Diabetic Wound Care

Diabetes is a condition in which the body fails to utilize the ingested glucose properly. This could be due to lack of the hormone insulin, or because the insulin that is available is not working effectively. Diabetes is the fastest growing long-term disease that affects millions of people worldwide. 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 million undiagnosed people. The latest statistic from 2007 (indicated on death certificates) placed diabetes as the seventh leading cause of death in the United States. That year, the estimated cost direct and indirect for diabetes treatment was $174 billion dollars.

In 2010, about 1.9 million new cases of diabetes were diagnosed. Over the next 20 years, it is said that if this trend continues, 1 in 3 Americans will be diabetic by 2050. This means that on average one person in every family will have diabetes.

Diabete**s 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

When Type 1 DM occurs in children, these children are usually active and thin, 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.

Diagnosed and undiagnosed diabetes among people aged 20 years or older in the United States, 2010:

 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 of 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, it 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.

More than 60% of nontraumatic lower-limb amputations occur in people with diabetes.

Diabetic patients can experience nerve damage, circulation problems and infections that can cause serious foot problems. There are many things patients can do to prevent problems when dealing with a diabetics feet.

It is important to control blood glucose, quit smoking or using tobacco can help to protect the feet. Over half of diabetes related amputations can be prevented with regular exams and patient education.

Understanding why foot problems happen is important. Nerve damage can cause a patient to loose feeling in their feet. Sometimes nerve damage can deform or misshape a diabetic's foot or both feet, causing pressure points that can turn into blisters, sores, or ulcers, creating a wound. Poor circulation can make these injuries slow to heal.

Signs of foot problems:

Foot problems may start with loss of the ability to feel touch including sensing heat or cold to the foot. Feet may tingle, burn or hurt. Over time the shape of a diabetic foot may change. There could be changes in color and temperature of the feet. Patients with hair on their toes may lose the hair on the toes, which may also include the entire foot and lower leg. Feet may appear dry and cracked, and the toenails may become thick and turn yellow. Diabetics are susceptible to fungal

infections that can grow between the toes, blisters sores, ulcers, infected corns, and ingrown toenails.

It is important for diabetics to have their health care provider check their feet at least 4 times a year. Make sure they have the health care provider show them how to care for their feet. One important piece of education is to have the patient look at their feet every day, inspecting for scratches, cracks, cuts, blisters, sore or wound, these can get bad quickly. If a patient cannot bend over to inspect their feet, have the patient use a mirror. Make sure that a patient knows to wash their feet daily and taking care to dry them thoroughly, paying close attention to drying between the toes.

Educate the patient to put lotion or creams on the tops and bottoms of the feet, but never between the toes. This can allow germs to grow that can cause infection. Diabetics should trim their toenails after they have washed their feet, as this makes the nails softer and safer to cut. Health care providers should teach them to trim the nails following the natural curve of the toenail, however never cut into the corners of the nail bed. If the patient cannot safely cut their own nails, have them seek a professional.

Diabetics should always wear well-fitting shoes and cotton or wool socks to keep their feet dry. It is important to wear shoes at all times, never walk barefoot, not even indoors. Make sure to always look and feel inside each shoe every time before putting them on. Any loose object inside the shoe could cause an injury to the foot.

People with diabetes 60 or older are 2-3 times more likely to report an inability to walk one-quarter of a mile, climb stairs, or do housework compared with people without diabetes in the same age group.

Diabetes can cause serious complications leading to lower-limb amputations. Comprehensive foot care programs that include risk assessment, foot-care education and preventive therapy, treatment of foot problems, and referral to

specialists, can reduce amputation rates by 45% to 85%. More than 60% of nontraumatic lower-limb amputations occur in people with diabetes.

What happens when a patient develops a foot wound? Let us discuss the types of wounds and the healing process.

What is a wound, and how do wounds heal?

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:

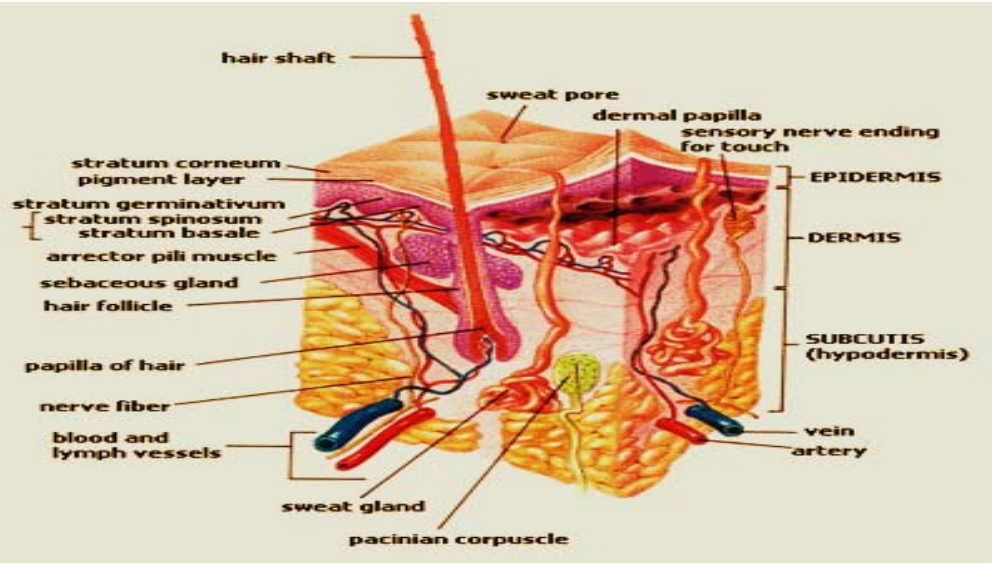
- The papillary dermis is a thin layer of tissue just beneath the epidermis, and contains capillary blood vessels and a few elastic and collagen fibers.
- The deeper reticular dermis contains large bundles of collagen and elastic fibers that run parallel to the skin surface. The collagen and elastic 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:

