The Need-to-Know Info:
Preventing pressure ulcers and managing the non-healing wound

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Disclosure

- Terry Coggins is employed by Smith & Nephew Wound Management
- This presentation has been peer-reviewed for fair balance
Objectives

- Describe the state of pressure ulcers in the US and which hospital patients are at greatest risk
- Identify emerging therapies for pressure ulcer prevention
- Identify the **TIME** principles of wound bed preparation to include: **Tissue** nonviable or deficient, **Infection** or inflammation, **Moisture** imbalance and **Edge** of wound non-advancing or undermined.
### NDNQI data – pressure ulcers US hospitals

<table>
<thead>
<tr>
<th></th>
<th>Prevalence %</th>
<th>HAPU %</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004 (Q2, Q3)</td>
<td>11.4</td>
<td>6.4</td>
</tr>
<tr>
<td>2006-2007 (Q4, Q 1)</td>
<td>11.4</td>
<td>6.5</td>
</tr>
<tr>
<td>2010 (Q1, Q2)</td>
<td>9.1</td>
<td>3.8 (2.6 when stage I removed)</td>
</tr>
</tbody>
</table>

NDNQI data – % HAPU adult critical care

<table>
<thead>
<tr>
<th></th>
<th>Average</th>
<th>&lt; 100 beds</th>
<th>&gt; 500 beds</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>13.0</td>
<td>5.7</td>
<td>14.3</td>
</tr>
<tr>
<td>2006-2007</td>
<td>13.3</td>
<td>9.6</td>
<td>15</td>
</tr>
<tr>
<td>2010</td>
<td>8.6</td>
<td>4.3</td>
<td>10.1</td>
</tr>
</tbody>
</table>

The Braden Scale

- 58% of HAPU were found among patients who were at mild to moderate risk (Braden score) for breakdown\(^1\)
- Nurses often underestimate pressure ulcer risk when using the Braden Scale\(^2\)
- Nurses are challenged when choosing PUP interventions for patients with Braden Scale sore of 13 to 18 (mild to moderate risk)\(^3\)


\(^3\)Maklebust J, Magnan MA. A quasi-experimental study to assess the effect of technology-assisted training on correct endorsement of pressure ulcer prevention interventions. *Ostomy Wound Manage.* 2009;55(2)32-42.
Comparison of risk factors: Epidemiological studies vs. assessment tools

- Activity/mobility limitations
- Poor nutritional status
- Increased skin moisture
- Sensory perception
- General health status
- Skin status
- Perfusion and oxygenation
- Increased body temp
- Advanced age
- Hematological measures

Comparison of risk factors: Epidemiological studies vs. assessment tools

- Skin status
- Perfusion and oxygenation
- Increased body temp
- Advanced age
- Hematological measures

Not included in the Braden risk assessment tool
Risk factors for pressure ulcers
14-bed Surgical ICU

- Low Braden Scale score
- Age greater than 70 years
- Diagnosis of diabetes

Risk for pressure ulcers
In a 12-bed Medical/Surgical ICU

- Level of mobility
- Friction and shear
- Length of stay
  - Mean 11.7 days = PU
  - Mean 3.3 days = no PU
  - 66% within first 6 days
- Age (mean 73 for PU development)
- Cardiovascular disease
- Norepinephrine use

Individuals to consider at-risk

- Older adults
- People who have experienced trauma
- Spinal-cord injured
- Those with hip fracture
- People in LTC homes or community care
- The acutely ill
- People with diabetes
- The critically ill

Medical device-related pressure ulcers (MDRPUs)

Medical device related pressure ulcers in hospitalized patients
Black J, Cuttigan JE, Walko MA, Lander MI, Kelpe MR.

- 2079 patients: adults in ICU, Step-down, Med/Surg floors
- Data from a series of 8 quarterly survey dates (P & I)
Results:
Medical device-related pressure ulcers (MDRPUs)

- MDRPUs represented 1/3 of all PUs during the study
- Most common stages/categories
  - Stage I (35%)
  - Stage II (32%)
  - Unstageable (24%)
- Most common location
  - Ears (35%)
  - Lower legs (11%)
  - Heels (8%)

Results:
Medical device-related pressure ulcers (MDRPUs)

- Risk factors
  - Age
  - Gender
  - Admitting diagnosis
  - BMI
  - Surgery
  - Diabetes
  - Edema
  - Serum albumin levels

Not unique for MDRPUs vs. non-MDRPUs

Results:
Medical device-related pressure ulcers (MDRPUs)

• Patients with medical devices were 2.4 time more likely to develop PU of any kind
• In this study, no statistical difference in Braden scores for those with MDRPUs vs. non-MDRPUs
• MDRPUs decreased as continuous quality improvement interventions were added.

