Comparative Surface Analysis of Patient Care Slings and Body Pressure & Temperature

SAFER Handling Conference 2014 – **AAMHP**

Australian Association for the Manual Handling of People

Patricia Mechan, PT, MPH **May 26, 2014**

Guldmann

SOUTHCOAST
HOSPITALS GROUP

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Sling or No Sling?

Background

- The complex dynamics of patient care delivery often create perceptions of potential conflict between treatments, care plans and technology options available.

- Patients and Clinical team members are often in the ‘eye of the storm’ of mixed signals and care standards to follow.

- One such conflict at Southcoast, existed between directions to use SPH technology and repositioning slings for dependent patients and directions to minimize layers beneath patients and the negatively perceived but untested influence of repositioning slings.

- Southcoast’s expert teams for Safe Patient Handling *(Nelson, Cabral)* and Wound & Skin Care *(McDonald & Cyr)* agreed to a pilot investigation of bed surfaces and repositioning slings used at Southcoast’s hospitals to explore the bed surfaces and slings interaction.

- Southcoast collaborated with clinical support *(Mechan)* from their SPH supplier *(Guldmann)* for use of industry standard testing equipment made available for data collection sessions.

Objective

The main objective of this investigation was to measure the effect of patient lift repositioning slings on interface pressure and temperature of subjects on standard and special hospital bed surfaces.

Purpose

The purpose of obtaining this critical data is to gain knowledge of the slings and surface interaction; which will better inform clinicians when making decisions for patient care, skin management, and staff safety.

Manual Lifting is Not Safe

Nurses aides, orderlies, attendants rank first in all US occupations in the number of MSD's involving days away from work. (*BSL 2000 - 2007)*

"There is no safe way to lift a patient manually (loads are too great for the body mechanics to make a difference)."

William H. Marras, PhD, CPE, *Spine Biomechanics and Patient Handling Risks.* Honda Chaired Professor and Director, Biodynamic Laboratory, The Ohio Sate University.

"During any patient handling task, if the caregiver is required to lift more than 35lb of the patients weight, then the patient should be considered fully dependent and an assistive device should be used"
(Waters, 2007)


CE 2 Continuing Education

WHEN IS IT SAFE TO MANUALLY LIFT A PATIENT?

The Revised NIOSH Lifting Equation provides support for recommended weight limits.

BY THOMAS R. WATERS, PHD

Waters T. R. *When is It Safe To Manually Lift a Patient?* American Journal of Nursing. August 2007, 107 (8) 53-58

Safe Lifting Limits

- Safe Limits Limb Lifting (holding no more than a few seconds):
  - 1 handed lift **arm**: 140 – 190lb. patient
  - 2 handed lift **arm**: 390 – 440lb. patient
  - 1 handed lift **leg**: < 40lb. patient
  - 2 handed lift **leg**: 90-140lb. Patient

- Safe Limits Logrolling:
  - 1 person assist: 78lb. patient
  - 2 person assist: 156lb. patient
  - 3 person assist: 234lb. patient

Waters, T. (2007). When is it safe to manually lift a patient? *American Journal of Nursing, 107 (8), 53-59.*

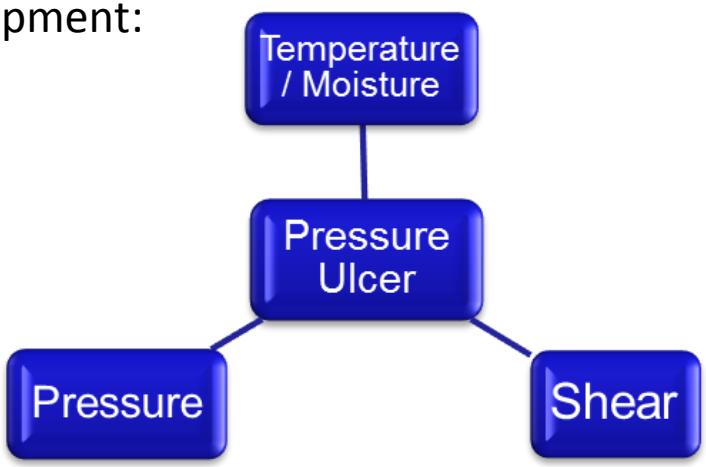
Waters, T. (2009). Recommended weight limits for lifting and holding limbs in the orthopaedic practice setting. *Orthopaedic Nursing, 28 (2S),* 28 -32.

Waters, T. (2009). Recommendations for turning patients with orthopaedic impairments. *Orthopaedic Nursing, 28 (2S),* 28 -32.

Risk Factors for Pressure Ulcers

- A pressure ulcer is a localized injury to the skin or underlying tissue, usually over a bony prominence, as a result of unrelieved pressure.

- Risk Factors that increase Pressure Ulcer Development:
  - -impaired sensory perception
  - -friction + shear
  - -excessive moisture (ex: incontinence)
  - -decreased activity
  - -immobility
  - -poor nutrition



- Pressure and shear in combination considerably impairs blood circulation and oxygen levels in skin tissue . Therefore, the reduction of friction and shear at the skin–textile interface is a key measure in the prevention of skin injuries.

Bluestein, D. et.al.: *Pressure Ulcers: Prevention, Evaluation, and Management*. American Family Physician, November 15, 2008. Volume 78, Number 10. www.aafp.org/afp

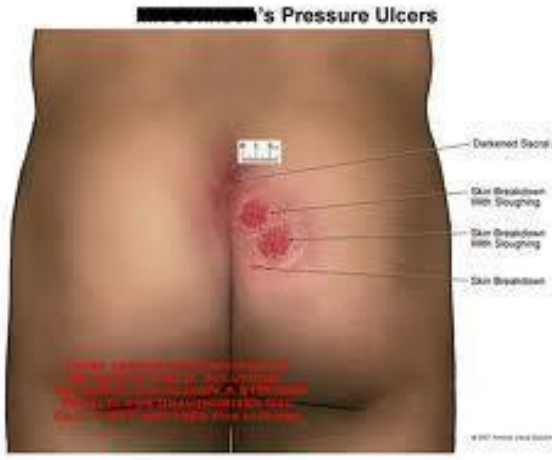
Gerhert, E. et al.: *Study of skin–fabric interactions of relevance to decubitus: friction and contact-pressure measurements.* http://onlinelibrary.wiley.com.silk.library.umass.edu/doi/10.1111/j.1600-0846.2007.00264.x/full 01/13/12

International review: Pressure Ulcer Prevention: pressure, shear, friction and microclimate in context. A consensus document. London: Wounds International, 2010

Pressure Ulcer

- The coccyx is the most common site of pressure ulcers. Patients who are immobile and dependent are at high risk of skin breakdown.

