# Enhancing efficiency of pressure ulcer/pressure injury care and patient outcomes with the SEM Scanner

ZENA MOORE
*Professor of Nursing and Head of the School of Nursing & Midwifery, Royal College of Surgeons in Ireland*

JACQUI FLETCHER
*Independent Nurse Consultant*

JEANETTE MILNE
*Lead Nurse in Tissue Viability, Northumbria NHS Trust*

Pressure ulcers/pressure injuries (PUs/PIs) remain a widespread issue in healthcare facilities, incurring high treatment costs and leading to extended hospital stays (Demarre, 2015). This meeting report highlights how the use of technology like the SEM scanner, an innovative diagnostic tool, can facilitate early detection and enable earlier targeted interventions for preventing PUs/PIs.

Opening the session at the Wounds UK conference, held in Harrogate in November 2017, Professor Zena Moore explained how over the past year, more evidence has been collected around sub-epidermal moisture (SEM) measurement and the role this plays in PU/PI prevention. As well as providing an update on the evidence in support of SEM Scanner, including a pilot study in Northumbria NHS Trust, the meeting shone the light on the challenges of risk assessment, critically examining how current practice might be improved.

Independent Nurse Consultant Jacqui Fletcher began the meeting by challenging the *status quo* for PU/PI risk assessment; it is over-complicated, with more than 90 risk assessment tools measuring similar but not the same things. Identifying multiple known risk factors and with scoring systems being largely subjective, the limitations of these general tools are well documented and do not replace clinical judgement (Lyder, 2008). This view was supported by Tissue Viability Nurse Jeanette Milne, who advocated a simple two-step approach that asks, 'can a patient move, and will they move?' as being the most effective determinant of risk. The audience was reminded that despite being widely used, there is no reliable evidence to suggest that the use of a structured systematic risk assessment tool reduces the incidence of PUs/PIs (Moore, 2014). Furthermore, the time and effort associated with amending and creating new tools is not warranted when there is no clear link between the parameters of these assessments and patient outcomes (Samuwiro, 2009). *Table 1* compares current risk assessment and detection methods.

Too strong an emphasis is being placed on the documentation of risk assessment, instead of on the administration of preventative care and effective PU/PI management. The cost of treating a PU/PI is approximately 2.5 times the cost of prevention, making prevention efforts, undertaken as soon as possible after admission, critical to any PU/PI management programme (Oot-Giromini, 1989; Schuurman, 2009). Risk assessment tools do not encourage the delivery of interventions and new, simpler ways of determining risk are needed in order to target the right healthcare resources to patients and utilise limited, siloed budgets. Progress has already been made in PU/PI prevention in the UK, but technology has the potential to play a critical role here. The SEM Scanner is a tool that can be used to detect sub-epidermal inflammation, before breach of the damage threshold and the presentation of visual signs of inflammation, such as redness.

## THE ROLE OF THE SEM SCANNER IN EARLY DETECTION OF PUs/PIs
SEM is a biophysical marker related to skin and tissue water, associated with localised oedema in the inflammatory phase of healing. An integral part of the tissue damage process during prolonged periods of mechanical loading is an increase in SEM — that is, an increase in the water present in the tissues below the skin surface (Moore et al, 2016).

The SEM Scanner is a hand-held diagnostic tool that determines levels of SEM using electrical properties of the skin; it uses capacitance technology to measure changes in SEM, which fluctuates upon damage and throughout the wound healing process.

Capacitance: the ability of a system to store an electric charge.

| Table 1. Comparison of current risk assessment and detection methods | | | | |
|---|---|---|---|---|
| Assessment tool | Sensitivity | Specificity | Odds ratio | 95% Confidence ratio |
| Braden scale | 57.1% | 67.5% | 4.08 | 2.56-6.48 |
| Norton scale | 46.8% | 61.8% | 2.16 | 1.03-4.54 |
| Waterlow scale | 75.8% | 27.4% | 2.05 | 1.11-3.76 |
| Clinical judgement | 50.6% | 60.1% | 1.69 | 0.76-3.75 |

The SEM Scanner detects these changes beneath the surface of the skin using an integrated electrode sensor to measure electrical capacitance, which is determined by the impedance (i.e. the effective resistance) of the skin to electrical forces. Thus, it can reflect oedema and water content of the epidermal and sub-epidermal tissues (Bates-Jensen, 2009).

The SEM Scanner produces a score based on the level of SEM, and a SEM Score of >0.5 (0.6 and above) denotes possible underlying tissue damage and suggests the presence of early pressure damage (it is suggested that at least two consecutive days of deviation confirms a diagnosis of tissue damage). The frequency of the use of SEM Scanner can be individualised to each patient, with measurements taken for deviation in SEM scores against the patient's own baseline, which could be affected by medicines, comorbidities (i.e. diabetes), or lifestyle choices (i.e. smoking) (Moore et al, 2016).