- Contusions: 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.
- Hematomas: 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 die 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 Classification**s**

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, PGH_2. 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 peeks about twenty minutes or so post wound trauma.

The main factor involved in causing vasodilation is histamine ($C_5H_9N_3$ 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 programed 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 the end of the inflammatory phase.

The inflamatory 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 to 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 peeks 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 II 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

This chart gives an overview of the involvement of growth factors in wound healing:

Growth Factor	Abbreviation	Main Origins	Effects
Epidermal growth factor	EGF	Activated macrophages Salivary Glands Keratinocytes	Keratinocyte & Fibroblast mitogen Keratinocyte migration Granulation tissue formation
Transforming growth factor-α	TFG-α	Activated macrophages T-lymphocytes Keratinocytes	Hepatocyte & epithelial cell proliferation Expression of antimicrobial peptides Expression of chemotactic cytokines
Hepatocyte growth factor	HGF	Mesenchymal cells	Epithelial & endothelial cell proliferation Hepatocyte motility
Vascular endothelial G.F.	VEGF	Mesenchymal cells	Vascular permeability Endothelial cell proliferation
Platelet deprived growth Factor	PDGF	Platelets Macrophages Endothelial cells	Granulocyte, macrophages, fibroblast & smooth muscle cell chemotaxis Granulocyte, macrophage & fibroblast

		Smooth muscle cells Keratinocytes	activation Fibroblast, endothelial cell & smooth muscle cell proliferation Matrix metalloproteinase, fibronectin & hyaluronan production Angiogenesis Wound remodeling Integrin expression regulation
Fibroblast growth factor 1 and 2	FGF-1,-2	Macrophages Mast cells T-lymphocytes Endothelial cells Fibroblasts	Fibroblast chemotaxis Fibroblast & keratinocyte proliferation Keratinocyte migration Angiogenesis Wound contraction Matrix (collagen fibers) deposition
Transforming growth factor-β	TGF-β	Platelets T-lymphocytes Macrophages Endothelial Cells Keratinocytes Smooth muscle cells Fibroblasts	Granulocyte, macrophage, lymphocyte, fibroblast, & smooth muscle cell chemotaxis TIMP synthesis Angiogenesis Fibroplasia Matrix metalloproteinase production inhibition Keratinocyte proliferation
Keratinocyte growth factor	KGF	Keratinocyte	Keratinocyte migration, proliferation & differentiation

*Growth Factor (G.F.) Chart 1 of 6:

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.
3 Exuberant Granulation (Proud Flesh).
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 Clean	Operative wound clean Non-traumatic No inflammation encountered No break in surgical technique No entry into respiratory, alimentary, genitourinary, oropharyngeal tracts	Examples: Vascular procedures Orthopedic surgeries Eye Surgeries
Class II Clean Contaminated	Operative wound clean-contaminated Non-traumatic wound with minor break in technique, Gastrointestinal surgery (without spillage): □ Appendectomy, Gallbladder, biliary tracts without infected bile Respiratory (ENT) surgery: □ Tonsillectomy, Sinus Surgery Genitourinary Surgery: □ Urology surgeries, Vagina entered Alimentary surgery: □ The digestive system Fractures	Thoracic procedures (except mediastinoscopy I, Inflammation / foreign body III, Infected IV) GI procedures GYN procedures
Class III Contaminated	Major break in technique (rips in gloves with puncture of the skin, Persistent coughing and sneezing in to the mask) Gross spillage from the gastrointestinal tract Traumatic wound, fresh Entrance of the genitourinary in presence of infected urine	Foreign bodies in a wound (bullet, etc….)

	Entrance of the Biliary tracts in presence of infected bile Pins present that pierce skin (like external-fixators for removal)	
Class IV Dirty and infected Chart 2 of 6:	Acute bacterial infection and inflammation encountered, without pus Puss is always a IV Transection of “clean” tissue for the purpose of surgical access to a collection of pus Perforated viscus (any internal organ enclosed within a cavity such as abdomen) encountered Traumatic wound with retained devitalized tissue, foreign bodies, fecal contamination and / or delayed treatment from a dirty source	Incision and drainage of an infected wound Incision and drainage of an abscess

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
- ✌■♏

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-  V /
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

