



Wound Management: Identifying Risks, Complications and Treatments

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Disclosures

Jennifer Donnelly, PharmD has no relevant financial relationships to disclose.

Gil Holland, MD has no relevant financial relationships to disclose.

Brian Masterson, MD has no relevant financial relationships to disclose.

Agenda

- Skin Overview
- Chronic/Non-healing Wounds Overview
- Four Stages of Normal Wound Healing
- Risk Factors
- Wound Assessment
- Four Classifications for Non-healing Wounds
- Treatment Modalities
- Behavioral Health
- Prevention
- Case Studies
- **Case Management Opportunities**

Objectives

At the end of this activity, participants should be able to:

- Identify the factors that impact wound healing and may increase the risk of wound infection.
- Explore clinical features, complications of and treatment options for wound management.
- Discuss the importance of a multidisciplinary approach for optimal wound management.
- Identify optimal clinical management strategies for wound management through case study examples.

Chronic / Non-healing Wounds Overview

Chronic Wounds:

- Often termed “ulcers”
- Is a breakdown of the skin integrate that fails to proceed through an orderly and timely reparative process of healing for a period of time
- There is no specific time-frame that differentiates an acute from a chronic wound
- Chronic wounds are generally associated with physiological impairments that are slow to heal
- It is estimated that 1-2% of the population of developing countries will develop a chronic wound within their lifetime
- United States Cost (2015)
 - Annual cost \$25 billion affecting 6.5 million of the population
 - Additional costs not figured in, such as the loss of productivity
 - Care and treatment accounts for 3% of total healthcare expenditures
- Non-healing ulcers lead to 85% of all amputations
- Non-healing diabetes ulcers account for 70% lower limb amputations

NCBI/PMC: Prevalence and incidence of chronic wounds and related complications. A protocol for a systematic review, www.ncbi.nlm.nih.gov/pmc/articles/PMC5017042, background

Chronic / Non-healing Wounds Risk Factors



UpToDate: Risk factors for impaired wound healing and wound complications, www.uptodate.com/contents/risk-factors-for-impaired-wound-healing-and-wound-complications, risk factors

Chronic / Non-healing Wounds Risk Factors

- Advances in treatment modalities for other conditions
- Population is aging: longer life expectancies, decreased ability to heal and increased healing time
- **Medical**
 - Diabetes
 - Rheumatological disorders
 - Cardiovascular disease (CVD) and vascular disorders – venous insufficiency, arterial insufficiency
 - History of radiation therapy
 - Obesity
- **Social History**
 - Smoking
 - Alcohol
 - Malnutrition
 - Living conditions
- **Immobility**
 - Elderly
 - Hospitalized
 - Movement disorders or wheelchair bound

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#1

UpToDate: Risk factors for impaired wound healing and wound complications. www.uptodate.com/contents/risk-factors-for-impaired-wound-healing-and-wound-complications, risk factors

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Skin Overview

Skin Purpose

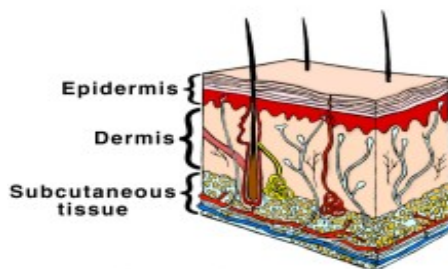
Acts as a barrier to protect the body from harm: such as from moisture, cold, sun-rays, infectious agents, pain and environmental toxicants
Assist with body temperature regulation
Deepest layers function as storehouse, e.g., water, fat, and metabolic products

Consist of 3 Layers

Epidermis, outer layer
Dermis, middle layer
Subcutaneous, deepest layer¹

Wounds

Occur when the skin is cut, injured or broken²



Picture: Google advance search, Skin and sense of touch

¹ U.S. National Library of Medicine, How does skin work? www.ncbi.nlm.nih.gov/pubmedhealth/PMH0072439/, what do skin do?
² U.S. National Library of Medicine, Chronic wounds overview. www.ncbi.nlm.nih.gov/pubmedhealth/PMH0079406/, symptoms

