shearing forces</td>
<td>Continuous</td>
<td>Intermittent (5 min on/ 2 min off) for duration of therapy</td>
<td>125 mm Hg</td>
<td>125 – 175 mm Hg titrate up for more drainage</td>
<td></td>
</tr>
<tr>
<td>Chronic ulcer (diabetic / arterial vascular)</td>
<td>Edema removal, Granulation tissue growth, enhance epithelial cell migration, provide moist wound healing, protection from outside contaminants</td>
<td>Continuous</td>
<td>Continuous for duration of therapy</td>
<td>50 – 75 mm Hg</td>
<td>125 – 175 mm Hg titrate up for more drainage</td>
<td></td>
</tr>
<tr>
<td>Fresh Flap</td>
<td>Surgical / wound drainage removal underneath sutures, promotes flap adherence to wound base, helps immobilize flap, protects from contaminants</td>
<td>Continuous</td>
<td>Continuous for duration of therapy</td>
<td>125 mm Hg</td>
<td>125 – 175 mm Hg titrate up for more drainage</td>
<td></td>
</tr>
<tr>
<td>Compromised flap</td>
<td>Edema removal, Granulation tissue growth, adherence of flap</td>
<td>Continuous</td>
<td>Continuous for duration of therapy</td>
<td>125 mm Hg</td>
<td>125 – 175 mm Hg titrate up for more drainage</td>
<td></td>
</tr>
</tbody>
</table>

Chart 7 of 9:

Before any wound care modality is used, the clinician must understand how the modality assists in wound healing and when it should be utilized. Remember any off – label use of any medical product comes with associated risks.

**Dressing change procedure:**

1. Use universal precautions, perform hand hygiene. Make sure to explain the procedure to the patient.
2. Administer analgesics PRN (offer pain medication prior to dressing changes – may need to obtain a specific order for pain medication for dressing changes. Provide the patient privacy.
3. Remove old dressing from the wound. Normal saline may be used to loosen foam.
4. Perform hand hygiene and apply gloves.
5. Cleanse the wound with normal saline and dry thoroughly. Thoroughly visualize the wound bed, ensure there is enough bright light to clearly see as much of the wound as possible. Palpate the wound edges and check not only for depth if possible, but for tracks or undermining.
6. Apply skin barrier around the wound to protect intact skin.
7. Apply clear adhesive around the wound, approximately 3 to 5 centimeters wide to protect the skin from foam macerating skin with contact.
8. Open appropriate wound care supplies on a clean dry level surface. Select the dressing sit most appropriate to the approximate size and shape of wound.
9. Now that it is time to address the wound use aseptic / sterile technique. After putting on sterile gloves cut Wound Vac foam to fill wound cavity. The type of foam used will be determined by the physician or experienced clinician. Protect barrier such as Adaptic may be used over exposed bone, tendon, etc. Trim the dressings as necessary for proper fit. Foam should not contact intact skin or it will cause maceration. Cover the foam with clear adhesive dressing.
10. Place track pad over area with foam and clear adhesive dressing after cutting opening in clear dressing to obtain suction to foam.
11. Change or insert canister to suction machine and them connect to patient tract tubing. Make sure clamps are open. Canister changes are weekly, unless full or vacuum not working due to obstruction in system.
12. Turn the machine on and then touch screen for therapy. Make sure the suction is on 125 mm HG continuous pressure, unless white foam is used, then set pressure to 150 mm HG continuous pressure. Adjust to a lower pressure if patient’s individual needs are determined by the situation. If the dressing does not collapse, check tubing and clear adhesive for leaks. Use additional clear adhesive for leaks. Make sure the tubing will not lay
over any bony prominences or lay flat on intact skin under body. Label dressing indicating products used and foam count.

13. Assist the patient back into a comfortable and safe position.

Documentation:

1. Assess and document on patient Documentation flowsheet and / or note each shift.
   A. Level of suction.
   B. Dressing change procedure.
   C. Status of Wound Vac (no alarm condition).
   D. Appearance of skin around dressing and underneath tubing.
   E. Approximate wound drainage in canister.
   F. Foam count and products used.

Wound Vac maintenance:

If there is an alarm, read the face of Wound Vac for cause of alarm condition. Change canister if 200 – 250 ml’s of drainage. Seal leaks using clear adhesive dressing (Vac dressing or tegaderm). If pump has a problem, change to a different Vac pump. If operation is stopped for two hours for any reason, discontinue and change to wet – to – dry dressing. Always change a home pump to the inpatient pump when a patient is admitted.

A team approach will help in deciding the appropriate direction a patient’s care should take. This approach will also help to individualize the care for each patient. Ongoing assessment is essential when dealing with wound care and the treatment needed to correct the wound issue as soon as possible.

