Early detection technology transforms care and releases productivity: an NHS case study

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With NHS strategy focusing increasingly on improving safety and quality of care, pressure ulcer (PU) incidence is regarded more and more as an indicator of this quality, or lack thereof. This meeting report highlights the importance of early detection of PUs, as presented at the Wounds UK conference in Harrogate in November 2016. It also provides clinical evidence in support of the SEM Scanner™, an innovative early diagnostic tool for PUs, including results of a recent evaluation undertaken by the Isle of Wight NHS Trust in an inpatient setting. Jacqui Fletcher began this meeting with a reminder that the strategic direction of the NHS is changing, as evidenced by the Carter report in England (Department of Health, 2016), which puts great emphasis on improved quality and safety of care, and the need for reduction in variation of outcomes. Increasingly, this message is relevant to the work of the tissue viability nurse, particularly with regards PU prevention.

While PU risk assessment tools are used widely, they are primarily a guide and can be inaccurate, potentially leading to unnecessary costs and overuse of resources. Moreover, clinicians do not always focus their plan of care on the parameters from these assessments or those that are most important to the final outcome; for example, a Waterlow score and details of a repositioning regimen may be recorded, but not whether the repositioning made a difference to the patient's outcome. While improvements have been made in recent years, PUs are still a burden to the NHS both clinically and financially, so a focus is needed on recording and acting on information that could affect patient outcomes directly.

AETIOLOGY OF PRESSURE ULCERS

The aetiology of PUs was introduced by Zena Moore: PUs are *"a localised injury to the skin and/or underlying tissue usually over a bony prominence, as a result of pressure, or pressure in combination with shear"* (NPUAP, EPUAP, PPPIA, 2014). While there are four mechanisms that result in PU formation, this meeting focused on sustained cell deformity (Stekelenburg et al, 2008).

When muscle cells are under pressure, their metabolism changes immediately to an anaerobic state; these cells are then destroyed either by waste product suffocation or through cell deformation, which changes the osmotic process, with death occurring as quickly as between 2 hours and 4 hours (Gawlitta et al, 2007). Cells can tolerate strains for up to 1 hour, but this tolerance gradually begins to reduce at up to 3 hours, after which cell death is evident. Upon cell death, deprivation of oxygen and nutrient supply to the affected area accelerates damage and, after 20 hours, a large inflammatory response is clear (Gefen et al, 2008).

Figure 1 provides a visual overview of the biological processes that lead to tissue damage. It is important to remember that PUs often develop from the inside out, so damage may be present even if a surface wound is not visible. When sensate patients complain of pain despite no obvious changes at the skin surface, it may be that damage exists internally. For insensate patients, undetected ulcers can start in the deeper tissues and progress to become ulcers with varying amounts of destruction (Oomens et al, 2010).

IMPACT OF THE SEM SCANNER ON PATIENT OUTCOMES AND NURSING PRODUCTIVITY

Sub-epidermal moisture (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, 2016a). Surface electrical capacitance of the skin is determined