Stag**e** 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

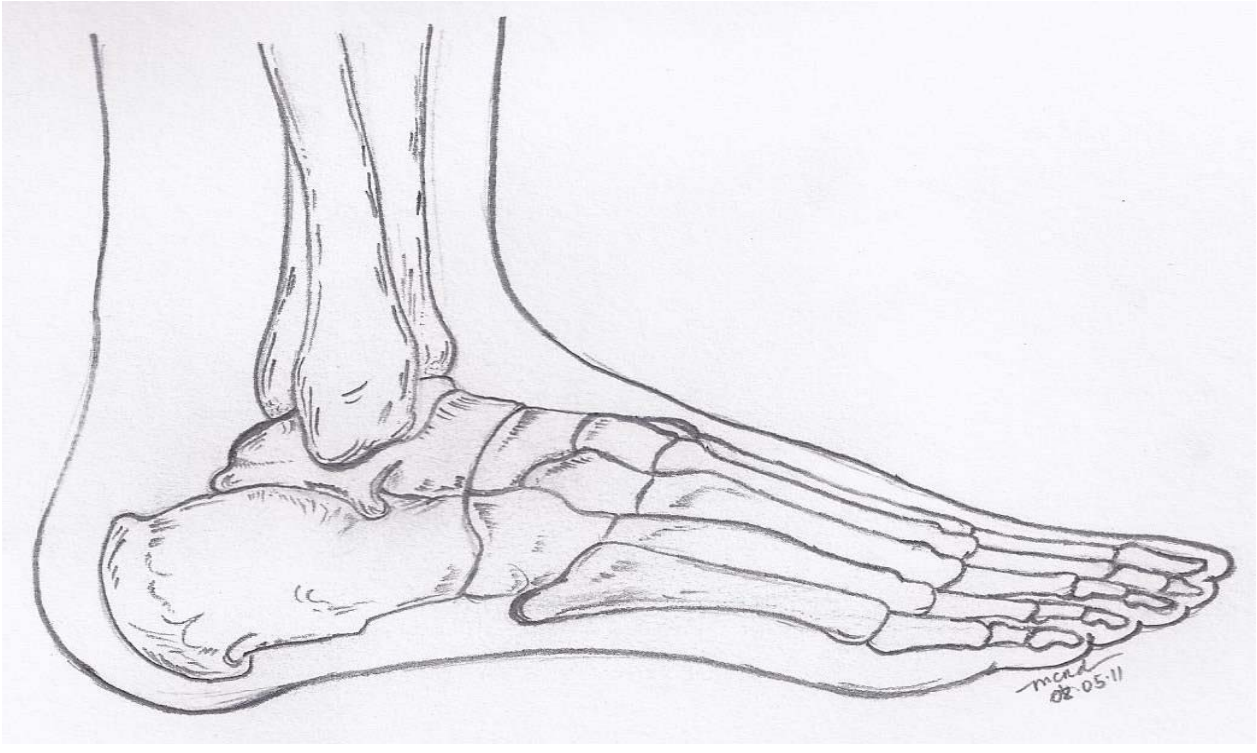
Unstageable: Full thickness tissue loss in which the base of the ulcer is covered by slough (yellow, tan, gray, green, or brown) and / or eschar (tan, brown, or black) in the wound bed. Until enough slough or eschar is removed to expose the base of the wound, the true depth, and therefore staging may 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.

Ulcer Documentation: After assessing a wound, proper documentation is necessary for medical, legal and reimbursement reasons. A photograph of the wound is the most reliable documentation. Nurses charting should include the following information:

- Patient's name and date of wound assessment.
- Vital signs: Temperature, pulse, respirations, blood pressure.
- If there was a dressing present was it intact. Was the dressing wet, dry, loose, clean or dirty.
- Strikethrough: Was there any drainage on the outside of the dressing material.

- Location of wound: Where wound is located and is it left or right, medial or lateral, anterior or posterior be as clear as possible of location.
- Size: Length, width and depth measure in centimeters. Change gloves and instruments if the patient has multiple wounds, DO NOT CROSS CONTAMINATE WOUNDS.
- Tracking: Defined as skin overhanging a dead space
- Undermining: Look for skin overhangs the wound's edges
- Drainage: Is there drainage on the contact layers of the dressing? What does it look like (serous, purulent, bloody, green, yellow, clear, thick, etc.) Is the drainage a breakdown of the wound dressing (like a hydrocolloid) or actual drainage from the wound? Yellow could indicate staphylococcus involvement. Green drainage could indicate pseudomonas involvement. Estimate the amount of drainage present.
- Odor: Is there any odor from the wound? What does it smell like? Fruity smell could indicate staphylococcus organisms.
- Necrotic tissue: What percentage of the wound appears to be necrotic tissue.
- Infection: Is the wound red (or streaking redness), hot swollen? Is there soreness out of proportion to what should be present given the medical history?
- Stage pressure ulcers: Use the facilities staging chart to set the stage and then do not reverse the stage of a healing ulcer.
- Classify non pressure ulcers: It is best to use the Wagner classification for foot ulcers if your facility does not have a process in place.
- Past treatment: not the past treatments and any changes in products used.
- Current treatment: Document the type of irrigation, products and secondary dressings used during the dressing change.
- Follow up: Contact the appropriate doctor, nurse, therapist or other health care professional to discuss any findings, especially if there is deterioration.
- Signature at the bottom of the note.

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).

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 to 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.

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
- ☞❒♓♍&●♓■g sensations (paresthesia)

- 👌◆❒■♓■g 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, CO_2 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.