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Wound Care Glossary

**Acute wound**: A wound that heals as planned, usually within several weeks of injury. Examples include sunburn, a simple surgical incision, an eye injury, a scrape or a sutured trauma wound.

**Airborne infection isolation room (AIIR)**: Formerly, negative pressure isolation room, an AIIR is a single-occupancy patient-care room used to isolate persons with a suspected or confirmed airborne infectious disease. Environmental factors are controlled in AIIRs to minimize the transmission of infectious agents that are usually transmitted from person to person by droplet nuclei associated with coughing or aerosolization of contaminated fluids. AIIRs should provide negative pressure in the room (so that air flows under the door gap into the room); and an air flow rate of 6-12 ACH (6 ACH for existing structures, 12 ACH for new construction or renovation); and direct exhaust of air from the room to the outside of the building or recirculation of air through a HEPA filter before returning to circulation (MMWR 2005; 54 [RR-17]).

**Air – Purifying respirator**: A respirator with an air – purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air – purifying element.

**American Institute of Architects (AIA)**: A professional organization that develops standards for building ventilation, The "2001Guidelines for Design and Construction of Hospital and Health Care Facilities", the development of which was supported by the AIA, Academy of Architecture for Health, Facilities Guideline Institute, with assistance from the U.S. Department of Health and Human Services and the National Institutes of Health, is the primary source of guidance for creating airborne infection isolation rooms (AIIRs) and protective environments (www.aia.org/aah).

**Ambulatory care settings, Ambulatory Surgery Centers (ASC), Home after surgery (has)**: Facilities that provide health care to patients who do not remain overnight (e.g., hospital-based outpatient clinics, nonhospital-based clinics and physician offices, urgent care centers, surgery centers, free-standing dialysis centers, public health clinics, imaging centers, ambulatory behavioral health and substance abuse clinics, physical therapy and rehabilitation centers, and dental practices.
Antibiotic: is a substance or compound that kills or inhibits bacteria. Antibacterial is an alternative name.

Association: An organization of people with a common purpose and having a formal structure.

Atmosphere - supplying respirator: A respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere, and includes supplied – air respirators (SARs) and self – contained breathing apparatus (SCBA) units.

Background Diabetic Retinopathy: is thought to be caused by chronic damage to small retinal blood vessels produced by the diabetic condition, thus leading to macular edema.

Bed sore: A layman's term for pressure ulcer, pressure sore or decubitus ulcer. A chronic wound caused by sustained pressure, usually to a bony prominence. Contributing factors include friction, shear and moisture.

Bioaerosols: An airborne dispersion of particles containing whole or parts of biological entities, such as bacteria, viruses, dust mites, fungal hyphae, or fungal spores. Such aerosols usually consist of a mixture of mono-dispersed and aggregate cells, spores or viruses, carried by other materials, such as respiratory secretions and/or inert particles. Infectious bioaerosols (i.e., those that contain biological agents capable of causing an infectious disease) can be generated from human sources (e.g., expulsion from the respiratory tract during coughing, sneezing, talking or singing; during suctioning or wound irrigation), wet environmental sources (e.g. HVAC and cooling tower water with Legionella) or dry sources (e.g., construction dust with spores produced by Aspergillus spp.). Bioaerosols include large respiratory droplets and small droplet nuclei (Cole EC. AJIC 1998;26: 453-64).

Bioburden: The number of contaminating microorganisms present on an object. Reduction of bioburden is the goal of infection control programs and protocols.

Biological Indicator: A device to monitor the sterilization process that consists of a standardized population of bacterial spores known to be resistant to the mode of
sterilization being monitored. The spores are in a media cohesive to growth and if not killed in the sterilization process show that load of instrument are not sterile and should be recalled. Biological indicators indicate that all the parameters necessary for sterilization were present when they are negative.

**Bowie-Dick Test:** Autoclave testing services describes as: A Bowie-Dick test is used in pre-vacuum type (or dynamic air removal) sterilizers. They are used to detect air leaks and inadequate air removal and consist of folded 100% cotton surgical towels that are clean and preconditioned. A commercially available Bowie-Dick-type test sheet should be placed in the center of the pack.

The test pack should be placed horizontally in the front, bottom section of the sterilizer rack, near the door and over the drain, in an otherwise empty chamber and run at 134°C for 3.5 minutes. The test is used each day the vacuum-type steam sterilizer is used, before the first processed load.

Air that is not removed from the chamber will interfere with steam contact. Smaller, commercially available disposable test packs (or process challenge devices) have been devised to replace the stack of folded surgical towels for testing the efficacy of the vacuum system in a prevacuum sterilizer.

