Emerging trends and evolving technologies in dressing material science research for wound prevention and treatment

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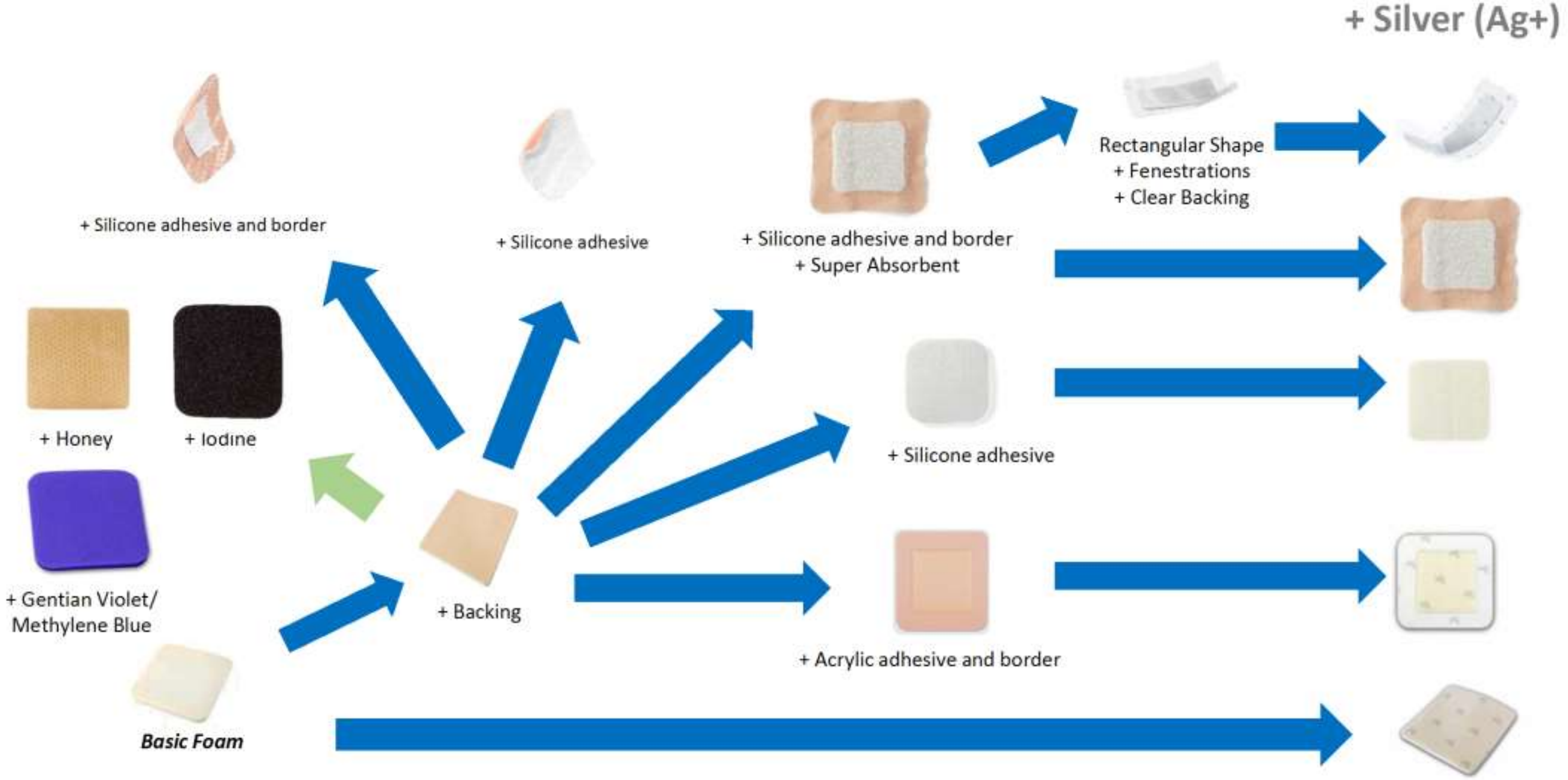
Objectives

- Review evolution of dressing technologies used for prevention and treatment of pressure injuries
- Explore a new use of an old technology and the potential benefits to patient care
- Share potential future methods for testing dressing efficacy

How did we get here?

Foam Product Evolution



Most innovation is related to treatment, not prevention.