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Functions of Skin

- | | |
|--|--|
| <ul style="list-style-type: none"> ▫ Barrier ▫ Mechanical barrier <ul style="list-style-type: none"> - Pressure - Shear forces and stress - Trauma ▫ Fluid barrier <ul style="list-style-type: none"> - Dehydration - Blocks absorption of external fluids and substances ▫ UV protection <ul style="list-style-type: none"> - Foreign organism ▫ Neurological <ul style="list-style-type: none"> - Nociceptors - Pressure - Sensation | <ul style="list-style-type: none"> ▫ Endocrine (Vitamin D) ▫ Thermoregulation <ul style="list-style-type: none"> - Sweat glands - Smooth muscle relaxation/contraction to blood flow of capillaries ▫ Vascular supply <ul style="list-style-type: none"> - Arterial <ul style="list-style-type: none"> • Oxygen • Nutrients ▫ Venous <ul style="list-style-type: none"> - Removal of waste |
|--|--|

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Book: Text and Atlas of Wound Diagnosis and Treatment

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Four Stages of Normal Wound Healing (Basic Science)

1. Hemostasis

- Endothelial collagen
- Platelets

2. Inflammation

- Neutrophils
- Macrophages

3. Proliferation

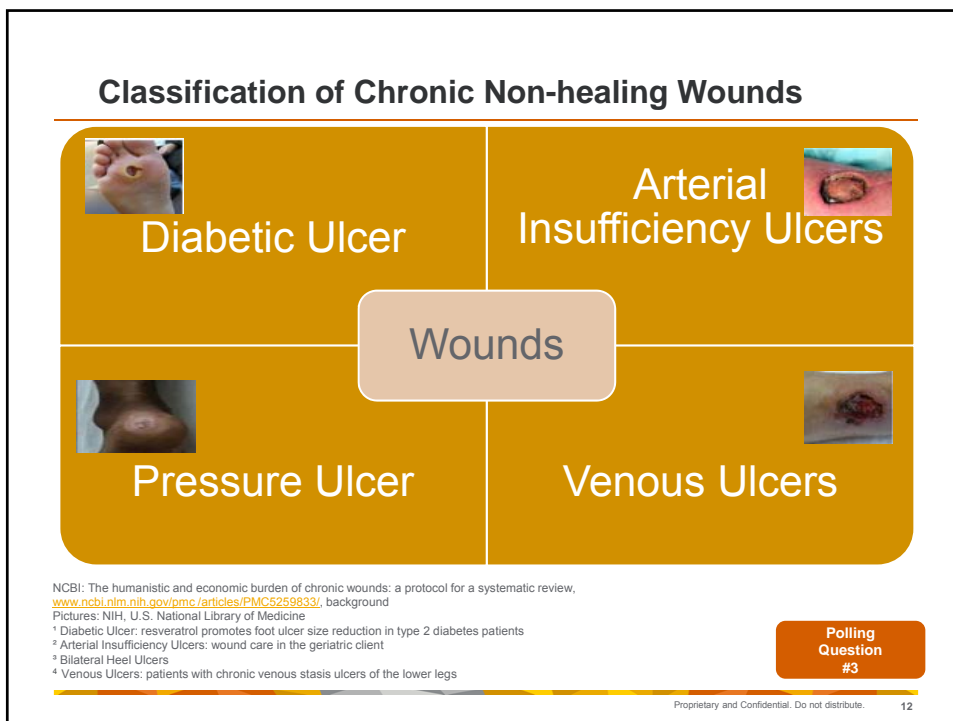
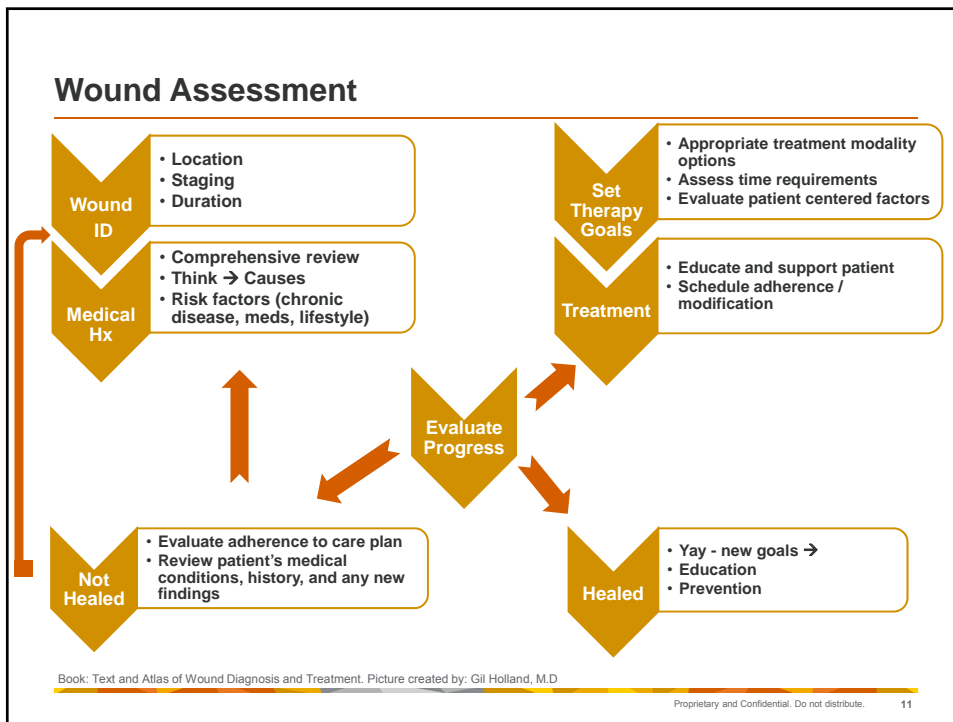
- Fibroblasts

