Understanding Support Surface Testing and Performance

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Introduction

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  – NPUAP and S3I Committee Member

• Evan Call, MS, CSM (NRM)
  – Adjunct Faculty Member, Department of Microbiology, Weber State University
  – Board of Directors, NPUAP / Research Scientist / Co-Chair of S3I Committee
5-Step Surface Selection Process

Step 1: Determine Support Application
Step 2: Identify Patient Needs
Step 3: Determine Type of Surface
Step 4: Research Surface Performance
Step 5: Review Other Decision Points

Common Decision Points
- Bed
- Seat
- Overlay
- Acute Care / ICU / LTC
- Moisture
- Mobility
- CLP / AP / AFT
- LAL
- Percussion
- Vibration
- Lateral Rotation
- Evaporation
- Heat Withdrawal
- Friction / Sheer
- Pressure Redistribution
- Durability
- “Cleanability”
- Cost
- Warranty
- Service
- Clinical Support

The Right Surface Solution
Step 1 - Determine Support Application

<table>
<thead>
<tr>
<th>Mattress</th>
<th>Integrated Bed System</th>
<th>Overlay</th>
<th>Overlay Seat Cushion</th>
<th>Seat Cushion</th>
</tr>
</thead>
</table>

“Specialized devices for pressure redistribution designed for management of tissue loads micro-climate and or other therapeutic functions”

NPUAP, S3I Terms and Definitions, 2007
Step 2 - Identify Patient Needs for a Support Surface

• Understand there are 5 “surface related” factors to skin care

• Patient risk factors for moisture and mobility impact surface selection

• The care setting and other patient acuities drive specific surface needs
The Impact a Surface Can Have on the Skin

<table>
<thead>
<tr>
<th>Factors</th>
<th>Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pressure</strong> (1,2,3,15)</td>
<td>- Pressure compresses tissue&lt;br&gt;• Tissue deformed and blood flow is impeded&lt;br&gt;• Tissue may die as a result of lack of oxygen</td>
</tr>
<tr>
<td><strong>Shear</strong> (1,4,5,6,15)</td>
<td>- Tissue is stretched&lt;br&gt;• Tissue deformation, blood flow is impeded due to stretching and distortion of vessels&lt;br&gt;• Broken skin is more susceptible to other factors of pressure, shear, and moisture</td>
</tr>
<tr>
<td><strong>Friction</strong> (1,7)</td>
<td>- Rubbing of surface or bedding against skin&lt;br&gt;• Broken skin is more susceptible to other factors of pressure, shear, and friction</td>
</tr>
<tr>
<td><strong>Heat</strong> (1,8,9,12,13,14)</td>
<td>- Heat build-up can lead to perspiration&lt;br&gt;• Moist skin becomes more fragile and susceptible to forces of pressure, shear, and friction</td>
</tr>
<tr>
<td><strong>Moisture</strong> (1,8,9,10,11)</td>
<td>- Excessive moisture impairs the ability of tissue to absorb oxygen and rid itself of waste</td>
</tr>
</tbody>
</table>
Select the Right Surface Based on Risk Factors

Evidence based on WOCN® Support Surface Consensus\textsuperscript{16}

<table>
<thead>
<tr>
<th>BRADEN MOISTURE SUBSCALE SCORES</th>
<th>4 or 3</th>
<th>2 or 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rarely or occasionally moist</td>
<td>No limitation or slightly limited</td>
<td>Very limited or completely immobile</td>
</tr>
<tr>
<td>Very moist</td>
<td>Reactive/CLP (air, foam, gel, fiber, or viscous fluid, or combinations)</td>
<td>Reactive/CLP</td>
</tr>
<tr>
<td></td>
<td>AMG sheepskin overlay (Prevention only)</td>
<td>Active with AP feature</td>
</tr>
<tr>
<td>Constantly moist</td>
<td>Reactive/CLP</td>
<td>Reactive/CLP with LAL feature</td>
</tr>
<tr>
<td></td>
<td>Reactive/CLP with LAL feature</td>
<td>Reactive/CLP with LAL feature</td>
</tr>
</tbody>
</table>

\(AF = \) air fluidized; \(AMG = \) Australian Medical grade; \(AP = \) alternating pressure; \(CLP = \) constant low pressure; \(LAL = \) low air loss.

Determine Support Application  
Identify Patient Needs  
Determine Type of Surface  
Research Surface Performance  
Review Other Decision Points
Select the Right Surface Based on Care Setting

**ICU**
- Percussion and Vibration Features
- Lateral Rotation
- Frame Integration

**Acute Care / LTC**
- Pressure Redistribution
- Low Air Loss
- Air Fluidized Therapy
- Affordable Sleep Surface

Can the Surface Assist in:
- Skin Care?
- Pulmonary Needs?
- Patient Mobility?

Can the Surface Assist in:
- Moisture Management?
- Wound Healing?
- Patient Comfort?