Advances in foam dressing technology

Trend 1: Use of Silicone adhesive – 2000s

- Emergence of multilayer, silicone-faced foams; clinical evidence of efficacy emerging around 2010
- In response, more manufacturers launched multilayer silicone foams, ***but some were stiffer than others***

Trend 2: Dressing flexibility – 2020s

- **Wear time importance**: Stay down is a combination of stiffness and how much you have to manipulate the dressing
- Manufacturers start updating products to be more flexible to add fenestrations, change film backing, modify superabsorbents, etc.

Trend 3: Mechanical & thermal properties matter – 2022+

- Investment in in-vitro test methods
- Research into more materials

Current Standard of Care: The Reality is...

Utilize a prophylactic multilayer foam dressing within a PIP protocol (skin care, offloading, etc)

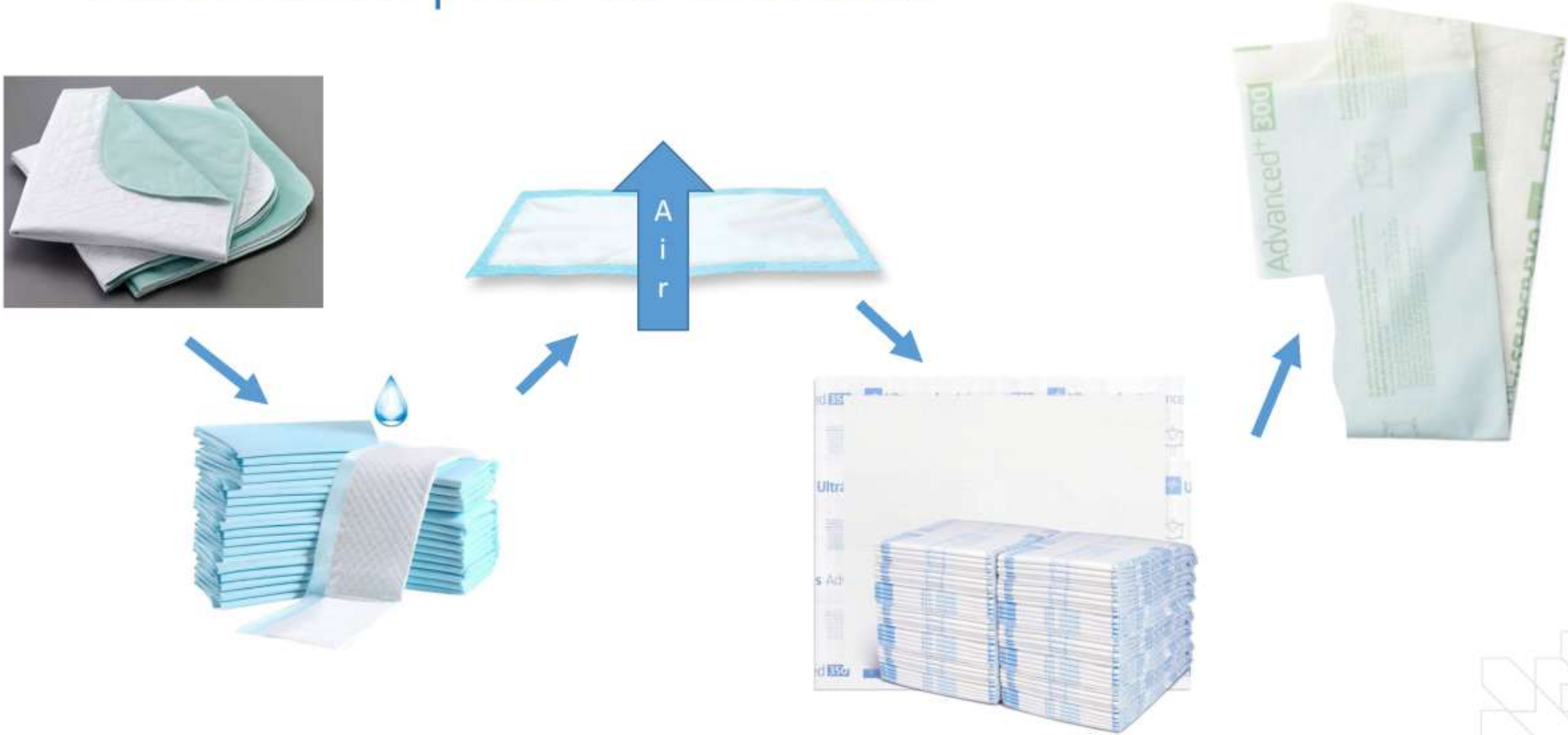
Requires skin assessments (at least once a shift) that lift the dressing to visualize the skin:

