Wound Bed Preparation 2013
Current and Future Predictions

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ELIZABETH A. AYELLO PHD, RN, ACNS-BC, CWON,ETN, MAPWCA, FAAN

Clinical Symposium on Advances in Skin and Wound Care
Orlando, Florida, Friday October 25, 2013
PARTICIPANTS WILL:

- Assess the Wound Bed Preparation paradigm
- Describe healable, non-healable & maintenance wounds as part of wound bed preparation
- Review appropriate debridement methods
- Diagnose: Superficial critical colonization & deep surrounding infection (NERDS & STONEES)
- Differentiate 5 classes of topical antimicrobial agents
- Assess moisture balance for dressing selection
- Outline the appropriate use of active therapies
Wound Bed Preparation Paradigm

Person with a Wound

Treat the cause
Local wound care
Patient centered concerns

D - Debridement
I - Infection/Inflammation
M - Moisture balance
E - Edge effect

Sibbald, Goodman, Woo et al. Special Considerations in Wound Bed Prep. 2011: An Update
Advances in Skin & Wound Care Sept. 2011
<table>
<thead>
<tr>
<th>Type of Wound</th>
<th>Treatment of the Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Venous Ulcers</td>
<td>• Compression Bandages for healing</td>
</tr>
<tr>
<td></td>
<td>• Compression Stockings for maintenance</td>
</tr>
<tr>
<td>Pressure Ulcers</td>
<td>• Relief, reduce, redistribute pressure</td>
</tr>
<tr>
<td></td>
<td>• Activity and increase Immobility</td>
</tr>
<tr>
<td></td>
<td>• Incontinence and moisture management</td>
</tr>
<tr>
<td></td>
<td>• Shear and friction reduction</td>
</tr>
<tr>
<td></td>
<td>• Enhance &amp; Optimize nutrition</td>
</tr>
<tr>
<td>Diabetic Foot Ulcer</td>
<td>• Vascular supply adequate</td>
</tr>
<tr>
<td>Callus= pressure</td>
<td>• Infection control</td>
</tr>
<tr>
<td>Blister= friction &amp; shear</td>
<td>• Plantar Pressure redistribution</td>
</tr>
</tbody>
</table>
CASE STUDY

- 46 year old female
- Married, mother of two
- History
  - Hypothyroidism
  - Low ferritin levels
  - Venous insufficiency
- Bilateral leg ulcerations present since Dec. 2009 – right leg >involvement than Left
- Developed cellulitis - course of IV antibiotics
What is the most likely Diagnosis?

1. Lipedema
2. Venolymphedema
3. Lipodermatoscleroris
4. Lipolympheledema
5. Lymphedema

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**Lipedema:**

Adapted from *Frequently Misdiagnosed & Misunderstood Fatty Deposition Syndrome.*

*Fife, Maus, Carter, AS&WC Feb 2010*

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Excess</th>
<th>Associated</th>
<th>Stemmer’s Sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lipedema</td>
<td>Fat, bruising</td>
<td>Ankle fat pad</td>
<td>-ve</td>
</tr>
<tr>
<td></td>
<td>Bilateral, soft foot</td>
<td>More common in females</td>
<td></td>
</tr>
<tr>
<td>Lymphedema</td>
<td>Fibrosis</td>
<td>Lymphatics Abnormal</td>
<td>+ve</td>
</tr>
<tr>
<td></td>
<td>hard foot</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Usually unilateral</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Veno-lymphedema</td>
<td>Venous lipodermatosclerosis</td>
<td>Varicosities/Pitting edema, pigment</td>
<td>+ve</td>
</tr>
<tr>
<td></td>
<td>+ 2nd/lymphedema</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lipolympedema</td>
<td>Fat + 2nd lymphedema</td>
<td>Longstanding Lipidema develops lymphedema</td>
<td>-ve but eventually becomes +ve</td>
</tr>
</tbody>
</table>
TREATMENT

Lipedema
• Weight loss
• Exercise
• Low compression
• No benefit from manual lymph drainage

Lymphedema
• Exercise
• Compression hosiery
• Manual Lymph drainage
• Self Lymph Drainage
• Multilayer Compression Systems (non-elastic bandages)
• Pneumatic compression
• Elevation

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WHAT IS A MAINTENANCE WOUND?

