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Abstract
Although many types of wounds are easily treated, some require specialized expertise in order to resolve or treat the primary cause and to prevent additional wounds. Registered nurses and advanced RNs who opt to specialize in wound care provide an important skillset to patients suffering from chronic or acute injury, disease, or medical treatment. Most of these nurses adopt a holistic approach, coordinating efforts from the medical team to ensure that all aspects of a patient's health are considered in the treatment plan. These nurses provide both initial and ongoing wound care and serve as a resource to prepare the patient to continue care at home. As wound care is a rapidly advancing field, continuing education is necessary to ensure that nurses stay on top of the latest techniques and strategies.
Nurses also have several options for certification in the field of wound care.

**Continuing Nursing Education Course Planners**

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**Policy Statement**

This activity has been planned and implemented in accordance with the policies of NurseCe4Less.com and the continuing nursing education requirements of the American Nurses Credentialing Center's Commission on Accreditation for registered nurses. It is the policy of NurseCe4Less.com to ensure objectivity, transparency, and best practice in clinical education for all continuing nursing education (CNE) activities.

**Continuing Education Credit Designation**

This educational activity is credited for 3.5 hours. Nurses may only claim credit commensurate with the credit awarded for completion of this course activity.

**Statement of Learning Need**

Nurses need to understand causes of skin breakdown, and, importantly, of wound prevention, types of wounds, and the treatments of acute and chronic wounds to allow healing.

**Course Purpose**
To provide nursing professionals with knowledge of wound risk, phases of development and healing.

**Target Audience**

Advanced Practice Registered Nurses and Registered Nurses

(Interdisciplinary Health Team Members, including Vocational Nurses and Medical Assistants may obtain a *Certificate of Completion*)

**Course Author & Planning Team Conflict of Interest Disclosures**

Jassin M. Jouria, MD, William S. Cook, PhD, Douglas Lawrence, MA, Susan DePasquale, MSN, FPMHNP-BC – all have no disclosures

**Acknowledgement of Commercial Support**

There is no commercial support for this course.

**Activity Review Information**

Reviewed by Susan DePasquale, MSN, FPMHNP-BC

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Please take time to complete a self-assessment of knowledge, on page 4, sample questions *before* reading the article.
Opportunity to complete a self-assessment of knowledge learned will be provided at the end of the course.

1. **In the initial assessment the nurse should determine and document:**
   
   a. underlying conditions that could delay wound healing  
   b. the patient’s pain level  
   c. improper treatment strategies of the wound care team  
   d. answers a and b above

2. **True or False. Dry necrotic should be removed from the wound during debridement, and is recognized by a yellow or gray appearance.**
   
   a. True  
   b. False

3. **Biological debridement is:**
   
   a. one of the oldest forms of debridement  
   b. used on the wound surface to break down and loosen debris  
   c. commonly associated with the use medical-grade maggots placed in the wound bed  
   d. all of the above

4. **The concept of wound bed preparation has been**
   
   a. devised as a structured approach to promote healthy tissue within the wound bed  
   b. most often used for an acute wound with good healing potential  
   c. associated with high levels of infection  
   d. answers a and b above

5. **TIME is a mnemonic used to best manage a wound and to promote healing that stands for:**
   
   a. Tunneling-Infection-Moisture-Edge of the Wound  
   b. Tissue-Infection/Inflammation-Moisture-Edge of the Wound  
   c. Tissue-Induration/Inflammation-Moisture-Edge of the Wound  
   d. Tissue-Infection-Maggots-Elasticity of the tissue
**Introduction**

Assessment is the first step in the management of a wound. It should be performed during the initial stages, such as when a patient seeks care for treatment of a wound or when a nurse or caregiver discovers that a wound has developed. Continual assessment is important throughout the treatment process to discern how well the wound is healing and to determine if treatment measures are being effective. Wound Care Part II discusses key aspects of the assessment process, preparation of the wound area for treatment, and basic wound dressing types to manage exudate and to facilitate healing.

**Wound Assessment**

Wound assessment involves ongoing observation whereby the nurse inspects the wound and notes characteristics present. Observing the wound is the time to identify the overall appearance, its approximate size, and whether any other tissue or drainage is present, such as granulation tissue or slough. Other characteristics of the wound that the nurse may determine upon inspection include the approximate size and depth of the wound, where it is located on the body, whether tunneling or undermining are present, what type of drainage is present, if any, and if the skin or tissue is infected or necrotic.

The nurse may also measure the size and depth of the wound by examining its width and length. To measure the wound, the nurse uses a flexible tape measure and measures the width and length at the longest portions of the wound; this information is then documented in
the patient’s chart. The depth of the wound can be measured by inserting a cotton-tipped applicator and very carefully touching the base of the wound. This method may be necessary if the wound is unstageable or the nurse is unable to see if underlying structures, such as fascia or muscle tissue, are exposed at the base of the wound.

When tunneling is evident, a cotton-tipped applicator or a gloved finger can be used to assess the length and the area of tunneling. For instance, if tunneling appears from one side of the wound to an underlying area, the nurse can use this method to measure how deep the tunneling extends. If infection is apparent, the nurse can collect a sample for a wound culture during the assessment and measuring process.

The nurse should also talk with the patient and obtain subjective information about the wound and the patient’s medical history. Information about how the wound developed, how long it has been present, and whether the patient has taken measures to treat the wound are important aspects to note and document in the assessment. The nurse should also determine if the patient has any underlying conditions that would contribute to wound development or delayed wound healing, such as diabetes, malnutrition, or immobility.

The patient’s report of pain from the wound is also important to note. A wound may cause a range of reactions from patients, from mild discomfort to excruciating pain. An infected wound may cause pain when inflammation is present as well. The nurse should assess the patient’s level of pain by asking the patient to identify pain intensity
and describe the type of pain present. Treating pain associated with the wound is part of overall wound care management.  

**Foreign Bodies**

A foreign body is an object in the skin that is not supposed to be part of the wound. A foreign body may be in a chronic wound if the ulcer was exposed to some sort of material or object that inadvertently became embedded in the wound. An example of this might be when a patient with a healing diabetic ulcer on the foot walks barefoot without a covering on the wound and an object is embedded in the wound.

A foreign body may also enter the skin as part of the cause of the wound. An accident or injury that causes the wound may leave retained objects associated with the injury causing mechanism inside the skin as part of the wound. When the objects are not found and removed, the body recognizes them as foreign, thereby starting the inflammatory process in response. Foreign objects that become embedded in the skin can come from any number of items and can range from shards of glass, pieces of wood from splinters, dirt, sand, rocks, or various other materials.