- Patients that require the use of the lift equipment due to their immobility are also at risk for development of pressure ulcers



- This high risk population are routinely placed on pressure re-distribution support surfaces for pressure redistribution

- Manufacturers of the support surfaces recommend limiting the quantity of linen under the patient to maximize the therapeutic effects of the support surface.

Pressure Ulcer Prevention: an Evidence-Based Analysis Ont Health Technol Assess Ser. 2009; 9(2): 1–104. Published online 2009 April 1.http://www-ncbi-nlm-nih-gov.silk.library.umass.edu/pmc/articles/PMC3377566/

Pressure

Capillary closure and ischemia ranges 12-40 mmHg.

Pressure on the skin has been shown to produce greater reductions in blood flow in a deep artery than in skin capillaries.

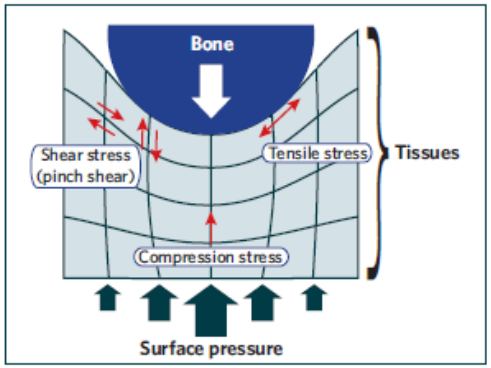
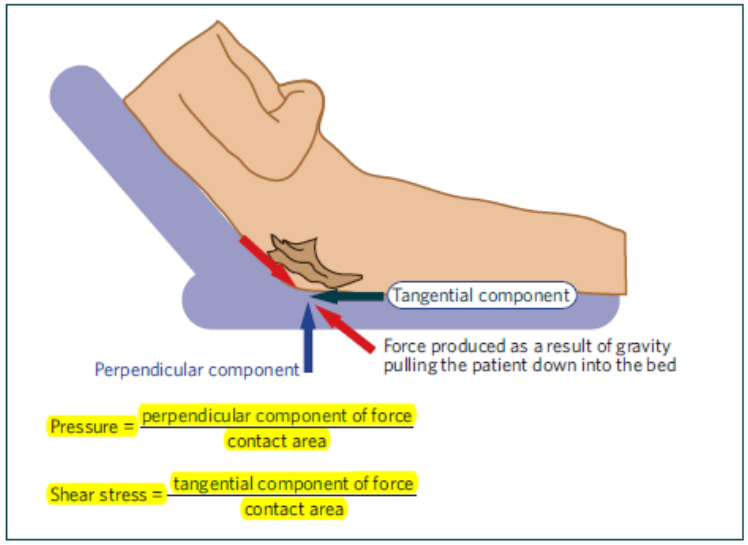


FIGURE 3 Uneven pressure distribution as a cause of shear stresses (adapted from[10])

Shear stresses are caused by:

- Friction: when sliding down a bed
- Uneven Pressure Distribution: over a bony prominence



Recommendations:

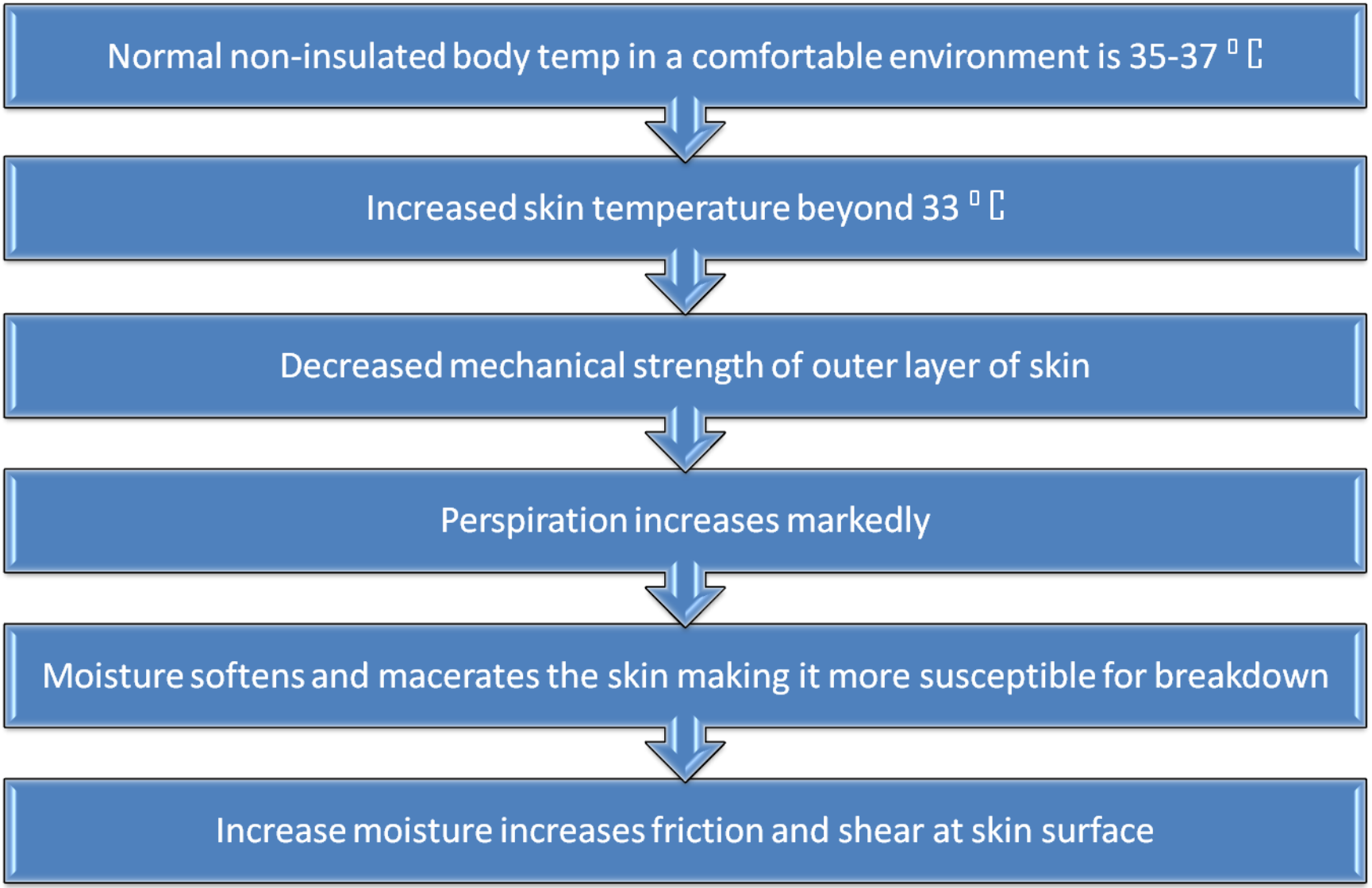
- The gold standard in nursing for turning patients is at least every 2 hours for mechanical offloading.
- Utilizing turn-assist features of the bed
- Head of the bed at the lowest possible position. Patients with contraindications such as G-tube, Vent's require HOB at 30°.

