

MINISTRY OF HEALTH OF UKRAINE  
I. YA. HORBACHEVSKY TERNOPIL NATIONAL MEDICAL UNIVERSITY  
OF THE MINISTRY OF HEALTH OF UKRAINE

Olena Collins

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Master's thesis

**THE ROLE OF THE NURSE ON THE MANAGEMENT OF WOUNDS AND  
PRESSURE ULCERS**

(223 Nursing)

**Academic supervisor:**

PhD, Professor of higher nursing education, patient  
care, and clinical immunology Department Ivan  
Horbachevsky Ternopil State Medical University

Julia Danylevych

## ABSTRACT

A pressure ulcer is localized injury to the skin or underlying tissue, usually over a bony prominence, as a result of unrelieved pressure. Predisposing factors are classified as intrinsic or extrinsic. Prevention includes identifying at-risk persons and implementing specific prevention measures, such as following a patient repositioning schedule; keeping the head of the bed at the lowest safe elevation to prevent shear; using pressure-reducing surfaces; and assessing nutrition and providing supplementation, if needed. When an ulcer occurs, documentation of each ulcer (i.e., size, location, eschar and granulation tissue, exudate, odor, sinus tracts, undermining, and infection) and appropriate staging are essential to the wound assessment. Treatment involves management of local and distant infections, removal of necrotic tissue, maintenance of a moist environment for wound healing, and possible surgery. Debridement is indicated when necrotic tissue is present. Urgent sharp debridement should be performed if advancing cellulitis or sepsis occurs. Mechanical, enzymatic, and autolytic debridement methods are non-urgent treatments. Wound cleansing, preferably with normal saline and appropriate dressing, is a mainstay of treatment for clean ulcers and after debridement. Bacterial load can be managed with cleansing. Typical antibiotics should be considered if there is no improvement in healing after 14 days. Systemic antibiotics are used in patients with advancing cellulitis, osteomyelitis, or systemic infection.

## INTRODUCTION

Education of patients, family members, caregivers and healthcare providers is the key to a proactive program of prevention and timely, appropriate intervention (Erwin-Toth and Stenger 2001). Wound management involves a comprehensive care plan with consideration of all factors contributing to and affecting the wound and the patient. No single discipline can meet all the needs of a patient with a wound. The best outcomes are generated by dedicated, well educated personnel from multiple disciplines working together for the common goal of holistic patient care (Gottrup, Nix & Bryant 2007).

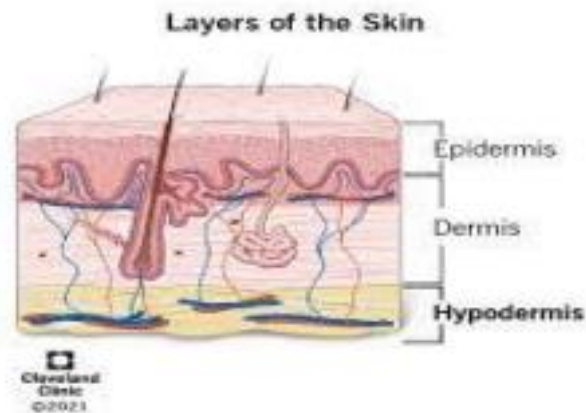
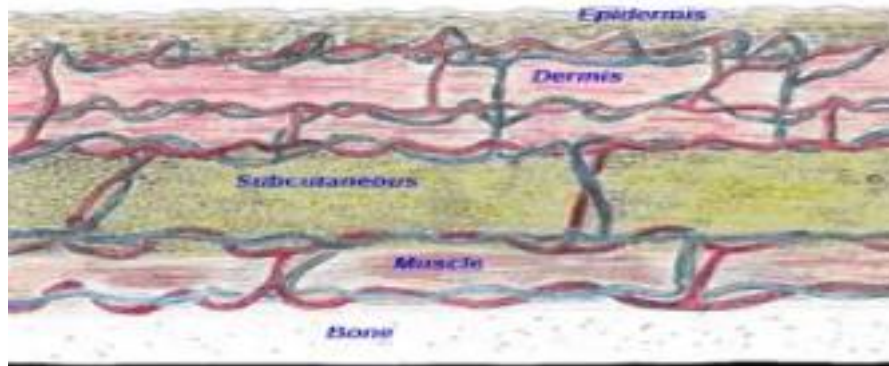
Pressure ulcers, also called decubitus ulcers, bedsores, or pressure sores, range in severity from reddening of the skin to severe, deep craters with exposed muscles or bone. Pressure ulcers significantly threaten the well-being of patients with limited mobility. Although 70% of ulcers occur in persons older than 65 years, younger patients with neurologic impairment or severe illness are also susceptible. Prevalence rates range from 4.7 to 32.1 percent in hospital settings and from 8.5 to 22 percent in long term care facilities.

### SIGNIFICANCE OF THE PROBLEM:

1. Pressure ulcer incidence is associated with an increased Morbidity & Mortality - near 70% die within six months (Brown 2003).
2. Pressure ulcer incidence is increasing in long term care and hospital setting (Horn et al. 2004).
3. Reduction of pressure ulcers prevalence in long term care and hospital setting is a Healthy People 2010 initiative.
4. Pressure ulcer incidence has been determined to be a quality of care indicator for long term care and hospital setting facilities and compliance is regulated by the Center for Medicare and Medicaid (CMS 2004).
5. Lawsuits due to pressure ulcers are on the rise (Voss et al. 2005).
6. Leg ulcers affect more individuals than pressure ulcers; one in four Americans over the age of 65 will develop a leg ulcer in their lifetime (Wound Ostomy and Continence Nurses Society 2002).
7. Skin and wound allegations are the second leading cause of litigation in long term care and

hospital setting (Chizek 2003).