Using the SEM Scanner allows clinicians to detect pressure damage before it becomes evident at the surface level. Evidence has shown that PU/PI damage is reversible, if it is identified early and appropriate interventions are put in place (Oomens, 2015). The SEM Scanner has been found to detect pressure-induced skin damage on average 5 days earlier than visual assessment and with greater certainty than either risk assessment tools or visual assessment.

### Relationship between risk assessment tools and SEM measurement

The Royal College of Surgeons in Ireland has conducted a number of studies examining the effectiveness of the SEM Scanner as a diagnostic tool; Jacqui Fletcher highlighted the findings of two such studies.

Malloy et al (2015) examined 29 older patients (62.1% aged over 81 years) with a higher ratio of female patients (65.5%) to male (34.5%).

Participants were observed over a 4-week period and current risk assessment techniques Waterlow and Braden were compared to SEM measurement for ability to detect pressure damage occurrence activity. While the Waterlow and Braden scores remained constant throughout the 4-week follow up period, SEM readings fluctuated, representing changes in tissue health and the impact of pressure-redistributing interventions (*Figure 1*). The results highlight that SEM is more sensitive in detecting changes in a patient's condition over time than alternative measures, such as risk assessment tools. (de Oliviera, 2015).

O'Brien et al (2015) assessed SEM measurement versus visual skin assessment in 47 at-risk adults in acute care; data were collected over 20 days and 34% (16 patients) went on to develop 18 early signs of pressure damage. The study clearly identified that compared to visual inspection by nurses, SEM Scanner detected skin damage on average 3.9 days ahead of visual assessment. The mean number of days for a nurse to detect change was 5 days (SD: 5.15), whereas for the SEM Scanner it was 1.1 (SD: 0.75).

These studies suggest that interventions should be implemented or escalated sooner, and could also be targeted to the at-risk area in the body. For example, if just the heel is at-risk, intervention could focus on enhanced heel protection rather than a superior mattress.

### PILOT STUDY OF SEM SCANNER IN AN INPATIENT SETTING

In the second section of this meeting Jeanette Milne, Lead Nurse in Tissue Viability, presented real-world evidence supporting the use of the SEM Scanner in an orthopaedic trauma ward at Northumbria NHS Trust. The ward had one of the highest number of hospital-acquired PUs/PIs in the Trust (27 in one year, median 2 per month), but there
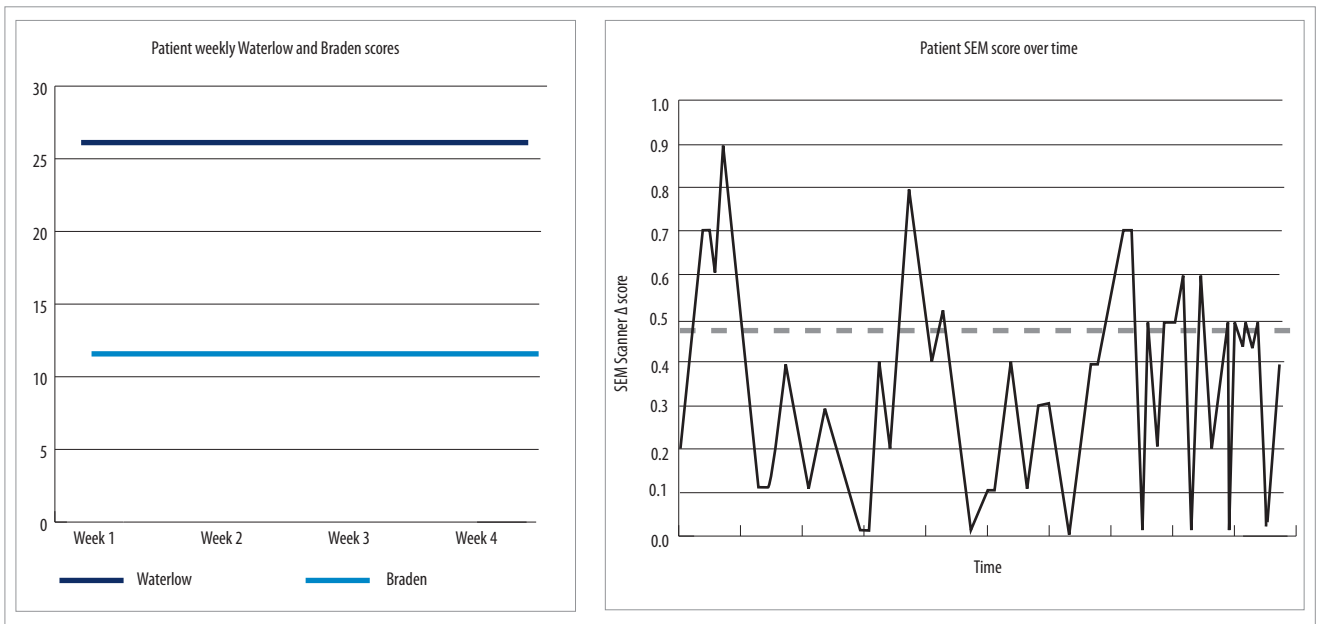
**Figure 1. Waterlow and Braden measurements versus SEM scores (Malloy et al, 2015)**
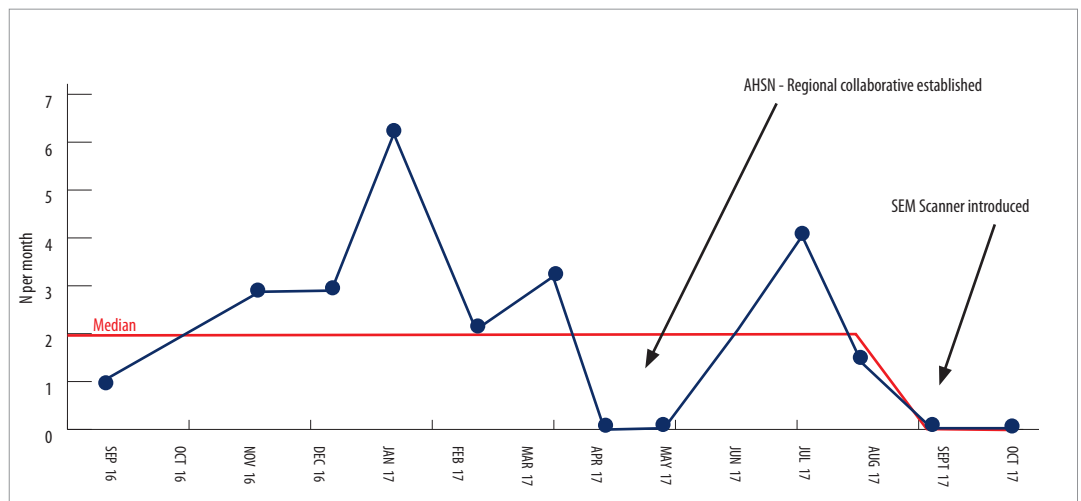