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1. ORANGE: Stalled chronic wound

2. BLUE: Healable wound: Patient adherence issues

3. YELLOW: Healable wound with Health Care system problems for delivery of services

4. GREEN: A Nonhealable chronic wound that is not deteriorating

5. RED: Both YELLOW (3) & BLUE (2) above options options
Healable:
Underlying cause can be corrected + adequate blood supply to heal

Maintenance:
The cause can be corrected—but lack adherence or system resources

Non-healable:
Inadequate systemic or local factors for healing
VASCULAR SUPPLY AND HEALING ABILITY

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palpable pulse</td>
<td>&gt;80 mm Hg</td>
</tr>
<tr>
<td>Ankle-brachial pressure index (ABPI)</td>
<td>&gt;0.5 and &lt;1.3</td>
</tr>
<tr>
<td>Transcutaneous $O_2$ tension</td>
<td>&gt;30 mm Hg</td>
</tr>
<tr>
<td>Toe pressure</td>
<td>&gt;55 mm Hg</td>
</tr>
</tbody>
</table>

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Male Age 68 Malignant mesothelioma with removal of the left pleura & pericardium + chemotherapy + Radiation (intentional post surgical wound called a Clagett window)
WHAT WOULD YOU USE IN THE WOUND?

1. ORANGE: Povidone Iodine soaked gauze

2. BLUE: PHMB/ Chlorhexidine gauze

3. YELLOW: Normal Saline Gauze

4. GREEN: Dilute Acetic Acid soaked gauze

5. RED: Wound does not need packing

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Maintenance/ Non-healable Wound

- Male Age 68 Malignant mesothelioma with removal of the left pleura & pericardium + chemotherapy + Radiation (intentional post surgical wound called a Clagett window)

**Treatment:**

- Saline gauze packing x2-3 per day with odour / discharge
- Intermittent Oral antibiotics (clavulin-ampicillin or Ciprofloxacin or Moxifloxacin)
- **Povidone Iodine packing** alternating with saline soaked gauze= odour, discharge and changes reduced to x1 day
- **Developed hypothyroidism** with ↑↑↑sTSH/ ↓free T4 requiring replacement
- Switched to PHMB gauze packing: ↓ odour / discharge & ↑↑↑ QoL for last year of life
Antiseptic Agents For Use In Non-healable Wounds Where Cytotoxicity Is Less Important Than Anti-microbial Action

<table>
<thead>
<tr>
<th>AGENT</th>
<th>EFFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorhexidine (PHMB)</td>
<td>Non-release, Low toxicity</td>
</tr>
<tr>
<td>Povidone Iodine</td>
<td>Broad spectrum</td>
</tr>
<tr>
<td>Acetic Acid</td>
<td>Pseudomonas</td>
</tr>
<tr>
<td>Crystal violet/ Methylene Blue</td>
<td>Non-release low toxicity</td>
</tr>
<tr>
<td>Dyes-Scarlet red, Proflavine</td>
<td>Select out Gm neg.</td>
</tr>
<tr>
<td>Na Hypochlorite -Dakins, Eusol</td>
<td>Toxic = bleach</td>
</tr>
<tr>
<td>Hydrogen Peroxide</td>
<td>Action = Fizz</td>
</tr>
<tr>
<td>Quaternary Ammonia- Cetrimide</td>
<td>Very high toxicity</td>
</tr>
</tbody>
</table>

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Wound Bed Preparation Paradigm

Person with a Wound

- Treat the cause
- Local wound care
- Patient centered concerns

- Debridement
- Infection/Inflammation
- Moisture balance

Edge effect

Sibbald, Goodman, Woo et al. Special Considerations in Wound Bed Prep. 2011: An Update
Advances in Skin & Wound Care Sept. 2011

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Pharmacological management is the use of analgesic medications to address wound pain.