Lyder, Courtney et al. Patient Safety and Quality: An Evidence-Based Handbook for Nurses. Pag 6. AHRQ Publication No. 08-0043, Department of Health and Human Services. http://www.ahrq.gov/qual/nurseshdbk/

International review: Pressure Ulcer Prevention: pressure, shear, friction and microclimate in context. A consensus document. London: Wounds International, 2010

Temperature

37ºC = 98.6ºF



Lachenbruch, Charles. PhD: *Skin Cooling Surfaces: Estimating the Importance of Limiting Skin Temperature.* Ostomy Wound Management, Volume 51 - Issue 2 - February, 2005. http://www.o-wm.com) 11.15.12

Normative Values for Pressure and Temperature

Scientific validation of specific values parameters for pressure interface and surface temperature interface have not been clearly established.

*"While research has shown a relationship between **PRESSURE** magnitude and duration and tissue damage, these **studies have not defined** a **critical magnitude** above which ischemia occurs"*
"To date, research has not identified a specific threshold at which loads can be deemed harmful across people or sites on the body."
Sprigle, 2011

*"Until therapeutic ranges for **TEMPERATURE** and humidity/skin moisture at the pt.-support surface interface are identified, clinical judgment should be exercised to **avoid extremes (high or low) in these factors.**"*
International Review Pressure Ulcer Prevention, 2010

Support Surfaces

Types powered and non-powered surfaces

- Pressure redistribution mattress
- Alternating pressure redistribution mattress
- LAL: low air loss mattress
- Air fluidized beds – (not tested)

Manufacturers of the various support surfaces strongly recommend eliminating or reducing the quantity of any surface covering between the patient and the support surface to assure full therapeutic benefit of the device.

- Limit the Linen
- Less is Best
- Draw sheet only
- Nothing between the patient and the sheet

Pressure Ulcer Prevention: an Evidence-Based Analysis Ont Health Technol Assess Ser. 2009; 9(2): 1–104. Published online 2009 April 1.http://www-ncbi-nlm-nih-gov.silk.library.umass.edu/pmc/articles/PMC3377566/

Support Surface

A review of the literature of the efficacy of support surfaces and it's impact on reduction of pressure ulcers that

- Foam mattress produces a relative risk reduction (RRR) of 69% in the incidence of pressure ulcers compared with a standard hospital mattress.

- The evidence does not support the superiority of one particular type of alternative foam mattress.

- The relative merits of alternating and constant low pressure devices, and of the different alternating pressure devices for pressure ulcer prevention are unclear.

Investigation

Subject:

- Healthy adult female, BMI of 22 (normal BMI ranges between 18.5 and 24.99)
- *Braden Scale:* 23. The Braden Scale is composed of 6 subscales: sensory perception, moisture, activity, mobility, nutritional status, and friction/shear. The scores range from 6 to 23.
- Subject position: legs extended, arms at side
- Subject clothed in cotton-poly material si nd pants

Support Surface:

- Head of the bed at a 30 degrees
- Applicable directions for use of powered support surfaces were followed according to manufacturers' instructions
- No linen on support surface or layered under patient
- Pillow with pillow case under subjects head

Sling types:

- Three (3) full bed length : polyester washable; polyester single patient use (disposable); and polyester mesh washable

Testing:

- Pressure Mapping interface values with no sling and each of three sling types on various surfaces
- Temperature Testing values with no sling and each of the three sling types on various surfaces

Gerhert, E. et al.: **Study of skin–fabric interactions of relevance to decubitus: friction and contact-pressure measurements.** http://onlinelibrary.wiley.com.silk.library.umass.edu/doi/10.1111/j.1600-0846.2007.00264.x/full 01/13/12

Support Surfaces Tested

Non-Powered Pressure Redistribution

Powered Alternating Pressure Redistribution

Powered Low Air Loss

Slings Tested

All were length- equivalent to bed surface

Polyester washable

Polyester mesh washable

Polyester single patient use Disposable

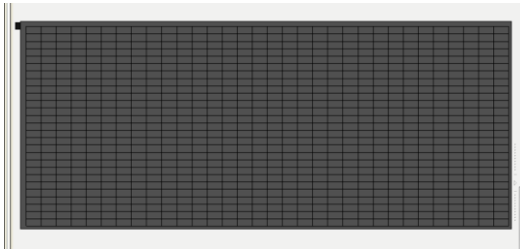
Pressure Measurement

Interface pressure measurements tool:

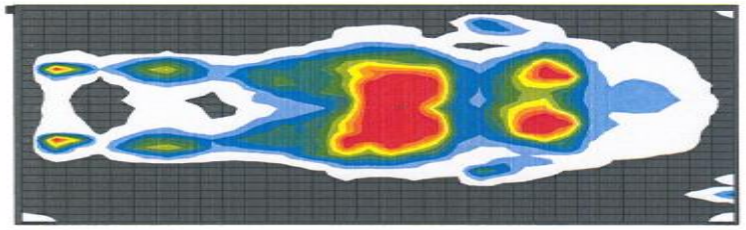
Force Sensitive Applications, FSA Pressure Mapping System (Vista Medical, Ltd)

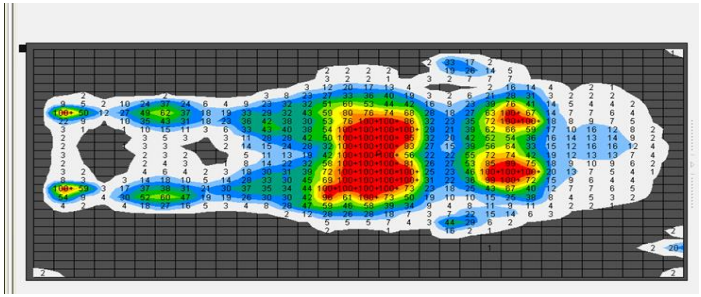
The FSA Pressure Mapping System uses paper-thin, 1”x1” flexible force sensors to measure and display interface pressures.