- Dressing loses integrity with multiple lifts (folding, rolling, loses tack) - leads to over-utilization
- Time consuming
- Potential trauma to the skin
- Bony prominences can be hard to dress
- Impact on microclimate
- Product waste

Source: Journal of Tissue Viability, https://doi.org/10.1016/j.jtv.2019.01.001

What's old can be new again

Absorbent pads for the bed



Some Dressing Materials Used for Prevention

Foam

Gel pads

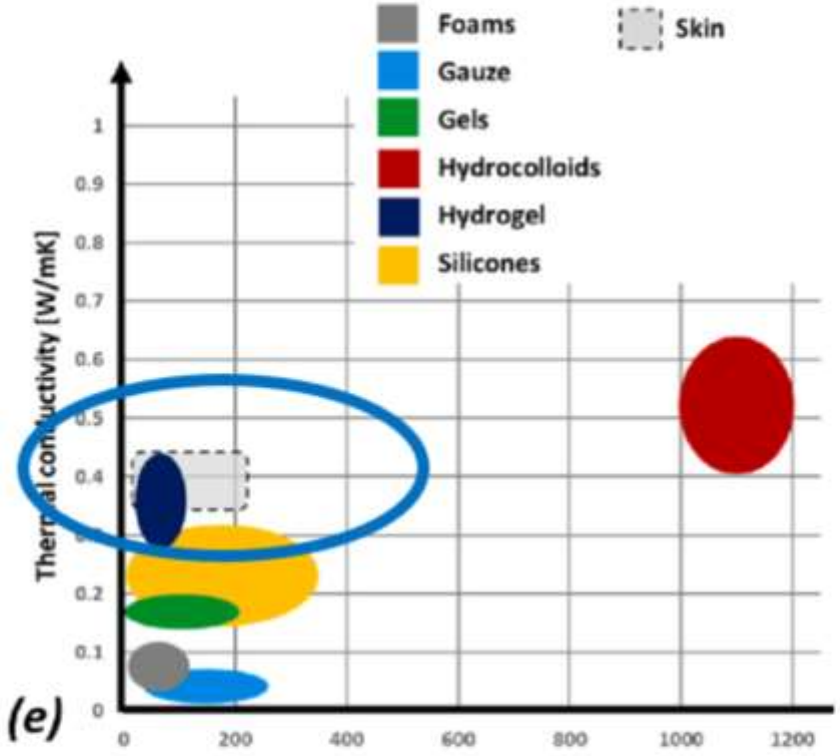
Gauze

Hydrocolloid

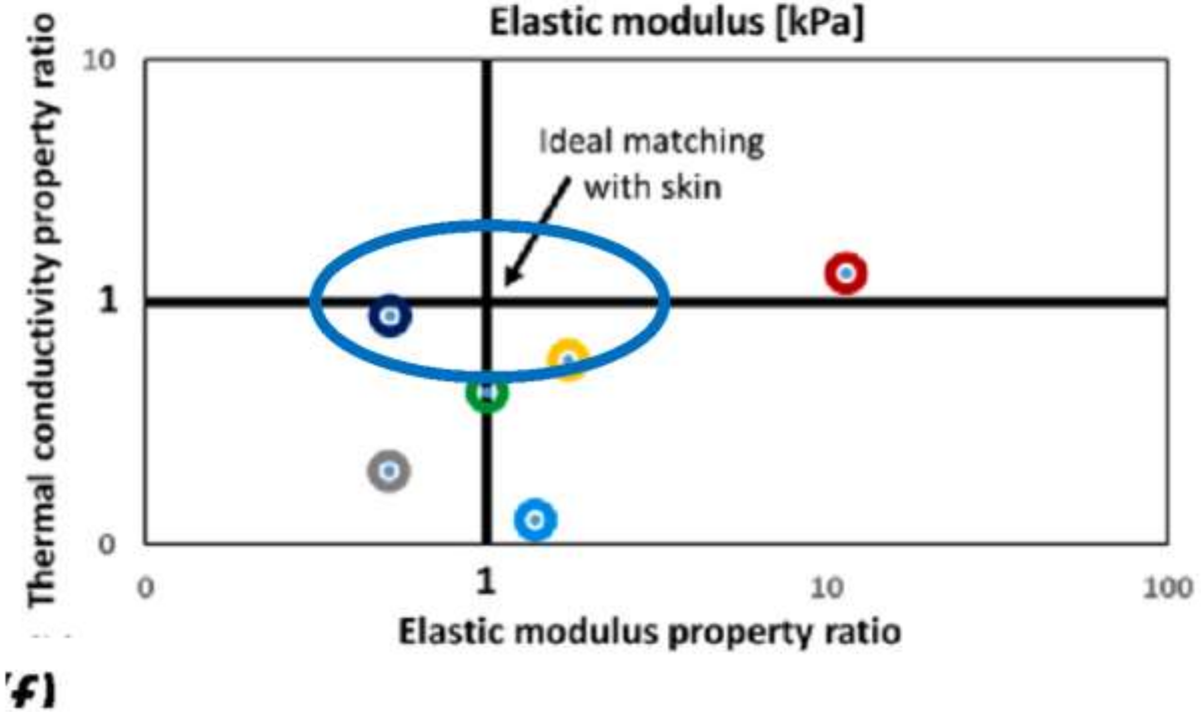
Silicone

Hydrogels

How closely do dressing materials act like skin?



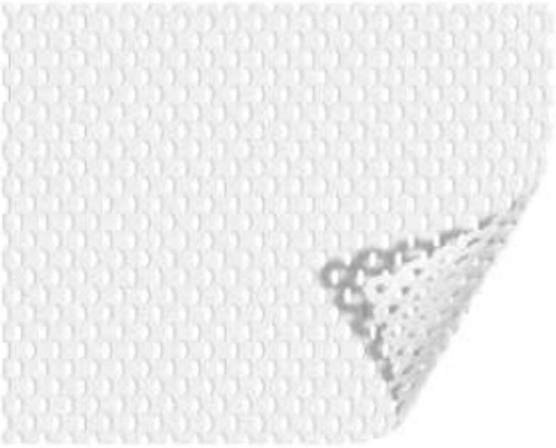
Thermal Conductivity