Determine Support Application  
Identify Patient Needs  
Determine Type of Surface  
Research Surface Performance  
Review Other Decision Points
Step 3 - Determine the Type of Surface Needed

• Understand the NPUAP terms and definitions for a support surface

• How each surface type works to provide therapy

• Determine therapeutic benefits of other surface features
# NPUAP Surface Definitions

<table>
<thead>
<tr>
<th>NPUAP* Term</th>
<th>NPUAP Definition</th>
</tr>
</thead>
</table>
| **Constant Low Pressure (CLP) or Reactive** | Consensus definition: A powered or non-powered support surface that provides pressure redistribution in response to an applied load (patient) through immersion and envelopment.  

*Includes alternative, contoured, or textured foam; gel or silicone; fiber; viscous fluid; static air-, water-, or bead-filled mattresses or overlays; and Australian Medical-grade sheepskin* |
| **Alternating Pressure (AP) or Active** | Provides pressure redistribution via cyclic changes in loading and unloading as characterized by frequency, duration, amplitude, and rate of change parameters |
| **Low Air Loss (LAL)** | Provides a flow of air to assist in managing the heat and humidity (microclimate) of the skin |
| **Air Fluidized (AF)** | Provides pressure redistribution via a fluid-like medium created by forcing air through beads as characterized by immersion and envelopment |
Reactive / Constant Low Pressure (CLP)

Pressure Redistribution through **Immersion & Envelopment**

**Immersion** = Depth of Penetration into Surface

**Envelopment** = Ability to conform to Irregularities and Contact Area for Level of Immersion

- Poor Envelopment (trampoline support)
  - Conventional Surface
  - High Envelopment (Fluid support)

**Determine Support Application**
**Identify Patient Needs**
**Determine Type of Surface**
**Research Surface Performance**
**Review Other Decision Points**
Alternating Pressure vs. Continuous Low Pressure

<table>
<thead>
<tr>
<th>Alternating Pressure (AP) (Active)</th>
<th>Continuous Low Pressure (CLP) (Reactive)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>(<em>Moves w/o patient on surface)</em></td>
<td>(<em>Does Not Move w/o patient on surface)</em></td>
</tr>
</tbody>
</table>

**Alternating Pressure**

- Single Zone Foams and Gels
- Multi Zone Foams and Gels
- Self-Adj. Technology
- Static Air
- Low Air Loss
- Air Fluidized Therapy

**Pressure management**

- Periodic Load Reduction
- Immersion & Envelopment

**Shear management**

- Periodic Shear Reduction
- Low Friction /Compliant Materials

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**Determine Support Application**

**Identify Patient Needs**

**Determine Type of Surface**

**Research Surface Performance**

**Review Other Decision Points**
Low Air Loss (LAL)\textsuperscript{17,18}

**Uses the flow of air to combat the build-up of heat and humidity on skin**

**Mild Skin Cooling**

- Cooler skin has a reduced need for nutrients, making it less vulnerable to wounds caused by unrelieved pressure
- Maintains skin temperature below threshold for local perspiration
- Normally increases comfort

**Removal of Moisture**

- Helps maintain strength of skin
- Reduces Friction

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Determine Support Application  Identify Patient Needs  Determine Type of Surface  Research Surface Performance  Review Other Decision Points
Air Fluidized Therapy

High Air-Flow and Fluidized Bath

- Excellent envelopment and immersion (low interface pressure)
- Low Shear
- High Microclimate management capability (high evaporative capacity)

Air cushions between beads allow them to move independently

Beads not fluidized

Beads fluidized

Air-flow OFF

Air-Flow ON

Determine Support Application

Identify Patient Needs

Determine Type of Surface

Research Surface Performance

Review Other Decision Points
Other Features of Support Surfaces

<table>
<thead>
<tr>
<th>Therapy</th>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Support</td>
<td>Weight-based Pressure Redistribution</td>
</tr>
<tr>
<td></td>
<td>Shear Relief Features</td>
</tr>
<tr>
<td>Pulmonary</td>
<td>Percussion / Vibration</td>
</tr>
<tr>
<td></td>
<td>Lateral Rotation</td>
</tr>
<tr>
<td>Patient Handling</td>
<td>Turn-Assist</td>
</tr>
<tr>
<td></td>
<td>Chair Egress</td>
</tr>
<tr>
<td>Patient Safety</td>
<td>Bed Exit Alarm</td>
</tr>
<tr>
<td></td>
<td>Welded Seams / No Removable Parts</td>
</tr>
</tbody>
</table>

Determine Support Application  Identify Patient Needs  Determine Type of Surface  Research Surface Performance  Review Other Decision Points
Step 4 – Research Surface Performance Testing and Results

• What is the NPUAP Support Surface Standards Initiative

• Understand how each test is performed and interpret the results

• Know why pressure mapping is not a valid method of measurement
Surface Performance Testing – Why do it?