Pressure Sensing Mat : Stretch Bed sized (80”x 34.75”)



The FSA software provides a view of the pressure data in the form of a colored map of the pressure distribution with an overlay of the numerical values. Red areas indicate the higher pressure and blue areas indicate lower pressure





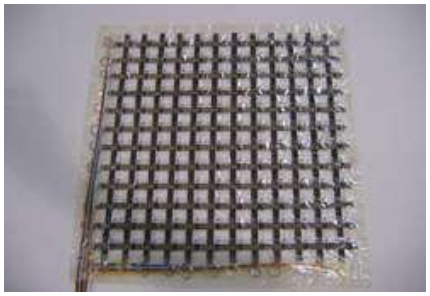
- Range of pressures captured - Minimum 1 mmHg Maximum 100 mmHg
- Parameters examined - minimum, maximum, and average
  (coefficient of variation monitored for consistency between scans of surfaces and slings)
- Subject placed on sensor mat for duration of eight (8) minutes*
- Pressure scan taken at eight minute interval

* Vista Medical & literature recommended duration minimum of 6 minutes; allows for statis or ‘creep’ to occur. Statis or creep describes the settling or accommodation of subject’s pressure onto surfaces(s). *Stinson et al, Am J OccupTher 2002; Stinson et al, Clin Rehab 2003*

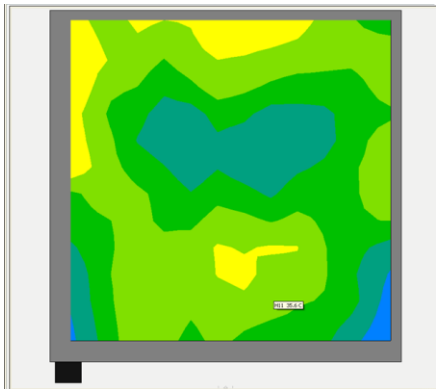
Temperature Measurement

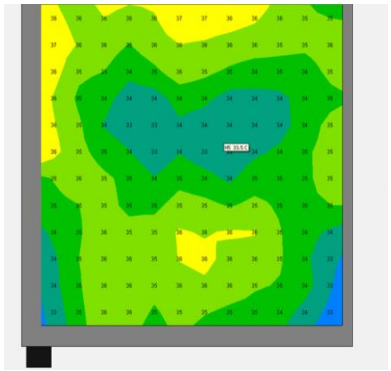
Interface temperature measurements tool:

Force Sensitive Applications, FSA Temperature Mapping System (Vista Medical, Ltd)



Temperature Sensing mat 15.5” x 15.5”; 144 sensors in a 12 x 12 array





The FSA software provides a view of temperature data in the form of a colored map of the temperature distribution with an overlay of the numerical values.

Red areas indicate the higher pressure and blue areas indicate lower pressure

- Range of pressures captured - Minimum 27°C Maximum 40°C
- Parameters examined - minimum, maximum, and average

  (coefficient of variation monitored for consistency between scans of surfaces and slings)
- Subject placed on sensor mat for duration of ten (10) minutes*
- Temperature scan taken at ten minute interval

* Vista Medical recommended duration minimum of 10 minutes; allows for temperature accommodation to occur. No known literature validation for reliability in temperature testing.

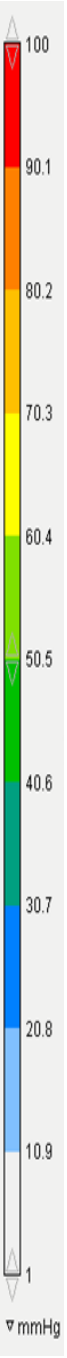
Non Powered Pressure Redistribution

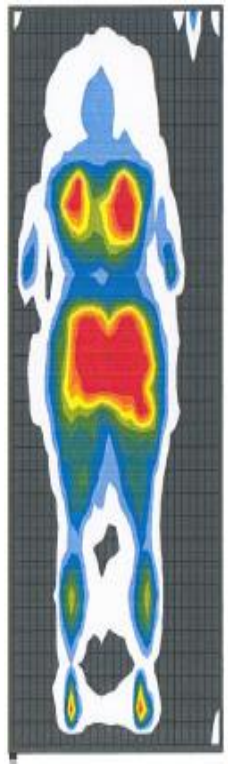
Pressure Mapping

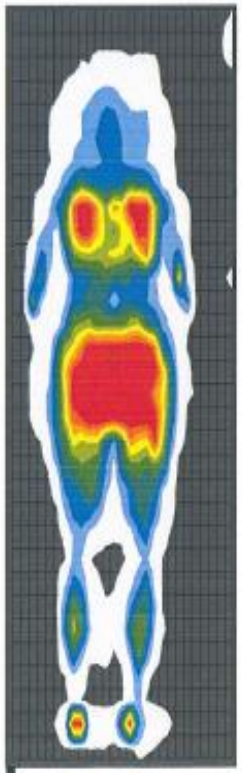
+/- 15% variation in values produced by the pressure mapping equipment

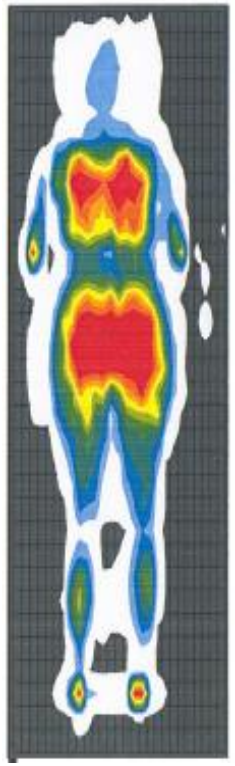
Vista Medical

Capillary Closure 12 - 40 mmHg / 32				
	No Sling	**Gold**	**Mesh**	**Disposable**
Surface #1 (images below)	29.72	29.44	31.27	31.71
Surface #2	29.18	30.54	31.5	35.63
Point comparison M16	100	100	100	100









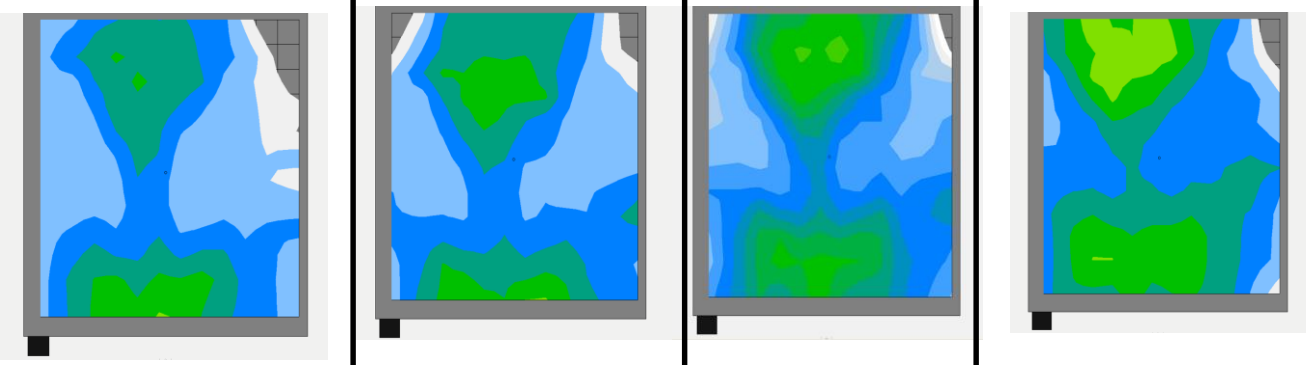
Non Powered Pressure Redistribution

Temperature Testing

+ / - 5 % variation in values produced by the temperature testing equipment –Vista Medical