Flexibility and Conformability

Grigatti & Gefen:What makes a hydrogel-based dressing advantageous for the prevention of medical device-related pressure ulcers" Intl Wound Journal, Mar 2022

What about a dressing combining silicone and hydrogel?



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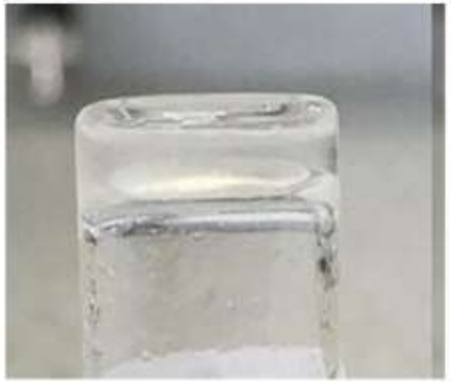

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Transparent Gel Dressing (TGD)

TGD: Visibility

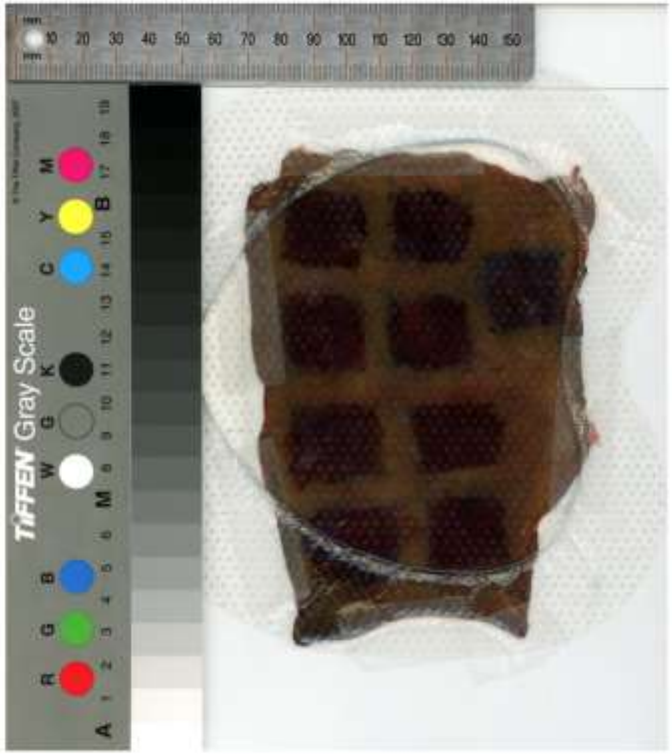
Visibility: Clear island allows for skin assessments without lifting the dressing

- ✓ Promotes skin assessment best practices
- ✓ Allows for early intervention of PIs
- ✓ Decreases staff time during skin assessments