They should be representative of the load and simulate the greatest challenge to the load. Sterilizer vacuum performance is acceptable if the sheet inside the test pack shows a uniform color change. Entrapped air will cause a spot to appear on the test sheet, due to the inability of the steam to reach the chemical indicator. If the sterilizer fails the Bowie-Dick test, do not use the sterilizer until it is inspected by the sterilizer maintenance personnel and passes the Bowie-Dick test.

See the complete recommendations on sterilizer and disinfection at www.cdc.gov “Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008”.

**Capillaries:** The minute blood vessels, approximately 0.008mm in diameter that connects the ends of the smallest veins.

**Caregivers:** All persons who are not employees of an organization, are not paid, and provide or assist in providing healthcare to a patient (e.g., family member,
friend) and acquire technical training as needed based on the tasks that must be performed.

**Chemical Indicators**: or CI that change color or physical form when exposed to certain temperatures. These would include autoclave tape, special markings on sterilization pouches and bags. This does not show that sterilization has been achieved or that a complete sterilization cycle has occurred. These are just process indicators, and show that the item has passed through a sterilizer.

**Chronic wound**: A wound (or ulcer) that does not heal as planned. Chronic wounds may take weeks, months or even years to heal. Chronic wounds often occur again and again. Examples are diabetic ulcers, pressure ulcers (bed sores) and venous ulcers.

**Cohorting**: In the context of this guideline, this term applies to the practice of grouping patients infected or colonized with the same infectious agent together to confine their care to one area and prevent contact with susceptible patients (cohorting patients). During outbreaks, healthcare personnel may be assigned to a cohort of patients to further limit opportunities for transmission (cohorting staff).

**Colonization**: Proliferation of microorganisms on or within body sites without detectable host immune response, cellular damage, or clinical expression. The presence of a microorganism within a host may occur with varying duration, but may become a source of potential transmission. In many instances, colonization and carriage are synonymous.

**Corium dermis**: is composed of fibrous connective tissue made of collagen and elastin. Corium dermis contains numerous capillaries, lymphatics and nerve endings. This layer contains hair follicles and their smooth muscle fibers, sebaceous glands, sweat glands and their ducts.

**Corticosteroids (steroids)**: Are used to treat inflammatory illness. Side effects include high blood pressure, mood swings, and increased risk of infection, stronger appetite, facial swelling and fluid retention.
**Demand Respirator**: An atmosphere – supplying respirator that admits breathing air to the face-piece only when a negative pressure is created inside the face-piece by inhalation.

**Dermis**: is the deeper layer of skin that lies directly under the epidermis and is the true skin. Depending on its location, the dermis can be 15 to 40 times thicker than the epidermis. It has two layers Papillary and the reticular that are responsible for supporting the dermis.

**Diabetic retinopathy**: May damage sight by either a non-proliferative or proliferative retinopathy. The proliferative type is characterized by formation of new unhealthy, freely bleeding blood vessels within the eye (called vitreal hemorrhage) and / or causing thick fibrous scar tissue to grow on the retina detaching it. When bleeding or retinal detachment occur, vitrectomy is employed to clear the blood, membranectomy removes the scar tissue, and injection of gas or silicon with scleral buckle may be needed to return sight.

**Droplet nuclei**: Microscopic particles < 5 µm in size that are the residue of evaporated droplets and are produced when a person coughs, sneezes, shouts, or sings. These particles can remain suspended in the air for prolonged periods of time and can be carried on normal air currents in a room or beyond, to adjacent spaces or areas receiving exhaust air.

**Employee exposure**: Exposure to a concentration of an airborne contaminates that would occur if the employee were not using respiratory protection.

**End – of – Service – Life Indicator (ESLI)**: A system that warns the respirator user of the approach of the end of adequate respirator protection, for example, that the sorbent is approaching saturation or is no longer effective.

**Engineering controls**: Removal or isolation of a workplace hazard through technology. AllIRs, a Protective Environment, engineered sharps injury prevention devices and sharps containers are examples of engineering controls.

**Epidemiologically important pathogens**: Infectious agents that have one or more of the following characteristics: 1) are readily transmissible; 2) have a proclivity toward causing outbreaks; 3) may be associated with a severe outcome; or 4) are
difficult to treat. Examples include Acinetobacter sp., Aspergillus sp., Burkholderia cepacia, Clostridium difficile, Klebsiella or Enterobacter sp., extended-spectrum-beta-lactamase producing gram negative bacilli [ESBLs], methicillin-resistant Staphylococcus aureus [MRSA], Pseudomonas aeruginosa, vancomycin-resistant enterococci [VRE], methicillin resistant Staphylococcus aureus [MRSA], vancomycin resistant Staphylococcus aureus [VRSA] influenza virus, respiratory syncytial virus [RSV], rotavirus, SARS-CoV, noroviruses and the hemorrhagic fever viruses).