37°C = 98.6° F
Benchmark < 33° C

	No Sling	Gold	Mesh	Disposable
Surface #1	33.81	34.28	34.77	34.93
Surface #2 (images below)	30.08	30.4	31	31.36
Point Comparison E6	31.3	31.8	31.1	31.3



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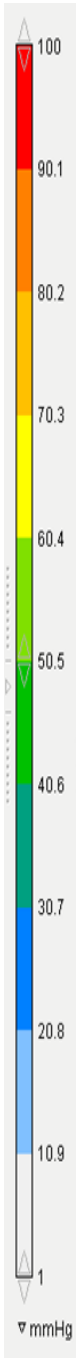
Powered Alternating Pressure Redistribution

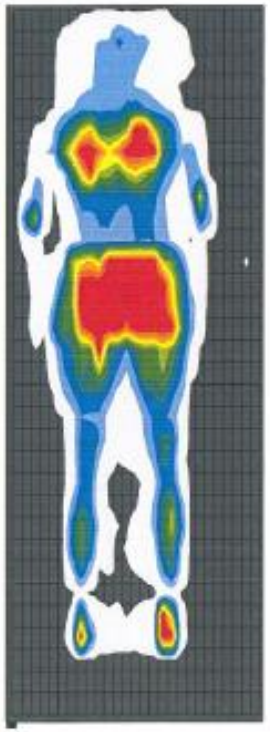
Pressure Mapping

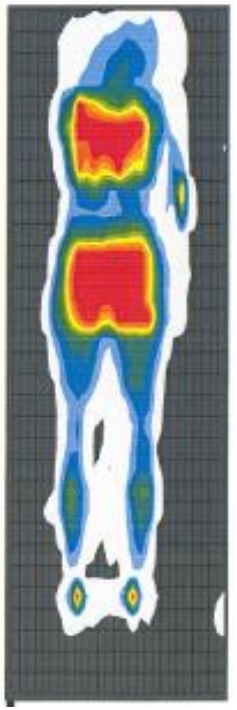
+/- 15 % variation in values produced by the pressure mapping equipment –Vista Medical

Capillary Closure 12 - 40 mmHg / 32

	No Sling	Gold	Mesh	Disposable
Surface #1 (images below)	28.77	30.45	30.09	30.61
Point comparison L13	100	100	100	100







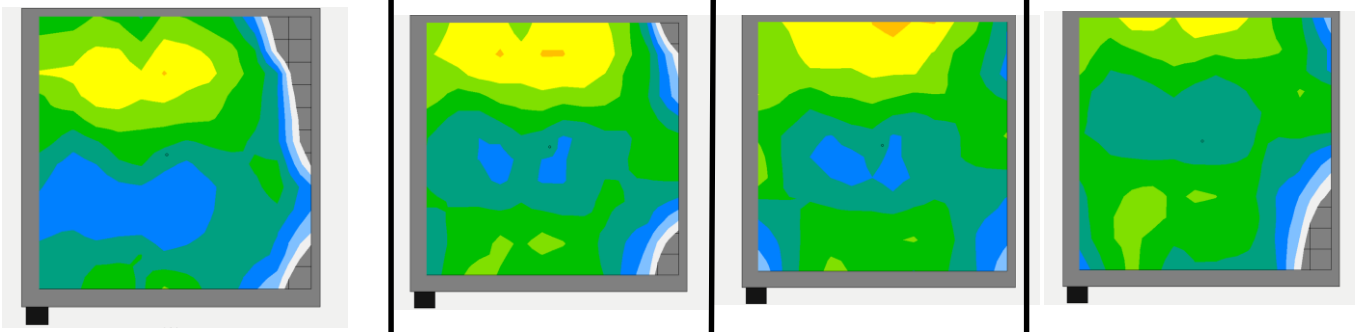
Powered Alternating Pressure Redistribution

Temperature Testing

+ / - 5 % variation in values produced by the temperature testing equipment –Vista Medical

37°C = 98.6° F
Benchmark < 33° C

	No Sling	Gold	Mesh	Disposable
Surface #1 (images below)	34.05	34.3	34.39	34.14
Comparison Point E5	35.4	34.7	34.5	33.5



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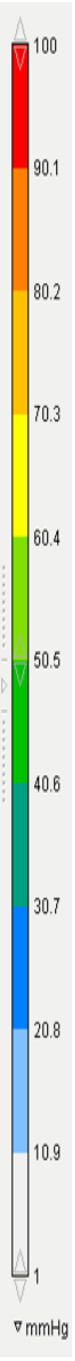
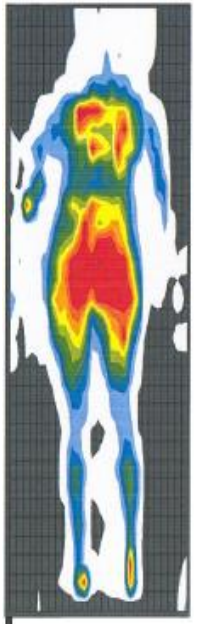
Low Air Loss (LAL)

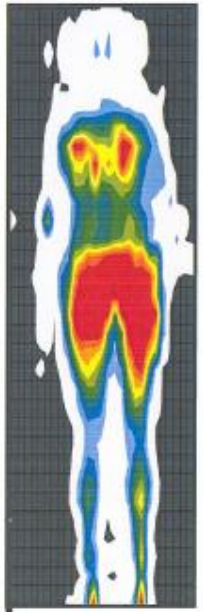
Pressure Mapping

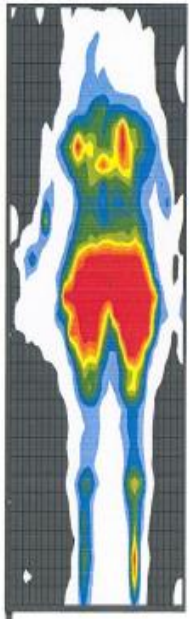
+/- 15% variation in values produced by the pressure mapping equipment –Vista Medical

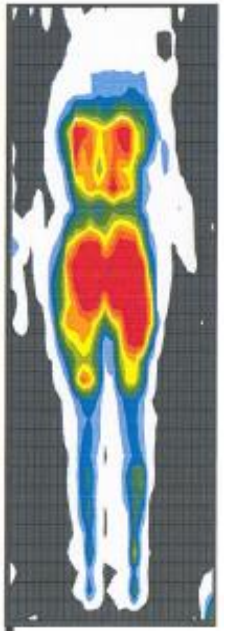
Capillary Closure 12 - 40 mmHg / 32				
	No Sling	**Gold**	**Mesh**	**Disposable**
Surface #1	27.08	31.77	33.88	28.75
Surface #2	34.43	29.52	30.43	31.2
Surface #3 (images below)	28.28	30.73	28.01	30.67
Surface #4	27.98	30.92	31.95	32.69
Point comparison M16	100	100	100	100