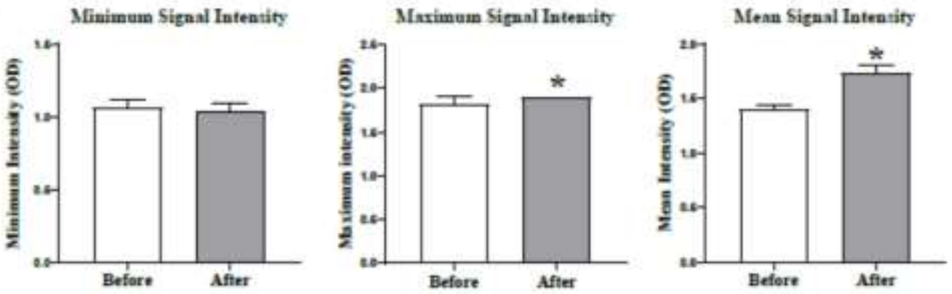
Source Novel Clear Sacral Dressing to Address Microclimate and Skin Checks

TGD: Visibility

African American Skin Explant
(No Dressing)



African American Skin Explant
(Covered with Dressing 1)



TGD: Extended Wear Time

Extended Wear Time: Clear and flexible island allows for visibility to underlying skin without lifting the dressing, improving dressing adhesion

- ✓ Decreases usage and unnecessary dressing changes
- ✓ Decreases overall nursing time per patient

Source: Transparent Gel Dressing Used to Simplify Skin Evaluation and Prevent Pressure Injury NPIAP 2023

What are the main causes of PIs?