## ANATOMY OF NORMAL SKIN



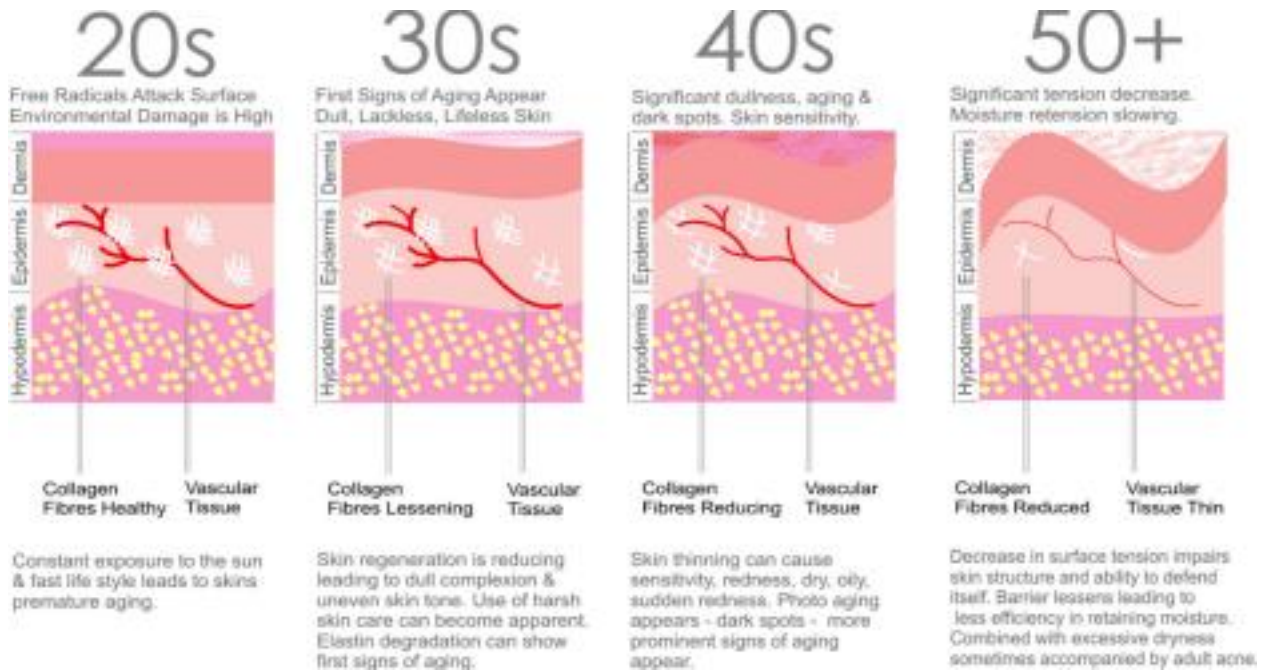
Age related skin changes include thinning and atrophy of epithelial and fatty layers. Additionally, collagen and elastin shrink and degenerate, and dermal fibroblasts cease replicating, all resulting in thinner, drier and less elastic skin that heals more slowly.

### Age-Related Changes in Skin

The diagram illustrates various age-related changes in the skin, with text boxes providing details for each:

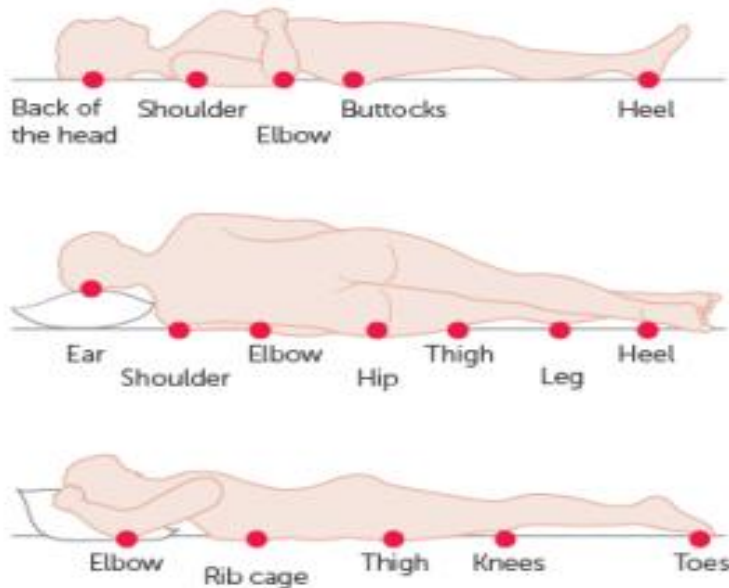
- Fewer Melanocytes:** Melanocyte activity declines, and in light-skinned individuals the skin becomes very pale. With less melanin in the skin, people become more sensitive to sun exposure and more likely to experience sunburn.
- Drier Epidermis:** Sebaceous gland secretion decreases, and the skin becomes dry and often scaly.
- Thinning Epidermis:** The epidermis thins as generative cell activity declines, and the connections between the epidermis and dermis weaken, making older people more prone to injury, skin tears, and skin infections. The metabolic activity of the skin decreases as well. The epidermis normally produces vitamin D<sub>3</sub>, and decreased production leads to muscle weakness and brittle bones.
- Diminished Immune Response:** The number of dendritic cells decreases to about half the levels seen at maturity (roughly age 25). This reduction in cells may decrease the quality of the immune response and further encourage skin damage and infection.
- Thinning Dermis:** The dermis becomes thinner and has fewer elastic fibers, making the integument weaker and less resilient. The results—sagging and wrinkling—are most pronounced in body regions with the most exposure to the sun.
- Decreased Perspiration:** Merocrine sweat glands become less active, and with impaired perspiration, older people cannot lose heat as fast as younger people. Thus, the elderly are at greater risk of overheating in warm environments.
- Altered Hair and Fat Distribution:** With declining levels of sex hormones, differences in secondary sexual characteristics with respect to hair distribution and body-fat distribution begin to fade. As a consequence, people age 50–100 of both sexes tend to look alike.
- Fewer Active Follicles:** Hair follicles stop functioning or produce thinner, finer hairs. With decreased melanocyte activity, these hairs are gray or white.
- Slower Skin Repair:** Skin repairs proceed more slowly. Thus, someone who gets an uninfected blister might take three to four weeks in a young adult, the same repairs could take six to eight weeks at age 65–75.
- Reduced Blood Supply:** A reduction in dermal blood supply cools the skin, which can stimulate thermoreceptors and make a person feel cold even in a warm room. Reduced circulation and sweat gland function in the elderly lessens their ability to lose body heat, which can allow body temperatures to soar dangerously high with overexertion.

