A Note About Standards

- S3I Terms and Definitions were now 9 years old
- Should we find a different reference so it is "NEW Science"
- Standards are Voted on for Renewal every 3 years.
- They are never more than 3 years old
Terms and Definitions

1. Scope
This section of RESNA 55-1 specifies a vocabulary consisting of terms and definitions used in this test for the design, support surfaces, patient positioning, and respiratory care. This section is an integral part of the American National Standards for the design, support surfaces, patient positioning, and respiratory care. While it is written to be consistent with American National Standards for the design, support surfaces, patient positioning, and respiratory care, it does not include terms considered to be adequately defined in everyday English.

2. Rules and elements used in vocabulary
When terms defined are used in more than one section of the RESNA standard, making specifically in the terms defined in this section. Terms defined in this section are defined in the terms defined in this section.

3. Terms and definitions
For the purposes of this section of RESNA 55-1, the terms and definitions below apply:

3.1 *Immersion*
A method of pressure relief in which the patient's entire body is submerged in a fluid medium.

3.2 *Resting pressure*
A measure of pressure applied to a support surface that is sustained for a period of time.

3.3 *Alternating pressure*
A method of pressure relief in which the pressure is increased and decreased in a cyclical manner.

4. Principle
A group of professionals, researchers, and industry representatives identified important parameters for the design, engineering, and manufacturing of support surfaces. These parameters are based on principles of fluid dynamics, biomechanics, and polymer science.

The immersion method outlined in this section measures the ability of a support surface to redistribute pressure by increasing the contact area around the patient.

4. Immersion

4.1 *NPAP 40th percentile male mannequin, rigid version*
A mannequin used to test support surfaces (see Figure 1).

**Figure 1. NPAP 40th percentile male mannequin**

NOTE: Supplementary instructions to ensure the NPAP 40th percentile male mannequin are available in the RESNA 55-1.

2. Terms and Definitions

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**Figure 1. NPAP 40th percentile male mannequin**

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Microclimate

What do These Tests Results Mean?
### Examples of the Numbers

<table>
<thead>
<tr>
<th>Description</th>
<th>Immersion Distance (mm)</th>
<th>EvapCap (gm^2/hr)</th>
<th>Heat Removal W/m^2</th>
<th>Peak Temp (°C)</th>
<th>Peak RH (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High is Good</td>
<td>High may be good</td>
<td>Low may be Good</td>
<td>Low is good</td>
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<td>LAL 1</td>
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<td>LAL 2</td>
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<td>Visco Foam 1</td>
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<td>Visco Foam 2</td>
<td>50</td>
<td>1</td>
<td>29</td>
<td>32.8</td>
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</tbody>
</table>

### How Can We Use the Results
We’ve Gone From Theory…

… To Bench Research…
...Moving to Practice

Bench Validation

From Theory to Practice Requires Validation
S3I Validation

- Strong committee requirement
  - All tests will have validation
  - All tests will meet a minimum of repeatability
  - All tests will meet a minimum of reliability
- All of the Standard Methods put forward by S3I have been through this process

Clinical Validation

From Bench to Practice also requires Validation!
How?

- Clinical trials
- Surfaces with known Standard test results
- Tested in specific care arenas
  - ICU, CCU, TCU, GC, LTC
- Controlled for health status and patient risk factors

Where We Go Next: First Steps

- To climb this mountain
  - Gather available results
  - Predict performance
    - In given environment
    - With defined care practices
    - Formulate test plan
- Perform Clinical Validations
Model the Effect of Care on Elements of Risk

- Using Test Results, Literature and Expert Opinion
  - Determine the positive or negative impact of Devices and Practices -Direction-
  - Measure where possible – Magnitude-
  - Estimate where not possible – Magnitude-

- Construct a Mathematical Model
  - Predict impact of devices and practices
  - Test Predictions

Test Result Input

- Immersion in mm
- Body Analog Microclimate in C° and % RH
- Sweating Guarded Hotplate
- Friction
Include Influence of Care Practices

- In depth interview with 5 nurses from 4 Care settings
  - Boosting
  - Turning program,
  - Use of draw sheets and positioners
  - Positioning
  - Early Mobility
  - Micro turns

Include Influence of Care Practices

- Heel Elevation
- HOB Restrictions
- Skin Care Products
- Protectants
- Moisturizers
- Prophylactic Dressings
**Literature as Input**

<table>
<thead>
<tr>
<th>Element</th>
<th>Literature</th>
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<tbody>
<tr>
<td>Sheets and layers on the Surface</td>
<td>Williamson P, Lachenbruch C, VanGilder C, Sauser F. The effect of Multiple layers of Linens on Surface Interface Pressure: Results of a Laboratory Study Ostomy Wound Management. Jue 2013 pgs 38-47</td>
</tr>
</tbody>
</table>

**For a Given Patient, Predict Performance of the Surface**

- The model takes into account:
  - BMI
  - Metabolic status
  - State of health
    - Conscious
    - Unconscious
    - Mobility
    - Febrile
  - Treatments
    - Intubated
    - Vasopressors
What the Model Looks Like

Working from the Body Analog
Microclimate Data
Patient on Support Surface w/ Chuck