Assessment of foreign bodies must be part of the initial examination of the wound. If the object is not removed right away, the wounded area can become reddened and the tissue can become inflamed. If an infection does not develop in spite of the foreign body, the wound may start to heal around the object, leaving a lump or nodule under the skin that is very painful.
An article in *The Nurse Practitioner: The American Journal of Primary Healthcare* describes other factors that can indicate if a foreign body is present in a wound, which affects its healing process. The wound may have continuous purulent drainage or may develop an abscess, which indicate that infection has developed around the item. If a patient is allergic to a substance that enters the wound, the body may respond with substantial inflammation, itching, and skin breakdown. A wound with a retained fragment that has not been found and that develops an infection may not respond well to antibiotic therapy as it normally should.69

Assessment for a foreign body within a wound may be demonstrated as increased patient pain with skin palpation, decreased circulation, and diminished sensation in the region distal to the wound. The object, if large enough, may compress the blood vessels or nerves and ultimately affect sensation and blood flow, causing pain, numbness, tingling, pallor, and poor peripheral pulses.69

Identification of a foreign object may require diagnostic tests, such as an X-Ray or MRI. The type of test ordered depends on the patient’s history and physical, the potential factors of what the foreign object might be, and whether or not the object is visible through examination of the wound. If the practitioner suspects a foreign object in the wound but cannot visualize it, he or she should not blindly probe the wound to search for it to be removed, as this can cause further trauma to the tissue and could lead to increased bleeding or infection.

When the object is identified and should be removed, removal often requires exposing the wound bed, if possible, and irrigating the wound
with normal saline. The clinician may then pull the object from the wound if it is accessible. In some cases, a foreign object cannot be removed without significant tissue trauma, in which case, surgical intervention is necessary. When working with a wound that contains a foreign object, pain medication and comfort care for the patient is necessary, as the process can be quite painful and can produce significant anxiety.

Once the object has been removed, the wound should be cleaned and covered with a dressing for further protection. The provider may order antibiotic ointment or a specialized dressing to protect the wound. The nurse should monitor the wound closely during the period following foreign body extraction, as the wound can still develop an infection after exposure to the item. Frequent assessment for skin changes, including an increase in drainage, skin redness, inflammation, and increased pain can all indicate a developing infection after the foreign object has been removed. Further treatments with regular dressing changes, cleansing, and balance of moisture are also necessary to promote healing long after the object is out of the wound.

**Sensation**

Some patients, particularly those with neuropathy associated with diabetes, have decreased sensation in the lower extremities. When this occurs, the patient may be unable to sense an injury to the skin or that breakdown is happening at all unless he or she checks the feet and legs on a regular basis. Assessment of sensation is important to determine if the patient is at risk of skin breakdown because of decreased feeling in the lower extremities.
One of the most common forms of testing for sensation is by using the Semmes-Weinstein monofilament test. To perform the test, the nurse exposes the patient’s feet by removing the shoes and socks. The nurse uses a 5.07 monofilament and presses it against the patient’s skin for one second at a time. Without watching what the nurse is doing, the patient tells the nurse when he or she feels the filament against the skin.

The monofilament exerts approximately 10g of pressure against the skin, making this a useful test for determining loss of sensation. The nurse should press the monofilament into various locations in the lower legs and feet, avoiding calloused or thickened areas of skin. A patient who cannot consistently detect the monofilament during the test should receive further evaluation for decreased sensation due to neuropathy.

The monofilament test should be combined with checking the foot for signs of injury, ulceration, decreased blood flow, or decreased sensation, as well as checking the patient’s history for reports of decreased sensation, numbness, tingling, pain, or decreased movement in the lower extremities.

**Blood Flow**

Assessment of blood flow to the affected area is combined with information gained from the patient’s history description of the cause of the wound. Wounds are significantly impacted by proper blood flow; decreased blood flow to an area results in deoxygenation of tissues and increased risk of skin and tissue breakdown. It is therefore
important that part of the focused exam include assessment of blood flow to the area.

Arterial insufficiency leads to ulcers that most commonly develop in the lower extremities, so when a patient presents with a wound and has a condition that impacts circulation, the nurse should assess for adequate blood flow to the affected area. This includes assessing and noting skin color, such as whether it is pink and looking healthy or if it is pale or cyanotic, as well as patterns of hair growth in the lower extremities. Assessment of capillary refill can be performed in various areas by lightly depressing an area of the skin with a finger to cause it to blanch and then counting how long it takes for blood to return to the area and for color to be restored.

The nurse may also assess pulses, both proximal and distal to the wound site. Assessing pulses in various locations also provides a more comprehensive view of the patient’s circulatory status. For example, if a patient presents with a wound on the lower leg on the calf, the nurse may assess the popliteal pulse behind the knee as well as the dorsalis pedis and posterior tibial pulses in the ankle and foot. Use of a Doppler to assess pulse may be necessary if it cannot be found through palpation.

Signs and symptoms associated with peripheral artery disease, such as poor skin color, pain in the lower legs, and intermittent claudication, can also appear when a patient has arterial insufficiency and should be assessed when the client presents with a wound that has developed from diminished arterial circulation.
Erythema, or redness of the skin and mucous membranes, occurs when the capillaries near the surface of the skin dilate and blood flow is increased to an affected area. Erythema that is blanchable should briefly turn white when the skin is compressed and then return to a red color. An early wound, such as a stage I pressure ulcer, occurs as non-blanchable erythema, in which the skin does not change color when it is compressed slightly during the assessment. When skin has non-blanchable erythema present, it is a sign that tissue damage has occurred under the surface, even if the outer layers of skin remain intact.

When assessing erythema, the nurse should note the size of the reddened area, measuring it, if possible. If the area blanches when pressed and then fills in with redness again (which is a test of capillary refill) the nurse should note the length of time it takes for color to return. Capillary refill should be brief; the longer it takes for the tissue to return to its color after finger pressure, the greater the risk of damage to the skin. A slow return of color to the affected area indicates that blood flow is sluggish and the skin could become ischemic. If the nurse provides an early assessment and catches a situation where non-blanchable erythema is present, the condition may still be reversed before permanent damage ensues.