- Pain is classified into mild, moderate or severe
- Use pain meds. with caution in the elderly
- Start with low dose, frequent monitoring & titration
- May take a few days to a week
- Often short acting to determine long acting + breakthrough

World Health Organisation (WHO) pain ladder

- **Neuropathic Pain**
  - Burning, stinging: Use Tricyclic anti-depressants
  - Stabbing, shooting: Use Anti-epileptic agents

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<table>
<thead>
<tr>
<th>Recommendation – Guideline process</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 person expert panel</td>
<td></td>
</tr>
</tbody>
</table>

**Acetaminophen** should be considered as first line treatment for the management of both acute & persistent pain
- Important *not to exceed* the maximum daily dose **4 gm per day**
- Common dose **1 gram (500x2) tid**

**NSAIDs** should be used with caution after safer treatments have not provided sufficient pain relief
- Routinely monitor **gastrointestinal, renal, & cardiovascular side effects** & drug-drug, drug-disease interactions
- **Use lowest dose for shortest period**

**COX-2 selective inhibitors** should be co-prescribed with a proton pump inhibitor
- Use lowest acquisition cost PPI

**Opiate therapy** may be considered for patients with moderate to severe pain
- Nausea, vomiting
- **Appropriate laxative therapy** - stool softener + stimulant laxative

Adjunctive- tricyclic antidepressants (especially **Nortriptyline**) & antiepileptic drugs (**gabapentin, pregabulin**) have demonstrated efficacy
- Tolerability, and adverse events often limit their use in an older population
- Start low & go slow
Person with a Wound

Treat the cause
Local wound care
Patient centered concerns

Debridement
Infection/Inflammation
Moisture balance

Edge effect

Sibbald, Goodman, Woo et al. Special Considerations in Wound Bed Prep. 2011: An Update
Advances in Skin & Wound Care Sept. 2011

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How would you Debride this wound?
TO INITIATE / PROMOTE THE HEALING PROCESS - THIS PATIENT NEEDS DEBRIDEMENT:

1. ORANGE: only after adequate blood supply to heal has been established

2. BLUE: Hydrogel/ Autolytic

3. YELLOW: Mechanical debridement

4. GREEN: Enzymatic debridement

5. RED: Sharp Surgical
For Wounds That Can Heal

Debridement

- **Surgical**
  - Sharp
  - Conservative

- **Autolytic**
  - Hydrogels
  - Hydrocolloids
  - Alginites

- **Biological**
  - Sterile Maggots
  - Accidental Larvae

- **Mechanical**
  - Wet to dry
  - Whirlpool
  - Ultrasound
  - Water stream
  - Hydrojet

- **Chemical/Enzymatic**
  - Collagenase

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## Relationship of Debridement to Healing

<table>
<thead>
<tr>
<th>PDGF DNFU</th>
<th>PDGF+ %active</th>
<th>%heal</th>
<th>Placebo %active</th>
<th>%heal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center One</td>
<td>15</td>
<td>20</td>
<td>19</td>
<td>10</td>
</tr>
<tr>
<td>Center Six</td>
<td>81</td>
<td>83</td>
<td>87</td>
<td>25</td>
</tr>
</tbody>
</table>

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Steed et al 1996
Serial Surgical Debridement

- Healing outcomes of debridement DFUs
- 310 DFUs retrospective analysis from two RCTs
- More frequent debridement: higher rates of closure ($P=0.015$)
- Debridement frequency per patient not statistically co-related higher rates of closure (odds ratio 2.35, $p=0.069$)
- More studies are needed to clarify

Cardinal 2009
Wound Bed Preparation Paradigm

Person with a Wound

- Treat the cause
  - Debridement

- Local wound care
  - Infection/Inflammation

- Patient centered concerns
  - Moisture balance

- Edge effect

Sibbald, Goodman, Woo et al. Special Considerations in Wound Bed Prep. 2011: An Update
Advances in Skin & Wound Care Sept. 2011
Levine Technique

Figure 6-4: Levine Technique for Taking a Quantitative Wound Culture

Rotate the swab over a 1 cm square area with sufficient pressure to obtain fluid from within the wound tissue.