Two popular guidelines for prevention of pressure ulcers

Prevention and treatment of pressure ulcers: Clinical practice guideline

- NPUAP/EPUAP/PPPIA
  - www.npuap.org

Guideline for Prevention and Management of Pressure Ulcers

- WOCN Society
  - www.wocn.org
EPUAP/NPUAP/PPPIA Guidelines PU Prevention

Areas of significance

• Implement individualized continence plan - cleanse promptly after an episode
• Use barrier products to protect skin from moisture to reduce the risk of pressure damage
• Moisturize to hydrate skin and reduce the risk of skin injury

EPUAP/NPUAP/PPPIA Guidelines PU Prevention

Areas of significance

- Address nutritional needs
- Reposition appropriately – supine, prone, chair
- Use appropriate support surfaces – bed and chair
Emerging therapies for pressure ulcer prevention

- Microclimate
- Prophylactic dressings
- Fabrics and textiles
- Electrical stimulation

Microclimate control

• Consider support surface features that help control moisture and temperature

• Think about moisture and temperature control when selecting support surface covers

• Do not place heating devices directly to the skin or pressure ulcer

Prophylactic dressings

• Consider the use of polyurethane foam dressings over bony prominences for prevention of pressure ulcers
• Considerations for prophylactic dressings:
  • Ability to manage microclimate
  • Ease of application and removal
  • Ability to regularly assess the skin
  • Location of dressing application
  • Correct dressing size

Prophylactic dressing differ in quality; select an appropriate dressing for the individual and clinical use

Prophylactic dressings for pressure management

**Title:** Pressure ulcers of the heel – comparative study of a heel protecting bandage and a specially heel shaped hydrocellular dressing.

Prophylactic dressings for pressure management

- 8-week multi-center comparative study
- 130 patients enrolled
- 2 groups – both used normal preventive measures

One group included a control bandage (50)
One group included Hydrocellular foam heel dressing (61)

Prophylactic dressings for pressure management

PU Incidence

Control
Foam dressing

P = 0.001
Nursing care has a direct impact on the prevention of hospital-acquired pressure ulcers (HAPUs)

- **Goal:** to empower beside nurses with knowledge and interventions to reduce pressure ulcers
- **Goal:** to reduce pressure ulcers by 50% in one ICU (n = 21)
  - Reduce cost by approximately $793,800
  - Average cost of HAPU = $37,800 (NDNQI’s website*)

**Notes:**

* https://www.nursingquality.org/improvequality.aspx**
Eskenazi Health
Project to reduce pressure ulcers in adult ICU*

- Created Braden algorithm Month 1
- Revised hospital-wide skin care protocol Month 1
- Educated care providers about new project/goals Month 1
- Introduced silicone adhesive, hydrocellular foam dressing Month 4

Results

- **Goal:** 50 percent fewer HAPUs in 2013 than in 2011
  
  \[
  \frac{1,587,600}{2} = 793,500 \text{ cost avoidance}
  \]

- **Actual HAPUs 2013:** 15
  
  Total savings = $1,020,600
Fabrics and electrical stimulation

- Consider use of silk-like fabrics, rather than cotton or cotton blends, to reduce friction and shear
- Consider the use of electrical stimulation for anatomical locations at risk for pressure ulcers – especially among patients with spinal cord injuries
  - Evidence suggest that tetanic muscle contraction from ES reduces pressure ulcer risk by improving tissue oxygenation
Managing the non-healing wound
Normal acute wound healing

Phases

- **Hemostasis**
  - Minutes

- **Inflammation**
  - Days

- **Proliferation**
  - Weeks

- **Remodeling**
  - Year +

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Chronic/non-healing wound

Ischemia
Physical trauma
Bacterial burden
Necrotic tissue
Foreign body

Prolonged inflammation

Defective wound repair

Potential for further wound breakdown

Failure to epithelialize

Assessment – systemic factors for impaired wound healing

Age
Body build
Stress
Nutrition
Medications
Tissue oxygenation
Concomitant disease

3Doughty & Sparks-Defriese (2007)
Assessment – systemic factors for impaired wound healing

- Perfusion
- Mechanical stressors
- Edema
- Wound temperature
- Cytotoxic agents
- Necrotic/nonviable tissue
- Bacterial burden
- Moisture imbalance
  - Desiccation
  - Excess exudate
- Edge of wound non-advancing
Wound bed preparation – defined

Wound bed preparation is the management of a wound in order to accelerate endogenous healing or to facilitate the effectiveness of other therapeutic measures.