It may be difficult to assess areas of erythema among patients who have dark skin. In these cases, skin may appear to have purple undertones and the skin surface may be shiny and firm. The nurse can use a direct light over the affected area for assessment and look for other signs of injury beyond erythema, such as tissue swelling and warmth.
Development Of A Treatment Plan

The development of wounds within the hospital environment is an unacceptable complication that can occur with some patients who are at high risk. Some patients, particularly those who are immobile and who require multiple devices for their care, such as ventilators and hemodynamic monitoring, are at greater risk of wounds developing in the healthcare environment. The development of severe wounds such as stage III and stage IV pressure ulcers while under care in a healthcare facility has actually been classified as a “never event.” In 2008, the Centers for Medicare and Medicaid Services announced that it would no longer pay for treatment measures for pressure ulcers that have developed while patients were in the hospital.\textsuperscript{3} Beyond the obvious effects of preventing pain and infection as a result of wounds, this statement is another form of evidence that prevention and treatment of wounds is important to avoid costly consequences for the healthcare center.

When a wound is found to have developed, the wound must undergo cleansing and evaluated for a method of clearing away debris and/or unviable tissue so that healthy tissue can form. The following section outlines wound care options that may be found in the patient’s treatment plan.

**Wound Cleansing**

Wound cleansing is a routine procedure that reduces the amount of debris and bacteria that can build up in the wound. Wound cleansing should be performed regularly when a nurse changes the wound dressing and both before and after wound debridement. If a skin graft
has been placed, the nurse should cleanse the skin around the graft but should not disturb the graft itself.\textsuperscript{20}

Cleansing is done gently, both for comfort of the patient, as the wound can be extremely painful, and to prevent further trauma to the wound. It should be noted that trauma can occur during cleansing both by physical and chemical means. Vigorous scrubbing of a wound can cause physical trauma, but gentle application of a harsh chemical to the wound can also cause tissue trauma. The type of cleanser and method of administration is determined by the healthcare provider and typically considers such factors as the amount of necrotic tissue present, the amount and type of exudate present, and the area of the body affected by the wound. When applying a cleanser and cleaning the wound, the nurse should stimulate the tissue enough that debris and excess drainage is removed but that the healthy, growing tissue is not disturbed.

The clinician applies the cleanser to the wound, which is designed to break up debris and to collect drainage, which is then rinsed away. While commercial cleansers that contain additives effective for cleansing may be ordered, normal saline has also been effectively used as part of wound cleaning. When normal saline is added to a wound bed with the correct amount of pressure, it can lift and wash away wound debris and exudate without damaging the wound. Alternatively, wound cleansers that contain antimicrobial agents, such as hydrogen
peroxide or povidone-iodine can cause cytotoxicity and could more likely damage the tissue instead of adequately cleaning it.\textsuperscript{20,21}

Once a wound has been cleaned, the nurse should assess for whether odor is present in the wound, which can indicate infection. Odor should be assessed after wound cleansing, as the presence of odor before the wound is cleaned could be caused by dead tissue that must be removed but that is not infecting the wound. When odor is present after a wound has been cleaned, the nurse should assess further for other signs of infection.

If odor or other signs of infection are present in the wound, the patient may benefit from a short-term cleansing regimen of antimicrobial wound cleansing products, despite their potential cytotoxicity. Examples of these types of agents include Dakin’s solution, Hibiclens, and hydrogen peroxide. These agents should not be used on clean wounds with regular cleansing, but their application to contaminated or infected wounds may be considered on a case-by-case basis.\textsuperscript{20}

**Debridement**

Debridement is the process of removing dead tissue from the wound in order to promote new growth, reduce infection, and promote wound healing. The wound bed should be evaluated during the assessment phase and the nurse should understand the various types of drainage and tissue that indicate growth and healing, particularly before embarking on the debridement process, in which healthy new growth could otherwise be accidentally removed.
Necrotic tissue is one element that should be removed from the wound during debridement. When moist, necrotic tissue may appear as yellow or gray; and, when dry, necrotic tissue has the appearance of black, tough eschar that may be thick or leathery. An area of necrotic tissue may be covering an infection or a collection of fluid. When the necrotic tissue is removed with debridement, the underlying area is exposed, which may cause fluid drainage or could reveal an infection. Eschar differs from a scab, however, and the nurse should be familiar with the differences in appearance and the make-up of these two wound components.

While eschar consists of necrotic skin that has hardened into a tough layer, a scab is made up of dried blood and exudate from the wound. A scab may or may not need to be removed during the healing process, but the nurse should understand that the terms eschar and scab are not interchangeable and they should not be treated as such. A scab is not associated with tissue necrosis and it is not dead tissue.22

Before starting the process of debridement, the nurse should be able to identify necrotic tissue, as compared to granulation or epithelial tissue, which indicates that the wound is healing. As stated, necrotic tissue is tough and black. Fibrin is another element that must be removed as part of debridement; it appears as white, yellow or gray in color and may look stringy or rubbery. Slough is also yellow or gray and has a similar, stringy texture.

Necrotic tissue must be removed through debridement when it is present, as failure to remove it can lead to proliferation of bacteria and increased risk of infection. A wound that contains necrotic tissue will
be unable to synthesize new tissue in a normal manner and necrotic tissue prohibits the skin cells from communicating with each other to form new granulation tissue.

The only exception to when eschar should be removed is when it is found intact on a wound on the heel. The Agency for Healthcare Research and Quality (AHRQ) has issued guidelines that state that it is better to leave this type of eschar in place, rather than trying to remove it through debridement. The eschar must be flat and well adhered to the heel, without evidence of surrounding edema, sponginess, or drainage. If the eschar is found to be intact without surrounding signs of infection or disease, it should remain in place, as the structure of the heel does not allow the clinician to determine the depth of the ulcer. In other words, a nurse may view a heel wound with solid eschar covering it, but the nurse may not know if the wound is relatively superficial or if it extends down to the connective tissue and bone of the heel. In this case, it is safer to leave the eschar in place if the wound it not infected.

When this occurs, instead of removing the eschar on the heel, the nurse should keep it in place as a method of sealing off the wound. Skin care is still required in this area, even without debridement. The nurse should take pressure off of the heel by elevating the area when the patient is at rest; this method of pressure relief, called off-loading, is the standard form of treatment in place of debridement of this type of heel wound.

There are several different forms of debridement. The decision of which type to perform is based on the type of wound, the physician’s
orders, and surrounding circumstances that affect the removal of wound tissue, such as the presence of infection or inflammation in the wound. The types of debridement that may be used include surgical, autolytic, mechanical, enzymatic, and biological debridement.