Note effect of patient control of room temperature

Influence of Ambient Temperature
Example of Impact of Turning on Microclimate

Factoring in Devices that Interact With the Body

- **Dressings**
  - Small temperature increase
  - Large shear reduction
  - Small to moderate pressure redistribution

- **Chucks and Chuck Management**
  - Reduction in moisture at skin surface
  - Air wash due to replacement of soiled chuck
  - Small increase in temperature
Reusable vs Disposable Chuck

- Plastic backing restricts moisture removal
- Multiple layers
  - Reduce immersion
  - Reduce heat loss
  - Reduce moisture loss

Positioning

- Air charge in positioner provides temperature reset
- Over time Air becomes an insulator
- Turning schedule becomes the microclimate reset cycle
- Air charge increases effective immersion
Turning

- Creates Air Exchange Reset of Microclimate
- Resets tissue deformation
- New Position Provides Altered Airflow and Circulation

Boosting

- Devices reduce Friction
- Devices reduce Shear
- Microclimate
  - Resists heat and moisture movement
  - Makes microclimate reset more consistent
Dressings for Prevention

Shear Displacement
Force Redistribution
Moisture Management
Slight increase in Temperature

Bed Dressing

- Devices on the surface reduce immersion
  resist heat and moisture escape
  - Turning Devices
  - Chucks,
  - Multiple Chucks
  - Extra blankets
  - Pillows
  - Positioning
  - Wedges and Bladders
• High forces on skin
• Highly variable microclimate
• Procedure dependent
  • Temperature
  • Repositioning
  • Positioning
  • Friction
  • Shear

Skin Care Routine

• Reduces exposure to moisture, fecal bacterial exposure, pH and enzymes
• Reduces Moisture Vapor Transmission
• Alters Friction and Shear Profile
Positioning Heels

Microclimate Reset, air circulation
Force Removed from Heel

Positioning Head

• Offloads Critical Surfaces
• Microclimate reset
  • Thermal Mass of Devices
Progressive Mobility

- Improved Circulation
- Loading Force Removed from Heel, Sacrum, Occiput etc.
- Loading Force Applied to I.T.s and Soles
- Microclimate Reset

Side Chair

Transition from bed to chair
- Microclimate reset
- Improved or altered circulation
- Decreased Force on the Sacrum
- Increased on the Ischial Tuberosity
Concern Arises From the Extremes

- Clinically an 88 lb elderly woman will be placed in the same bed as a 380 lb middle aged man
- If we model these extremes we can
  - Predict surface performance at the low mass
  - Predict surface performance at high mass
- Using these as limits we can calculate a Support Surface Population Risk Factor

Support Surface Population Risk Factor

- For a given set of care practices and patient conditions
- A score is generated.
- Low is better

<table>
<thead>
<tr>
<th>Description</th>
<th>HPMRF</th>
<th>TPMRF</th>
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<tbody>
<tr>
<td>LAL 1</td>
<td>5.0</td>
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<td>LAL 2</td>
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<tr>
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<td>Visco Foam 1</td>
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<td>3.2</td>
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<tr>
<td>Visco Foam 2</td>
<td>15.3</td>
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</table>
### Final Ranking Considering all Test Results and Care Practices

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<tr>
<th>Mattress Type</th>
<th>Foam</th>
<th>Foam and Air</th>
<th>AP</th>
<th>LAL</th>
<th>LAL</th>
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<th>LAL</th>
<th>Powered Air</th>
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<td>Temp Diff (°C)</td>
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<td>5</td>
<td>6</td>
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<tr>
<td>Max RH (%)</td>
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<td>7</td>
<td>3</td>
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<td>6</td>
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<td>1</td>
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<tr>
<td>RH Diff (%)</td>
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<td>6</td>
<td>7</td>
<td>8</td>
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<td>3</td>
<td>4</td>
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<tr>
<td>EvapCap (gm²/2hr)</td>
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<td>2</td>
<td>6</td>
<td>7</td>
<td>3</td>
<td>5</td>
<td>1</td>
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<tr>
<td>Q dry (W/m²2)</td>
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<td>Immersione (mm)</td>
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<td>Peak Temp (°C)</td>
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<td>6</td>
<td>3</td>
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<td>7</td>
<td>2</td>
<td>1</td>
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<td>HPMRF</td>
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<td>5</td>
<td>7</td>
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<td>2</td>
<td>4</td>
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<tr>
<td>Over all Rank, Low score is best</td>
<td>72.5</td>
<td>55.5</td>
<td>49</td>
<td>65</td>
<td>40</td>
<td>39.5</td>
<td>26</td>
<td>48.5</td>
</tr>
</tbody>
</table>

### Conclusions:

- The model yields different results based on care environment and practices
- Care practices have the single largest impact on final ranking
- Care plans should factor in the surface that is in use
- This type of analysis should be used to generate the test plan for Clinical Validation of Support Surface Test Results.
Envelopment Test is Almost Here

Horizontal Stiffness Test Almost Here
Still to Come Disinfectant /Aging

Credits

Susan Jellum MS, WCN
Marianne Russon, Tech
Marie Gardner, Model
Josh Burton
Anh Dang