## TIME principles of wound bed prep

<table>
<thead>
<tr>
<th>Tissue nonviable or deficient</th>
<th>Infection or inflammation</th>
<th>Moisture imbalance</th>
<th>Edge of wound non-advancing or undermined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defective matrix and cell debris</td>
<td>High bacterial counts or prolonged inflammation</td>
<td>Desiccation or excess fluid</td>
<td>Non-migrating keratinocytes Non-responsive wound cells</td>
</tr>
<tr>
<td>Debridement</td>
<td>Antimicrobials</td>
<td>Dressings Compression</td>
<td>Biologicals agents Adjunct therapies Debridement</td>
</tr>
<tr>
<td>Restore wound base and ECM proteins</td>
<td>Low bacterial counts and controlled inflammation</td>
<td>Restore cell migration, maceration avoided</td>
<td>Stimulate keratinocyte migration</td>
</tr>
</tbody>
</table>
Tissue: nonviable or deficient
Nonviable tissue

- **Slough** – moist yellow, tan or gray
- **Eschar** – dry, leather-like black, brown
Debridement methods

- Surgical
- Mechanical
- Autolytic
- Enzymatic
- Biological
Surgical debridement

- Scalpel
- Scissors
- Curette
- Laser
- Hydrosurgical

Recommended for removal of thick, adherent eschar and devitalized tissue in large wounds.

Sharp/surgical debridement

- Fast debridement.
- Requires adequate perfusion.
- Not recommended for severely compromised individuals.
- Analgesia/anesthesia required.
- Associated with increased healing rates among individuals with diabetic foot ulcers.\(^5\)
Conservative sharp debridement

- Selective removal of loose, nonviable tissue using sterile instruments.
- Performed by wound specialist, MD or other qualified individual.
- No harm to viable tissue.
- May be performed at the bedside.
- Check your state and employer requirements.

Mechanical debridement

- **Definition** – The removal of foreign material and dead or damaged tissue by the use of physical forces.

- **Methods**
  - Irrigation
  - Hydrotherapy
  - Wet-to-dry dressings
  - Lower frequency ultrasound

Mechanical debridement

- Usually non-selective debridement.
- Wet-to-dry dressing may be painful.
- Dressing changes may be time-consuming.
- Trauma to capillaries can cause bleeding.
- Skin maceration may occur.
Autolytic debridement

- **Definition** – The process by which the wound bed utilizes phagocytic cells and proteolytic enzymes to break down nonviable tissue.

This process can be promoted and enhanced by maintaining a moist wound environment.

Autolytic debridement

- Slower than other methods
- Easy to perform
- Little or no discomfort
- Contraindicated in the presence of infection

Enzymatic debridement

- **Definition** – The use of topically applied enzymes, which work with the body’s own enzymes to stimulate the breakdown of necrotic tissue.

Enzymatic debridement

- Easy to perform.
- Less traumatic than surgical or mechanical debridement.
- May choose faster method if infection is suspected.
Debridement decisions

Selecting the appropriate method

- Wound characteristics
- Desired speed of debridement
- Time available for debridement
- Skill/licensure of clinician
- Care setting

Clinicians may choose more than one method of debridement – e.g., surgical, followed by enzymatic.

Infection or inflammation
Impact of surgical site infection (SSIs)

- Extend length of stay by 9.7
- Increase cost of care by $20,842 per admission*
- Up to 84% of SSIs estimated to occur post discharge\(^2,3\)
- An estimated 40 - 60% of SSIs are preventable\(^4\)
- Most common cause for < 30-day readmission among surgical patients\(^5\)

*Based upon data from 723,490 surgical hospitalizations.