**Sharp debridement**

Surgical debridement is an effective form of wound management, and is used for some particular wounds, such as diabetic foot ulcers. It is used with a scalpel or scissors to cut away dead tissue and is often performed in a surgical suite, depending on the extent of the wound. A surgeon or physician typically performs surgical debridement under sterile conditions. Surgical debridement quickly removes the dead skin and eschar that are covering the wound to expose the underlying portion to heal. A surgeon, advanced practice nurse, or specially trained RN may perform conservative sharp debridement as a method of removing dead tissue through cutting. This type of procedure can be performed in an operating suite or it could be done at the bedside. Sharp debridement carries an increased risk of wound bleeding following the procedure.²²

**Autolytic debridement**

Autolytic debridement uses the body’s own tissues and cells to break down necrotic tissue for removal. Autolytic debridement utilizes the fluid found in the wound as a healing mechanism to remove dead tissue. The fluid within the wound contains such components as macrophages and neutrophils that work to support the immune system and to tackle foreign pathogens that have invaded a portion of the body. To perform autolytic debridement, the nurse applies a dressing over the wound to keep the wound bed moist. The fluid released from
the wound liquefies the dead tissue so that it can be cleared away.\textsuperscript{23} Autolytic debridement is one of the most painless forms of removing dead tissue; however, because it can take longer when compared to some other forms of debridement, the patient may be at a greater risk of infection with this process.

\textit{Mechanical debridement}

Mechanical debridement includes physical means of removing dead skin tissue. Examples of mechanical debridement are using a force of water to eliminate dead tissue, such as with a whirlpool; and, using wet-to-dry dressings, and performing wound irrigation.

Using a whirlpool provides a form of mechanical debridement, as the use of warm water with a slight pressure can soften eschar and make it easier to remove necrotic skin. A whirlpool tub may be available at a fixed location in a healthcare center or it could be a portable device used to take between patients who need this type of debridement. The whirlpool utilizes warm water and the patient either submerges the wounded area or his entire body into the water.

Whirlpools, when used as a form of mechanical debridement, have not only been shown to effectively remove necrotic wound tissue, but also to improve circulation by promoting vasodilation, reducing instances of infection by removing exudate, and providing comfort for a patient during the debridement process. To use, the wound care patient is taken to the whirlpool for the number of minutes prescribed by the physician. The temperature of the water is well controlled and a
patient with cardiovascular disease or peripheral neuropathy should not use water with temperatures over 38°C. After using the whirlpool for the prescribed time, the clinician rinses the patient’s wound with enough vigor to remove the softened, necrotic skin and exudate from the wound bed.

A whirlpool treatment should not be used for all wound patients, and not everyone can tolerate time in a whirlpool for debridement. A patient who is immobile may not be able to get out of bed or move much to get to the whirlpool, even if the tank is portable. Some patients have clinical conditions in which they do not tolerate high water temperature or they would not be able to endure the time spent in the water. Further, whirlpool treatment should not be performed on certain types of wounds, such as venous insufficiency wounds. Placing the affected extremity in a dependent position in a whirlpool when a venous ulcer is present is not helpful; the fibrous tissue sometimes formed in a venous ulcer is relatively unchanged by whirlpool debridement and this form of therapy is usually not successful at removing it.

Finally, whirlpool tubs, because they are often used for more than one patient, may carry a risk of infection if they are not properly cleaned and maintained. All facilities should have protocols in place for cleaning and disinfecting whirlpool tanks, and a facility should use this form of treatment very carefully when working with wound care patients to prevent the development of healthcare-acquired wound infections that are transmitted between whirlpool tanks.
Another type of mechanical debridement that can be done at the bedside and regularly performed by the nurse is the use of wet-to-dry dressings. This type of dressing change, while serving as a form of mechanical debridement, has come under fire in recent years as to its purpose and its potential for negating some of the factors associated with wound healing. When using a wet-to-dry dressing, the nurse places a saline-soaked piece of gauze onto the wound bed. The gauze eventually dries and once dried, the nurse pulls it off, taking debris and dead tissue with it. The process is then repeated as the wound heals; it is sometimes performed up to four times per day.

Although the process of pulling off a dry piece of gauze can be efficient in removing eschar and dead tissue from the wound bed, this type of debridement unfortunately also can remove healthy tissue as well, which slows and impairs the healing process.\textsuperscript{25} It is also extremely painful for the patient when the nurse pulls the dressing off. The wound itself may already be painful, but then pulling off a piece of gauze that has dried and become stuck to the wound bed can be agonizing. Some nurses, in an attempt to provide comfort, have wetted the gauze before removal so that it might be less painful for the patient, but this actually negates the process of debridement.

Wet-to-dry dressings are warranted in some situations that require mechanical debridement and they may be ordered as such. However, there are a number of various debridement techniques and dressings available as treatment for wound care such that wet-to-dry dressings are becoming less common in favor of other measures. While still used, this type of mechanical debridement may not be the best choice for some wound care patients.
Irrigation is a third type of mechanical debridement; like the whirlpool, irrigation uses hydrotherapy to soften necrotic tissue and cleanse the wound bed of debris. Irrigation involves using a syringe or catheter to irrigate the wound at a certain level of pressure to loosen and wash away debris and dead tissue.\textsuperscript{22} Irrigation may be performed at the bedside by the nurse; it must be done at a pressure between 4 psi and 15 psi in order to be effective: pressures less than 4 psi are not strong enough to loosen tissue and pressures greater than 15 psi have been shown to damage healing skin and to drive debris deeper into the tissues.

Irrigation by hand with a syringe can be performed relatively easily as long as the nurse places a basin next to the wound to collect the drainage and irrigant solution. This type of debridement is most effective for wounds that are not infected or that only have minor infections, those that do not contain significant amounts of debris, and those that do not have thick eschar, as the pressures used with irrigation are not high enough to loosen and remove very thick or tough eschar.\textsuperscript{20}

Another more technical form of irrigation is pulsatile lavage with suction, which is designed to mechanically irrigate and cleanse a wound to remove debris, exudate, and slough tissue from the wound bed while simultaneously suctioning the fluid and output. This type of irrigation may be more likely to stimulate granulation tissue formation because of its action of slight pressure with irrigation combined with negative pressure of suction. McCullogh and Kloth, in the book \textit{Wound Healing}, cited a study that showed that wound care patients who
received pulsatile lavage with suction had an over 12 percent increase in granulation tissue formation per week when compared to 4.8 percent increase among those who used whirlpool therapy. Further, pulsatile lavage with suction can be used on many different types of wounds and it is site specific, meaning a patient does not have to have an extremity or the entire body submerged in a tub of water to derive the benefits of debridement. Pulsatile lavage has been used for successful debridement of diabetic wounds, venous ulcers, surgical wounds, pressure ulcers, and wounds that have become infected. It can also be used on complicated wounds where tunneling or undermining is present. Pulsatile lavage can be performed by a nurse and it does not require advanced training, although it should be done by someone who has some experience with the procedure; however, when a patient has a significant wound, such as one that extends to the bone or that is near a great vessel, it is better to have an advanced practice nurse or physician perform the procedure.