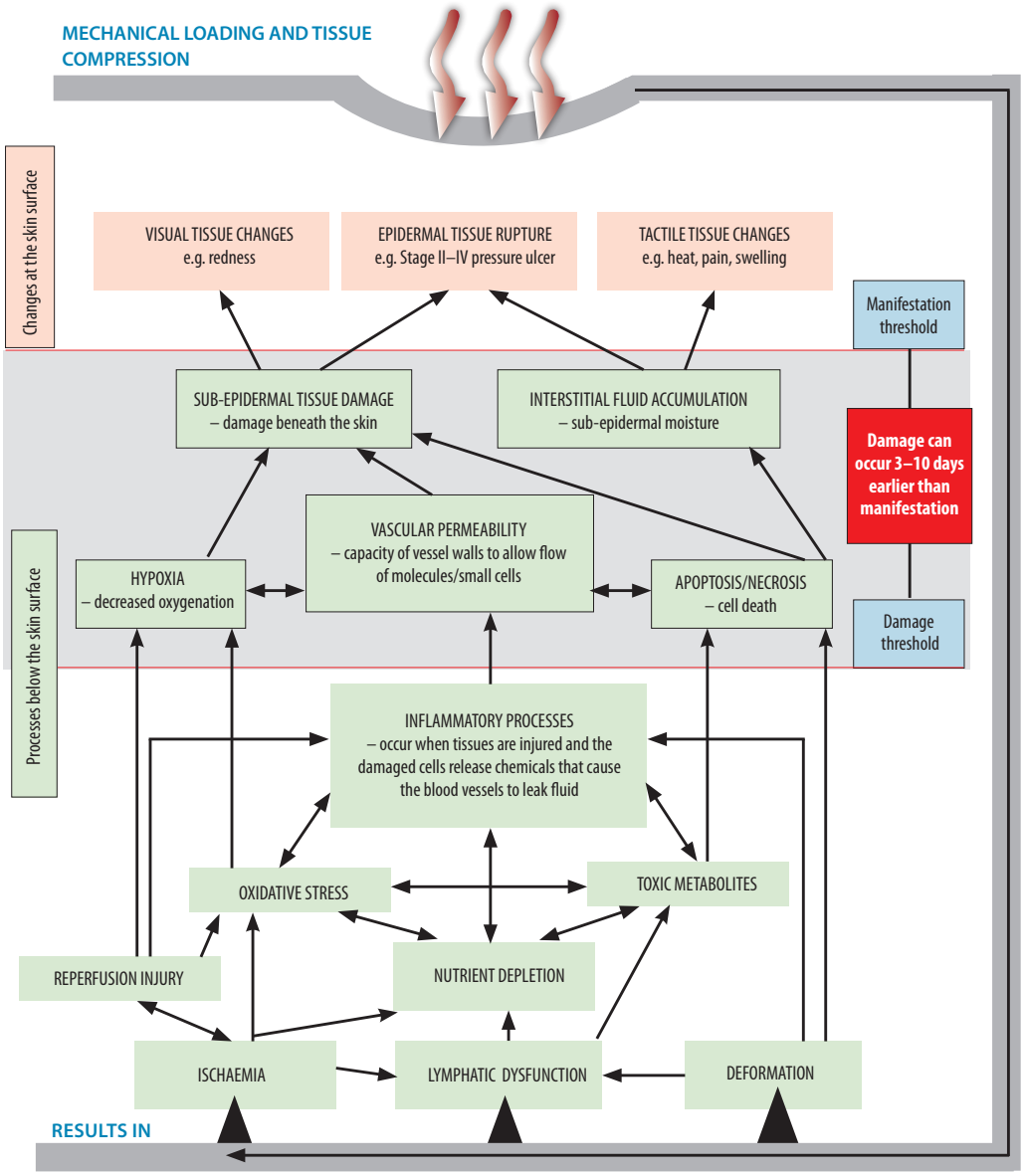

Figure 1. Biological processes that lead to tissue damage (Adapted from Moore et al, 2016b)

by the impedance of the skin to electrical forces, and thus can reflect oedema and water content of the epidermal and sub-epidermal tissues (Bates-Jensen, 2009).

The SEM Scanner is a diagnostic tool that determines levels of SEM using electrical properties of the skin; it measures this electrical capacitance via a signal picked up by an integrated electrode placed directly in contact with the skin for at least 1 second. Reading at least three measurements at each anatomical location (six measures at the sacrum and four at the heel), with a difference of ≥0.6 between the lowest and highest values recorded, denotes elevated SEM levels indicative of early PU development.

Highlights from data supporting of the SEM Scanner

Numerous studies and a systematic review undertaken during the past year have provided data in support of the SEM Scanner (Moore et al, 2016a; O'Connor et al, 2015; O'Connor et al, 2016). Various highlights can be drawn from this collective data. First, SEM measurement results in a higher incidence of PU detection compared with visual assessment (VSA). There is a moderate-to-strong correlation between SEM scores and VSA at all anatomical sites,

suggesting that SEM scores are a reliable method for detecting early pressure damage. Moreover, negative correlations between SEM scores and mobility show that decreasing mobilisation corresponds with rising SEM scores; this suggests that the SEM Scanner is capturing decreased mobility as a primary risk factor for PU development. Indeed, while a negative correlation with mobility scores has been detected at the sacrum by VSA, the data suggest that the SEM Scanner is actually more sensitive to changes in mobility.