TGD: Skin Microclimate

Cooling: The island transfers heat away from the skin, keeping the skin cooler

✓ Reduces metabolic demand on skin tissue

✓ Reduces the development of pressure injuries

Source Novel Clear Sacral Dressing to Address Microclimate and Skin Checks

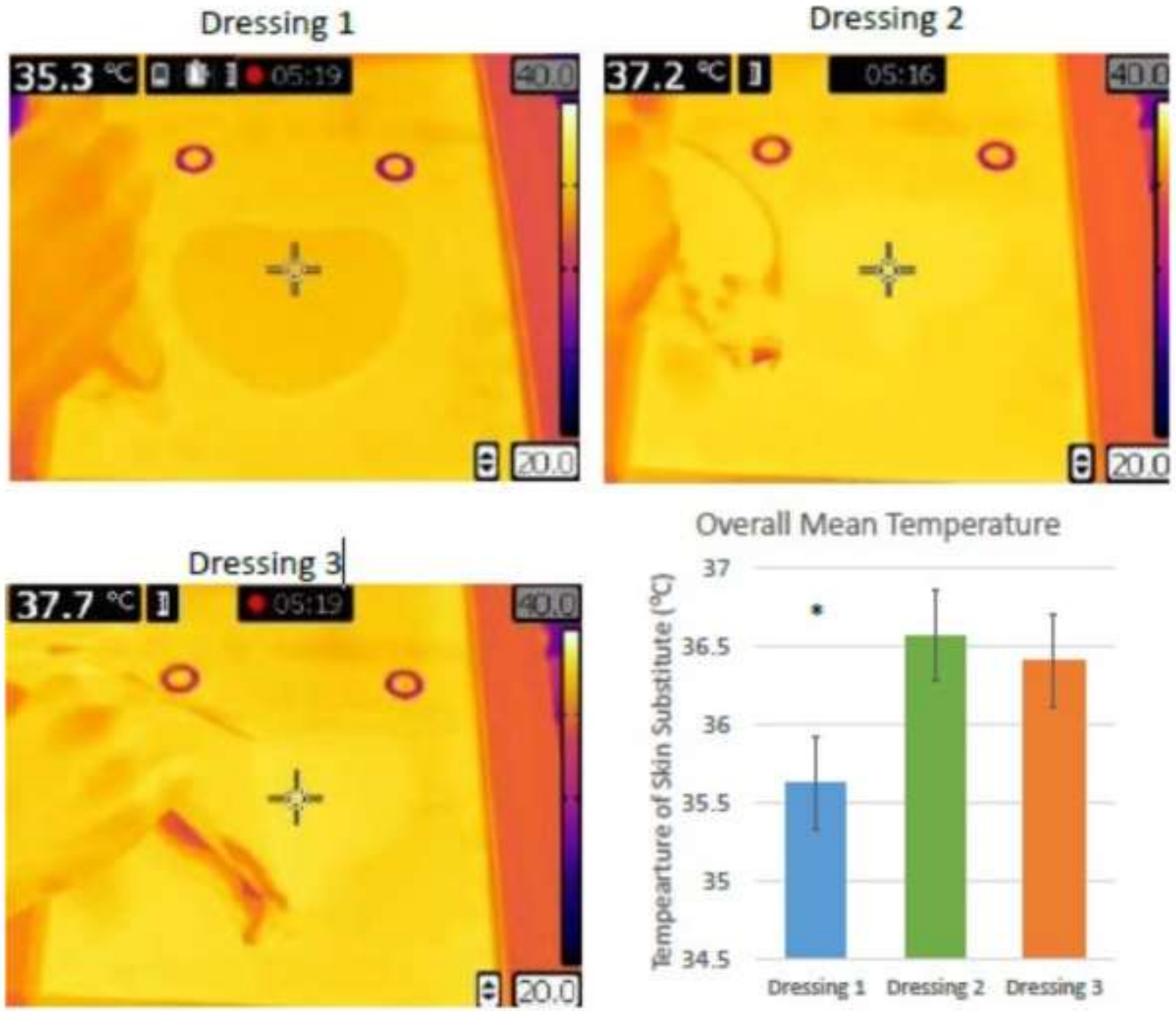
Microclimate Study Design

Problem	**Excess heat on the skin can greatly increase the risk of pressure injury development. Studies show that for every 1° C increase in temperature there is a 10% increase in metabolic demand on the skin, leading to an increased risk of breakdown.[2]**
Study Method	**Each dressing was applied to the skin substitute heated to body temperature, 37° C, by a hot plate and allowed to stabilize for 5 minutes, and then the dressing was removed. The temperature of the skin substitute was monitored over time using a thermal camera.**

Source: Transparent Gel Dressing Used to Simplify Skin Evaluation and Prevent Pressure Injury NPIAP 2023

Microclimate Study Results

TGD helps keep skin cooler



TGD: Shear/Pressure

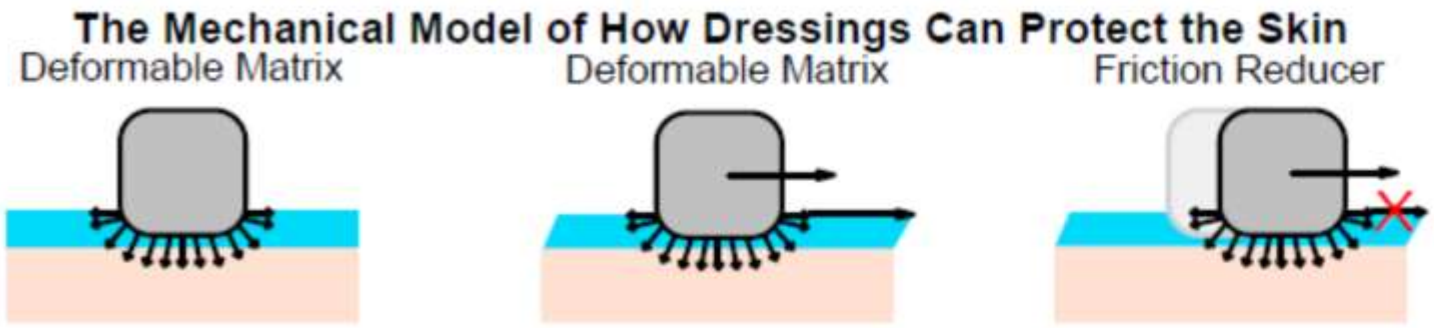
Shear/Pressure: TGD effectively manages the physical forces associated with PI development

- ✓ Reduces shear forces transmitted to the sacral tissue
- ✓ Redistributes pressure across the island
- ✓ Backing has same coefficient of friction as foam