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WHAT IS THE BACTERIAL RELATIONSHIP WITH THIS WOUND?

1. ORANGE: Contaminated
2. BLUE: Colonized
3. YELLOW: Critically colonized
4. GREEN: Infected
5. RED: There are no bacteria in the wound
PAIN AND WOUND INFECTION
Sibbald, Woo, Ayello 06
Woo, Sibbald 09

NERDS
Superficial:
Treat topically

- Non-healing
- Exudate
- Red + Bleeding
- Debris
- Smell

STONEES
Deep:
Treat Systemically

- Size is bigger
- Temperature ↑
- Os (probes, exposed)
- New breakdown
- Exudate,
- Erythema, Edema
- Smell

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STONEES

Exudate (Pus)
Infection vs. peri-wound skin temperature

One way AVOVA between and within wounded non-infected and infected groups:

\[ F = 44.238 \]
\[ \text{Significance} = .000 \]

Mean 4.3 °F ± 2.44
Mean 0.383 °F ± 0.893

Range -0.5 - 8.7°F
Range -1.0 - 3.0°F

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Fierheller Advances 2010
Deep Infection & Chronic Wounds

Infection with wound duration < 1 month or immune competent

- Treat for gram positive or culture result

Infection with wound duration > 1 month or immune compromised

- Gram positive
- Gram negative
- Anaerobes

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NERDS /STONEES analysis

- A total of 92 patients with leg and foot ulcers
- Cross-sectional design study
- Recruited from ambulatory wound care clinics and in the community
- Each wound was evaluated for the presence or absence of the clinical signs of infection (NERDS and STONEES)
- Mean age=66 (33-90)

Diagnosis:
- Venous (28)
- DM neuropathic (27)
- DM neuroischemic (17)
- Other: lymphedema, trauma, non DM neuropathic (20)
# of NERDS | Sensitivity % | Specificity %
--- | --- | ---
2 | 85/ 87.5 | 33.3/ 20
3 | 73.3/ 75 | 80.5/ 75
4 | 38.3/ 40 | 100/ 100
<table>
<thead>
<tr>
<th># of STONEES</th>
<th>Sensitivity %</th>
<th>Specificity %</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>95/ 97.5</td>
<td>50/ 40</td>
</tr>
<tr>
<td>3</td>
<td>90/ 92.5</td>
<td>69.4/ 55</td>
</tr>
<tr>
<td>4</td>
<td>53.3/ 60</td>
<td>91.6/ 85</td>
</tr>
</tbody>
</table>
Clinicians often need to triangulate and look for 2 or 3 of these signs and symptoms before they make a diagnosis of increased superficial bacterial burden.
Evaluate and document pain intensity /characteristics on a regular basis (before, during, and after dressing change)
Topical Honey

1. Yellow is hypo-osmolar
2. Red treats infection
3. Blue improves venous ulcer healing
4. Orange removes thick eschar
5. Green may improve healing of superficial burns
Medical Grade Manuka Honey

- RCT multiple center, venous leg ulcers
  - Honey dressing 187 patients
  - Usual care 181 patients (Alginate, hydrofiber, hydrocolloid, foam, hydrogel, non-adherent, iodine, silver)
- Healed at 12 weeks (p=0.258)
  - Honey 104 (55.6%)
  - Usual 90 (49.7%)
- More adverse effects 1.3 RR (CI 1.1-1.6)

### Venous Leg Ulcers

“Honey used alongside compression therapy does not improve healing of **venous leg ulcers**.”

### Superficial & Partial Thickness Burns

“Honey may shorten healing times for **moderate burns** compared with some conventional dressings.

“**There is not enough evidence to give guidance for the use of honey in other types of wounds.**”
1. Yellow may be contraindicated with thyroid disease

2. Red treats infection

3. Blue improves venous ulcer healing

4. Orange has a broad spectrum

5. Green has high tissue toxicity
10 trials with cadexomer iodine

One study 6 wk. healing better daily use of cadexomer iodine vs. standard care (not involving compression) (RR 2.29, 95% CI 1.10 to 4.74).