EVALUATION AND IMPLEMENTATION OF SEM SCANNER TECHNOLOGY IN AN INPATIENT SETTING

In the second section of this meeting, Glenn Smith, a Patient Safety Lead with 11 years of experience as a Tissue Viability Nurse, discussed efforts to reduce PUs at a hospital in the Isle of Wight. This hospital was already participating in a local collaborative review of PU development. As demonstrated by the linear plots in *Figure 2*, improvements had been made during 2016 compared with 2015, but step-change was required. As such, the decision was taken to conduct a clinical evaluation of the SEM Scanner.

Evaluation process

The evaluation took place in one medical-surgical mixed ward for 2 months. Patients with a Waterlow score of 10 or above who could not be repositioned (i.e. patients considered at risk of PUs in an inpatient setting) were assessed across two bays. Scanning took place on admission and thereafter on a daily basis. Patients were traced from admission to discharge and beyond, with an identifying patient number attached to each incident. Monitoring continued during the outpatient phase, for comparison with patients in the ward's care.

Healthcare assistants conducted the scans as part of their intentional rounding routine, with scanning taking place at the same time every day. Initial integration of scanning into the ward routine took time, but eventually became normal practice within about 2 weeks. Registered nurses interpreted the results and adjusted the clinical preventative interventions in accordance with the findings. Training was supported with biweekly visits by territory representatives from the SEM Scanner manufacturers.

Evaluation results

Of the 35 study participants, 82% were aged >65 and 74% were aged >75, with 51% females and 49% males. All patients showed SEM Scanner deviations ≥0.6 at some point during their stay, indicating comprised skin integrity. The majority of SEM readings were between 0.6 and 1.5, although several were significantly higher. *Figure 3* shows the distribution of SEM Scanner scores taken during the evaluation.

The relationship between Waterlow scores and SEM readings was measured based on data from 35 patients. Daily scanning was demonstrated to be a more sensitive method of assessing incipient risk objectively, as opposed to using risk assessment scales. Indeed, several patients were assessed to be 'at-risk' by a risk assessment tool, whereas their SEM readings indicated no damage was present (*Figure 4*). In practice, SEM scanning was shown to be a simpler, faster and more practical way of conducting daily assessments when compared with risk assessment tools.

None of the patients scanned during this evaluation went on to develop a PU whilst in the care of the ward. One patient demonstrated irretrievable deterioration in their SEM readings

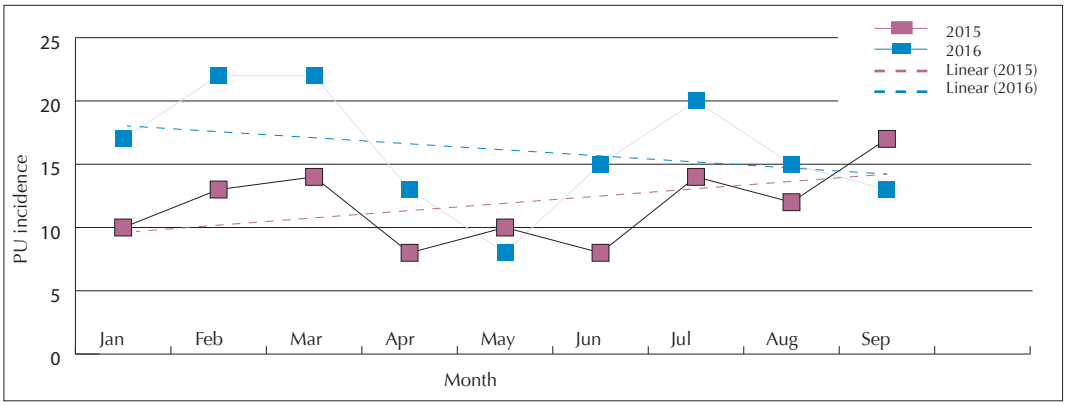

Figure 2. Grade 2 PU incidence month-by-month since start of hospital PU collaborative review