**Enzymatic debridement**

Enzymatic debridement is a form of topical debridement that may be combined with other forms, such as surgical or sharp debridement. Enzymatic debridement is done when a formulation of enzymes is applied to the wound bed, which breaks down necrotic tissue so that it can be removed. The process is performed once or twice daily and it can easily be done at the bedside without excess equipment or the use of a surgical suite. The advantages of enzymatic debridement include its use in patients with bleeding or clotting disorders. Other forms of debridement may increase the risk of bleeding in the wound, which can be harmful to a patient who has difficulties with blood clotting.
Enzymatic debridement can also be used among patients who have various types of wounds and it has been used successfully among patients with such wounds as diabetic ulcers, burn wounds, venous ulcers, wounds that are infected, and wounds that contain large amounts of slough and eschar.\textsuperscript{26}

To perform enzymatic debridement, the nurse first cleanses the wound site with normal saline or with a cleansing agent. The nurse then applies the exogenous enzymes directly to the wound bed. If black eschar is present, a process called cross-hatching is first required, which involves cutting a crisscross pattern into the surface of the eschar with a scalpel. This ensures that the enzymatic solution is more likely to reach the wound bed under the layer of thick eschar.\textsuperscript{26} The process typically causes little pain to the patient, particularly when compared with some other forms of debridement.

The goal of enzymatic debridement is to soften and liquefy necrotic tissue to the point that it can be easily removed after a short time spent with the application of enzymes. The process of cross-hatching the eschar prior to administration may be painful for the patient, but the process otherwise does not typically cause significant pain. Enzymatic debriding agents are available by prescription only and may be available through the healthcare pharmacy. Examples of enzymatic debridement preparations include collagenase, Panafil\textsuperscript{®}, and papain and urea (Accuzyme\textsuperscript{®}).

\textit{Biological debridement}

Perhaps one of the most interesting and oldest forms of debridement is the use of biological substances on the wound surface to break down
and loosen debris in order for it to be quickly removed. One of the most common forms of biological debridement is the use of medical-grade maggots placed in the wound bed. Several sterile maggots — the number of maggots used is determined by the size of the wound — are placed in the wound bed and then covered with a light dressing or gauze. The maggots sit in the wound bed and digest necrotic tissue. Use of maggots is beneficial in that they focus on digesting necrotic tissue only and they leave healthy tissue alone. After hours or days of the maggots being in the wound bed, the covering is removed and the maggots are rinsed away. The process of using maggots for debridement has been in use for hundreds of years and was a relatively common form of wound debridement during the American Civil War. Its popularity declined in the following period but has gained interest again, starting in about the 1990s with the rise of more and more resistant organisms. The maggots work not only by digesting the necrotic tissue, but they also release a type of enzyme that works to break down dead tissue in the wound, making it easier to remove.

The practice of using medical-grade maggot as a form of biological debridement has other benefits as well. Its use has been shown to decrease wound odor and increase the rate of generation of granulation tissue.27 Most patients suffer only minor discomfort with this type of debridement; they may state that they do not notice the maggots or only feel a slight tingling sensation. Some people, although they do not experience much physical discomfort, instead feel uncomfortable with the idea of using maggots in a wound bed, which can be a barrier to this type of treatment and must be further explored if biological debridement is to be used in a chronic wound.
There may be times when it is better for a wound not to be debrided. As stated, the AHRQ has specified that dry heel wounds that are covered with eschar should not be debrided because it may be difficult to determine the depth and extent of the wound. Additionally, patients who have severe peripheral vascular disease that significantly compromises circulation to the area of the wound should not have wounds debrided. Further, a condition known as dry gangrene, which develops as a result of poor blood flow rather than an infectious process, is also considered a contraindication to debridement because of the potential for infection and lack of blood flow to the affected site.²²

**Moist Wound Bed and Healing**

A wound requires a moist wound bed in order to best promote healing. Moisture is necessary throughout the body for the cells to function properly; however, moisture must be controlled and kept within a delicate balance. In the case of a wound, the wound bed should be kept moist but without affecting the surrounding tissues, as excess moisture in areas outside of the wound bed can lead to maceration and skin and tissue breakdown.

A moist wound bed is required for new granulation tissue to form in the wound bed. As the cells migrate toward each other during healing, they must have moisture. If the wound bed is too dry, the cells are unable to move together to heal the wound and to close the edges. In order for the wound to heal in a timely manner, the wound bed must remain moist, or the wound will heal much more slowly when compared with other wounds that are kept moist.²⁹
The idea of keeping the wound bed moist originated in the 1960s when Dr. George Winter, a urologist, determined that moisture was an essential component of epithelialization and that open wounds healed at a faster rate when kept moist. Prior to this time period, many practitioners believed in keeping wounds open and/or uncovered; today, many people still believe in keeping a wound “open to air” as it heals, but this process actually negates the healing process because it causes the cells to dry out. Moisture is also important for keeping the wound at an appropriate temperature that is best for healing. Finally, a moist wound bed reduces the risk of infection, as it is necessary to support debridement. During enzymatic or autolytic debridement, for example, the moist wound bed supports the environment for the process to work. In other words, application of a debridement solution, such as that used for enzymatic debridement, will have a much more positive effect on healing when it is applied over a moist wound bed instead of trying to get the solution to work to debride a dry wound bed.

The concept of wound bed preparation has been devised as a structured approach to promoting healthy tissue within the wound bed while supporting the effectiveness of other forms of therapy and treatment. Preparation of the wound bed allows the provider to determine if there are factors that are affecting the process of wound healing; this concept is most often used when dealing with a chronic wound that is not healing. Wound bed preparations focuses on maintaining moisture levels in the wound bed, promoting new tissue growth, and preventing infection.
The provider can implement the mnemonic TIME when considering how to best manage the wound and provide an optimal wound bed for healing. The TIME mnemonic is described as follows:

- **T** - Tissue:
  This step describes whether the tissue is healing or is not viable and needs debridement. When assessing a wound, a look at the wound bed will tell the provider of the presence of eschar or slough that needs to be removed. Performing debridement then provides a healthier wound bed in which new tissue can grow.

- **I** - Infection or Inflammation:
  Infection and inflammation may be apparent when assessing certain types of wounds, as some signs, such as odor, can indicate a pathologic process going on. However, signs of infection or inflammation in a wound may also be subtle and difficult to accurately determine without a wound culture and examination by a trained eye. Following wound culture, the patient may need antibiotics in the form of topical or systemic treatments to control bacterial growth. If inflammation is present, anti-inflammatory medications can control continued irritation and swelling.