80% of surgical site infections are a result of 8 pathogens

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Percent found in SSIs</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. aureus</td>
<td>30.0% (8% MRSA)</td>
</tr>
<tr>
<td>Coagulase Negative Staph.</td>
<td>&gt;18%</td>
</tr>
<tr>
<td>Enterococcus spp.</td>
<td>11.2%</td>
</tr>
<tr>
<td>E. coli</td>
<td>9.6%</td>
</tr>
<tr>
<td>P. aeruginosa</td>
<td>5.6%</td>
</tr>
<tr>
<td>Enterobacter spp.</td>
<td>4.2%</td>
</tr>
<tr>
<td>K. pneumonia</td>
<td>4.2%</td>
</tr>
<tr>
<td>Candida spp.</td>
<td>2.0%</td>
</tr>
</tbody>
</table>

Bacteria commonly found in Chronic Wounds

**Aerobic organisms**
- Staphylococcus aureus
- Coagulase negative Staphylococcus
- Pseudomonas aeruginosa
- Klebsiella sp.
- E. coli
- Proteus sp.
- Enterobacter
- Enterococci

**Anaerobic organisms**
- Peptostreptococcus
- Prevotella
- Bacteriodes

Wound Infection

“The presence of replicating micro-organisms within a wound with subsequent host injury.”

Gordon Dow, MD

Bacterial balance

Control mechanism

- Intact skin is a physical barrier
- pH is not conducive to bacterial growth
- Skin secretes fatty acids and antibacterial polypeptides
- Normal flora prevent pathogenic flora from establishing

Risk factors for infection

**Systemic**
- Vascular disease
- Edema
- Malnutrition
- Poorly controlled diabetes
- Alcoholism
- Prior surgery or radiation
- Drugs e.g. corticosteroids
- Inherited immune defects

**Local**
- Large wound area
- Increased wound depth
- Degree of chronicity
- Anatomic location (distal extremity, perineal)
- Presence of foreign bodies
- Necrotic tissue
- Mechanism of injury
- Degree of post wounding contamination
- Reduced perfusion

Determinants for chronic wound infection
Local

• Size and location of the wound
  • Large wounds = greater risk
  • DFU or PU on sacrum vs. scapula

• Age of the wound
  • Greater than 6 weeks = increase risk for deep tissue/bone infection

• Vascular perfusion
  • Poor tissue oxygenation = increase risk for infection; poor healing.

• Presence of devitalized tissue or foreign body
  • Slough/eschar = source of food for bacteria; foreign bodies may harbor microorganisms

Determinants for chronic wound infection: Systemic and personal

Behavioral
• Difficulty adhering to treatment plan
• Poor hygiene, ETOH abuse, smoking
• Poor nutrition

Social
• Lack of resources for needed items

Co-morbidities
• Poorly controlled diabetes, immunosuppression, conditions resulting in peripheral edema, renal or liver impairment, chronic viral infections

Factors influencing wound infection

Bacterial quantity

Host resistance

Bacterial virulence

Definition of biofilm

A structured community of bacterial cells enclosed in a self-produced polysaccharide matrix, which adheres to an inert or living surface

• Found in 70% of chronic wounds; 6% of acute wounds

• Biofilms stimulate a chronic inflammatory response in an attempt to rid the wound of the biofilm

Biofilm in wounds: treatment options

- Sharp debridement, followed by products to prevent recurrence: antimicrobial dressings
- One study (porcine) suggests that antibiotics, silver, povidone iodine, and PHMB are ineffective antimicrobial agents in killing/eliminating existing mature *P. aeruginosa* biofilm.
- Cadexomer iodine – demonstrated *in vitro* to penetrate a mature *Psuedomonas* biofilm

Free download from Wounds International.


http://www.woundsinternational.com/pdf/content_8851.pdf
Wound Infection
Assessment and Management
Classic signs and symptoms of infection

- Advancing erythema
- Fever
- Warmth
- Edema/swelling
- Pain
- Purulence

Acute wound infection or Severe chronic wound infection
Secondary signs and symptoms of infection

- Delayed healing
- Change in color of wound bed
- Friable granulation tissue
- Absent or abnormal granulation tissue
- Increased or abnormal odor
- Increased serous drainage
- Increased pain at wound site

Critically colonized
↑ Bacterial burden
Local wound infection


Bacterial burden: why it’s problematic

- Increases metabolic load
- Produces endotoxins and proteases
- Stimulates a pro-inflammatory wound environment

Wounds don’t heal
What’s the scoop on wound cultures?