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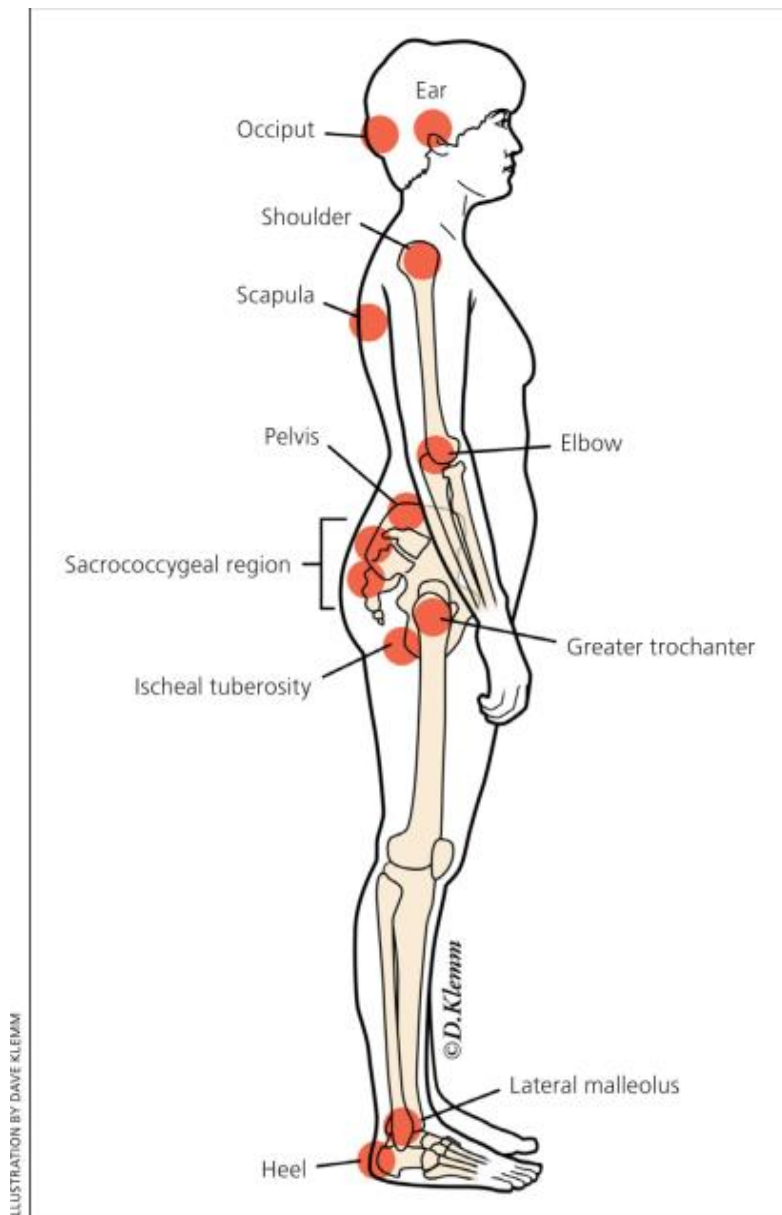


## ETIOLOGY

Pressure ulcer is the result of damage caused by pressure over time causing an ischemia of underlying structures. Bony prominences are the most common sites and causes.



Cancer Research UK  
Original diagram by the Tissue Viability Society



There are many risk factors that contribute to the development of pressure ulcers. CMS (2004) recommends patients in long term care facilities and hospital settings be assessed for risk on admission, weekly for the first four weeks then reassessed quarterly.

Risk assessment begins by identifying risk factors and inspecting the skin. Risk factors for pressure ulcers are classified as intrinsic or extrinsic. Caregivers should be educated about risk assessment and prevention and should inspect often to prevent pressure ulcers or identify them at early stages. Risk assessment scales may further heighten awareness, but have limited predictive ability and no proven effect on pressure ulcers prevention. The Braden Scale is the most commonly used tool for predicting pressure ulcer risk.

## INTRINSIC CONTRIBUTING FACTORS INCLUDE:

### 1) Limited mobility:

- Spinal cord injury
- Cerebrovascular accident
- Progressive neurologic disorders (Parkinson disease, Alzheimer disease, multiple sclerosis)
- Pain
- Fractures
- Post Surgical procedures
- Coma or sedation
- Arthropathies

### 2) Malnutrition

### 3) Anorexia

### 4) Dehydration

### 5) Chronic conditions

### 6) Decreased LOC

### 7) Infections

### 8) Advance age

### 9) Steroid use

### 10) Poor dentition

### 11) Dietary restrictions

### 12) Weak sense of smell or taste

### 13) Pressure ulcer present.

## EXTERNAL CONTRIBUTING FACTORS:

### 1) Pressure

- 2) Friction
- 3) Moisture
- 4) Incontinence
- 5) Shear.

### PREVENTION OF PRESSURE ULCERS

Proper skin care is crucial and involves inspecting skin daily and an individualized bathing schedule, using warm (not cold) water and mild soap. Avoid massage over bony prominences and use lubricants if skin is dry.

Managing pressure is also necessary and the following is recommended: - Provide appropriate support surface

- Reposition every 2 hours in bed and every hour when in chair - Off-load heels - use pillows or positioning boot
- Use pillow between legs for side lying
- Do not position directly on trochanter
- Do not use doughnut-type devices

Friction and shear need to be reduced. Friction is the mechanical force exerted when skin is dragged against a coarse surface while shear is the mechanical force caused by the interplay of gravity and friction. It exerts a force parallel to the skin resulting in angulation and stretching of blood vessels within the sub-dermal tissues, causing thrombosis and cellular death. This manifests as necrosis and undermining of the deepest layers (Pieper 2007).

To reduce friction and shear, the following is recommended: - Use draw sheets for repositioning

- Encourage use of trapeze if possible
- Keep head of bed elevated 30 degree if tolerated
- Elevate foot of bed slightly, if conditions permits
- Use pillow or wedge to support hip for 30 degree side-lying, lateral position
- Utilize lifts and transfer devices



- Rehabilitation or restorative care if indicated

Manage incontinence:

- Timely cleansing
- Apply barrier ointment to intact skin
- If skin is red or denuded use a paste
- Use appropriate incontinence disposables
- Apply fecal incontinence pouch if needed

Preventive measures should be used in at-risk patients. Pressure reduction to preserve microcirculation is a mainstay of preventive therapy. There is no evidence to determine an optimal patient repositioning schedule, and schedules may need to be determined empirically. According to recommendations from the Agency for HealthCare Policy and Research, patients who are bedridden should be repositioned every 2 hours. To minimize shear, the head of the bed should not be elevated more than 30 degrees and should be maintained at the lowest degree of elevation needed to prevent other medical complications, such as aspiration and worsening congestive heart failure symptoms. Some patients can reduce pressure by repositioning themselves using manual aids, such as a trapeze bar.