**Exudate:** Drainage, fluid or pus coming from a wound.

**Failsafe interlock:** An interlock where the failure of a single mechanical or electrical component of the interlock will cause the system to go into, or remain in, a safe mode.

**Filter or air purifying element:** A component used in respirators to remove solid or liquid aerosols from the inspired air.

**Filtering face-piece (dust mask):** A negative pressure particulate respirator with a filter as an integral part of the face-piece or with the entire face-piece or with the entire face-piece composed of the filtering medium.

**Fit factor:** A quantitative estimates of the fit of a particular respirator to a specific individual and typically estimated the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.

**Fit test:** The use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual.

**Fluid – air exchange:** Injection of air into the eye to remove the intraocular fluid form the posterior segment of the globe while maintaining intraocular pressure to temporarily hold the retina in place or seal off holes in the retina.

**Hair follicles:** are a cylindrical invagination, of the epidermis that a keratinized thread like outgrowth from the skin of mammals.

**Hand hygiene:** A general term that applies to any one of the following: 1) handwashing with plain (nonantimicrobial) soap and water; 2) antiseptic handwash (soap containing antiseptic agents and water); 3) antiseptic handrub
(waterless antiseptic product, most often alcohol-based, rubbed on all surfaces of hands); or 4) surgical hand antisepsis (antiseptic handwash or antiseptic handrub performed preoperatively by surgical personnel to eliminate transient hand flora and reduce resident hand flora) 559.

**Healthcare-associated infection (HAI):** An infection that develops in a patient who is cared for in any setting where healthcare is delivered (e.g., acute care hospital, chronic care facility, ambulatory clinic, dialysis center, outpatient surgical centers, home) and is related to receiving health care (i.e., was not incubating or present at the time healthcare was provided). In ambulatory and home settings, HAI would apply to any infection that is associated with a medical or surgical intervention. Since the geographic location of infection acquisition is often uncertain, the preferred term is considered to be healthcare-associated rather than healthcare-acquired.

**Healthcare epidemiologist:** A person whose primary training is medical (M.D., D.O.) and/or masters or doctorate-level epidemiology who has received advanced training in healthcare epidemiology. Typically these professionals direct or provide consultation to an infection control program in a hospital, long term care facility (LTCF), or healthcare delivery system (also see infection control professional).

**Healthcare personnel, healthcare worker (HCW):** All paid and unpaid persons who work in a healthcare setting (e.g. any person who has professional or technical training in a healthcare-related field and provides patient care in a healthcare setting or any person who provides services that support the delivery of healthcare such as dietary, housekeeping, engineering, maintenance personnel).

**Hematopoietic stem cell transplantation (HSCT):** Any transplantation of blood-or bone marrow-derived hematopoietic stem cells, regardless of donor type (e.g., allogeneic or autologous) or cell source (e.g., bone marrow, peripheral blood, or placental/umbilical cord blood); associated with periods of severe immunosuppression that vary with the source of the cells, the intensity of chemotherapy required, and the presence of graft versus host disease (MMWR 2000; 49: RR-10).

**High-efficiency particulate air (HEPA) filter:** An air filter that removes >99.97% of particles > 0.3μm (the most penetrating particle size) at a specified flow rate of air. HEPA filters may be integrated into the central air handling systems, installed at
the point of use above the ceiling of a room, or used as portable units (MMWR 2003; 52: RR-10).

**Home care:** A wide-range of medical, nursing, rehabilitation, hospice and social services delivered to patients in their place of residence (e.g., private residence, senior living center, assisted living facility). Home health-care services include care provided by home health aides and skilled nurses, respiratory therapists, dieticians, physicians, chaplains, and volunteers; provision of durable medical equipment; home infusion therapy; and physical, speech, and occupational therapy.

**Hood:** a respirator inlet covering that completely covers the head and neck and may also cover portions of the shoulders and torso

**Immediately dangerous to life or health (IDLH):** An atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual’s ability to escape from a dangerous atmosphere.

**Immunocompromised patients:** Those patients whose immune mechanisms are deficient because of congenital or acquired immunologic disorders (e.g., human immunodeficiency virus [HIV] infection, congenital immune deficiency syndromes), chronic diseases such as diabetes mellitus, cancer, emphysema, or cardiac failure, ICU care, malnutrition, and immunosuppressive therapy of another disease process [e.g., radiation, cytotoxic chemotherapy, anti-graftrejection medication, corticosteroids, monoclonal antibodies directed against a specific component of the immune system]). The type of infections for which an immunocompromised patient has increased susceptibility is determined by the severity of immunosuppression and the specific component(s) of the immune system that is affected. Patients undergoing allogeneic HSCT and those with chronic graft versus host disease are considered the most vulnerable to HAIs. Immunocompromised states also make it more difficult to diagnose certain infections (e.g., tuberculosis) and are associated with more severe clinical disease states than persons with the same infection and a normal immune system.