4. Remodeling

Most wounds will heal with adequate treatment within 15 weeks. Some may take years to decades. The most important variable is the knowledge and experience of the clinicians.

UpToDate: Basic principles of wound healing, www.uptodate.com/contents/basic-principles-of-wound-healing?search=Four%20Stages%20of%20Normal%20Wound%20Healing&source=search_result&selectedTitle=1~150&usage_type=default&display_rank=1, phases of wound healing

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Diabetic Foot Ulcer



Google, advance search, maxpixel.net



Google, advance search, classiquewatches.com

Globally, there is 1 amputation every 30 seconds due to diabetic foot ulcer

NIH: Financial burden of diabetic foot ulcers to world, A progressive topic to discuss always, www.ncbi.nlm.nih.gov/pmc/articles/PMC5761954/, introduction

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Diabetic Foot Ulcer Overview

Mechanism	Neuro	Presentation	Wound Bed	Periwound	Temp & Pulse
Neuropathic	Sensory loss, deep tendon reflexes are lost	Callous	Granulation, surrounded by callus	Calloused	Warm, pulse present
Ischemic	Claudication/painful at rest	Digital necrosis, dry gangrene	Sparse pale granulation	Loss of hair on dorsum of foot, pallor on elevation and dependent rubor	Cool and pulseless
Neuroischemic	Some sensory loss	Mixed	Poor granulation	Thin, shiny skin without hair	Cool and pulseless

Sequelae – infection, osteomyelitis, amputation



Book: Text and Atlas of Wound Diagnosis and Treatment. Grid created by Gil Holland, M.D.
Picture: NIH, U.S. National Library of Medicine, IP management of diabetic foot disorders

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Pressure Ulcer / Decubitus

Most common sites related to patient's position

- **Supine Positioning**
 - Occipital protuberance (back of the head)
 - Scapula (shoulder bone)
 - Olecranon (elbow)
 - Sacrum (base of the spine)
 - Calcaneus (heel)
- **Wheelchair Bound**
 - Ischial tuberosity (buttock sitting area)
- **Lateral Positioning**
 - Ear
 - Acromion process (a bony process on the shoulder blade)
 - Greater trochanter of femur (hip area)
 - Medial and lateral condyles of femur (knee area)
 - Lateral malleolus of fibula (ankle area)



Picture: NIH, U.S. National Library of Medicine, patient with occipital pressure ulcer

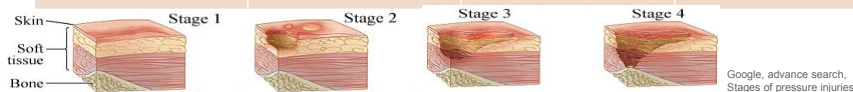
NCBI: Review of the Current Management of Pressure Ulcers, www.ncbi.nlm.nih.gov/pmc/articles/PMC5792240/, causation

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Pressure Ulcer / Decubitus Stages

Time to Tissue Destruction

Tissue Damage	Characteristic	Time Frame	Recovery Time
Hyperemia	Blanchable erythema or redness	30 minutes	1 hour if pressure is relieved
Ischemia	Deeper redness/damage of underlying tissue	2-6 hours	36 hours if pressure is relieved
Necrosis	Destruction of tissue	>6 hours	Reversal of tissue necrosis depends on patient's comorbidities



Book: Text and Atlas of Wound Diagnosis and Treatment. Grid created by: Gil Holland, M.D.