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.

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.	**Factors Further Increasing Risk** Peripheral Vascular Disease, impaired circulation, Vasoconstriction drugs, braces or stabilizing equipment, diabetes, CHF, COPD, history of ulcers, preterm neonates, obesity/thin **30>BMI<19 Critical** labs: pre albumin (reflects visceral protein stores) mild depletion = 10-15, moderate depletion = 5-10, Severe depletion = <5.

Braden Category	Braden Score: 1	Braden Score: 2	Braden Score: 3	Braden Score: 4	Score
Sensory Perception: Ability to respond meaningfully to pressure related discomfort.	**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**	**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.**	**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.**	**No limitation: Responds to verbal commands. Has no sensory deficit, which would Limit ability to feel or voice pain or Discomfort.**	
Moister: Degree to which skin is exposed to moisture.	**Constantly Moist: Skin is kept moist almost constantly by perspiration, urine, etc. Dampness is detected every time patient is moved or turned**	**Moist: Skin is often but not always moist. Linen must be changed at least once a shift.**	**Occasionally Moist: Skin is occasionally moist, requiring an extra linen change approximately one a day.**	**Rarely Moist: Skin is usually dry: linen requires Changing only at routine intervals.**	
Activity: Degree of Physical activity.	**Bedfast Confined to bed.**	**Chair Fast: Ability to walk severely limited or nonexistent. Cannot bear own weight and/or must be assisted into chair or wheelchair.**	**Walks Occasionally: During the day but for very short distances, with or without assistance. Spends majority of each shift in bed or chair.**	**Walks Frequently: Walks outside the room at least twice A day and inside the room at least once Every 2 hours during waking hours.**	
Mobility: Ability to change and control body position.	**Completely Immobile: Does not make even slight changes in body or extremity position without assistance.**	**Very Limited: Makes occasional slight changes in body or extremity position but unable to make frequent or significant change independently.**	**Slightly Limited: Makes frequent though slight changes in body or extremity position independently.**	**No Limitations: Makes major and frequent changes in Position without assistance**	
Nutrition: Usual food Intake pattern.	**Very Poor: Never eats a complete meal. Rarely eats more that ⅓ 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.**	**Probably Inadequate: Rarely eats a complete meal. Generally eats only about ⅓ 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.**	**Adequate: Eats over ½ 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.**	**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.**	
Friction and Shear	**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.**	**Potential Problem: Moves feebly 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.**	**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.**		**Total:**

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.	**Factors Further Increasing Risk** Peripheral Vascular Disease, impaired circulation, Vasoconstriction drugs, braces or stabilizing equipment, diabetes, CHF, COPD, history of ulcers, preterm neonates, obesity/thin **30>BMI<19 Critical** labs: pre albumin (reflects visceral protein stores) mild depletion = 10-15, moderate depletion = 5-10, Severe depletion = <5.

Braden Category	Braden Score: 1	Braden Score: 2	Braden Score: 3	Braden Score: 4	Score
Sensory Perception: Ability to respond meaningfully to pressure related discomfort.	**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**	**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.**	**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.**	**No limitation: Responds to verbal commands. Has no sensory deficit, which would Limit ability to feel or voice pain or Discomfort.**	
Moister: Degree to which skin is exposed to moisture.	**Constantly Moist: Skin is kept moist almost constantly by perspiration, urine, etc. Dampness is detected every time patient is moved or turned**	**Moist: Skin is often but not always moist. Linen must be changed at least once a shift.**	**Occasionally Moist: Skin is occasionally moist, requiring an extra linen change approximately one a day.**	**Rarely Moist: Skin is usually dry: linen requires Changing only at routine intervals.**	
Activity: Degree of Physical activity.	**Bedfast Confined to bed.**	**Chair Fast: Ability to walk severely limited or nonexistent. Cannot bear own weight and/or must be assisted into chair or wheelchair.**	**Walks Occasionally: During the day but for very short distances, with or without assistance. Spends majority of each shift in bed or chair.**	**Walks Frequently: Walks outside the room at least twice A day and inside the room at least once Every 2 hours during waking hours.**	
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Nutrition: Usual food Intake pattern.	**Very Poor: Never eats a complete meal. Rarely eats more that ⅓ 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.**	**Probably Inadequate: Rarely eats a complete meal. Generally eats only about ⅓ 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.**	**Adequate: Eats over ½ 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.**	**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.**	
Friction and Shear	**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.**	**Potential Problem: Moves feebly 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.**	**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.**		**Total:**

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).
    - Grade 4: Gangrene of the forefoot
    - 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 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.

Lower extremity amputations are performed to remove infected, necrotic, ischemic tissue or locally unrespectable tumor, and at times is a life-saving procedure. Factors that predict the need for lower extremity amputation in patients with extremity ischemia include tissue loss, end stage renal disease, poor functional status and diabetes mellitus. Amputees with diabetes are more likely to be severely disabled, to experience their initial amputation at a younger age, progress to higher-level amputations, and die at a younger age compared with patients without diabetes.

Amputation performed without an attempt at limb salvage (eg, revascularization, bony repair, soft tissue coverage) is termed primary amputation, whereas amputation following a failed attempt at revascularization is termed secondary amputation. Traumatic amputation refers to a limb loss that occurs in the field at the time of injury.