**Incontinence:** The loss of bladder (urine) or bowel (stool, feces) control.

**Infection:** The transmission of microorganisms into a host after evading or overcoming defense mechanisms, resulting in the organism's proliferation and
invasion within host tissue(s). Host responses to infection may include clinical symptoms or may be subclinical, with manifestations of disease mediated by direct organisms pathogenesis and/or a function of cell-mediated or antibody responses that result in the destruction of host tissues.

**Infection control and prevention professional (ICP):** A person whose primary training is in either nursing, medical technology, microbiology, or epidemiology and who has acquired special training in infection control. Responsibilities may include collection, analysis, and feedback of infection data and trends to healthcare providers; consultation on infection risk assessment, prevention and control strategies; performance of education and training activities; implementation of evidence-based infection control practices or those mandated by regulatory and licensing agencies; application of epidemiologic principles to improve patient outcomes; participation in planning renovation and construction projects (e.g., to ensure appropriate containment of construction dust); evaluation of new products or procedures on patient outcomes; oversight of employee health services related to infection prevention; implementation of preparedness plans; communication within the healthcare setting, with local and state health departments, and with the community at large concerning infection control issues; and participation in research. Certification in infection control (CIC) is available through the Certification Board of Infection Control and Epidemiology.

**Infection control and prevention program:** A multidisciplinary program that includes a group of activities to ensure that recommended practices for the prevention of healthcare-associated infections are implemented and followed by HCWs, making the healthcare setting safe from infection for patients and healthcare personnel. The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) requires the following five components of an infection control program for accreditation: 1) surveillance: monitoring patients and healthcare personnel for acquisition of infection and/or colonization; 2) investigation: identification and analysis of infection problems or undesirable trends; 3) prevention: implementation of measures to prevent transmission of infectious agents and to reduce risks for device- and procedure-related infections; 4) control: evaluation and management of outbreaks; and 5) reporting: provision of information to external agencies as required by state and federal law and regulation (www.jcaho.org). The infection control program staff has the ultimate
authority to determine infection control policies for a healthcare organization with the approval of the organization's governing body.

**Inflammation phase:** debris and bacteria are phagocytosed and removed, and during this phase factors are released that cause the migration and division of cells. Phagocytosis is a three stage process in which neutrophils, monocytes and macrophages engulf and destroy microorganisms, other foreign antigens, and cell debris.

**Keratinocytes:** Are the main skin cell that we see. These cells begin where the epidermis and the dermis meet. As they mature they rise to the surface of the skin and are eventually shed. Keratinocytes are any of the cells that synthesize keratin, which is a durable protein polymer only found in the epithelial cells. These cells provide structural strength to skin, hair and nails. This fibrous protein maybe either hard or soft to touch. The epidermis has no blood supply, so it receives its nutrition from the underlying dermis.

**Langerhan cells:** are created in the bone marrow and migrate to the surface of the skin to help fight infection. Langerhan cells are the structural origination of the fibrous tissue of the skin and form natural cleavage lines that are present throughout the body. An example of this would be the creases of the palm. These creases in surgery are used to guide the surgeon’s decision on where to cut and allowing them to make smaller parallel incisions. These scars could be much smaller when healing, over those that are made at right angles to those lines.

**Lensectomy:** Removal of the lens in the eye when it is cloudy (cataract) or if it is attached to scar tissue.

**Lymphatic:** is a system that includes all lymph vessels that collect tissue fluid and return it to the blood.

**Long-term care facilities (LTCFs):** An array of residential and outpatient facilities designed to meet the bio-psychosocial needs of persons with sustained self-care deficits. These include skilled nursing facilities, chronic disease hospitals, nursing homes, foster and group homes, institutions for the developmentally disabled, residential care facilities, assisted living facilities, retirement homes, adult day health care facilities, rehabilitation centers, and long-term psychiatric hospitals.
**Macular holes:** The normal shrinking of the vitreous with aging can occasionally tear the central retina causing a macular hole with a blind spot blocking sight.

**Macular pucker:** Formation of a patch of unhealthy tissue in the central retina (the macula) distorting vision. Also called epiretinal membrane. After vitrectomy to remove the vitreous gel, membranectomy is undertaken to peel away the tissue.

**Mask:** A term that applies collectively to items used to cover the nose and mouth and includes both procedure masks and surgical masks (www.fda.gov/cdrh/ode/guidance/094.html#4).

**Medical device labeling:** A term defined in the FDA Medical Device Regulations, 21 CFR 801, which includes all of the information required to appear in the device labeling including the intended use. Labeling for example is a user’s manual, is required to supply adequate directions

**Melanocytes:** contain the pigment and provide coloration to the skin and are responsible for absorbing radiation and protecting against the damage of ultraviolet radiation. They are found in the epidermis of the skin.