Three techniques

- Tissue biopsy
- Needle aspiration
- Swab culture

Tissue biopsy

• Removal of living tissue with scalpel or punch biopsy
  • The use of anesthetics may result in false negative due to possible antibiotic properties

**Disadvantages**

• Many facilities cannot process tissue for culture
• May disrupt the wound
• Painful
• Risk for bleeding among patients on anticoagulants

Needle aspiration

- Insertion of a needle into adjacent tissue to aspirate tissue fluid (10cc/22g)
  - Needle is moved backward/forward at different angles for 2 to 4 explorations

Disadvantages

- Damage from needle
- Underestimates the number of organisms (compared to tissue biopsy)\(^\text{21}\)

Swab culture

• Most common technique

• 2 approaches:
  • Z technique – zig-zag swab across wound base
  • Levine technique – Apply pressure and rotate swab within a 1-2 cm² of clean wound. Try to get tissue fluid.

• Z technique - 63% sensitivity; 53% specificity
• Levine technique – 91% sensitivity; 57% specificity

Assessing wound infection

Increasing clinical problems

Contamination | Colonization | Local infection/critical colonization | Spreading infection | Systemic infection

Vigilance required

Intervention required

Wound progressing?

- Cleanse
- Choose appropriate dressing

Secondary signs of infection?

• Cleanse
• Debride if necessary
• Use antimicrobial agents

Is it bactericidal?

<table>
<thead>
<tr>
<th>Colony forming units/gm of tissue</th>
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</thead>
<tbody>
<tr>
<td>10,000,000 (10^7)</td>
<td></td>
</tr>
<tr>
<td>1,000,000 (10^6)</td>
<td></td>
</tr>
<tr>
<td>100,000 (10^5)</td>
<td></td>
</tr>
<tr>
<td>10,000 (10^4)</td>
<td></td>
</tr>
<tr>
<td>1,000 (10^3)</td>
<td></td>
</tr>
<tr>
<td>100 (10^2)</td>
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</tbody>
</table>

To be bactericidal, an agent must kill 99.9% of the bacteria (3-log reduction).

Each 90% reduction in bacteria = 1-log reduction.

17 Stratton et al (1991)
Evaluating silver products

Bactericidal activity

- Amount of silver required for clinically relevant microbes = approx. 40+ ppm (mg/l)
- Amount of silver for MRSA = 60.5 ppm


Cellulites/systemic signs?

- Cleanse.
- Choose appropriate dressing.
- Debride if necessary.
- Use antimicrobial agents.
- Systemic antibiotics.

Contamination  Colonization  Local infection/critical colonization  Spreading infection  Systemic infection
Moisture imbalance
Exudate management

1960’s – Moist wound environment

Dr. George Winter

- Collagen synthesis and granulation tissue formation improved.
- Cell migration and epithelial resurfacing occur faster.
- Scabs, crusts, and eschar do not form.

Moist wound environment

**Additional benefits**

- Faster healing
- Capacity for autolysis
- Decreased rates of infection
- Reduced wound trauma
- Decreased pain
- Fewer dressing changes
- Cost effective
Moisture imbalance – dry

- Desiccation slows epithelial migration.
- Painful or uncomfortable for the patient.
- Delays normal healing process.
- Acts as a source of infection.
- Longer treatment time.
- Increased cost.
Moisture imbalance – wet

- Maceration of periwound skin.
- Chronic wound fluid issues.
Managing moisture imbalance

If the wound is dry, moisten it

If the wound is wet, absorb

• Address the underlying etiology of the exudate
  • Edema
  • Bacterial burden
  • Breakdown of non-viable tissue
Dressing selection factors

• Amount of exudate
• Anatomical location
• Presence of dead space (depth, undermining, tunneling)
• Condition of surrounding skin
• Caregiver ability
• Primary or secondary dressing
• Desired frequency of dressing change
• Cost/reimbursement
Dressing selection factors

- Large
- Med
- Small
- None

Films
Gels
HCD
Alginate/gelling fiber
Foam
Specialty absorptive
Edge of wound: non-advancing or undermined
Edge of wound: non-advancing or undermined

Problem:

• Cells not capable of responding to healing signals.
• Hyperproliferation of epidermal cells occurs at the wound margins.
• Epidermis fails to migrate across the wound.

Edge of wound: non-advancing or undermined

**Interventions**

- Debridement
- Collagen matrix dressings
- Biological agents
- Skin grafts
- NPWT
- Adjunctive therapies

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²Adapted from Schultz et al (2003)
Thank you!

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