Pressure-reducing devices can reduce pressure or relieve pressure (i.e., lower tissue pressure to less than the capillary closing pressure of 32 mm Hg) and are classified as static (stationary) or dynamic. Static devices include foam, water, gel, and air mattresses or mattress overlays. Dynamic devices, such as alternating pressure devices and low-air-loss and air-fluidized surfaces, use a power source to redistribute localized pressure. Dynamic devices are generally noisy and more expensive than static

Devices. Pressure-reducing surfaces lower ulcer incidence by 60% compared with standard hospital mattresses, although there is no clear difference among pressure-reducing devices. The benefit of dynamic versus static surfaces is unclear. Dynamic surfaces should be considered if a patient cannot reposition him- or herself independently or if the patient has a poorly healing ulcer. If there is less than 1 inch of material between the bed and pressure ulcer when feeling beneath the static surface, the device

may not be effective and an alternative should be considered. Other pressure-reducing devices include chair cushions and pillows, foam wedges, and materials that are placed between the knees or used to relieve heel pressure. Ring cushions can cause pressure points and should not be used.

Other preventive interventions include nutritional and skin care assessments. Although poor nutrition is associated with pressure ulcers, a causal relationship has not been established. One large trial has shown that oral nutritional supplementation reduces risk, but several other trials have not. A Cochrane review concluded that there is insufficient evidence on the relationship between nutrition and pressure ulcer prevention. A more recent meta-analysis concluded that dietitian consultation and the use of skin moisturizers are reasonable preventive measures. However, the role of bactericidal and growth factor preparations is unclear. Continence care programs have not proved successful. Despite proper risk assessment and preventive interventions, some pressure ulcers are unavoidable.

## ASSESSMENT

Assessment of an established pressure ulcer involves a complete medical evaluation of the patient. A comprehensive history includes the onset and duration of ulcers, previous wound care, risk factors, and a list of healthy problems and medications. Other factors such as psychological health, behavioral and cognitive status, social and financial resources, and access to caregivers are critical in the initial assessment and may influence treatment plans. The presence of a pressure ulcer may indicate that the patient does not have access to adequate services or support. The patient may need more intensive support services, or care-givers may need more training, respite, or assistance with lifting and turning the patient. Patients with communication or sensory disorders are particularly vulnerable to pressure ulcers because they may not feel discomfort or may express discomfort in atypical ways.

## HOLISTIC ASSESSMENT

Holistic assessment of a patient with a wound includes systemic factors, psychosocial factors, and local factors. Systemic factors assess etiology, duration, and decreased

oxygenation or perfusion to the wound as well as comorbid conditions, medications, and host infection of the patient.

Psychosocial factors to address in a holistic assessment include the patient's knowledge deficits, cultural beliefs and financial constraints including a lack of or insufficient health insurance. Additionally, it is necessary to assess whether the patient has impaired access to appropriate resources and any social support -family, significant others or community resources.

Local factors to assess include desiccation, excess exudates, low wound temperature, recurrent trauma (also friction & pressure), infection, and necrosis and foreign bodies.

## WOUND ASSESSMENT

Assessment of the wound should be done weekly and be used to drive treatment decisions. Wound assessment includes:

### 1) Location

Documentation of location including which extremity, nearest bony prominence or anatomical landmark is necessary for appropriate monitoring of wound (Hess 2005).

### 2) Class/Stage

Pressure ulcers are classified by staging as defined by the National Pressure Ulcer Advisory Panel. Originally there were 4 stages but in February 2007 these stages were revised and 2 more categories were added, deep tissue injury and unstageable.

### 3) Class

There are a number of classification and grading systems in wound care but the simplest method uses the terms partial or full thickness:

- Partial thickness wound: damage to epidermis and/or dermis only - Full thickness wound: damage to subcutaneous layer or deeper

### 4) Size Measurement:

- Length - from top edge to the bottom edge (head to toe) at longest point

- Width - from edge to edge perpendicular to the length at widest point

- Depth - straight in, perpendicular to the base, at deepest point

### 5) Undermining/Tunneling:

- Using the "clock concept" (12 o'clock is in the direction of the patient's head and 6 o'clock

is toward the feet)

- Where does it start and where does it end (clockwise direction) - Tunnel depth is at its deepest point

- Location of deepest point

#### 6) Base Tissue

Assessing the appearance of tissue in the wound bed is critical for determining appropriate treatment strategies and to evaluate progress toward healing (Keast et al. 2004).

- Necrosis/Eschar: black, brown or tan devitalized tissue that adheres to the wound bed or edges and may be firmer or softer than the surrounding skin.

- Slough: soft, moist avascular tissue that adheres to the wound bed in strings or thick clumps; may be white, yellow, tan or green. - Granulation: pink/red moist tissue comprised of new blood vessels, collagen fibers and fibroblasts. Typically the surface is shiny and moist with a granular appearance.

- Epithelium: new pink and shin tissue/skin that grows in from the edges or as islands on the wound surface.

#### 7) Exudates:

Amount:

- none: base and dressing dry

- slight: small amount in center of dressing

- moderate: contained within the dressing

- copious: extends beyond dressing onto clothing or bed linen Type:

- serous: thin, watery, clear or straw colored

- serosanguineous: thin, pale red to pink

- purulent: thick, opaque, tan, yellow to green and may have an offensive odor

- consider treatment modality and frequency of dressing changes 8) Odor

Assess after cleansing (Garcia & Thomas 2008). Extreme malodor, especially if accompanied by purulent exudates, is suggestive of infection. Most wounds do have an odor. The type of dressing can affect odor as well as hygiene and the presence of nonviable tissue (Keast et al.

2004). 9) Edge/ Perimeter:

- Describe wound edges (approximated, rolled, calloused) - Describe periwound skin (indurated, erythematous, macerated, healthy)

- Describe presence of excoriation, denudement, erosion, papules, pustules or other lesions

Induration - abnormal hardening of the tissue caused by consolidation of edema; this may be a sign of underlying infection.

Erythema - redness of surrounding tissue may be normal in the inflammatory stage of healing. However, if accompanied by an increase in temperature of tissue, exudates or pain may also be a sign of infection.

Maceration - caused by excessive moisture. Tissue loses its pigmentation (appears lucid or turns white) and becomes soft and friable. 10) Pain

A critical aspect of local wound assessment both from the perspective of the patient and as a clinical indicator of infection (Reddy, Keast, Fowler & Sibbald 2003). Include location, type/cause, rating (use validated scale), patient description and nonverbal signs.

11) Evaluation of infection (signs and symptoms):

- Redness, warmth and induration of adjacent tissue

- Pain or tenderness

- Dysmorphic and/or friable granulation

- Unusual odor

- Purulent exudates

- Systemic signs (fever, chills, sweats).

When to culture:

- When signs of infection are present or when a clean wound fails to heal

- Always cleanse wound first

- Semi-quantitative swab collection is acceptable

- Quantitative biopsy is “gold standards” but expensive and invasive.