Most indications for amputation are elective and should be preceded by perioperative evaluation and preparation of the patient with includes evaluation of medical risk, nutrition assessment, prosthetic and rehabilitation consultation and potentially psychological consultation.

In patients with a grossly infected extremity that cannot be brought under control by aggressive surgical drainage, debridement and antibiotics (with or without

systemic sepsis), or those with an unsalvageable mangled extremity, amputation is an emergent or urgent procedure that should proceed without delay.

Major amputations (below-knee amputation and higher) carry a significant risk of perioperative morbidity and mortality, particularly in patients with vascular disease. Identification of medical risk factors and appropriate pre-and postoperative care may decrease the rate of perioperative complications.

Lower extremity amputation is often associated with open, infected wounds. Surgical wounds are classified as contaminated (dirty) and associated with a higher risk for surgical site infection, thus antibiotics may be used as prophylaxis for prevention of surgical site infection. Antibiotic prophylaxis is recommended for all patients within one hour of the skin incision for lower extremity amputation.

Antibiotics are continued in the postoperative period in patients undergoing staged amputation for infection or gangrene. Broad spectrum antibiotics are selected in accordance with the local antibiogram and adjusted in response to wound culture and sensitivities.

Thromoprophylaxis is administered prior to amputation depending upon individual patient risk, amputation level and expected level of activity following amputation. Patients undergoing major lower extremity amputation are at high risk form thromboembolism due to the nature of the surgery. Patients undergoing amputation at the transmetatarsal level will have weight-bearing restrictions and will be immobilized postoperatively.

Amputation Techniques:

Above-knee amputation (AKA) in a major amputation and may include hip disarticulation or knee disarticulation amputation or above.

Below-knee amputation (BKA) is an amputation below the knee or the ankle and above.

There are various foot amputations including digit amputations, transmetatarsal amputations including mid and hindfoot.

Postoperative care of an amputation requires multidisciplinary cooperation, pain care services, rehabilitation medicine, physical therapy and psychiatry services each contribute to the patient's recovery.

Following amputation, the incision should be examined daily for signs of infection (erythema, excess warmth, wound drainage) particularly in patients with unexplained fever or excessive stump pain. Drains are left in place until volume in the drain reservoir is minimal, then the drain can be removed.

Stump pain can be acute following an amputation and gradually subsides over one to three weeks. Optimal management of preoperative and postoperative pain in patients undergoing amputation may be important for reducing the risk of phantom limb pain. Depression may complicate the treatment of pain in many amputees. Chronic pain to some degree is reported by up to 95 percent of amputees. Persistent pain may be a sign of stump ischemia, neuroma formation, infection, or a manifestation of phantom limb syndrome.

- Ischemic stump pain may be difficult to detect by physical examination alone but can be confirmed by transcutaneous oxygen tension less than 20 mmHg at the level of the stump.
- Neuroma can develop at the site of transaction of any peripheral nerve. The pain is usually well-localized to the site of injury and can be transiently blocked by anesthetic injection. The dominant theory for the cause of phantom limbs is the irritation of nerve endings called neuromas. Many nerve endings are terminated where the limb is amputated, and becomes inflamed sending anomalous signals to the brain.
- Pressure points that develop over bone spurs or pathologic bone formation can also be a source of localized pain and can be identified by a plain radiograph of the stump.

 Infection (osteomyelitis, residual graft infection) can also be a source of chronic postoperative pain. Phantom limb syndrome is a diagnosis of exclusion after the causes of stump pain listed above have all been eliminated.

The need for re-amputation remains high depending of the level of amputation the patient required. Postoperative bleeding may also require another surgery in 3 to 9 percent of amputees.

Phantom limb is the sensation that an amputated or missing limb (even an organ) is moving appropriately with other body parts. Phantom sensations in their amputated limb and the majority of sensations are painful. Phantom pain can be agonizing for some people. The shortening of the stump is sometimes performed in hopes that this will remove inflamed nerve endings relieving phantom pain. It however has been reported that in some cases the pain has actually increased. In the most severe cases surgeons have even cut the sensory nerves leading into the spinal cord, or even removed the part of the thalamus that receives sensory signals from the body.

Phantom sensations make the missing limb feel shorter and may feel as if it is a distorted or painful position. Occasionally, the pain can be made worse by stress, anxiety, and weather changes. Phantom limb pain is usually intermittent. The frequency and intensity of attacks usually declines with time.

Although not all phantom limbs are painful, patients will sometimes feel as if they are gesturing, feel itches, twitch or even try to pick things up. Some patients may experience as if their limb is cold, warm or a tightness even tingling. Some amputees their limbs do not feel like they match. An example is a patient reported her phantom arm felt 6” inches shorter instead of being gone.