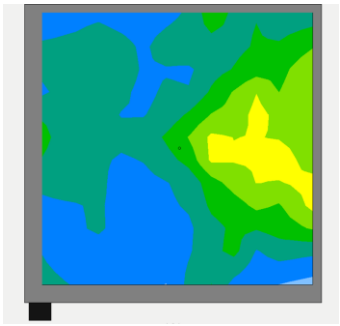
Low Air Loss (LAL)

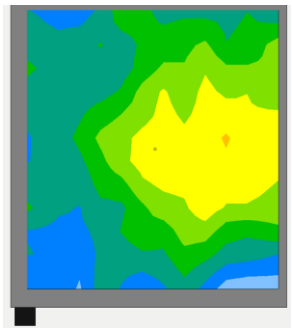
Temperature Testing

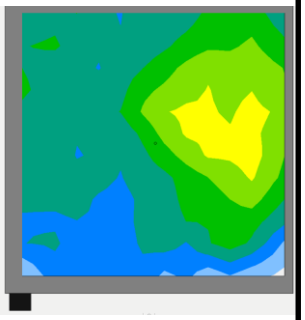
+ / - 5 % variation in values produced by the temperature testing equipment –Vista Medical

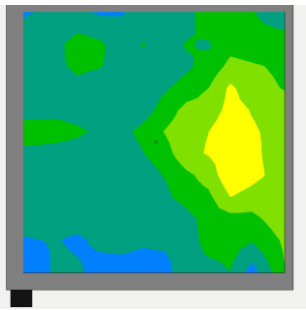
37°C = 98.6° F
Benchmark < 33° C

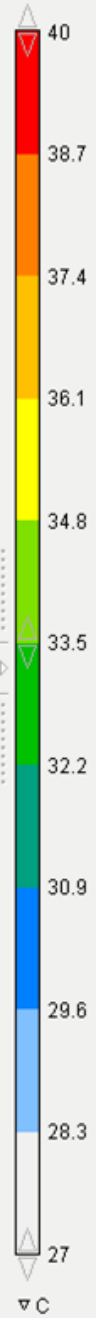
	No Sling	Gold	Mesh	Disposable
Surface #1	32.83	32.82	33.35	32.81
Surface #2	31.51	31.55	31.71	31.79
Surface #3 (images below)	31.94	32.84	32.21	32.36
Surface #4	33.38	33.83	34.52	33.05
Comparison Point E7	33.1	33.8	30.9	31.9