## ADDITIONAL ASSESSMENT FOR LOWER EXTREMITY WOUNDS:

### 1) Physical exam:

- Edema: extent and persistence of pitting (+1 - +4)
- Color changes: dependent rubor (purple-red discoloration) or elevation pallor (paling of the skin when leg raised to 60 degree angle for 15-60 seconds)
- Distal pulse: amplitude on palpation (0-4+)
- Neuropathy: skin changes (dryness, cracking), structural abnormalities, and loss of protective sensation (10gm monofilament exam - testing 10 points)

### 2) Diagnostic tests:

- Ankle-brachial index: comparison of perfusion pressures - Pulse volume recording: perfusion volume
- Doppler waveforms: single vessel flow
- Duplex imaging: ultrasound imaging for venous disease (also test for DVT)
- Transcutaneous oxygen pressure

## PRESSURE ULCERS STAGING:

### Stage 1

- intact skin with non-blanchable redness of a localized area, usually over a bony prominence. Darkly pigmented skin may not have visible blanching; its color may differ from the surrounding area.



## Stage 2

- partial thickness loss of derms presenting as a shallow open ulcer with a red/pink wound bed, without slough. May also present as an intact or open/ruptured serum filled blister.



## Stage 3

- full thickness skin loss. Subcutaneous fat may be visible but bone, tendon or muscle are not exposed. Slough may be present but does not obscure the depth of tissue loss. May include undermining/tunneling.



## Stage 4

- full thickness skin loss with exposed bone, tendon or muscle. Slough or eschar may be present on some parts of the wound bed. Often include undermining and tunneling.



### 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.



### Suspected Deep Tissue Injury

- Purple or maroon localized area of discolored intact skin or blood-filled blister due to damage of underlying soft tissue from pressure and/or shear. The area may be preceded by tissue that is painful, firm, mushy, boggy, warmer or cooler as compared to adjacent

tissue.

### DIFFERENT PRESSURE ULCERS:

1) Medical Device Related Pressure Injury - result from the use of devices designed and applied for diagnostic or therapeutic purposes. The resultant pressure injury generally conforms to the pattern or shape of the device. The injury should be staged using the staging system.



2) Mucosal Membrane Pressure injury - is found on mucous membranes with a history of a medical device in use at the location of the injury. Due to the anatomy of the tissue these ulcers cannot be staged.

3) Unavoidable Pressure Ulcer defines when the individual developed a pressure ulcer even though the provider had evaluated the individual's clinical condition and pressure ulcer risk factors: defines and implemented interventions that are consistent with individual needs, goals, and recognized standards of practice; monitoring and evaluated the impact of the interventions and revised the approaches as appropriate.

4) Kennedy Terminal Ulcer - can develop from 6 weeks to 2-3 days before death. These ulcers present as pear-shaped purple areas of skin with irregular borders that are often found in the sacrococcygeal areas. They are not considered Pressure injury related.

## WHAT IS NOT A PRESSURE ULCER

### 1. Skin tear

- is a wound that happens when the layers of skin separate or peel back. They can happen as a result of bumping something, dressing changes, or washing or drying the skin harshly.

Skin tear prevention:

- Wash with gentle cleansing products
- Use emollients on skin
- Ensure adequate hydration/nutrition
- Transfer techniques to avoid friction/shear

- Support dangling extremities
- Avoid use of adhesive products on skin.

## 2. Venous Stasis Ulcer

Venous ulcers typically occur because of damage to the valves inside the leg veins. These valves control the blood pressure inside the veins. They allow it to drop when a patient walks. If the blood pressure inside leg veins doesn't fall while walking, the condition is called sustained venous hypertension. That increase in blood pressure causes ulcers to form on ankles. Venous ulcers may also be caused by other problems with leg veins. These include:

- Varicose veins: these are large, bulging leg veins. They occur when valves in the leg veins don't work well, allowing blood to collect (pool) in the lower leg.
- Chronic vein insufficiency: like varicose veins, this condition occurs when leg veins can't pump blood back up to your heart. Blood then pools in lower legs, causing legs to swell. Since the blood can't flow well in the legs, the swelling may be extreme. This extreme swelling can put so much pressure on skin that venous ulcers form.

Venous ulcers tend to vary in appearance. They are usually deep red and may have an irregular shape. The wound itself may be more shallow. Venous ulcers are often painless unless they are infected. Other distinguishing characteristics might include:

- Inflammation
- Swelling
- Itchy skin
- Scabbing or flaking
- Brown or black skin
- discharge

Venous Ulcer Prevention (Vonden & Vonden 2006):

- Use compression stockings (contraindicated if  $ABI < 0.5$ ) - Elevation of affected leg above level of the heart at rest - Avoid use of products likely to be sensitizers (lanolin, fragrance) -

Avoid trauma to leg

- Calf muscle strengthening
- Regular follow up to monitor ABI

### 3. Arterial Ulcer

Arterial ulcers are painful injuries in skin caused by poor circulation. Arterial ulcers typically happen when blood is unable to flow into the lower extremities. When the skin and underlying tissue are deprived

of oxygen, the tissue starts to die off and form an open wound. Arterial wounds tend to be extremely painful and uncomfortable. Due to poor circulation, they may heal slowly. The lack of circulation can also make it difficult for the red cells to drive the nutrients needed to heal. Without oxygen-rich blood, white blood cells may not be able to fight off bacteria, making the wound more likely to become infected. If left untreated, arterial ulcers can lead to more serious diseases or complications, including infection, tissue necrosis, and, in extreme cases, amputation.

Symptoms: arterial wounds typically have a “punched-out” look. They may be round in shape with well-defined margins - meaning the sore may be deeper in the skin than the surrounding area of healthy skin.

They are often found on the outer ankle, on the heels, on the toes, or in between the toes. They can also happen in areas where there’s pressure from walking, exercising, or wearing footwear. Arterial ulcers also tend to have a distinct color. The wound itself typically doesn’t bleed and may be black, grey, brown, or yellow. The limb may turn red when dangled downward, and become pale when propped up or elevated. In addition, patient may have:

- There is little to no hair growth on the affected limb - The limb feels cold to the touch with little to no pulse. - Skin and nails appearing shiny, thin, and dry
- Skin feels tight or taut

Causes:

- Poor circulation
- Arteriosclerosis or atherosclerosis

- Venous insufficiency, when blood in leg veins doesn't flow back up to the heart
- Diabetes
- Kidney failure
- Hypertension
- Lying or sitting in one position for too long
- High cholesterol
- Heart disease
- Sickle cell anemia
- Obesity

Prevention of limb loss in Lower extremity arterial disease (Hopf et al. 2006):

- Consistent use of protective footwear
- Avoid friction, shear or trauma to feet/legs
- Apply emollients to keep skin pliable
- Avoid cold, caffeine, nicotine and constrictive garments - Planned graduated walking program
- No use of thermal devices
- Routine professional foot care

#### 4. Diabetic or neuropathic ulcers

A diabetic foot ulcer is an open sore or wound that occurs in approximately 15 percent of patients with diabetes, and is commonly located on the bottom of the foot. Of those who develop a foot ulcer, six percent will be hospitalized due to infection or other ulcer-related complications. Diabetes is the leading cause of nontraumatic lower extremity amputations in the United States, and approximately 14 to 24 percent of patients with diabetes who develop a foot ulcer have an amputation. Research, however, has shown that the development of a foot ulcer is preventable.