In 2012 V.S. Ramachandran and Paul Mcgeoch reported a case of a 57-year-old R.N., who was born with a deformity of the right hand consisting of only three fingers and a rudimentary thumb. After a car crash at the age of 18, the woman’s

deformed hand was amputated, which gave her phantom hand. The phantom hand was experience, however with all five fingers. 35 years after her accident, the woman was referred for treatment for her phantom hand because of the phantom pain had become unbearable. Ranachandran and Mcgeoch trained the R.N. using a mirror box for 30 minutes a day, in which the reflection of her healthy left-hand was seen as a superimposed onto where she felt her phantom right hand to be. After two weeks she was able to move her phantom fingers and was relieved of pain. Crucially, she also experienced that all five of her phantom fingers were now normal length. Ranachandran and Mcgeonch stated that this case provides evidence that the brain has an innate (hard-wired) template of a fully formed hand.

Treatments in patients with phantom limb pain have not shown improvement over the last two decades. Treatments range from antidepressants, analgesics, spinal cord stimulation, vibration therapy, acupuncture, hypnosis and biofeedback. The mirror box approach has gained a great deal of public attention from its successes. This has led to long-term improvement.

Mortality in the immediate postoperative period is related to the indication for the amputation and associated medical comorbidities. The most common causes of death following amputation for peripheral artery disease are cardiac complication, sepsis, and pneumonia. Another important cause of mortality following amputation is thromboembolism from deep vein thrombosis.

Wound Va**c** Therap**y** o**r** Negativ**e** pressur**e** woun**d** 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.

Application and use of the wound vac system can only be used with a physician’s order. Frequency of dressing changes is to be specified in the physician order.

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 is a 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:

- Provide privacy to the patient. Continually provide patient reassurance as needed throughout the procedure. Position the patient prior to dressing
- change and back into a comfortable and safe position after the procedure.

- Perform hand hygiene and apply gloves.
- 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. Count and document the exact number of foam or gauze pieces removed including contact layer if used.
- 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:

Wound Description	Polyurethane foam	PVA (soft foam)	Both	Either
Deep, acute wounds with moderate granulation tissue growth	X		X	
Deep wounds with extremely rapid growth in granulation tissue				
Deep pressure ulcers	X			
Superficial wounds				X
Post graft therapy		X		
Fresh grafts	X			
Compromised flaps	X			
Tunneling/sinus tracts/undermining				X
Diabetic ulcers		X		
Dry wounds	X		X	
Deep trauma wounds				X
Superficial trauma wounds				
*Consult treating physician for individual patient conditions and treatment protocols. Consult device user manual and recommended guidelines for details before use.				

Chart 9 of 9

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. Document the exact number of foam or gauze pieces inserted into the wound including contact layer if used.

Managing wounds with tunneled areas may need special consideration. In a tunnel that is wide enough, clinician can fill with the Renasys-gauze using the following technique:

1. Unfold the moistened gauze to a single layer.
2. Pinch a section in the center and loosely twist to create a wick.
3. Insert this wick to base of the tunnel and then pull about 1 cm to allow for healing from the base of the tunnel.
4. Continue filling the rest of the wound bed with this same piece of gauze.

5. For very narrow tunnels the nurse can use a woven gauze strip or ribbon type of dressing for the wick. NOTE: in this case, caution should be taken to ensure that there is an adequate length of the ribbon material is visible in the wound bed to ensure removal from the tunnel during the dressing changes. Recommend using enough ribbon to allow looping excess ribbon over the cover dressing.

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.

Wound Type	**Rationale for use**	**Initial Cycle**	**Subsequent Cycles**	**Target Pressure Polyurethane**	**Target Pressure Polyvinyl -alcohol**	**Dressing Change Interval**
Acute/traumatic wound	Edema removal, wound contraction, granulation growth, protection from outside contaminants	Continuous for first 48 hours	Intermittent (5 min on/ 2 min off) for duration of therapy	125 mm Hg	125 – 175 mm Hg	Every 48 hours (every 12 hours with untreated infection)
Surgical wound dehiscence	Edema removal, wound contraction, granulation growth, protection from outside contaminants	Continuous for first 48 hours	Intermittent (5 min on/ 2 min off) for duration of therapy	125 mm Hg	125 – 175 mm Hg	Every 48 hours (every 12 hours with untreated infection
Meshed Graft	Edema removal, adhere graft to wound bed, protect against shearing forces	Continuous	Continuous for duration of therapy	75 – 125 mm Hg	125 mm Hg; titrate up for more drainage	None; remove dressing after 3 – 5 days when using either type of foam
Pressure ulcer	Granulation tissue growth, Edema removal, wound contraction, protect against shearing forces	Continuous	Intermittent (5 min on/ 2 min off) for duration of therapy	125 mm Hg	125 – 175 mm Hg titrate up for more drainage	Every 48 hours (every 12 hours with untreated infection
Chronic ulcer (diabetic / arterial vascular	Edema removal, Granulation tissue growth, enhance epithelial cell migration, provide moist wound healing, protection from outside	Continuous	Continuous for duration of therapy	50 – 75 mm Hg	125 – 175 mm Hg titrate up for more drainage	Every 48 hours (every 12 hours with untreated infection

	contaminants					
Fresh Flap	Surgical / wound drainage removal underneath sutures, promotes flap adherence to wound base, helps immobilize flap, protects from contaminants	Continuous	Continuous for duration of therapy	125 mm Hg	125 – 175 mm Hg titrate up for more drainage	Every 72 hours (every 12 hours with untreated infection
Compromised flap	Edema removal, Granulation tissue growth, adherence of flap	Continuous	Continuous for duration of therapy	125 mm Hg	125 – 175 mm Hg titrate up for more drainage	Every 48 hours (every 12 hours with untreated infection

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. Provide the patient privacy. 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. Pain is a very subjective experience and will vary with each patient. Research has validated that patients experience less pain with gauze.