Compression + cadexomer iodine vs. standard care: 2 trials pooled estimate higher 6 week healing rates for cadexomer iodine (RR 6.72, 95% CI 1.56 to 28.95)

Surrogate healing outcomes:

- daily or weekly healing rate favored cadexomer iodine

1. Yellow treats bacteria in the Ag\(^0\) form

2. Red treats infection

3. Blue improves venous ulcer healing

4. Orange may impair re-epithelialization

5. Green can be used on non-exudating wounds
Everyone has a Silver Dressing

Cochrane review: “no data to support the use of silver dressings”

Lots of chatta & no data

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Conclusions

- No study was categorized as having very low risk of bias, but all studies were categorized as having low risk of bias.
- In reality very few studies reach a high standard.
- Reporting needs to be more consistent (use CONSORT) guidelines; data should include all variance measurements.
- There is strong meta-analytical evidence that silver-impregnated dressings improve one partial wound healing parameter (wound size reduction) but healing rates non-significant.
- Subgroup meta-analysis suggests that the healing effect does not last much more than 4 weeks.
- There is insufficient data to extrapolate whether time to heal for the average wound or ulcer is significantly different due to short study follow-up times.
Alex, EB, Apligraf And Acticoat
Topical *PHMB (Chlorhexidine)*

*PolyHexaMethyleneBiguanide*

1. Yellow is less toxic than Chlorhexidine
2. Red treats infection
3. Blue improves venous ulcer healing
4. Orange may affect thyroid function
5. Green can be combined with foam dressings
OVERALL RESULTS – WOUND SURFACE AREA

*Sibbald, Coutts, Woo Advances Feb. 2011*

- Median reduction in wound surface area
- PHMB foam dressing demonstrated: 35% (34.9 cm$^2$)
- Control group: 28% (27.8 cm$^2$)
1. Ayello treats critical colonization

2. Red treats infection

3. Blue is a non-release formulation

4. Orange can be used with collagenase

5. Green can be combined with foam dressings
Methylene Blue/ Crystal Violet
Case Series Results

<table>
<thead>
<tr>
<th>TYPE ULCER</th>
<th># SUBJECTS</th>
<th>SIZE</th>
<th>BACTERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>DFU</td>
<td>8</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>VENOUS</td>
<td>5</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>MISC</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>15</td>
<td>9</td>
<td>2</td>
</tr>
</tbody>
</table>

- Majority of ulcers ↓ in size
- Non-release= not pro-inflammatory
- Improved without influencing surface bacteria

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Debridement

Infection/Inflammation

Moisture balance

Edge effect

Sibbald, Goodman, Woo et al. Special Considerations in Wound Bed Prep. 2011: An Update

Advances in Skin & Wound Care Sept. 2011

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Sibbald Cube ©

- Use in the Healable Wound that is “stalled”. (Less than 30% decrease in size in 4 weeks)
- Correct & modify cofactors using Wound Bed Preparation©

Test to detect high surface MMPs

<table>
<thead>
<tr>
<th>SUPERFICIAL</th>
<th>HIGH PROTEASES</th>
<th>LOW PROTEASES</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH BACTERIA ≥ 3 NERDS</td>
<td>Anti-inflammatory dsg</td>
<td>Anti-microbial dsg</td>
</tr>
<tr>
<td></td>
<td>Anti-microbial dsg</td>
<td>e.g. Silvercel</td>
</tr>
<tr>
<td>LOW BACTERIA &lt; 3 NERDS</td>
<td>Anti-inflammatory ds</td>
<td>Moisture balance dsg</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DEEP &amp; SURROUNDING TISSUE</th>
<th>HIGH PROTEASES</th>
<th>LOW PROTEASES</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGH BACTERIA ≥ 3 STONEES</td>
<td>Oral Anti-inflammatory antimicrobial</td>
<td>Systemic Antimicrobial</td>
</tr>
<tr>
<td>LOW BACTERIA &lt; 3 STONEES</td>
<td>Systemic Anti-inflammatory</td>
<td>No systemic therapy</td>
</tr>
</tbody>
</table>