- **M** - Moisture:
  Wound moisture requires a careful balance to avoid both an overly dry wound bed, which can delay healing, as well as an overly moist wound bed, which can lead to maceration of surrounding tissues. To balance appropriate moisture levels,
the nurse must use the appropriate types of dressings that will retain a moist wound base from which to work without causing excess moisture on the edges of the wound or the surrounding tissues.

- **E - Edge of the wound:**
  Normal wound healing results in the wound edges migrating together to form a solid framework that indicates the wound has healed. When the edges are not coming together, there may be excess necrotic tissue still in the wound that needs to be debrided, or there may be other systemic factors that should be considered that are causing delayed wound healing, such as with the presence of certain types of chronic disease. Wound edges that are rolled or rounded may not migrate properly and can cause delayed healing. There may be evidence of other damage or disease processes associated with the wound, such as skin maceration or undermining of the wound edges. Ultimately, after management measures are taken, the wound edges should begin to migrate and fill in the wound tissue in a healthy and responsive manner.

The base of the wound, or the wound bed, should remain moist to promote new tissue growth. Alternatively, the skin surrounding the wound should be dry to prevent maceration and further skin breakdown. It is therefore important to concentrate on keeping the wound bed at the base of the wound moist while cleaning and drying other areas.

**Wound Protection And Dressing Types**
Wound dressings are applied to the wound to keep the wound bed moist. This moist, warm environment can be maintained for wound healing by the application of the right type of dressing that retains moisture, is semi-occlusive to allow for wound drainage, and that will not stick to the wound bed.\textsuperscript{29}

Foam dressings are thickened dressings that contain foam as a type of padding to protect the wound. Used in a number of different wound types, foam dressings can be packed into very deep wounds to fill space or they may be placed on top of superficial wounds to provide padding and protection from further injury. Foam dressings often have adhesive borders around the outside edge of the foam sheet. The adhesive allows the dressing to stick to the skin surrounding the wound and hold it in place. They may be changed several times a week, depending on the condition of the wound and the clinician should take care to examine the surrounding skin to ensure it is not being damaged by regular addition and removal of the adhesive from the dressing.\textsuperscript{21,30}

Impregnated dressings are those that are typically made up of gauze and are infused with a type of chemical, such as petroleum, silver, or collagen. Impregnated dressings are designed to keep the wound bed moist while promoting wound healing. They are available as either flat sheets of dressing that come in various sizes or they may be available in small strips that can be packed into wounds, such as in cases where wound tunneling is present.\textsuperscript{21} Impregnated dressings are often applied once per day. The gauze dressing is placed in the wound bed. It is typically flexible enough that it can be pressed lightly into the wound bed without needing to cut down the size of the gauze sheet. A larger
dressing is then placed over the wound site for protection and to help keep the impregnated dressing place. Examples of impregnated dressings available include Vaseline® gauze and Xeroform®.21,30

Transparent dressings are not typically used for wound healing, but they are included here as a type of wound dressing in that they can be placed over the wound and provide a barrier to prevent pathogens from entering the wound bed. Because they are transparent, these types of dressings allow the clinician to visualize the wound bed and to identify changes that can signify infection or complications. Transparent dressings are semi-occlusive in that they allow some oxygen to reach the wound, which decreases the risk of anaerobic microbes from growing in the wound bed to cause an infection. They do not absorb excess fluid from the wound and they are not intended for deep wounds. However, transparent dressings can be placed over shallow wounds and superficial skin tears, as long as neither type of wound is infected.30 Examples of transparent dressings include Tegaderm®, Op-Site®, Blisterfilm®, and AcuDerm®.

Hydrogel dressings are designed to maintain a moist wound environment because they contain a certain amount of gel within the dressing that maintains moisture but they can also absorb some exudate and drainage from the wound. Hydrogel dressings also work as a form of autolytic debridement in that they are placed in the wound bed, and they further keep the environment moist and thereby soften and break down necrotic tissue that can be removed when the dressing is changed.
Hydrogel dressings are made of polymers that can maintain wound moisture, but they may also have added components that can provide moisture control, such as silicone, polyethylene oxide, or glycerin.\(^{21}\) These types of dressings are placed on the wound bed; if the size available is larger than the size of the wound, it may be cut with sterile scissors down to fit the size and shape of the wound bed. Adhesive backing is often present on the dressing, which is removed after the dressing is placed on the wound to provide a non-occlusive surface that permits some airflow and fluid distribution. Once placed on the wound bed, the dressing is then covered with a larger dressing, such as a gauze pad, to provide protection. The hydrogel is typically changed every day. Examples of hydrogel dressings available on the market include DuoDERM®, Vigilon®, and Saf-Gel®, although there are many more brands available for use.\(^{21,30}\)

**Wound Exudate and Dressing Selection**

Exudate is a type of drainage that comes from the wound. It is necessary for a wound to create exudate, as this process can help to keep the wound bed moist. Exudate contains many important properties that are essential to the health of the wound, including electrolytes, protein, growth factors, and inflammatory mediators. It is usually clear or pale yellow in color and has a watery composition. Exudate plays a critical role in keeping the wound bed moist to facilitate migration of skin cells across the wound during healing.\(^{33}\)

Exudate may vary in its appearance, depending on how the wound is healing and if infection is present. The nurse should note whether exudate is present as well as its color and consistency. For example, exudate may drain from a wound and be described as a moderate
amount of serous drainage. When an infection is present, exudate may have an odor and may be thick and purulent. Wound dressings are applied to absorb exudate and to promote wound healing. Some examples of dressings that may be applied to absorb exudate include dry dressings and pads, hydrocolloid dressings, alginates, and hydrofiber dressings.

**Dry dressing**

Dry dressings consist of gauze in the form of a gauze pad or bandage that is applied to the wound as a covering. Dry gauze may be placed on the wound bed and then covered with tape or wrapped with a bandage. The gauze is designed to absorb small amounts of exudate and then it can be removed; however, when large amounts of exudate are present, the gauze may either become saturated and if not changed quickly enough can lead to a wet layer of drainage covering the wound, or it may stick to the wound bed and cause damage when the nurse tries to remove it.30

Gauze dressings are often used for surgical wounds, but they may be applied to many different types of wounds from various causes; the use of gauze to cover a wound is based on the patient’s condition, how the wound is healing, and whether there are other factors to consider that can affect wound healing. Gauze is useful because it not only absorbs small amounts of exudate but it also protects the wound from infection by providing a barrier that prevents bacteria from entering the wound, particularly when the gauze dressing is sterile.
Gauze pads are available in various sizes and may come in containers in which they are packed together for multiple use or they may be wrapped individually. Gauze is also available as a wrap, which is flexible and comes in a large roll that can be wrapped around an extremity or other area covering a wound to hold the underlying dressing in place. Examples of dry gauze dressings that may be used for wounds include a number of different products manufactured by various companies under different brand names and that come in various sizes and thicknesses for a multitude of purposes. Telfa is another type of gauze dressing contains a coating so that it will not stick to a wound.