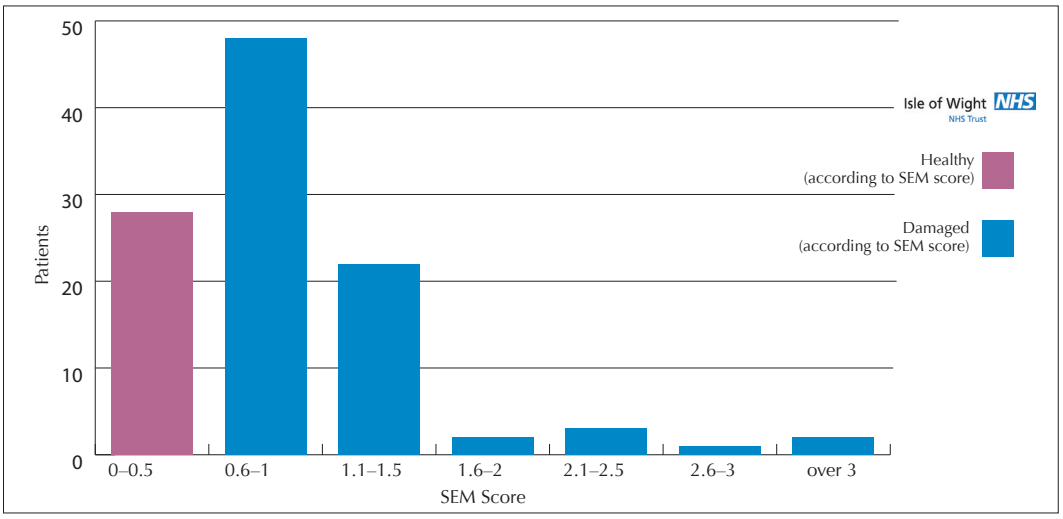

Figure 3. Distribution of SEM Scanner scores taken during an evaluation within the Isle of Wight NHS Trust

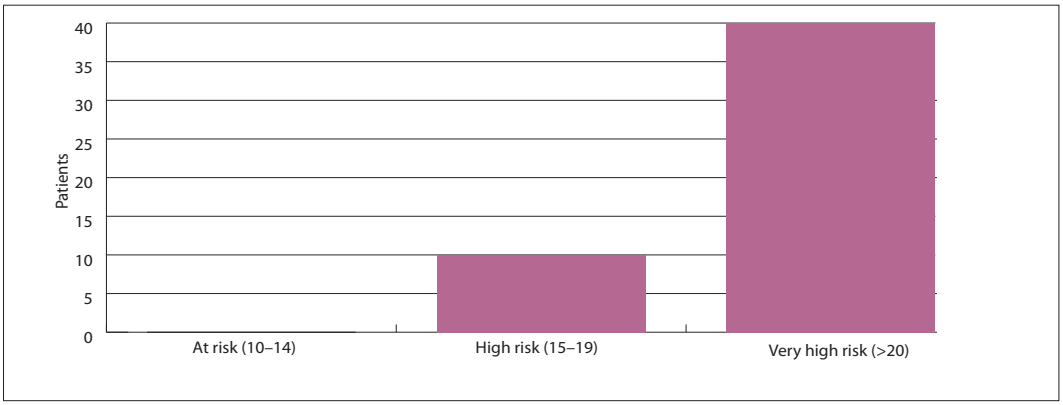

Figure 4. Waterlow scores for patients with SEM variations below the 'healthy skin' threshold

that appeared as a PU within hours of transfer onto the ward, which was clearly not attributable to the care of the ward. One patient who was being followed in the community after discharge was shown to have an incipient PU, but this was also not due to care on the ward. There is good evidence from this evaluation that the SEM Scanner was able to demonstrate the efficacy of the interventions put in place for PU prevention on the ward.