Based on the EPA test

Based on clinical criteria
Assessment of exudate for moisture balance

- No reliable and valid tool exist
- Has a subjective element

**In clinical setting:**

- evaluate the amount of exudate
- Evaluate wound bed & peri-wound
Is the wound moisture balance correct? (asked nurses) 2012 Audit

In 2006 community Audit, with external expert assessment:

- Correct Moisture balance 30.7%
- Too wet 40.0%
- Too dry 29.3%

- With pre-ordered & pre-delivered dressings the 91.6% level of moisture balance is unlikely and this may be a subject for further targeting of education
Assessing the amount of exudate

<table>
<thead>
<tr>
<th>Wound condition</th>
<th>Amount of exudate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wound is dry / Desiccated</td>
<td>No exudate</td>
</tr>
<tr>
<td>Slightly moist</td>
<td>Small (Scant)</td>
</tr>
<tr>
<td>Wound bed is wet</td>
<td>Moderate</td>
</tr>
<tr>
<td>Wound bed is saturated / Maceration</td>
<td>Large (Heavy)</td>
</tr>
</tbody>
</table>
Dry

Moist

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## Dressing Categories & Moisture

<table>
<thead>
<tr>
<th>Hydrogel</th>
<th>Transparent Films</th>
<th>Hydrocolloid</th>
<th>Hydrofibers / Alginates</th>
<th>Foams/ Super-Absorbents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Donates moisture</td>
<td>Neither donates or absorbs moisture</td>
<td>Donates and absorbs a small to moderate amount of moisture</td>
<td>Absorbs moderate to large amount of moisture</td>
<td>Absorbs moderate to large amount of moisture</td>
</tr>
</tbody>
</table>

**Increasing Absorbency**
Need to Balance Dressing with Frequency

• Diaper type technology dressing-superabsorbent with **fluid lock**
• Foam (~3x more costly)- partial **fluid exchange** may lead to periwound maceration
• Consider the moisture balance of the wound for cost efficiency of care
Remember this patient?

Julia Paul: Characteristics of Wounds that itch
Advances in Skin and Wound Care 2013 vol 26 # 27 page 320-32
Wound Bed Preparation Paradigm

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Debridement

Infection/Inflammation

Moisture balance

Edge effect

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Advances in Skin & Wound Care Sept. 2011

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### Factors That Can Impair Healing

<table>
<thead>
<tr>
<th>Factor</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient comorbidities</td>
<td>uncontrolled diabetes, active autoimmune disease, malnutrition,</td>
</tr>
<tr>
<td></td>
<td>neuromuscular diseases cardiorespiratory problems</td>
</tr>
<tr>
<td>Other patient factors</td>
<td>smoking or alcohol use non-adherence Problems with AODL lack of social/</td>
</tr>
<tr>
<td></td>
<td>family support</td>
</tr>
<tr>
<td>Medications,</td>
<td>corticosteroids, immunomodulation chemotherapy, radiation therapy</td>
</tr>
<tr>
<td>Wound environment</td>
<td>longer duration, Larger size poor wound bed condition infection or inflammation</td>
</tr>
</tbody>
</table>
Edge Effect - not usually for the treatment of infection

- Growth factors
- Skin substitutes
- Complementary therapies
  - HBO (occ. Severe infections are treated)
  - NPWT (co-treat infection)
  - Physical modalities - Ultrasound, E-stim.
- Skin grafts

• Non advancing edge
• Cliff like appearance
• Need for active therapy

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PARTICIPANTS HAVE:

• Described *healable, non-healable & maintenance wounds* as part of wound bed preparation
• Reviewed appropriate *debridement methods*
• Assessed moisture balance to select an appropriate *dressing*
• Diagnosed: *Superficial critical colonization & deep surrounding infection* (NERDS & STONEES)
• Differentiated *5 classes of topical antimicrobial agents*
• Reviewed the appropriate use of *active therapies*