Google, advance search, Stages of pressure injuries

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Pressure Ulcers: Venous Leg Ulcers (VLU) & Arterial Insufficiency (AI Ulcers)

VLU

- Smoking
- Diabetes (DM)
- Advanced age
- Family history
- Previous deep vein thrombosis (DVT)
- Congestive heart failure (CHF)
- Varicosities
- Poor nutrition
- History of:
Intravenous/intramuscular/
subcutaneous drug use in legs

AI Ulcers

- Smoking
- Diabetes (DM)
- Advanced age
- Family history
- Peripheral vascular disease
- Coronary artery disease (CAD)
- Obesity
- Hypertension (HTN)
- Dyslipidemia
- Sedentary lifestyle

Book: Text and Atlas of Wound Diagnosis and Treatment

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VLU and AI Ulcers

Characteristics	VLU	AI Ulcers
Sensation	Throbbing, aching, heaviness	Painful, worse with exercise, improves while standing
Appearance	Hemosiderin, variable pigmentation	Skin and nail atrophy with minimal to no hair growth
Temp and pulses	Higher temp	Lower limb cool, decrease or no pulse
Exudate and edema	Heavy exudate, pitting edema	Minimal exudate with little or no edema



Picture: NIH, U.S. National Library of Medicine: Venous Leg Ulcer



Picture: NIH, U.S. National Library of Medicine: Patients with chronic venous stasis ulcers of the lower legs

Book: Text and Atlas of Wound Diagnosis and Treatment, Created by Gil Holland, M.D.

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Treatment Modalities

T.I.M.E.

T = Tissue Management (remove necrotic tissue to improve wound healing)

I = Infection/Inflammation (prevent/treat infection or inflammation)

M = Moisture (avoid formation of scab as this slows healing)

E = Epithelial advancement (keep the wound edges healthy to improve wound closure)

International Wound Infection Institute, Consensus Update 2016, www.woundinfection-institute.com/wp-content/uploads/2017/03/IWII-Wound-infection-in-clinical-practice.pdf, wound bed preparation, pp 17

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Ulcers Treatment Modalities

Dressings: Ulcers should be kept clean and moist but free of excess fluids

- Different function of different dressings / treatment:
 - Absorb moisture
 - Promote wound hydration
 - Debride / remove tissue
 - Promote granulation
 - Prevent infection

Cochrane review – insufficient evidence to determine that choice of dressing affects the healing of arterial LE ulcers. Compression is considered the main determining factor.

Book: Text and Atlas of Wound Diagnosis and Treatment

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Pressure Ulcer / Decubitus

- Treatment of underlying disease
 - Diabetes control
 - Vascular conditions
 - Arterial insufficiency
 - Venous insufficiency / stasis / reflux
 - Movement disorder
 - Elderly
 - Paralysis
 - Neuropathy
 - Correction of nutritional deficit
- Off loading of affected area
 - Off loading cushion
 - Air mattress bed
 - Total contact casting

Book: Text and Atlas of Wound Diagnosis and Treatment

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Treatment Modalities: Negative Pressure Wound Therapy (NPWT)

NPWT/also called vacuum-assisted closure (VAC)

- Application of controlled negative pressure to the surface of the ulcer
- Enhances healing by increasing wound perfusion, reducing edema, reducing the local bacterial burden, and increasing the formation of granulation tissue

Advantages

- NPWT dressings are changed once every two to three days and anticipated pain can be managed preemptively
- NPWT is easier to tailor and maintain in position
- Accelerated wound healing with NPWT significantly reduces the time to wound closure in diabetic patients
- Reduced complexity of subsequent reconstructive procedures

Disadvantages

- Need to carry portable pump
- Cost is often greater
- Contraindications – Exposed vital structures, ongoing infection, devitalized tissue, malignant tissue, fragile skin, adhesive allergy, ischemic wounds



UpToDate: www.uptodate.com/contents/negative-pressure-wound-therapy?topicRef=2887&source=see_link

Picture: NIH, U.S. National Library of Medicine, Negative pressure wound therapy

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FDA Approved Indications for Hyperbaric Oxygen Therapy (HBOT)