Shear

Source Novel Clear Sacral Dressing to Address Microclimate and Skin Checks

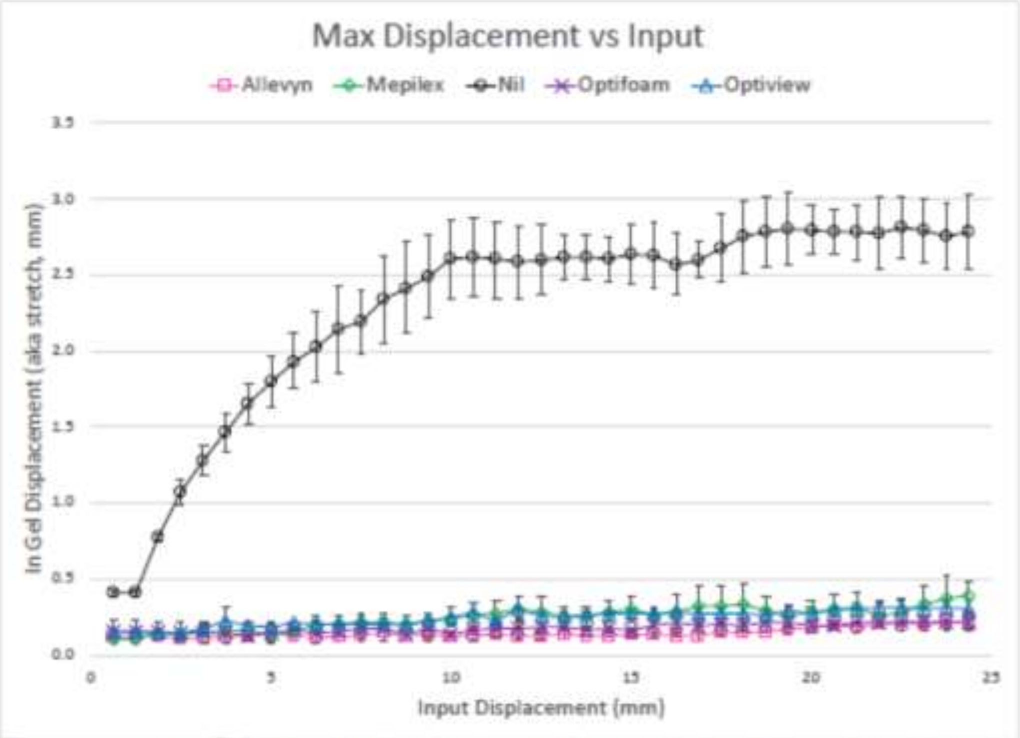
Shear Study Design



Problem	**Shear forces (i.e., gravity force pushing down on the patient's body with resistance between the patient and the chair or bed) contribute to an increased risk of pressure injuries.**
Study Method	**The sacral dressings were applied onto a gel containing blue beads, a skin substrate, and the system was subjected to stress. The strain on the skin substrate was measured to determine shear displacement.**

Source Novel Clear Sacral Dressing to Address Microclimate and Skin Checks

Shear Study Results



There was an ~7-fold reduction between the control and dressings (p = 1 x 10^{9}), and Tukey's HSD determined that the differences only existed between the treatments and control (p = 0.001) and not among the dressings (minimum p = 0.6084).

TGD
provided substantial protection to the model tissue, equivalent to multi-layer foam dressings

Pressure Redistribution Study Design

Problem	**Pressure against a bony prominence (sacrum, hips, elbows, shoulders) can damage at-risk skin.**
Study Method	**A 2.1 kg, 4-inch diameter sphere was used to mimic a bony prominence. The weight was then placed on top of the adhesive side of the dressing (facing up), and pressure distribution data was collected by a surface pressure mapping system over approximately 5 minutes.**