Development of a business case

Following this evaluation, a business case was developed for implementation of the SEM Scanner across inpatient settings. The business case was underpinned by the current climate of strategic change within the NHS, emphasising:

- National and local drivers for reduction in PUs (CQUIN, Quality Contract Monitoring, NHS Safety Thermometer; Safeguarding Adults Reviews of patients who died as a result of PUs; Coroners Inquests)
- Cost-benefit evaluation of devices against budget lines in financing of preventative care
- Elevation of the pivotal role of the healthcare assistant in ward-based preventative care for PUs.

A major obstacle to implementing this business case was that current cost modelling for PUs confuses costs of prevention and costs of treatment. It is very difficult to account for the total cost of PUs, as this must take into account cost avoidance (resulting from prevention versus treatment), nursing productivity and revenue (i.e. optimisation of bed usage). A new approach to cost modelling was required, which distinguished between costs and resources that could not be avoided by PU reductions (i.e. risk assessment, planning, use of support surfaces) and those that could be avoided or reduced by decreasing incidence of PUs (i.e. costs of dressing change, length of stay in hospital, community visits). There was a need to focus on released productivity, increased revenue from reductions in length of stay and avoidance of costs.

Parameter	Saving	Comments
Hard costs	£29,000	A reduction of 20% in the over-prescription of alternating devices, aligned to rolling replacement programmes, was calculated as just under **£20k cost avoidance for 2016–17 (if achieved)** 13% of PUs during 2015–2016 were coded as infected via HRG coding. This equated to **£2,785 in antibiotic costs during this period** based on local antibiotic guidelines and NHS Drug Tariff costs **Annual dressing costs for PUs was calculated as £6,203** based on an evaluation of the dressings used in 150 dressing changes.
Nursing productivity	1,420 hours (36 weeks) of nursing time	**596 hours of nurse time would have been released** in 2015-2016 if the PUs had not occurred and therefore did not require dressings **84.7 hours of band 7 nursing time would be released** if the time needed to conduct SIRI investigations and cluster reviews were not needed **739 hours of registered nursing time, or a little under 20 weeks of a whole time equivalent nurse** for PUs in the community (22% of PU contacts in the community setting were for PUs caused in hospital).
Revenue	£563,000	There was a differential of 5637 bed days between the hospital stays of patients without PUs compared with patients with PUs As hospital stays beyond HRG Trimpoint involve a loss in revenue of approximately £100 per bed day, that equate to **£563k in 2015–2016**.

Table 1. Estimates of annual cost savings based on PU data for the Isle of Wight NHS Trust

Table 1 provides estimates for annual cost savings for the hospital Trust. Based on these findings, a proposal for widespread implementation of the SEM Scanner is under consideration for organisational approval at this hospital on the Isle of Wight. Evidence has been used to develop a local cost model that is clinically valid and excludes the costs of PU prevention, focusing specifically on the costs of PU development. This takes into account:

- Released productivity due to over-prescription of intentional rounding
- Released replacement costs due to reduction in over-prescription of support surfaces
- Released productivity due to reduction in senior nurse time for cluster and local reviews
- Reduction in dressings costs (NHS Supply Chain)
- Reduction in infected PUs (HRG coding data)
- Likely revenue loss due to increased length of stay associated with Finalised Consultant Episodes that included coded PUs
- Reduction in community nursing time for nosocomial PUs.

Conclusion

The incidence of PUs in hospitals is an indicator of the quality and safety of patient care, improvements to which are high on the strategic agenda for the NHS. This meeting report summarised data for the SEM Scanner, an innovative early diagnostic tool for PU identification that allows the clinician to 'visualise pathology' below the skin before it becomes apparent at the surface. It presented results of an evaluation of the SEM Scanner undertaken in an inpatient setting. The positive impact of this evaluation could be seen for patients, clinicians and organisational finances, so this article also provides details of a business case supporting organisational roll out of the SEM Scanner. WUK

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