1. Air or Gas Embolism	8. Intracranial Abscess
2. Carbon Monoxide Poisoning	9. <u>Necrotizing Soft Tissue Infections</u>
3. Clostridial Myositis and Myonecrosis (Gas Gangrene)	10. <u>Osteomyelitis (Refractory)</u>
4. Crush Injury, Compartment Syndrome and Other Acute Traumatic Ischemia	11. <u>Delayed Radiation Injury (Soft Tissue and Bony Necrosis)</u>
5. Decompression Sickness	12. <u>Compromised Grafts and Flaps</u>
6. <u>Arterial Insufficiencies</u>	13. <u>Acute Thermal Burn Injury</u>
7. Severe Anemia	14. Idiopathic Sudden Sensorineural Hearing Loss (Newest: approved on October 8, 2011 by the UHMS Board of Directors)

Wound care applications are in **BOLD**

Undersea and Hyperbaric Medical Society, www.uhms.org/resources/hbo-indications.html, indications

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Drugs That Impair Healing

- Vasoconstrictors
 - Nicotine, ergotamine, cocaine, epinephrine
 - Causes tissue hypoxia, affects circulation and tissue formation
- Amlodipine (Norvasc®)
 - Cause edema
- Immunosuppressants Medications
 - Prevents body's ability to heal wounds
- Corticosteroids (Prednisone®)
 - High dose (>10mg prednisone/day) and long term (>7d) can shut down immune system and prevent wound healing
- Nonsteroidal anti-inflammatory drug – NSAIDS (Advil®)
 - Interfere with platelet functions and clots cannot form
- Anticoagulants (Heparin® and Warfarin®)
 - Can interrupt normal cell division, delays fibrin formation

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Behavioral Health

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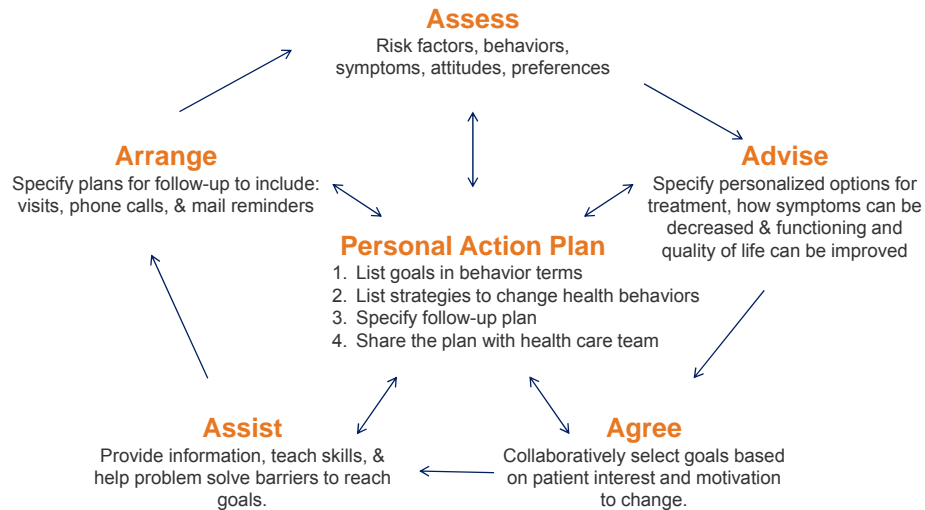
Behavioral Health Paradigm for Evaluation

- Biological
 - Genetic predisposition and exposures
 - Medical causes of brain dysfunction
 - Rule out the WHIMP (Wernicke's: **H**ypo's & **H**yper's (K+, Ca++, Thyroid, etc.) & **H**IV; **I**nfections & **I**ntracranial events; **M**etabolic & **M**etastases; **P**oisonings & **d**rugs
- Psychological
 - What are the rules we learned along the way?
- Social
 - What are the interactions?
 - What are the social determinants?
- Community and Health Systems
 - What are the complexities to getting care and assistance?

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The 5 A's for Evaluation and Management of Behavior



Source: R.E. Glasgow, et al., 2002, *Annals of Behavioral Medicine*, 24, pp. 80-87, Copyright 2002 by Erlbaum, Text reprinted with permission

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Common Psychiatric Disorders

