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## Using SEM (Sub Epidermal Moisture) Measurement for Timely Detection of PUs and Improvement of Outcomes

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### What is SEM?

Tissues have capacitive and conductive properties that are dependent on water content. Measures of bio impedance can be correlated to physiological events related to changes in volume, orientation and distribution of dermal fluids and tissues.

SEM can be measured through the use of surface electrical capacitance – it's related to the capacity of tissue to hold or store energy (like an electrical charge)

and it's determined by the resistance of the skin to electrical forces.

It reflects oedema and water content of the epidermal and subepidermal tissues.

### How is it measured?

The SEM Scanner detects charges beneath the surface of the skin using an integrated electromode sensor.

Place the SEM Scanner directly in contact with the skin for 1 second.

Unit processes and signal and displays a reading.

Take readings at each anatomical location.

A reading of delta  $\geq 0.6$  suggests presence of pressure ulcer development.



## Using SEM and PUs

In pressure ulcer development, apoptosis, necrosis, the inflammatory process leads to leakage from vascular vessels and other changes that modify the underlying structure of the damaged tissue.

The result is an increase in sub-epidermal moisture (SEM).

This process makes changes in SEM a physiological marker of PU development.

This is important because we cannot see under the skin with the naked eye – we must know what's individually happening for that patient at that time – we need information on ONE patient. Not averages.

When we have pressure/shear/cell deformation – we must be able to recognize the deformation BEFORE there is evidence of damage to the naked eye.

The inflammatory process starts well below the level we can see.

It occurs when tissues are damaged and cells release chemicals that cause blood vessels to leak.

Damage can take place 3-10 days before the injury manifests on the skin.

### **Pre-manifestation damage:**

- Hypothia - decreased oxygenation
- Vascular permeability - capacity of vessel walls to allow flow of molecules
- Apoptosis - cell death
- Sub-epidermal tissue damage - damage beneath the skin
- Interstitial fluid buildup - sub-epidermal moisture

### **Manifestation of pressure injury:**

- Visual changes like redness
- Skin rupture - stage II-IV pressure injury
- Tactile changes - heat, swelling, pain

80 stage 2+ PUs developed across the studies

**All studies showed that skin damage was associated with high Sub-Epidermal Moisture levels.**

**Once the SEM was elevated, this predicted PI development one week later.**



Measuring the SEM, keeping an eye on your patient – THIS IS CRITICAL!

You cannot simply introduce SEM without it being part of an overall strategy, including leadership buy-in.

### **Study 1:**

- 417 NH residents
- 19 facilities
- Mean age: 77
- 58% female
- At risk of pressure injury development
- Mean Braden score 15.6
- Mean SEM readings rose in tandem with increasing tissue damage
- SEM is significant for predicting stage 2 or greater PUs

### **Study 2: SEM vs. Visual Skin Assessment:**

- 31 patients in short stay surgery
- 41% aged under 49 years
- 55% Female
- Prevalence: Visual assessment 6%
- Prevalence: SEM 42%
- As immobility increases on day of surgery, elevated SEM deltas were recorded
- SEM deltas decreased on re- mobilisation

### **Study 3: Relationship between Nurses' Visual Assessment of the Skin and Sub-Epidermal Moisture Measurement**

- Acute care – general
- 47 at-risk adults
- Data collected daily for 20 days
- 62% female
- Mean Age: 74.7 years; (Min 34; Max 95)
- 34% developed signs of early pressure ulcer damage.
- Mean number of days for nurses to detect damage: 5.0 (max 11, min 3)
- Mean days for SEM measurement to detect damage: 1.1 (max 2, min 1)
- SEM measurement identified early damage 3.9 days earlier than nurses' assessment



#### **Study 4: Pressure risk assessment: risk factors and risk screening in older persons - a validation study**

- 48 patients in older person setting
- Data collected daily for 20 days
- 71% female
- Mean Age: 85.6 years (range: 60-104 )
- 10.41% developed stage 1 PI
- Mean days to visual PI: 12
- Mean days for SEM: 5.9

#### **Conclusions:**

1. SEM measures corroborated the fact that PU damage can start well below the skin and develop upwards, and not always at the skin surface and develop downwards
2. SEM measurement might be a reliable method for early prediction of tissue damage and of PU presence.

#### **Real world evidence:**

632 patients were scanned from 9 different hospitals across UK, Canada, and Spain

Departments: Orthopaedic Trauma, ICU, Elderly Care, Medical/Stroke

56% of the hospitals, achieved zero Hospital acquired pressure injuries during the evaluation period

2 hospitals observed reductions from 87% to 90%

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