Ulcers form due to a combination of factors, such as lack of feeling in the foot, poor

circulation, foot deformities, irritation (such as friction or pressure), and trauma, as well as duration of diabetes. Patients who have diabetes for many years can develop neuropathy, a reduced or complete lack of ability to feel pain in the feet due to nerve damage caused by elevated blood glucose levels over time. The nerve damage often can occur without pain and one may not even be aware of the problem. Your podiatric physician can test feet for neuropathy with a simple and painless tool called a monofilament.

Vascular disease can complicate a foot ulcer, reducing the body's ability to heal and increasing the risk for an infection. Elevations in blood glucose can reduce the body's ability to fight off a potential infection and also retard healing.

Prevention of diabetic/ neuropathic ulcers (Steed et al. 2006): - Control diabetes

- Daily care and inspection of feet
- Wear well-fitting protective footwear
- Avoid application of extreme heat or cold
- Avoid use of OTC meds for corns/callus
- Avoid cold, caffeine, nicotine and constrictive garments - Routine professional foot care

## WOUND HEALING

### PHASES OF WOUND HEALING

#### 1. Inflammation phase:

- 0 - 3 days
- Hemostasis (bleeding stops)
- Inflammation (redness, swelling, warmth and pain may be present)
- Phagocytosis (WBC's engulf bacteria and foreign debris) - Growth factor stimulation

#### 2. Proliferation :

- 3 - 21 days
- Angiogenesis (new blood vessels develop)
- Collagen synthesis (protein fibers)

- Granulation formation
  - Epithelization
  - Contraction
3. Maturation phase:
- 21 days - 2 years
  - Reorganization of collagen
  - Tensile strength improves (up to 80% of original)

The healing process varies depending on the stage of the pressure ulcer. Stage 1 & 2 pressure ulcers and partial thickness wounds heal by tissue regeneration. Stage 3 & 4 pressure ulcers and full thickness wounds heal by scar formation and contraction. Data indicate a 20% reduction in wound size over 2 weeks is a reliable predictive indicator of healing.

#### OPTIMIZATION OF WOUND ENVIRONMENT

Nutritional evaluation:

Despite the consensus that adequate nutrition is important in wound healing, documentation of its effect on ulcer healing is limited; recommendations are based on observational evidence and expert opinion. Nutritional screening is part of the general evaluation of patients with pressure ulcers. In patients who are malnourished, dietary consultation is recommended and a swallowing evaluation should be considered. Intervention should include encouraging adequate dietary intake using the patient's favorite foods, mealtime assistance, and snacks throughout the day. High-calorie foods and supplements should be used to prevent malnutrition. If oral dietary intake is inadequate or impractical, enteral or parenteral feeding should be considered, if compatible with the patient's wishes, to achieve positive nitrogen balance (approximately 30 to 35 calories per kg per day and 1.25 to 1.5 g of protein per kg per day). Protein, Vitamin C, and Zinc supplements should be considered if intake is insufficient and deficiency is present, although data supporting their effectiveness in accelerating healing have been inconsistent.

### 1. Manage comorbid conditions:

- Optimize cardiovascular and pulmonary functioning
- Support tissue oxygenation
- Maintain blood glucose level

### 2. Adequate nutrition & hydration:

- Encourage protein, calorie-dense foods and fluids, unless contraindicated
- Monitor intake, weight and skin turgor
- Assess and address impairments in dentition and swallowing - Assist patients with meals if needed
- Dietary consult

### 3. Removal of Nonviable Tissue (Debridement):

Necrotic tissue promotes bacterial growth and impairs wound healing, and it should be debrided until eschar is removed and granulation tissue is present.

Removes growth medium, controls/prevents infection, defines extent of the wound and stimulates the healing process.

#### Contraindications:

- Dry stable eschar
- Ischemic wounds with dry gangrene
- Coagulation disorders

#### Types of debridement:

##### 1) Autolytic debridement:

- Lysis of necrotic tissue by the body's white blood cells and enzymes - Leaves healthy tissue intact
- Naturally occurring physiological process that occurs in a moist environment

##### 2) Chemical debridement - accomplished by topical application of enzymes:

- Collagenase (Santyl)
- Papain with urea (Accuzyme, Ethezyme, Gladase)
- Denaturing agents are also used: Sodium hypochlorite (Clorpactin, Dakin's). This is

nonselective method

### 3) Mechanical debridement:

- Wet to dry dressing (not recommended as it is nonselective, causes repeated trauma to the wound bed and is frequently painful)
- Whirlpool (risk of cross contamination and contraindicated for some wounds such as venous stasis)
- Pulse lavage (requires skilled clinician, rigorous infection control precautions and may be cost prohibitive)

### 4) Sharp debridement:

- Conservative, sequential removal of avascular tissue, using sterile scalpel and mouse-tooth forceps
- Check for bleeding or clotting problem
- Premedicate if wound is painful
- Avoid local anesthetics

### 5) Surgical debridement

#### 4. Maintain Moisture Balance:

- Dressing with a high moisture vapor transmission rate will allow moisture to escape and evaporate in minimally exudative wounds - Moderate to heavily draining wounds require absorptive dressing

#### 5. Eliminate or minimize pain:

- Address the cause (remove the source if external, treat the infection or medicate based on physiological stimulus)
- Pharmacological strategies - long acting drugs preferable, use breakthrough doses and prevent adverse effects
- Incorporate psycho-social, spiritual and culturally sensitive support
- Appropriate dressing selection, gentle removal and “Time Out” during treatment administration

#### 6. Cleanse:



Wounds should be cleansed initially and with each dressing change. Use of a 35-ml syringe and 19-gauge angiocatheter provides a degree of force that is effective yet safe; use of normal saline is preferred. Wound cleansing with antiseptic agents (e.g., povidone-iodine - Betadine, hydrogen peroxide, acetic acid) should be avoided because they destroy granulation tissue.