- **Delirium** – A symptom of acute mental status change manifested by attention deficits, disorientation, lability, distorted perceptions
- **Depression** – Symptoms should be at least two weeks in duration, hallmark symptoms are low mood and anhedonia (inability to feel pleasure), followed by the SIGECAPS (changes with: **S**leep, **I**nterest in pleasurable activities, **G**uilt/remorse, **E**nergy/ fatigue, **C**oncentration/Focus, **A**ppetite, **P**sychemotor retardation/agitation, **S**uicidal)
- **Anxiety** – “Sense of impending doom”; may be existential in nature
- **Insomnia** – Multiple causes – sleep hygiene needs evaluation
- **Suicidal Ideation** – A psychiatric emergency – **don't be afraid to ask about thoughts of self-harm – you won't give the person ideas**
- **Assaultive Behavior** – Intentional or unintentional always make sure you have an unobstructed exit
- **Treatment Refusal and Capacity** – Medical ethics – must respect individuals autonomy to make decisions – capacity is the ability to understand and articulate the ramification of one's decisions

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Behavioral Health Management

- Treat underlying medical condition
- Psychotropic medication use as appropriate for psychiatric symptoms
 - Attempt to limit drug-drug interactions
 - If multiple drugs are used for symptomatology – limit the number of drugs from any given class
- Listen to the individual
- This is a team sport – communication is critical!

Behavioral Health Coordination of Care

- Assess patient's understanding
 - Meet the patient's where their understanding is
 - Reassess
 - Confirm Communication Chain
 - Who to call for what
 - Follow-up plan

Prevention

“An ounce of prevention is worth a pound of cure.”

Benjamin Franklin

Prevention

- **Control Chronic Disease**

- Diabetes control
- Vascular conditions
 - Arterial insufficiency
 - Venous insufficiency / stasis / reflux
- Movement disorder
 - Elderly
 - Paralysis
 - Neuropathy
 - Wheelchair bound
- Nutritional deficit

Requires a close monitoring by medical providers
especially for those at risk

Case 1: Diabetes

47 yo male Mick "Sugar" Sweetney has a reported 18 month history of a non-healing painless ulcer on the heel of his right foot that he had been treating with OTC triple antibiotic cream without improvement. He notes that he has T2DM and is trying to get it under better control. BMI is 45, HbA1c is 11.2. He recently started insulin due to poor diabetes control and lost his job as a truck driver; which he had for 15 years. Although, once a boxer in his younger years, he has had difficulty exercising recently. Yet, he shows you his new sneakers as he describes a desire to get back in shape, and reports that he has begun walking 2-3 miles daily.

1. Which of the following may be contributing to the non-healing of Mick's wound:
- a) Uncontrolled diabetes
 - b) Unemployment
 - c) Walking daily
 - d) a and c
 - e) All of the above

Case 1: Diabetes (*continued*)

1. Which of the following may be contributing to the non-healing of Mick's wound:
- a) Uncontrolled diabetes
 - b) Unemployment
 - c) Walking daily
 - d) a and c
 - e) All of the above

Case 1: Diabetes (*continued*)

2. When assessing Mick, it is important to gather the following:
- a) History of compliance/noncompliance with medical treatments
 - b) Thorough medical history
 - c) Residential living condition
 - d) Level of education
 - e) Depression screen (PHQ4)
 - f) All of the above

Case 1: Diabetes (*continued*)

2. When assessing Mick, it is important to gather the following:
- a) History of compliance/noncompliance with medical treatments
 - b) Thorough medical history
 - c) Residential living condition
 - d) Level of education
 - e) Depression screen (PHQ4)
 - f) All of the above

Case 1: Diabetes (continued)

3. Which of the following will most help reduce Mick's risk of an amputation:
- a) Stopping insulin as it is known to contribute weight gain
 - b) Increasing the number of miles he is walking daily
 - c) Appropriate footwear
 - d) Using a different topical agent
 - e) Finding another job

Case 1: Diabetes (continued)

3. Which of the following will most help reduce Mick's risk of an amputation:
- a) Stopping insulin as it is known to contribute weight gain
 - b) Increasing the number of miles he is walking daily
 - c) Appropriate footwear
 - d) Using a different topical agent
 - e) Finding another job

Case 2: Immobility

24 year old Ann Hedonia has been wheelchair bound for the past 2 years. Once a professional athletic swimmer, her career was cut short due to a diving accident. She has limited mobility of her upper extremities, and no motor or sensory function of the lower half of her body. She has a coccygeal wound the has been recurrent for over a year and a 3 month old non-healing L ankle wound.