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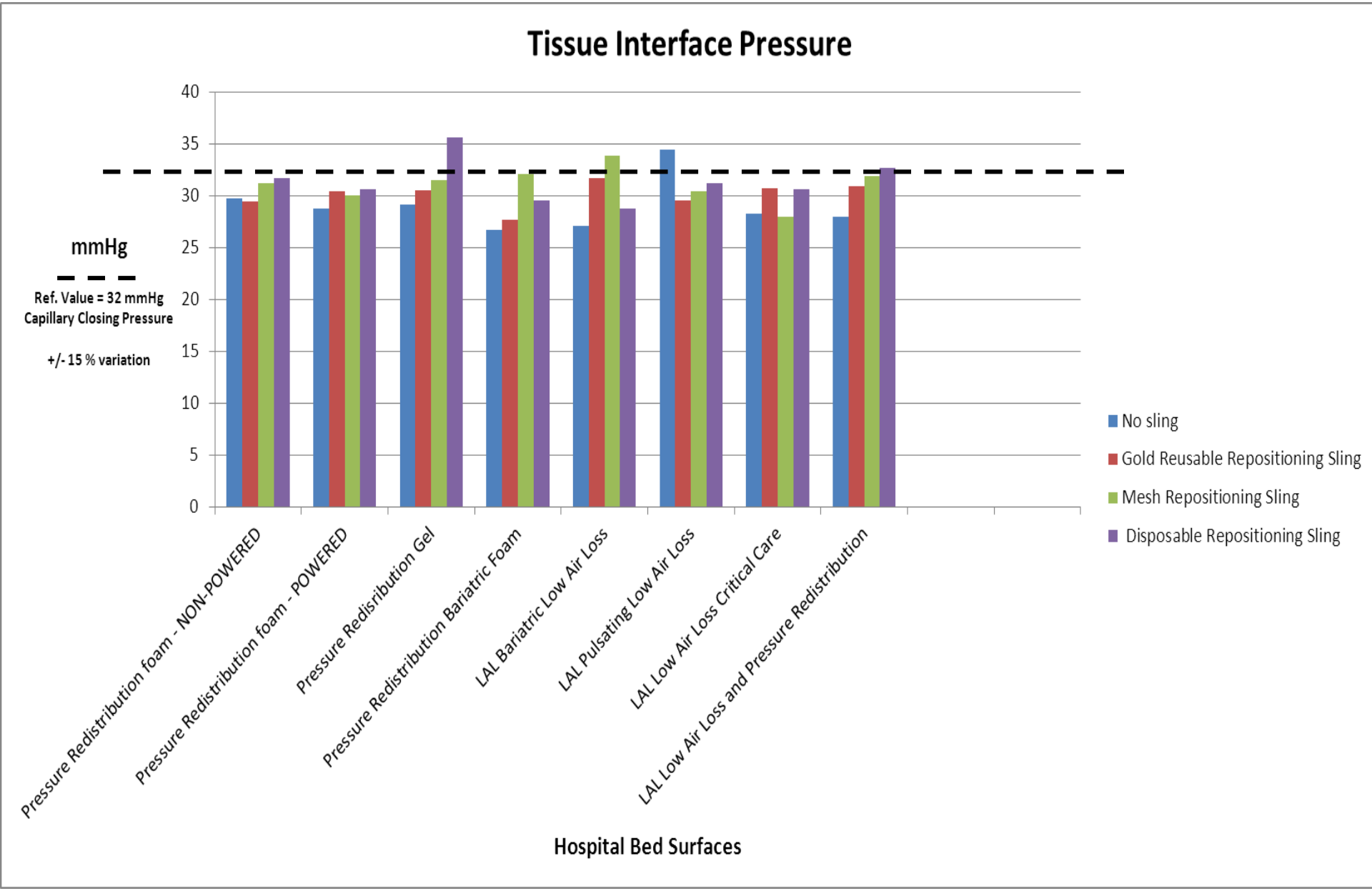
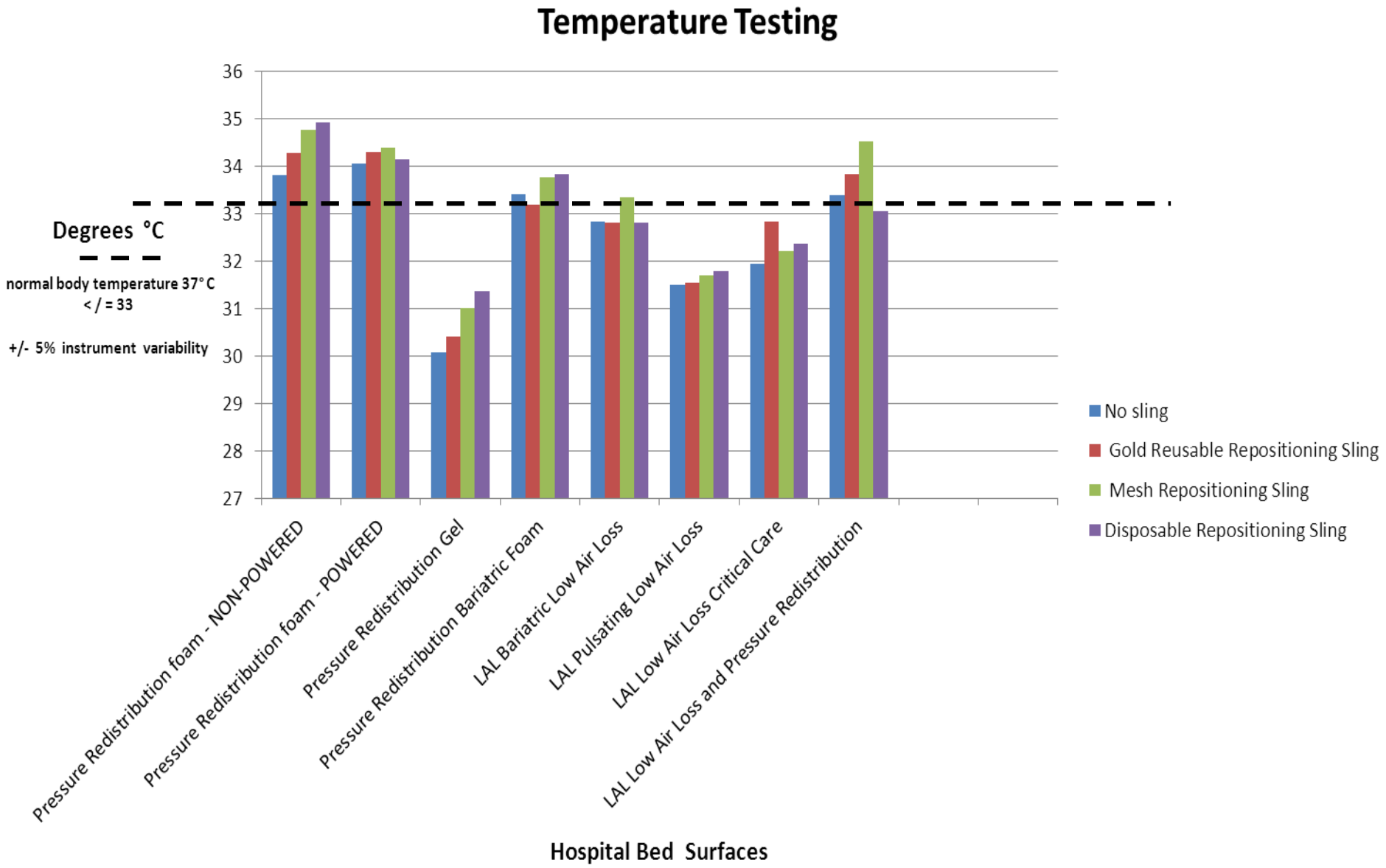
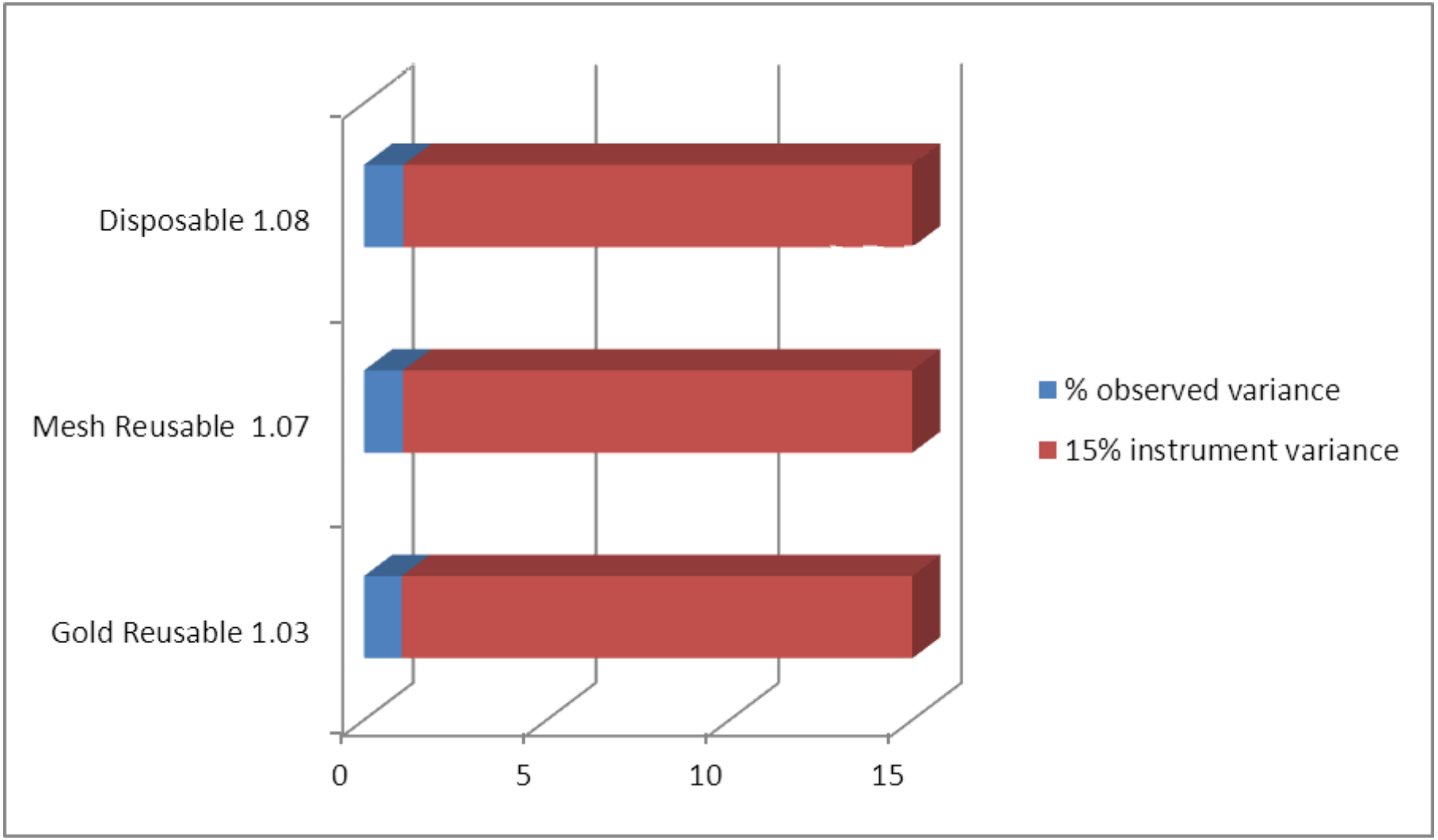
Pressure Outcomes – All Surfaces and Slings