**Wet-to-dry dressing**

Wet-to-dry dressings are also a form of dressing that is used for absorbing exudate from wounds. These types of dressings are used for mechanical debridement when they are saturated with saline, placed on the wound bed, and then allowed to dry, absorbing excess exudate and dead skin tissue along with it. The dried exudate is removed when the dressing is removed. As stated, wet-to-dry dressings, while still commonly ordered among many facilities as a form of mechanical debridement, are being replaced with other forms of treatment that are less damaging to the skin tissue and that are less painful for the patient.

**Hydrocolloid dressing**

Hydrocolloid dressings are another form of dressing material that is designed to absorb exudate from the wound bed when the dressing is placed on the wound. Hydrocolloid dressings typically contain polymers and other elements such as pectin or carboxymethylcellulose, and they
are waterproof. The hydrocolloid dressing is applied to the wound — it may need to be cut to fit the size of the wound — and it absorbs exudate from the wound bed without drying the tissue too much. Some types of dressings have a mark that indicates when the dressing has become saturated. When the dressing has absorbed enough exudate, it should be changed. Hydrocolloid dressings are changed anywhere from every 2 to 7 days, depending on the amount of exudate and how fast the dressing absorbs fluid.\textsuperscript{21,30} The dressing should not be left in place if it becomes saturated.

\textit{Alginate dressing}

Alginate dressings are designed for wounds that absorb large amounts of exudate; these types of dressings can be placed in the wound bed to rapidly absorb excess fluid while preventing the wound from drying out. An alginate dressing is made up of either brown seaweed or a combination of elements such as calcium or sodium salts. The dressing is not pre-moistened, but instead, it becomes a gel when it is exposed to moisture in the wound. For this reason, alginate dressings are best used for wounds that produce significant exudate, rather than those that are mostly dry or only slightly moist.

It’s important for the clinician to be aware that if there is not enough moisture in the wound bed, the alginate dressing may not keep its gel-like features and it may end up drying out the wound. Alginate dressings are available in many sizes of sheets, as well as ropes or pads. This type of dressing is applied to the wound bed and then covered with another dressing to keep it in place. In addition to wounds that excrete large amounts of exudate, alginate dressings are most useful for wounds that consistently ooze, such as those that have
just had surgical or sharp debridement because they contribute to hemostasis and can staunch blood flow when oozing is present.\textsuperscript{21,30}

*Hydrofiber dressing*

Hydrofiber dressings work in a manner similar to alginate dressings in that they expand upon contact with excess moisture. This action makes hydrofiber dressings useful for wounds that create large amounts of exudate. Unlike alginate dressings, though, hydrofiber dressings do not contribute to hemostasis, so they are not necessarily the best type of dressings to use when wounds are oozing blood.\textsuperscript{30} Hydrofiber dressings are made up of carboxymethylcellulose, which acts as an absorptive agent to collect exudate as it comes from the wound bed. When placed in the wound bed, the hydrofiber dressing wicks excess moisture away from the wound and collect it within the dressing, where it becomes a gel when it is exposed to the moisture.

In some cases, hydrofiber dressings should be moistened with saline before application; they come in sheets that can be cut to the appropriate size, which should be slightly larger than the wound bed. Some hydrofiber dressings are also impregnated with antibiotics, such as silver, so they work to prevent or treat infection while also controlling moisture levels in the wound.\textsuperscript{21,30}

*Additional considerations for the management of exudate*

After the nurse has applied a dressing to the wound, it may be helpful to then apply a barrier cream or emollient to the surrounding, intact skin in order to protect it from skin breakdown and to keep it healthy and dry. Management of exudate is important to keep surrounding
skin healthy and dry but it has also been shown to reduce instances of infection, reduce the number of dressing changes needed in a wound, and improve patient quality of life, according to a review from *Wounds International*.33

The amount of exudate produced by a wound is related to the size of the wound. As a wound heals, it typically tends to produce less exudate; however, a very large wound may produce large amounts of exudate that require special dressings for control of fluid volume. For example, a patient who has been burned may have one or more large wounds that cover a significant area of the body. Because of the size of these wounds, they typically produce much more exudate that needs to be controlled and maintained when compared to another type of wound, such as a small pressure ulcer on the heel.33 If a patient has a wound with a significant amount of exudate, the nurse should work with the provider to determine the most appropriate type of dressing that will absorb excess fluid and keep the wound clean and moist.

There are many indicators that demonstrate that exudate is not being well controlled, such as saturated dressings or changes in the appearance of the dressing on the outside of the wound, delayed wound healing, skin breakdown on the areas surrounding the wound, patient pain and embarrassment over the appearance, odor, or characteristics of the wound, electrolyte imbalances in the patient from loss of electrolytes and protein in the exudate, the need for frequent dressing changes, and soiling of clothing and linens near the wound dressing.
Control of exudate is important to prevent skin breakdown and further destruction of wound tissue that cannot only delay healing but can cause the condition to worsen. While it is important to keep the wound bed moist, the balance of moisture is imperative to maintain, as too little moisture, such as by absorbing every ounce of exudate until the wound bed is completely dry, will delay healing and can cause tissue damage. Alternatively, too much moisture and lack of exudate control will keep the wound and surrounding tissue too moist, which can lead to softening of the skin, maceration, and skin breakdown.

**Summary**

A treatment plan for wound care revolves around the assessment and preparation of the wound for successful treatment and healing. Prevention of wound development is primary to safe and appropriate skin care. Early recognition of wound development allows for prompt assessment and interventions to prepare the wound through cleaning and removal of unviable tissue through a type of debridement. There are various types of debridement that may be initiated depending on the wound type and the level of professional skill and training required for the debridement procedure.

Wound protection through initial selection of the type of dressing requires knowledge of the varied wound products. The management of exudate is basic to wound healing. Exudate plays a critical role in keeping the wound bed moist to facilitate migration of skin cells across the wound during the healing process. The primary goal in the initial treatment of a wound is to promote healthy tissue within the wound bed and wound healing through ongoing treatment and therapy. Wound Care Part III discusses ongoing and advanced treatment and
therapy options used to promote wound healing. It's important to assess all factors that could affect the process of wound healing, such as wound bed moisture levels and new tissue growth; and, to show vigilance in the prevention of infection.