Source Novel Clear Sacral Dressing to Address Microclimate and Skin Checks

Peak Redistribution Results

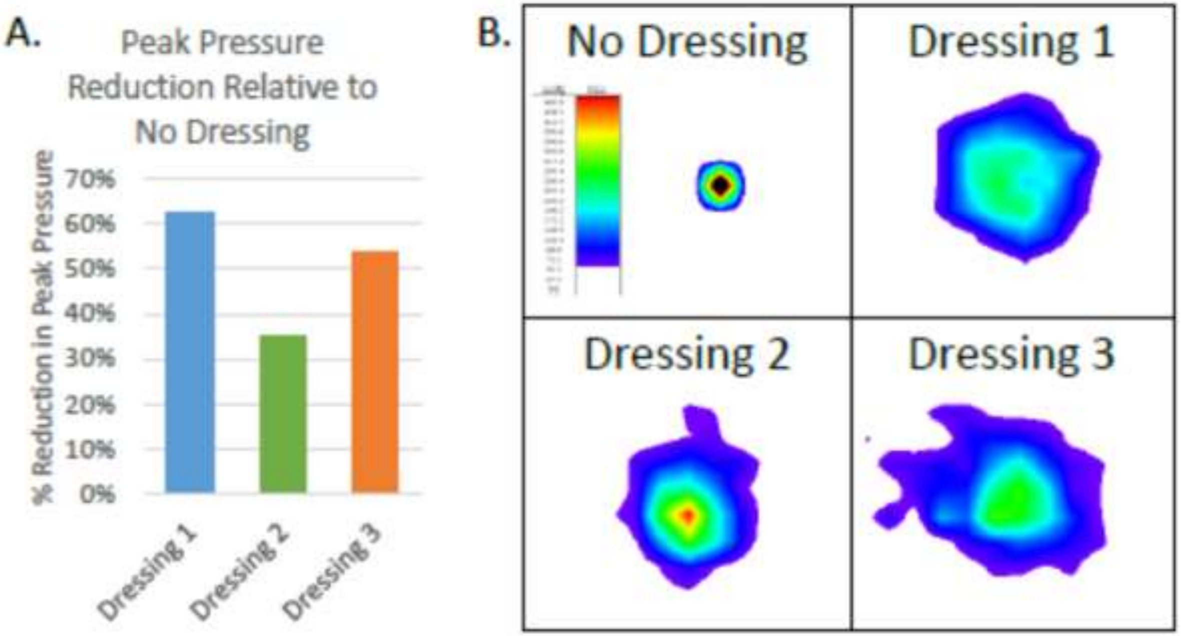
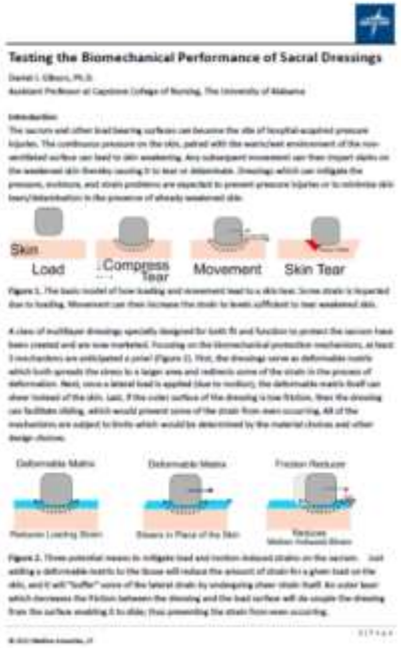


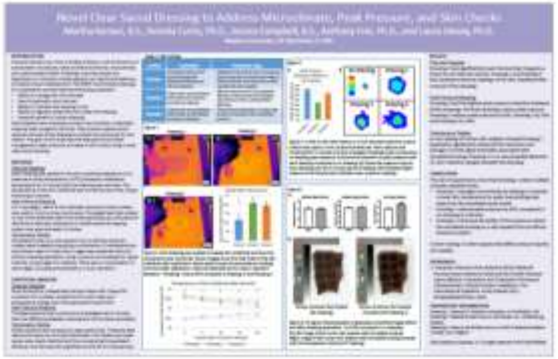
Figure 2: In this *in vitro* test method, a 4 inch diameter spherical contact surface was used to mimic anatomical features. Peak pressure was monitored for 5 minutes and then averaged. Dressings were compared to no dressing peak pressure. A) Shows the reduction in peak pressure with each dressing compared to no dressing. B) Shows the pressure map for each dressing over the 5 minute period of testing. Red indicates higher pressure while blue/purple indicates lower pressure readings.

Transparent Gel Dressing reduced peak pressure by 62% compared to no dressing

Source Novel Clear Sacral Dressing to Address Microclimate and Skin Checks

Comparative Lab Evidence Summary





Test	5 Layer Foam	TGD
Visibility		✚
Extended Wear Time		✚
Flexibility		✚
Conformability		✚
Peak Pressure Reduction		✚
Microclimate: Cooling		✚
Microclimate: Humidity	=	=
Microclimate: Moisture	=	=
Shear	=	=

Source: Transparent Gel Dressing Used to Simplify Skin Evaluation and Prevent Pressure Injury NPIAP 2023

What's next in Dressing Research

New innovation is on the horizon but how can we evaluate and compare to current standard of care?

- Prophylactic Dressing Standards Initiative (PDSI), part of the NPIAP, coming up with standard methods to evaluate dressing performance
  - Need to clinically validate lab tests to see if relevant beyond just an endpoint of reduced pressure injury rate
    - For example, adhesion testing done on steel doesn't match performance on human skin
    - Pressure mapping using a ball bearing pushed into a pressure plate doesn't act like a sacral bone

Upgraded testing: Understanding mechanism of what's happening biologically

- Research at Georgia Tech using an MRI of a dressing on a patient
  - What's happening inside the patient to their tissue?
- Computer modeling what would happen to the tissues based on different dressing physical parameters.

Questions & Thank You!