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 periwound 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.

Ergonomics is always important for the care provider to protect themselves against injury. Always avoid awkward positions or postures including twisting during dressing changes. Maintain good body mechanics during any dressing changes. If dealing with a patient who is hard to move use appropriate lift equipment or positioning devise. Always ask for help and wait for the help to arrive before positioning a patient.

Make sure to wear PPE since there will be bodily fluid exposure. This would include gloves, gowns, eye protection and masks.

Thank you so much for using Cutting Edge for your CE's. Don't forget to use the split screen available for having the PDF open while taking the exam. This will make taking the exam a lot easier. Please take our course survey. This will help guide us on our future courses. Make sure to tell your friends and co-workers about our courses. **Sincerely, Cutting Edge**

Wound Care Glossary

A1C: A test that sums up how much glucose has been sticking to part of the hemoglobin during the past three to four months. Hemoglobin is a substance is the red blood cells that supplies oxygen to the cells of the body. The A1C goal for patients in general is less than 7% and as close to 6% as possible without a considerable amount of low blood glucose.

ACE inhibitor: A type of drug used to lower blood pressure. Studies indicate that it may also help prevent or slow the progression of kidney disease in people with diabetes. ACE is an acronym for angiotensin-converting enzyme.

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.

Americ**a**n Institut**e** o**f** Architect**s** (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.

Autoimmune process: A process where the body's immune system attacks and destroys body tissue that it mistakes for foreign matter.

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.

Beta cells: Cells that make insulin. Beta cells are found in areas of the pancreas called Islets of Langerhans.

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.

Bladder: A hollow organ that urine drains into from the kidneys.

Blood glucose: The main sugar that the body makes from the food we eat. Glucose is carried through the bloodstream to provide energy to all of the body's living cells. The cells cannot use glucose without the help of insulin.

Blood pressure: The force of the blood against the artery walls. Two levels of blood pressure are measured: the highest, or systolic, occurs when the heart pumps blood into the blood vessels, and the lowest, or diastolic, occurs when the heart rests.

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".

Calluses: Thick, hardened areas of skin, generally on the foot, caused by friction or pressure. Calluses can lead to other problems, including serious infection and even gangrene.

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

Carbohydrates: One of three main groups of foods in the diet that provide calories and energy. The other two are proteins and fats. Carbohydrates are mainly sugars (simple carbohydrates) and starches (complex carbohydrates, found in bread, pasta and beans) that the body breaks down into glucose.

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.

Cholesterol: A substance similar to fat that is found in the blood, muscles, liver, brain, and other body tissues. The body produces and needs some cholesterol. However, too much cholesterol can make fats stick to the walls of the arteries and cause a disease that decreases or stops circulation.

Chronic kidney disease (CKD): The body retains fluids and harmful wastes as well as the kidneys, because the kidneys no longer work properly.

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.

Corns: A thickening of the skin of the feet or hands, usually caused by pressure against the skin.

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.

Dehydration: the loss of too much body fluid though frequent urinating, sweating, diarrhea, or vomiting.

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.

Diabetes: The short name for the disease called diabetes mellitus. Diabetes results when the body cannot use blood glucose as energy because of having too little insulin or being unable to use insulin. There are two types of diabetes type I and type 2.

Diabetes pills: Pills or capsules that are taken by mouth to help lower the blood glucose level. These pills may work for people whose bodies are still making insulin.

Diabetic ketoacidosis: High blood glucose with the presence of ketones in the urine and bloodstream often caused by taking too little insulin or during illness.

Diabetic kidney disease: Damage to the cells or blood vessels of the kidney.

Diabetic nerve damage: Damage to the nerves of a person with diabetes. Nerve damage may affect the feet and hands, as well as major organs. **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.

Dialysis: A method of removing waste from the blood when the kidneys can no longer do the job.

Dilated eye exam: Eye drops are placed in the eyes to widen the pupils to see the retina better. The eye physician will look for changes in the retina in the back of the eyes.

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. AIIRs, 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.

Gestational diabetes: A type of diabetes that can occur in pregnant women who have not been known to have diabetes before.

GFR (Glumerular Filtration Rate): A measure of the kidney's ability to filter and remove waste products. It is the best test to measure kidney function and stage of kidney disease.

Glucagon: A hormone that raises the blood glucose level.

Glucose: A sugar in our blood and a source of energy for our bodies.

Hair follicles: are cylindrical invaginations, 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) hand washing with plain (nonantimicrobial) soap and water); 2) antiseptic hand wash (soap containing antiseptic agents and water); 3) antiseptic hand rub (waterless antiseptic product, most often alcohol-based, rubbed on all surfaces of hands); or 4) surgical hand antisepsis (antiseptic hand wash or antiseptic hand rub performed preoperatively by surgical personnel to eliminate transient hand flora and reduce resident hand flora) 559.

HDL (or high-density lipoprotein): A combined protein and fatlike substance. Low in cholesterol, it usually passes freely through the arteries. HDL is Sometimes called "good cholesterol".