- Normal saline is the recommended solution
- Cavity wounds or tunnels may be irrigated
- Apply 4 - 15 (psi) pressure/force to remove debris without harming healthy tissue

#### 7. Prevent and manage infection:

- Use barrier products to protect from adhesives and moisture
- Change dressings at appropriate intervals to avoid pooling of exudates

#### 8. Prevent and manage infection:

critical colonization can result in failure to heal, poor quality tissue, increased friability and increased drainage; determining whether the wound has a bacterial imbalance (critical colonization and infection) is of primary importance to healing.

- Superficial increased bacterial burden - topical agent with low toxicity, not likely to cause allergy and not associated with bacterial resistance - Surrounding skin compartment infection - topical agent, swab culture and appropriate oral antibiotic agent
- Deep wound infection or osteomyelitis - parenteral antibiotics; also consider tissue culture and additional lab testing

Urinary catheters or rectal tubes may be needed to prevent bacterial infection from feces or urine. Pressure ulcers are invariably colonized with bacteria; however, wound cleansing and debridement minimize bacteria load. A trial of topical antibiotics, such as Silver Sulfadiazine cream (Silvadene), should be used for up to two weeks for clean ulcers that are not healing properly after two to four weeks of optimal wound care. Quantitative bacteria tissue cultures should be performed for nonhealing ulcers after a trial of topical antibiotics or if there are signs of infection (e. g., increased drainage, odor, surrounding erythema, pain, warmth). A superficial swab specimen may be used ; however, a needle aspiration or ulcer biopsy (preferred) is more clinically significant. Systemic antibiotics are not recommended unless

there is evidence of advancing cellulitis, osteomyelitis, and bacteremia.

9. Control odor:

- Appropriate frequency of dressing changes
- Clearance with each dressing change
- Debridement and antimicrobials as indicated
- Charcoal dressing

## MANAGEMENT

The management of pressure ulcers is interdisciplinary, including primary care physicians, dermatologist, infectious disease consultants, social workers, psychologists, dietitians, podiatrists, home and wound-care nurses, rehabilitation professionals, and surgeons. The basic components of pressure ulcer management are reducing or relieving pressure on the skin, debriding necrotic tissue, cleansing the wound, managing bacterial load and colonization, and selecting a wound dressing.

The pressure-reducing devices used in preventive care also apply to treatment. Static devices are useful in a patient who can change positions independently. A low-air-loss or air-fluidized bed may be necessary for patients with multiple large or a nonhealing ulcer, after flap surgeries, or when static devices are not effective. No one device is preferred.

### TREATMENT OF WOUNDS AND PRESSURE ULCERS 1. Objectives and Plans:

The provider's role is to assist in the development of a sustainable plan designed to help achieve mutually agreed upon goals. Treatment goals should be identified and can be curative or palliative. Palliative care objectives focus on symptom management and quality of life.

The objectives vary depending on the staging of the wound:

- Recently closed wound, stage 1 pressure ulcer, denuded or excoriated skin - encourage adequate perfusion and protect from further tissue damage
- Stage 2 or PTW - encourage regeneration of tissue and protect wound surface
- Stage 3/4 - promote granulation and contraction (epithelization)

2. Palliative Wound Care (Bradley 2004):

- Symptoms management: elimination or reduction of pain, control of odor and exudates,

treatment/prevention of infection

- Quality of life objectives: restoration of some sense of control, maintenance of function and independence, control of caregiver burden, reduction of distress for patient and family.

3. Factors for dressing selection:

1) Etiology - the cause of the wound directly affects dressing choices: - Arterial ulcers generally require moisture

- Neuropathic wounds often have tunnels which require packing strips - Pressure ulcers often have undermining which requires packing to fill dead space

- Venous insufficiency requires compression and exudate management 2) Wound history:

- Duration and course of wound healing

- Previous dressing/treatment strategies

- Health care providers consulted for wound

- success/challenges of previous treatment

3) Comorbid conditions:

- Diabetes - impairs wound healing, compromises perfusion and there is an increased risk of infection

- Mixed (arterial and venous disease) or CHF - compression may be contraindicated

- Obesity - increased risk of venous hypertension, infection and dehiscence (Wilson & Clark 2003)

- Immunosuppression - increases risk of infection and impairs healing 4) Size:

- Size and extent of tissue loss determines both the dressing size and material

- Wound packing needed for large wounds

- Exposed tendons/ligaments require moisture and protection 5) Base:

- Clean healthy granulation - keep moist

- Slough - debridement: if slight amount, keep moist to encourage autolysis; if there is a moderate amount, use a chemical or mechanical agent; for large amount, perform serial sharp debridement and may also use adjunct treatment with chemical or mechanical agent

- Epithelium - moist protective dressing

#### 6) Exudates:

- The volume and type of exudates are significant determinants in selection of primary and secondary dressings
- Adequate containment of exudate is critical to manage increased bioburden, protect the periwound skin, control odor and avoid overuse of wound care products (Rolstadt & Ovington 2007)

#### 7) Odor:

- Commonly associated with an infected wound
- Fungating lesions or wounds with high colonization due to necrotic debris may be malodorous
- Odor may cause considerable patient/caregiver stress and embarrassment

#### 8) Perimeter:

condition of the periwound skin influences the type of products used and may indicate the need for additional products

- Barrier are indicated for fragile or compromised skin - Maceration indicates need for exudate management - Topical treatment may be required for fungal infection

#### 9) Patient/caregiver needs:

- Who is providing the care?
- Do they have cognitive, dexterity or visual impairments to consider? - In what setting will the dressing be done?
- Are education and/or training needed?
- Are health care resources available?
- Is the treatment plan congruent with the culture/beliefs of the patient/caregiver?

#### 10) Access:

- Does the patient have access to supplies and services? - Are there financial constraints or limitations with insurance coverage? - Is transportation a factor in accessing care or supplies?

#### 4. Products categories:

There are a great deal of products on wound management. Below is a breakdown of products

by their role in wound and ulcer care.