**Membranectomy:** Removal of layers of unhealthy tissue from the retina with minute instruments such as forceps (tiny grasping tools), picks (miniature hooks), and visco–discection (separating layers or tissue with jets of fluid.)

**Merkel cells:** are specialized skin cells that help with sensing light touch. These cells are located on the tips of fingers and toes, but are in other specialized area as well.

**Multidrug-resistant organisms (MDROs):** In general, bacteria that are resistant to one or more classes of antimicrobial agents and usually are resistant to all but one or two commercially available antimicrobial agents (e.g., MRSA, VRE, extended spectrum beta-lactamase [ESBL]-producing or intrinsically resistant gram-negative bacilli) 176.

**Necrotic tissue:** is non-viable tissue, where there is no blood supply and the tissue has died. This tissue will begin to slough; it might be yellow, green or grey in color. There could be Escher present and may present as black, brown or grey. This is usually darker and thicker. This area might even have the feel of being harder.
**Nerve endings:** are the termination of a nerve fiber (axon or dendrite) in a peripheral (away from the center of the body) structure.

**Nosocomial infection:** A term that is derived from two Greek words "nosos" (disease) and "komeion" (to take care of) and refers to any infection that develops during or as a result of an admission to an acute care facility (hospital) and was not incubating at the time of admission.

**Papillary dermis:** is a thin layer of tissue just beneath the epidermis and contains capillary blood vessels and a few elastic and collagen fibers.

**Personal protective equipment (PPE):** A variety of barriers used alone or in combination to protect mucous membranes, skin, and clothing from contact with infectious agents. PPE includes gloves, masks, respirators, goggles, face shields, and gowns.

**Plume:** Gases, vapors and aerosol created by vaporization of tissue or other materials and may contain viable bacteria, viruses, cellular debris or noxious fumes.

**Policies and procedures (P&P’s):** Written policies and procedures that list administrative and procedural control safety measures.

**Pressure ulcer:** Also called a bed sore, pressure sore or decubitus ulcer. A pressure ulcer is usually caused by unrelieved pressure on a bony part of the body and often occurs in people who are in beds, wheelchairs or chairs for long periods of time.

**Primary dressing:** The layer of the dressing that touches the base or bottom of the wound.

**Procedure Mask:** A covering for the nose and mouth that is intended for use in general patient care situations. These masks generally attach to the face with ear loops rather than ties or elastic. Unlike surgical masks, procedure masks are not regulated by the Food and Drug Administration.

**Proliferative diabetic retinopathy:** Involves the development of new blood vessels on the retina because of the metabolic changes produces by diabetes. The proliferation of blood vessels is thought to be caused by hypoxic retinal pigment cells that produce a neovascular growth factor that stimulates vessel growth.
These vessels lead to retinal and vitreal hemorrhage, retinal traction, and detachment.

**Proliferative phase:** Begins, while the inflammation phase is occurring. This phase is characterized by angiogenesis (the development of blood vessels) from vascular endothelial cells. Fibroblasts from and form a new, provisional extracellular matrix (ECM) by excreting collagen and fibronectin. Concurrently, re-epithelialization of the epidermis occurs, in which the epithelial cells proliferate and “crawl” atop the wound bed, providing cover for the new tissue.

**Protective Environment:** A specialized patient-care area, usually in a hospital, that has a positive air flow relative to the corridor (i.e., air flows from the room to the outside adjacent space). The combination of high-efficiency particulate air (HEPA) filtration, high numbers (>12) of air changes per hour (ACH), and minimal leakage of air into the room creates an environment that can safely accommodate patients with a severely compromised immune system (e.g., those who have received allogeneic hemopoietic stem-cell transplant [HSCT]) and decrease the risk of exposure to spores produced by environmental fungi. Other components include use of scrubbable surfaces instead of materials such as upholstery or carpeting, cleaning to prevent dust accumulation, and prohibition of fresh flowers or potted plants.

**Quasi-experimental studies:** Studies to evaluate interventions but do not use randomization as part of the study design. These studies are also referred to as nonrandomized, pre-post-intervention study designs. These studies aim to demonstrate causality between an intervention and an outcome but cannot achieve the level of confidence concerning attributable benefit obtained through a randomized, controlled trial. In hospitals and public health settings, randomized control trials often cannot be implemented due to ethical, practical and urgency reasons; therefore, quasi-experimental design studies are used commonly. However, even if an intervention appears to be effective statistically, the question can be raised as to the possibility of alternative explanations for the result. Such study design is used when it is not logistically feasible or ethically possible to conduct a randomized, controlled trial, (e.g., during outbreaks). Within the classification of quasi-experimental study designs, there is a hierarchy of design features that may contribute to validity of results (Harris et al. CID 2004:38: 1586).
**Remodeling phase:** collagen is remodeled and realigned along tension lines and cells that are no longer needed are removed by apoptosis.