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 blood glucose: A condition that occurs in people with diabetes when their blood glucose levels are too high. Symptoms include having to urinate often, being very thirsty, and losing weight.

High blood pressure: A condition where the blood circulates through the arteries with too much force. High blood pressure tires the heart, harms the arteries, and increases the risk of heart attack, stroke and kidney problems.

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.

Hormone: A chemical that special cells in the body release to help other cells work. For example, insulin is a hormone made in the pancreas to help the body use glucose as energy.

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.

Immunization: Often called vaccination; an injection or nasal drops that protect a person from an illness by making a person "Immune" to a particular illness such as influenza (flu).

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.

Inflammatio**n** 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.

Insulin: A hormone that helps the body use blood glucose for energy. The beta cells of the pancreas make insulin. When people with diabetes can't make enough insulin, they may have to take insulin from another source.

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 may be either hard or soft to touch. The epidermis has no blood supply, so it receives its nutrition from the underlying dermis.

Ketones: A chemical substance that the body makes when it does not have enough insulin in the blood. When ketones build up in the body for a long time, serious illness or coma can result.

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.

LDL (or low density lipoprotein): A combination protein and fatlike substance. Rich in cholesterol, it tends to stick to the walls in the arteries. Sometimes called "bad cholesterol".

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

Low blood glucose: A condition that occurs in people with diabetes when their blood glucose levels are too low. Symptoms include feeling anxious or confused, feeling numb in the arms and hands, and shaking or feeling dizzy.

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.

Major amputation: Refers to any amputation performed above the level of the ankle. Foot amputations are those at or below the ankle.

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.

Microalbumin: A protein found in blood plasma and urine. The presence of microalbumin in the urine can be a sign of kidney disease.

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.

Pancreas: An organ in the body that makes insulin so that the body can use glucose for energy. The pancreas also makes enzymes that help the body digest food.

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.

Phantom Limb: Is a sensation that an amputated or missing limb (even an organ) is still attached to the body and is moving appropriately with other body parts. Approximately 60 to 80 percent of individuals with an amputation experience phantom sensations in their amputated limb, and the majority of sensations are painful.

Phantom limb pain: True phantom limb pain is a complex, poorly understood syndrome that is described as itching, burning, aching, tingling or electric-type pain in the amputated limb. Three theories are the most prominent: 1) maladaptive changes in primary sensory cortex after amputation (maladaptive plasticity), 2) a conflict between the signals received from the amputated limb (proprioception) and the information provided by vision that serves to send motor commands to the missing limb, 3) vivid limb position memories that emerge after amputation.

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 ICHE 2004; 25: 1020; www.cdc.gov/flu/professionals/infectioncontrol/resphygiene.htm).

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 620.

Self-monitoring blood glucose: A way for people with diabetes to find out how much glucose is in their blood. A drop of blood from the fingertip is placed on a special coated strip of paper that “reads” (often through a glucose meter) the amount of glucose in the blood.

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 Encephalopalopathies (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.

Type I diabetes: A condition in which the pancreas makes so little insulin that the body can’t use blood glucose as energy. People with type 1 diabetes need to take insulin every day.

Type II diabetes: A condition in which the body either makes too little insulin or can't use the insulin it makes to utilize the blood glucose as energy. All people with diabetes need to eat healthy foods and stay at a healthy weight and be active everyday and be active everyday.

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

Vitrectomy: An operation to remove the blood that sometimes collects at the back of the eyes when a person has eye disease.

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 (Association of PeriOperative Registered Nurses): AORN standards,

recommended practices, and guidelines, Denver, 2006, The Association. AORN Journals

AORN online Ask.com

Encyclopedia

Beare, Patricia Gauntlet, and Judith L. Myers. Adult Heath Nursing, 3rd ed., ed. Michael S.Ledbetter. St Louis: Mosby, Inc., 2011

Berry & Kohn's Operating Room Technique, Nancymarie Phillips, 2007 Burke, J. (2003). Infection control-A problem for patient safety. New England Journal of Medicine, 348(7), 651-656.

www.cdc.gov Cohen ML: Proper hand washing protocols, SSM 6(3):21-28, 2010. www.eHow.com www.emedicinehealth.com

http://endofliecare.tripod.com

www.ezinearicles.com

www.FDA.com

WWW.gallup.com

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

m Http://inventors.about.com www.jama.com

www.kci.com Http://Library.thinkquest.org

www.medicaledu.com

The Merriam thesaurus and Webster Dictionary

Merriam-Webster's Collegiate Dictionary Eleventh Edition 2011

http://.niaid.nih.gov/topics/strep/pages/diagnosis.aspx

www.nurses.com

Operating Room Technique Eleventh Edition Berry and Kohn's

www.osha.gov

Random House Webster's College Dictionary 1997

www.remierinc.com

Taber's Cyclopedic Medical Dictionary "21" 2005

Http://www.ucmp.berkeley.edu/bacteria/bacterialh.html

www.Uptodate.com. Lower extremity amputations. Http://Wikipedia.org

Wikipedia.org: Wound Care Woods, A. (2005). Key points in the CDC's

Surgical Site Infection Guideline.

Advances in Skin and Wound Care, 18(4), 215-220.

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Network www.medicaledu.com