**Figure 2. Run-sequence plot of PU/PI incidence over time (Northumbria NHS Trust ward pilot data)**

was a suspicion that some patients had acquired damage prior to admission.

Over an 8-week evaluation period, from September to October 2017, the SEM Scanner was used to routinely monitor 59 patients. Of these, 58 patients were identified a deviated SEM score when compared to the SEM reading taken from the skin in the adjacent areas to the pressure point. A total of 34 patients (58%) showed signs of skin redness, while 24 (42%) identified by the SEM Scanner had no visible signs of skin damage.

A significant reduction in the incidence of PUs/PIs was noted during the months in which the SEM Scanner was introduced, with zero hospital-acquired PUs/PIs recorded, including category 1 PUs/PIs

(*Figure 2*).

The evaluation proved to be significant in another manner: of the 59 patients scanned during the evaluation period, 58 (98%) had a high deviation on admission, confirming suspicions that not all incidences of PUs/PIs were trust acquired. Jeanette explained that, where previously the trauma ward had been in the spotlight for not providing good quality care because of the high number of reported hospital-acquired PUs/PIs, the evaluation proved this not to be the case. Furthermore, a study of historic patient data revealed that a large proportion of patients at the Trust who developed PUs/PIs had a history of a prior PU/PI, signifying the need for a new approach to risk assessment that flags these

patients as high risk, something that blanket risk assessment tools often fail to do.

A survey among the clinical team involved in the pilot found that 86% felt they had seen a benefit throughout the evaluation period. The Trust is currently building a business case to adopt the SEM Scanner into clinical practice. Jeanette reported that in her Trust, the SEM Scanner was challenging everything previously known about PU/PI management, enabling targeted interventions that free time and valuable resources, and gain patient benefits. The potential financial benefits are also being monitored.

## CONCLUSION

The studies discussed in this report demonstrate that the SEM Scanner is effective in detecting early changes in SEM levels, can pre-empt the development of pressure ulcers and does so earlier than the standard practice of visual skin assessment. 'Reacting to red' is too late, and it is important to direct efforts towards what is happening below the skin by reacting to risk and individual SEM scores. Doing so is also likely to have major economic gains, as confirmed by a recent systematic review comparing cost of prevention with the cost of treatment (Demarre, 2015).