**Residential care setting:** A facility in which people live, minimal medical care is delivered, and the psychosocial needs of the residents are provided for.

**Respirator:** A personal protective device worn by healthcare personnel to protect them from inhalation exposure to airborne infectious agents that are < 5 μm in size. These include infectious droplet nuclei from patients with M. tuberculosis, variola virus [smallpox], SARS-CoV), and dust particles that contain infectious particles, such as spores of environmental fungi (e.g., Aspergillus sp.). The CDC's National Institute for Occupational Safety and Health (NIOSH) certifies respirators used in healthcare settings (www.cdc.gov/niosh/topics/respirators/). The N95 disposable particulate, air purifying, respirator is the type used most commonly by healthcare personnel. Other respirators used include N-99 and N-100 particulate respirators, powered air-purifying respirators (PAPRS) with high efficiency filters; and non-powered full-facepiece elastomeric negative pressure respirators. A listing of NIOSH- approved respirators can be found at www.cdc.gov/niosh/npptl/respirators/disp_part/particlist.html. Respirators must be used in conjunction with a complete Respiratory Protection Program, as required by the Occupational Safety and Health Administration (OSHA), that includes fit testing, training, proper selection of respirators, medical clearance and respirator maintenance.

**Respiratory Hygiene/ Cough Etiquette:** A combination of measures designed to minimize the transmission of respiratory pathogens via droplet or airborne routes in healthcare settings. The components of Respiratory Hygiene/Cough Etiquette are 1) covering the mouth and nose during coughing and sneezing, 2) using tissues to contain respiratory secretions with prompt disposal into a no-touch receptacle, 3) offering a surgical mask to persons who are coughing to decrease contamination of the surrounding environment, and 4) turning the head away from others and maintaining spatial separation, ideally >3 feet, when coughing. These measures are targeted to all patients with symptoms of respiratory infection and their accompanying family members or friends beginning at the point of initial encounter with a healthcare setting (e.g., reception/triage in emergency departments, ambulatory clinics, healthcare provider offices) 126 (Srinivasin A
Reticular dermis: contains large bundles of collagen and elastic fibers that run parallel to the skin surface. The collagen and elastic fibers are responsible for helping the skin to resist injury from shearing or other types of trauma, and allow the skin to return to its resting state after being stretched or compressed. This is the layer where hair follicles, sweat glands and sebaceous glands are found.

Retinal detachment: A blinding condition where the lining of the eye peels loose and floats freely within the interior of the eye.

Safety culture/climate: The shared perceptions of workers and management regarding the expectations of safety in the work environment. A hospital safety climate includes the following six organizational components: 1) senior management support for safety programs; 2) absence of workplace barriers to safe work practices; 3) cleanliness and orderliness of the worksite; 4) minimal conflict and good communication among staff members; 5) frequent safety-related feedback/training by supervisors; and 6) availability of PPE and engineering controls.

Scleral buckling: Placement of a support positioned like a belt around the walls of the eyeball to maintain the retina in a proper, attached position.

Sebaceous glands: are oil secreting (sebum) holocrine glands of the skin, and can open into a hair follicle.

Secondary dressing: The outer layer of the dressing that provides support and protection from the outside environment, such as tape.

Service: The performance of those procedures or adjustments described in the manufacturer’s service instructions which may affect any aspect of the performance of the laser or laser system. These are usually performed by qualified technical personnel provided by the manufacturer or other service companies. Is does not include maintenance or operation.

Silicone oil injection: Filling of the eye with liquid silicone to hold the retina in place.
Skin: is the largest organ of the body. The skin protects us from infection (bacterial) and chemical invasions, radiation, extreme temperatures (hot and cold) and is the primary body system affected by pressure injuries. There are two later of skin that cover the body, the epidermis and the dermis.

Source Control: The process of containing an infectious agent either at the portal of exit from the body or within a confined space. The term is applied most frequently to containment of infectious agents transmitted by the respiratory route but could apply to other routes of transmission, (e.g., a draining wound, vesicular or bullous skin lesions). Respiratory Hygiene/Cough Etiquette that encourages individuals to "cover your cough" and/or wear a mask is a source control measure. The use of enclosing devices for local exhaust ventilation (e.g., booths for sputum induction or administration of aerosolized medication) is another example of source control.