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1. In the initial assessment the nurse should determine and document:
   a. underlying conditions that could delay wound healing
   b. the patient’s pain level
   c. improper treatment strategies of the wound care team
   d. answers a and b above

2. True or False. Dry necrotic should be removed from the wound during debridement, and is recognized by a yellow or gray appearance.
   a. True
   b. False

3. Biological debridement is:
   a. one of the oldest forms of debridement
   b. used on the wound surface to break down and loosen debris
   c. commonly associated with the use medical-grade maggots placed in the wound bed
   d. all of the above

4. The concept of wound bed preparation has been
   a. devised as a structured approach to promote healthy tissue within the wound bed
b. most often used for an acute wound with good healing potential

c. associated with high levels of infection

d. Answers a and b above

5. **TIME** is a mnemonic used to best manage a wound and to promote healing that stands for:
   a. Tunneling-Infection-Moisture-Edge of the Wound
   b. Tissue-Infection/Inflammation-Moisture-Edge of the Wound
   c. Tissue-Induration/Inflammation-Moisture-Edge of the Wound
   d. Tissue-Infection-Maggots-Elasticity of the tissue

6. The only exception to when eschar should be removed is when it is found intact on a
   a. *heel wound
   b. facial wound
   c. back wound
   d. anything other than a limb wound.

7. True or False. The Agency for Healthcare Research and Quality (AHRQ) has issued guidelines that state that it is better to leave eschar in place, rather than trying to remove it through debridement, when it is flat and well adhered to the heel, without evidence of infection or disease.
   b. False.

8. Impregnated dressings are often applied _____________.
   a. twice per day.
   b. *once per day.
   c. once every other day.
   d. once every three days.
9. _________________ may carry a risk of infection.
   a. *whirlpool tubs.
   b. dry gauze dressings changed daily.
   c. 75% impregnated dressings
   d. Both b and c above.

10. True or False. Alginate dressings require dryness in the wound bed to maintain its gel-like features during wound treatment.
    a. True.
    b. *False.

11. When assessing erythema, the nurse should note the reddened area for
    a. size.
    b. capillary refill.
    c. *Both a and b above.
    d. size, depth and odor.

12. True or False. Identification of a foreign object may require X-Ray or MRI to diagnose cause of a wound.
    b. False.

13. Pulsatile lavage with suction can be used on
    a. *many different types of wounds
    b. only deep types of wounds
    c. requires full body submersion in a tub of water
    d. most deep wounds except for diabetic wounds or surgical wounds.

14. Collagenase, Panafil®, and papain and urea (Accuzyme®) are examples of
a. alginate dressings
b. *enzymatic debridement preparations

c. impregnated dressings
d. None of the above.

15. **Irrigation by hand with a syringe is type of debridement most effective for**

   a. infected wounds.
   
   b. wounds with thick eschar  
   
   c. *non-infected/minor wounds  
   
   d. site specific wounds, such as digits.

16. **Autolytic debridement is**

   a. a very painful form of debridement.  
   
   b. *a painless forms of removing dead tissue.  
   
   c. faster than other forms of debridement.  
   
   d. very effective with a low infection rate.

17. **A wound requires a ____________ wound bed in order to best promote healing.**

   a. *moist  
   
   b. dry  
   
   c. closed  
   
   d. < 5 cm diameter

18. ____________dressings are another form of dressing material that is designed to absorb exudate from the wound bed when the dressing is placed on the wound.

   a. *Hydrocolloid  
   
   b. Gauze  
   
   c. Seaweed  
   
   d. Impregnated
19. A study showed that pulsatile lavage with suction had an over _____ percent increase in granulation tissue formation per week when compared to 4.8 percent increase among those who used whirlpool therapy.
   a.  7.5
   b. *12
   c.  25
   d.  40

20. _______________ is an essential component of epithelialization and ____________ wounds heal at a faster rate.
   a. Dryness; Open
   b. *Moisture; Open
   c. Granulation; Dressed
   d. Cleaning; Dressed

21. Unlike alginate dressings, hydrofiber dressings
   a. contribute to hemostasis
   b. *do not contribute to hemostasis
   c. are the best type of dressings for wounds that ooze blood.
   d. Both a and c above.

22. Irrigation of a wound must be done at a pressure between ________________ in order to be effective.
   a. 3 psi and 5 psi
   b. 5 psi an 10 psi
   c. *4 psi and 15 psi
   d. 2.5 and 15 psi

23. One of the most common forms of testing for sensation is by using the
a. Sharp needle poke test.
b. *monofilament test.
c. Pinch test.
d. Ice to skin test.

24. **If a patient does not have sensation during properly performed testing, this may indicate**
   a. wound infection formation.
   b. *neuropathy
   c. blood clot formation
   d. that the wound is healing.

25. **A common form of biological debridement is the use of**
   a. medical-grade seaweed granules.
   b. medical-grade sponge.
   c. *medical-grade maggots.
   d. medical grade charcoal granules.

26. **When signs of wound infection occur, the patient may benefit from**
   a. a short-term antimicrobial wound cleansing product.
   b. Dakin’s solution.
   c. hydrogen peroxide.
   d. *All of the above.

27. **Foam dressings are**
   a. *thickened dressings with foam padding for wound protection.
b. used for specific superficial to moderate thickness wounds only.
c. are not intended to fill space
d. must be changed daily.

28. True or False. Preparation of the wound bed focuses on maintaining moisture levels in the wound bed, promoting new tissue growth, and preventing infection.
b. False.

29. Signs and symptoms associated with peripheral artery disease include
a. poor skin color
b. pain in the lower legs
c. intermittent claudication
d. *All of the above.

30. Surgical debridement is an effective form of wound management, and is used for
a. diabetic foot ulcers.
b. superficial burns.
c. cutting away of dead tissue.
d. *Both a and c above.

Correct Answers:

| 1. d | 11. c | 21. b |
| 2. b | 12. a | 22. c |
| 3. d | 13. a | 23. b |
| 4. a | 14. b | 24. b |
| 5. b | 15. c | 25. c |
| 6. a | 16. b | 26. d |
References Section

The reference section of in-text citations include published works intended as helpful material for further reading. Unpublished works and personal communications are not included in this section, although may appear within the study text.


http://woundeducators.com/wound-debridement-techniques-6-biological-debridement/


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