4. With regard to her wound history, the following are important to ask about when getting her history:
- a) Her living situation
 - b) Social support systems in place
 - c) Her wheelchair cushion
 - d) Type of wheelchair: electric or manual
 - e) Presence of symptoms of depression
 - f) All of the above

Case 2: Immobility (continued)

4. With regard to her wound history, the following are important to ask about when getting her history:
- a) What her living situation is like
 - b) Information on social support systems in place
 - c) Ask about her wheelchair cushion
 - d) Is her wheelchair electric or manual
 - e) Does she have feelings of sadness or inability to feel pleasure
 - f) All of the above

Case 2: Immobility (continued)

5. The following person is the most valuable member of her health care team:
- a) Care management nurse
 - b) Primary Care Physician
 - c) Podiatrist
 - d) Psychiatrist
 - e) None of the above

Case 2: Immobility (continued)

5. The following person is the most valuable member of her health care team:
- a) Care management nurse
 - b) Primary Care Physician
 - c) Podiatrist
 - d) Psychiatrist
 - e) None of the above

Case 3: Elderly

87 yo female Rebecca Pierson has a non-healing sacral decubitus ulcer that has been present for the past 5 months. Other significant diagnoses include Alzheimer's disease and history of depression. Rebecca has been living alone up to this time. Her daughter Kate has been staying with her for the past week as Rebecca has become increasingly confused. Rebecca had been calling her late at night asking to speak with her late husband Jack, Kate's father, The siblings, Kate, Kevin, and Randall have been discussing future living arrangements for Rebecca; however, Kevin has been opposed to placing her in a nursing facility.

6. All of the following are challenges to Rebecca's wounds healing *except*:
- Potential for malnutrition
 - Dementia affecting ability to care for self
 - Failure to reduce pressure or friction at affected site
 - Family dynamics interfering with an elderly patient receiving the RIGHT CARE
 - Having to wait several months for the next season premiere episode of "This is Us" on NBC

Case 3: Elderly (*continued*)

6. All of the following are challenges to Rebecca's wounds healing *except*:
- Potential for malnutrition
 - Dementia affecting ability to care for self
 - Failure to reduce pressure or friction at affected site
 - Family dynamics interfering with an elderly patient receiving the RIGHT CARE
 - Having to wait several months for the next season premiere episode of "This is Us" on NBC

Case 3: Elderly (continued)

7. Which of the following is true:

- a) Rebecca's health would be maximized if all her care was delivered by only one provider (RIGHT PROVIDER)
- b) Optimal diet for healing focuses on a low saturated fat , high complex carbohydrate diet (RIGHT LIFESTYLE)
- c) Immunization status of this patient should be evaluated (RIGHT CARE)
- d) A sleeping aid should be considered to help keep Rebecca from awakening and using the phone late at night (RIGHT MEDICATION)

Case 3: Elderly (continued)

7. Which of the following is true:

- a) Rebecca's health would be maximized if all her care was delivered by only one provider (RIGHT PROVIDER)
- b) Optimal diet for healing focuses on a low saturated fat , high complex carbohydrate diet (RIGHT LIFESTYLE)
- c) Immunization status of this patient should be evaluated (RIGHT CARE)
- d) A sleeping aid should be considered to help keep Rebecca from awakening and using the phone late at night (RIGHT MEDICATION)

Helpful Links

Prevent Diabetes Problems

www.niddk.nih.gov/health-information/diabetes

(under 'Diabetes Topics' see Prevent diabetes problems)

Diabetes and Foot Problems

www.niddk.nih.gov/health-information/diabetes/overview/preventing-problems/foot-problems

Nerve Damage (Diabetic Neuropathies)

www.niddk.nih.gov/health-information/diabetes/overview/preventing-problems/nerve-damage-diabetic-neuropathies

Appendix

Pressure Ulcer / Decubitus Treatment Modalities – Dressings

- **Gauze**, is a thin translucent fabric with a loose open weave
 - Mechanical debridement for wet to dry dressings
 - Pros: Easy to locate the product
 - Cons: Need to change daily, can remove healthy tissue, bacteria can penetrate, needs secondary dressing
- **Films - Tegaderm™** is a transparent medical dressing
 - Used for minor burns, simple wounds, surgical sutures
 - Pros: Bacteria can't get in, air and water can penetrate, comfortable, changed once a week
 - Cons: Can't absorb exudate/excess moisture, provide little protection



Picture: NIH, U.S. National Library of Medicine, Technique Gauze



Picture: NIH, U.S. National Library of Medicine, a skin fixation method

UpToDate: Basic principles of wound management, www.uptodate.com/contents/basic-principles-of-wound-management?search=T.I.M.E.%20wound%20care&source=search_result&selectedTitle=1-150&usage_type=default&display_rank=1, common dressing and films

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Pressure Ulcer / Decubitus Treatment Modalities – Dressings