To achieve PU/PI ulcer prevention goals, clinicians must redefine how they approach risk assessment. The panel agreed on a back-to-basics approach to identify specific challenges and consider how these may be addressed. Over reliance on skin assessment tools, that function more as a 'tick box' exercise than a pathway to appropriate prevention measures, is a drain on valuable resources and does little to drive the PU/PI prevention agenda forward.

Using innovative diagnostic tools such as the SEM Scanner can help to recognise early signs of damage and protect tissue viability through the implementation of timely, person-specific interventions. Small changes, such as more targeted interventions, can significantly enhance clinical outcomes and improve patient comfort and dignity later in life. **Wuk**

## REFERENCES

Bates-Jensen B, McCreath H, Pongguan V (2009) Subepidermal moisture is associated with early pressure ulcer damage in nursing home residents with dark skin tones: pilot findings. *J Wound Ostomy Continence Nurs* 36(3):277–84

Bethell E (1992) Controversies in classifying and assessing grade 1 pressure ulcers. *Nursing Times* 99:73–75

Braden B, et al (2005) Preventing pressure ulcers with the Braden Scale: An update on this easy-to-use tool that assesses a patient's risk. *Am J Nurs* 105(6):70–223

de Oliviera A. The accuracy of ultrasound, thermography, photography and subepidermal moisture as a predictor of pressure ulcer presence – a systematic review. [MSc Thesis]. RCSI, Dublin 2015

Demarre L, Van Lancker A, Van Hecke A, et al (2015) The cost of prevention and treatment of pressure ulcers: A systematic review. *Int J Nurs Stud* 52(11):1754–74

Gould D, Goldstone L, Kelly D, Gammon J (2004) Examining the validity of pressure ulcer risk assessment scales: a replication study. *Int J Nurs Stud* 41: 331–9

Kottner J, Dassen T (2010) Pressure ulcer risk assessment in critical care: Interrater reliability and validity studies of the Braden and Waterlow scales and subjective ratings in two intensive care units. *Int J Nurs Stud* 47(6):671–7

Lyder CH, Ayello EA. *Pressure ulcers: a patient safety issue.* In: Hughes RG, ed. Patient Safety and Quality: An Evidence-Based Handbook for Nurses. AHRQ Publication No. 08-0043. Rockville, MD: Agency for Healthcare Research and Quality 2008:1–33

Malloy S, Moore Z, O'Connor T, Patton D (2015) *The Relationship between Risk Assessment Tools and Sub-Epidermal Moisture Measurement.* MSc Thesis, RCSI

Moore Z, Cowman S (2014) Risk assessment tools for the prevention of pressure ulcers. *Cochrane Database Syst Rev*

Moore Z, Gershon S, Fletcher J (2016) *SEM Scanner Made Easy.* Wounds International Available at: www.woundsinternational.com

Norton D, McLaren R, Exton-Smith A (1962) *An investigation of geriatric nursing problems in hospital.* National Corporation for the Care of Old People (now Centre for Policy on Ageing), London

O'Brien G, Moore Z, Patton D, O'Connor T (2015) *The Relationship between Risk Assessment Tools and Sub-Epidermal Moisture Measurement.* MSc Thesis, RCSI

Oomens CJ, Bader D, Loerakker S, Baaijens F (2015). Pressure induced deep tissue injury explained. *Ann Biomed Eng* 43(2):297–305

Oot-Giromini B, Bidwell FC, Heller NB, et al (1989) Pressure ulcer prevention versus treatment, comparative product cost study. *Decubitus* 2(3):52–4

Pancorbo-Hidalgo P, Garcia-Fern F, Lopez-Medina I, Alvarez-Nieto C (2006. Risk assessment scales for pressure ulcer prevention: a systematic review. *JAN* 54(1): 94-110

Quintavalle P, Lyder C, Mertz P et al (2006) Use of high-resolution, high-frequency diagnostic ultrasound to investigate the pathogenesis of pressure ulcer development. *Adv Wound Care* 19:498–505

Samuwiro R, Dowding D (2009) Nurses' pressure ulcer related judgements and decisions in clinical practice: A systematic review. *Int J Nurs Stud* 51(12): 1667–85

Schuurman JP, Schoonhoven L, De oor T, et al (2009) Economic evaluation of pressure ulcer care: a cost minimization analysis of preventive strategies. *Nurs Econ* 27(6):390–400, 415

Thomas D (2001) Issues and dilemmas in managing pressure ulcers. *J Gerontol Med Sci* 56:238–340

Walsh B, Dempsey L (2011) Investigating the Reliability and Validity of the Waterlow Risk Assessment Scale: A Literature Review. *Clin Nurs Res* 20 (2): 197–208

Waterlow J (2007) *The Waterlow Score.* Available at: http://www.judy-waterlow.co.uk/waterlow_score.html (accessed 20.10.16)