Standard Precautions: A group of infection prevention practices that apply to all patients, regardless of suspected or confirmed diagnosis or presumed infection status. Standard Precautions is a combination and expansion of Universal Precautions 780 and Body Substance Isolation 1102. Standard Precautions is based on the principle that all blood, body fluids, secretions, excretions except sweat, non-intact skin, and mucous membranes may contain transmissible infectious agents. Standard Precautions includes hand hygiene, and depending on the anticipated exposure, use of gloves, gown, mask, eye protection, or face shield. Also, equipment or items in the patient environment likely to have been contaminated with infectious fluids must be handled in a manner to prevent transmission of infectious agents, (e.g. wear gloves for handling, contain heavily soiled equipment, properly clean and disinfect or sterilize reusable equipment before use on another patient).

Sterilization: is the process that eliminates or kills all forms of life, including transmissible agents. Sterilization removes and destroys all microorganisms from an object. These agents include fungi, bacteria, viruses, spore forms, parasites, etc. Sterilization can happen in many ways including heat - the most common form - and also chemical, irradiation, high pressure, and filtration. Sterilization definition
also includes disabling or destruction of infectious proteins such as prions related to Transmissible Spongiform Encephalopathies (TES).

**Surgical mask:** A device worn over the mouth and nose by operating room personnel during surgical procedures to protect both surgical patients and operating room personnel from transfer of microorganisms and body fluids. Surgical masks also are used to protect healthcare personnel from contact with large infectious droplets (>5 μm in size). According to draft guidance issued by the Food and Drug Administration on May 15, 2003, surgical masks are evaluated using standardized testing procedures for fluid resistance, bacterial filtration efficiency, differential pressure (air exchange), and flammability in order to mitigate the risks to health associated with the use of surgical masks. These specifications apply to any masks that are labeled surgical, laser, isolation, or dental or medical procedure (www.fda.gov/cdrh/ode/guidance/094.html#4). Surgical masks do not protect against inhalation of small particles or droplet nuclei and should not be confused with particulate respirators that are recommended for protection against selected airborne infectious agents, (e.g., *Mycobacterium tuberculosis*).

**Sweat glands (and ducts):** are simple coiled gland found on all body surfaces except margin of the lips, glans penis and inner surface of the prepuce. Sweat allows the skin to cool by evaporation.

**Vaporization:** A conversion of a solid or liquid into a vapor.

**Vitreous floaters:** Deposits of various size, shape and consistency, refractive index, and motility within the eye’s normally transparent vitreous humor which can obstruct vision. Here pars plana vitrectomy has been shown to relieve symptoms. Because of the possible side effects, it is used only in severe cases.

**Vitreous hemorrhage:** Bleeding in the eye from injuries, retinal tears, subarachnoidal bleedings (as Terson syndrome), or blocked blood vessels. Once blood is removed, Photocoagulation with a laser can shrink unhealthy blood vessels or seal retinal holes.
**Wound:** is considered to be a break in the continuity of body structures which is caused by injury, trauma, violence, tear, cut or puncture to the skin and / or underlying tissues, or surgery to tissues. It can also be a blunt force trauma that causes a contusion considered a closed wound. The pathology specifically refers to a sharp injury that damages the dermis of the skin.

**Wound care:** is any technique that enhances the healing of skin abrasions, blisters, cracks, craters, infections, lacerations, rupture injuries, punctures, penetrating wounds, necrosis, and/ or ulcers. Wound healing or cicatrization (healing by scar formation) is when the skin (or other organ tissues) can repair itself after an injury. Once an injury occurs to the skin or underlying tissues the healing process begins immediately.
References for Wound Care

About.com Dermatology

Alexander’s Care of the Patient in Surgery: 2011 Edition

WWW.AOLhealth.COM

WWW.AORN.com

AORN Journals

www.cdc.gov

www.eHow.com

www.emedicinehealth.com

http://endofliecare.tripod.com

http://.hpa.org.uk/infections/topics_az/esbl/default.htm

Http://inventors.about.com

www.jama.com

www.kci.com

Http://Library.thinkquest.org

www.medicaledu.com


Operating Room Technique Eleventh Edition Berry and Kohn’s

Random House Webster’s College Dictionary 1997

Taber’s Cyclopedic Medical Dictionary “21” 2005
Http://www.ucmp.berkeley.edu/bacteria/bacterialh.html

Http://Wikipedia.org

Wikipedia.org: Wound Care

WCIN: Wound Care Information Network www.medicaledu.com

References for Sterilization

www.aami.org/standards/

www.absoluteastronomy.com: Sushruta Samhita

Ask.com Encyclopedia

AORN Perioperative Nursing Clinics 2010

AORN online

A short history of the old trip of sterilization Irini Soulataitou: online

Autoclave testing services, Inc: online

www.CDC.com

www.ezinearticles.com

www.FDA.com

WWW.gallup.com

www.jewelprecision.com

The Merriam thesaurus and Webster Dictionary

www.nurses.com

www.osha.gov

www.remierinc.com
References for Aseptic Technique


Berry & Kohn’s Operating Room Technique, Nancymarie Phillips, 2007