- **Hydrogels (Curasol®)**, water- or glycerin-based amorphous gels, impregnated gauzes, or sheet dressings
 - Used for sloughy/necrotic wounds, dry wounds
 - Pros: Can absorb fluids, gives moisture to dry wounds
 - Cons: Changed every 1-3 days, can cause maceration
 - Secondary dressing

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Pressure Ulcer / Decubitus Treatment Modalities – Dressings

- **Hydrocolloids (Duo-DERM®)**
 - Used for non-infected wounds with low/moderate drainage
 - Pros: Provides moist environment, absorbs exudate, change every 3-7d
 - Cons: Smelly (doesn't mean infection)
- **Calcium alginate (Curasorb™)**
 - Used for deep cavities wounds and sinuses
 - Pros: Provides moist environment, nonconclusive, permeable, very absorptive
 - Cons: Needs secondary dressing, change daily, not for wounds with little drainage
- **Hydrofibers (Aquacel®)**
 - Used for wounds with heavy exudate
 - Pros: Can stay on for up to a week
 - Cons: Needs secondary dressing

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Pressure Ulcer / Decubitus Treatment Modalities – Dressings

- **Foam Dressing (CuraFoil™)**
 - Used to maintain a moist environment, prevents bacterial contamination, used to manage minor and acute wounds
 - For partial or full-thickness wounds with exudate
 - Pros: Change 2x/week
 - Cons: Needs secondary dressing, not for non-draining wounds
- **Composites (Covaderm®)**
 - Used for protective cushioning and optimal moist healing environment
 - Pros: Has 2 different products in various layers, convenient (all in one)
 - Cons: Less flexible, expensive



Picture: NIH, U.S. National Library of Medicine, wet foam dressing material



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Treatment Modalities – Antimicrobials/Antiseptics

- | | |
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| <ul style="list-style-type: none"> • Providone iodine (Betadine®) <ul style="list-style-type: none"> ▫ Little benefit in non-infected chronic wounds ▫ Use only on intact skin • Hypochlorites (Dakin's®) solution, diluted bleach <ul style="list-style-type: none"> ▫ In vitro data of cytotoxicity • Cchlorhexadine (Dyna-Hex®) <ul style="list-style-type: none"> ▫ Better as surgical scrub than for chronic wounds • Silver-based <ul style="list-style-type: none"> ▫ Controversial – few controlled studies, does not speed healing, can be painful | <ul style="list-style-type: none"> • Manuka -Medical Grade) MediHoney® <ul style="list-style-type: none"> ▫ Has antibacterial/anti-inflammatory properties ▫ Some evidence show may help with granulation and autolytic debridement of wound bed • Topical antibiotics (Neosporin®) <ul style="list-style-type: none"> ▫ Are NOT very effective and may increase bacterial resistance; systemic antibiotics for infections <p style="text-align: center;">Antiseptics generally NOT needed to keep a wound clean</p> |
|--|--|

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Pressure Ulcer / Decubitus Treatment Modalities – Other

- **Pentoxifylline (Trental®)**
 - Arterial ulcers, ulcers due to PVD
 - Improved perfusion of peripheral vascular beds
- **Iloprost (Ventavis®)**
 - Arterial ulcers, vasculitic ulcers, ulcers due to connective tissue diseases (RA, scleroderma)
 - Prostacyclin analog to treat intermittent claudication, limb ischemia, and prevent gangrene
- **Glyceryl trinitrate-GTN (Nitroglycerin®)**
 - Vasculitic ulcers
 - Nitric oxide donor – cause vasodilation for ischemic wounds
- **Calcium antagonists (Nifedipine®, Diltiazem®)**
 - Vasculitic ulcers secondary to Raynaud's
 - Restores blood flow to digits

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Pressure Ulcer / Decubitus Treatment Modalities – Other

- **Steroids (Corticosteroid®)**
 - Vasculitic ulcers
 - Decrease inflammation
- **Zinc Oxide Ointment**
 - Used to treat minor skin irritation
 - Antioxidant
- **Phenytoin-topically**
 - Low grade pressure ulcers, ulcers due to leprosy
 - Inhibits the enzyme collagenase
 - Limited use due to systemic absorption and toxicity
- **Retinoids**
 - Angiogenesis, collagen synthesis, and epithelialization
 - Unknown value for chronic wounds
- **Analgesics (NSAIDs - lower dose, short term)**
 - Pain control

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Thank You.

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