- The importance of a support surface and it’s impact on the skin

- The need to have a standardized method to compare surfaces to **empower the caregiver in product selection**
The Support Surfaces Standards Initiative (S3I) was founded in 2001 by the NPUAP to develop:

- uniform terminology
- test methods
- reporting standards

These guidelines provide an objective means for evaluating and comparing support surface characteristics to make an educated surface choice.
S3I Test Methods

Test methods address key surface-related pressure ulcer risk factors:

**Pressure***

- **Peak Sacral Pressure**
  - measures pressure of different weightloads with a sensored Indenter

**Shear / Friction**

- **Horizontal Stiffness**
  - measures shear forces using an Indentor ‘pulled’ across the surface

**Heat**

- **Heat Withdrawal ‘Dry Flux’**
  - measures the amount of heat withdrawn from the surface

**Moisture**

- **Evaporative Capacity ‘Wet Flux’**
  - measures the amount of moisture removed from surface

* Awaiting Approval

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**Determine Support Application**

**Identify Patient Needs**

**Determine Type of Surface**

**Research Surface Performance**

**Review Other Decision Points**
Pressure Redistribution - mmHG

- **How is it done?** Pelvic shaped indenter attached to force and immersion measuring device. Indenter is impressed into seat section with a force appropriate for patient weight and HOB angle.

- Multiple trials conducted to spatially sample the seat region

- **How to interpret results?** Peak pressure measured in mmHG and higher numbers indicate increased risk of skin breakdown
Pressure Redistribution - mmHG

Peak Sacral Pressure – HOB @ 0°

5% Percentile
50% Percentile
95% Percentile

Less Peak Sacral Pressure

HOB angle can impact results

3 surfaces tested at various simulated patient weights

Surface 1  Surface 2  Surface 3

Determine Support Application  Identify Patient Needs  Determine Type of Surface  Research Surface Performance  Review Other Decision Points
Shear / Friction - Newtons of Pushback Force

• **How is it done?** Pelvic indenter pulled toward foot of bed 10mm by force measuring device

• Pushback force measured every 60 seconds for 5 minutes

• **How to interpret the results?**
  – Peak shear at 0 min indicates instantaneous maximum pushback force
  – Pushback force at 5 min indicates high sustained shear

Horizontal Stiffness Test measures shear forces using an Indentor ‘pulled’ across the surface

Determine Support Application  Identify Patient Needs  Determine Type of Surface  Research Surface Performance  Review Other Decision Points
Shear / Friction - Newtons of Pushback Force

Horizontal Stiffness – HOB at 30°

- Less Horizontal Stiffness

HOB angle can impact results

- Three surfaces tested for instantaneous and sustained shearing

- Determine Support Application
- Identify Patient Needs
- Determine Type of Surface
- Research Surface Performance
- Review Other Decision Points
“Sweaty Butt” - Sweating Guarded Hot Plate

Measures equilibrium rates at which heat and moisture pass through surface.\(^\text{19}\)

- Determine Support Application
- Identify Patient Needs
- Determine Type of Surface
- Research Surface Performance
- Review Other Decision Points

Temperature - Watts/meter$^2$ Heat

- **How is it done?** “Sweaty butt” test device placed in seat section of support surface

- Measures heat withdrawal characteristics of the surface

- **How to interpret the results?**
  - High levels of heat withdrawal indicate high level of skin cooling
  - Degree of skin cooling can affect patient comfort, tissue ischemia and local perspiration
Temperature - Watts/meter$^2$ Heat

Heat Withdrawal – HOB at 45°

- Better heat withdrawal
- 3 surfaces tested for heat withdrawal
- HOB angle can impact results

3 surfaces tested for heat withdrawal:
- Surface 1
- Surface 2
- Surface 3

- Determine Support Application
- Identify Patient Needs
- Determine Type of Surface
- Research Surface Performance
- Review Other Decision Points
Moisture - Grams/meter$^2$ H2O

- **How is it done?** “Sweat butt” test device placed in seat section of support surface

- Measures moisture withdrawal characteristics of the surface

- **How to interpret the results?**
  - High levels of moisture withdrawal indicate ability to evaporate moisture effectively
  - Effective LAL products are meant to evaporate sweat but not incontinence
Moisture - Grams/meter$^2$ H2O

Evaporative Capacity – HOB at 0°

HOB angle can impact results

Better moisture removal

3 surfaces tested for evaporative capacity

Determining Support Application
Identify Patient Needs
Determine Type of Surface
Research Surface Performance
Review Other Decision Points
Why not Pressure Mapping?

- **Lack of precision**
  - Peak Sacral Pressure Testing results $\rightarrow +/\text{- }1\%$ variance
  - Vs. Pressure Mapping Results $\rightarrow +/\text{- }15\%$ variance (*no difference between “green” and “orange”*)

- **Pressure Mapping Pads affects surface performance**
  - Thick and non-conforming to surface
  - Impacts true immersion and envelopment

- **Different patients for every test = lack of comparability**
  - Every test patient has different body type
  - BMI, muscle mass, height, weight etc.
Step 5 - Other Factors to Consider

- Durability
- “Cleanability”
- Cost
- Warranty
- Service
- Clinical Support

Determine Support Application  Identify Patient Needs  Determine Type of Surface  Research Surface Performance  Review Other Decision Points
Questions?

- Please email your questions to: Clinical.Education@WoundCareJobs.com

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References


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