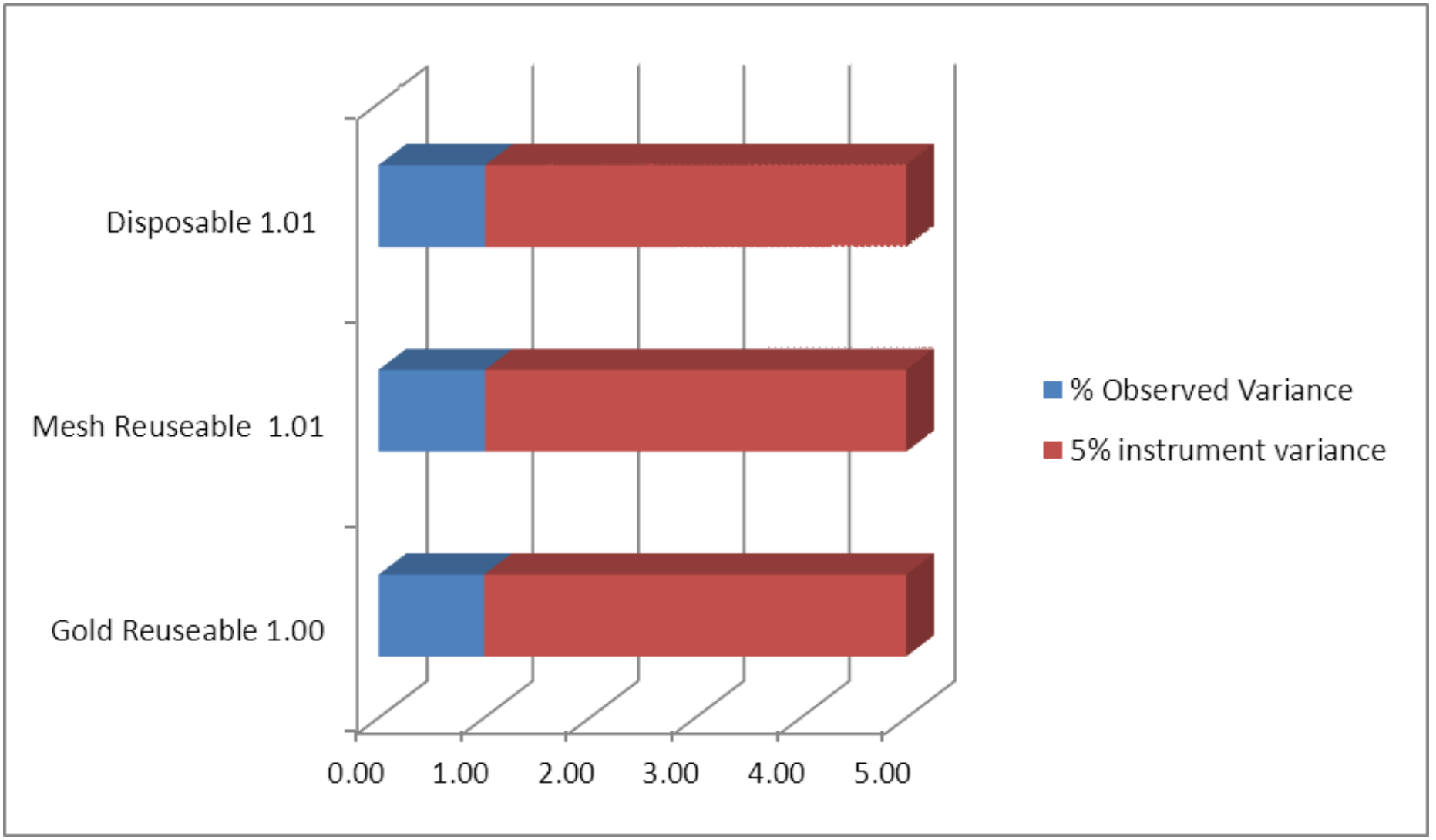
Temperature Outcomes – All Surfaces and Slings



Per Cent Variance in Pressure Outcomes
ALL SURFACES



Per Cent Variance in Temperature Outcomes
ALL SURFACES



Experience of Others

Pressure ulcer outcome data from hospitals with SPH Programs using ceiling lifts and repositioning slings

Christiana Care Newark, Delaware – Edupuganti & Price

- ✓ ***Repositioning Slings: The Effect on Pressure, pH, and Temperature;*** **American Journal of Safe Patient Handling and Movement , June 2013**

Hospital University of Pennsylvania – Romano & Rella

- ✓**31% decrease nosocomial pressure ulcers – 6 months**

Northern Michigan Regional – Hoover & Radawiec

- ✓**88% decrease hospital acquired pressure ulcers – 2 years**

Conclusions

1. The presence of various repositioning slings' fabrics, on various hospital bed surfaces, did not yield statistically significant increases in pressure or temperature compared to baseline measurements without a sling.

2. Effect of sling presence in this study was neutral.

3. Based on study findings, the presence of repositioning sling does not appear to be a significant factor in development of pressure ulcers or other related dependent patient skin impairments.

Conclusions

4. Utilization of ceiling lift slings for bed repositioning tasks with dependent patients can reduce the shear and friction exposure to skin, typically caused by incomplete manual lifting and drag of body weight and bony prominences on support surfaces; reduction of shear exposure will thereby reduce risks for pressure ulcer development.

5. Considering high frequency of bed mobility and repositioning care tasks performed, utilizing repositioning slings can reduce the musculoskeletal injury risk to healthcare workers by ensuring clinical team members can comply with recommended NIOSH parameters for safe patient handling.

Conclusions

6. Clinical team members' adherence to evidence based care standards of repositioning patients every two hours (GOLD standard) may be assisted by presence and utilization of repositioning slings and thereby assist in reduction of negative factors associated with infrequent mechanical unloading and pressure ulcer formation.

7. Further inquiry and additional studies are recommended to replicate finding from this study; explore influence of linen layers in combination with slings and surfaces; and test additional varieties of surfaces and slings.

Investigation published

Comparative Surface Analysis of Temperature and Pressure with Patient Care Slings and Bed Surfaces; The Column, National Back Exchange, May 2014

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Thank you!

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