### 1) Antimicrobials:

- Bacitracin - broad spectrum, low cost, apply daily
- Bactroban - excellent penetration, effective for MRSA; apply three times daily
- Cadexomer iodine - contains microspheres that absorb bacteria while slowly releasing iodine and is less toxic to granulation; broad spectrum, including virus and fungus; effective for up to 72 hours
- Nanocrystalline silver (Acticoat 7) - releases bactericidal concentrations up to 7 days; use sterile water, not saline; may stain skin;
- Polysporin powder - for Gram+ and Gram- organisms and Pseudomonas; may use with Santyl; apply daily
- Silver sulfadiazine (Silvadene) cream - broad spectrum; cost effective, but requires prescription; avoid in sulfa allergy; apply daily
- Silver impregnated hydrofiber (Aquacel Ag) - highly absorbent; silver stays in dressing, very little is deposited into wound base; change when saturated
- Silver gel (SilvaSorb) - broad-spectrum and low toxicity; delivers time-released silver for 3 days
- Sodium hypochlorite (Clorpactin) - most appropriate for malodorous wounds with large amount of slough; twice daily for short term treatment only (less than 10 days)

### 2) Alginates:

- Highly absorbent and biodegradable
- Hemostatic properties
- Comfort to wound shape
- Maintains moist environment
- Virtually painless removal
- Examples - Calginate, Algisite

### 3) Barriers - primary function is protection:

- Clear liquid - Skin Prep, No Sting
- Petrolatum based - Vaseline, A&D
- Pastes - Critic aid, Sensicare
- Powders - Stomahesive, Karaya
- Solids - Stomahesive wafer, Eakin seal

#### 4) Charcoal

- Activated charcoal dressing absorb volatile odors and bacteria - Also available with silver which enhances bactericidal properties - Examples - Clinisorb, Actisorb

#### 5) Collagen - to stimulate wound repair and epithelial activity:

- Mild absorptive capacity
- Usually derived from bovine source ( check for patient sensitivity) - Examples - Fibracol, Profore

#### 6) Composite products:

Most have three layers: a semi-adherent or non-adherent layer to protect the wound bed, an absorbent layer and a moisture vapor permeable layer with an adhesive border. Examples - Covaderm Plus, Alldress, CovRsite

#### 7) Compression wraps:

- Applied by trained professionals to reduce edema by increasing venous return
- Available as two, three or four layers
- Degree of tension used in application is critical to effectiveness - Contraindicated in severe LEAD and CHF
- Examples - Coban, Coflex, Profore

#### 8) Foams:

- Made from hydrophilic polyurethane
- Highly absorbent
- Decreases maceration of periwound tissue
- May be used as primary dressing for treatment of hypergranulation - Examples - Biatain, Allevyn, Polyderm

### 9) Gauze:

- Material may include cotton, rayon and/or polyester
- Available in rolls, strips or squares
- Adheres to wound tissue
- May lint or shred if cut

### 10) Hydrocolloids:

- Contain carboxymethylcellulose (CMC) combined with pectin - Mildly absorbent
- Maintains moist wound surface
- May have an acrid odor when removed
- Not recommended for ischemic wounds (due to occlusive properties) - Examples - Duoderm, Tegaserb

### 11) Hydrofiber:

- Composed of highly absorbent CMC
- Absorbs twice as much as alginates
- Require secondary dressing
- Examples - Aquac

### 12) Hydrogels:

- Consists of a three dimensional cross-linked structure made up of hydrophilic polymers
- Increases moisture content
- Produces soothing effect
- Available as amorphous gel and sheets
- Examples - Intrasite, Vigilon

### 13) NaCl impregnated dressings:

- For moderate to high exudates
- Hypertonic medium discourages bacterial proliferation - Promotes mechanical and autolytic debridement
- Available in sheets or ribbon (for tunnels)
- Examples - Mesalt, Curasalt.

14) Negative pressure wound therapy - use of sub-atmospheric pressure to promote contraction, remove excess exudates, reduce edema and increase blood flow:

- Indicated for deep chronic open wounds, dehisced surgical sites, pressure ulcers, mesh grafts and tissue flaps
- Requires trained clinician and is costly
- Example - V.A.C. system

15) Petrolatum impregnated dressings:

- For minimal exudates
- Non-adherent
- Protects wound base and perimeter
- Provides moist environment to promote epithelialization - Requires secondary dressing
- Examples - Vaseline gauze, Adaptic.

16) Transparent Films:

- Consists of polyurethane or synthetic polymer sheets
- Indicated for absent or minimal exudates
- May be used to promote autolysis
- Often used as a secondary dressing
- Examples - Tegaderm, Opsite.

## COMPLICATIONS

Although noninfectious complications of pressure ulcers occur, systemic infections are the most prevalent.

Noninfectious complications include:

- Amyloidosis
- Heterotopic bone formation
- Perineal Urethral fistula
- Pseudoaneurysm
- Marjolin ulcer

A Marjolin ulcer is a cutaneous malignancy that arises in the setting of previously



injured skin, longstanding scars, and chronic wounds. Historically, Marjolin ulcers are named for French surgeon Jean Nicolas Marjolin and first described as ulcerations with dense villi arising within a burn cicatrix. Squamous cell carcinoma is the most frequent malignancy identified, although other cell types have been described (i.e., basal cell carcinoma). Lesions are aggressive and carry a poor prognosis with a high rate of recurrence. This activity reviews the cause, pathophysiology, and presentation of Marjolin ulcer and highlights the role of the interprofessional team in its management.

Systemic complications of topical treatment.

Infectious complications include:

- Bacteremia
- Sepsis
- Cellulitis
- Endocarditis
- Meningitis
- Osteomyelitis
- Septic arthritis
- Sinus tracts or abscesses

Osteomyelitis has been reported in 17 to 32% of infected ulcers and may lead to non healing ulcers with or without systemic manifestations. Plain radiographs and bone scans are often unreliable. Magnetic resonance imaging has 98% sensitivity and 89% specificity for osteomyelitis in patients with pressure ulcers; however, needle biopsy of the bone (via orthopedic consultation) is recommended and can guide antibiotic therapy. Bacteremia may occur with or without osteomyelitis, causing unexplained fever, tachycardia, hypotension, or altered mental status. Overall mortality is high with both conditions, and empirical antibiotics pending culture results should cover methicillin-resistant *Staphylococcus aureus*, anaerobes, enterococci, and gram-negative organisms, such as *Pseudomonas*, *Proteus*, and *Providencia* species.

## CONCLUSION

The prevention of pressure ulcers represents a marker of quality of care. Pressure ulcers are a major nurse-sensitive outcome. Hence, nursing care has a major effect on pressure ulcer development and prevention. Prevention of pressure ulcers often involves the use of low technology, but vigilant care is required to address the most consistently reported risk factors for development of pressure ulcers. The literature suggested that not all pressure ulcers can be prevented, but the use of comprehensive pressure ulcer programs can prevent the majority of pressure ulcers. When the pressure ulcer develops, the goals of healing or preventing deterioration and infection are paramount. Randomized controlled trials are needed to determine optimal management strategies dependent on stage and comorbidities/severity of illness. Nursing remains at the forefront of protecting and safeguarding the patient from pressure ulcers.

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