Implementing a new approach to pressure ulcer prevention

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With pressure ulcers remaining a challenge to the healthcare system across all care settings, this 12-week pilot study aimed to evaluate implementation of the SEM Scanner as an adjunct to standard of care (SoC) in pressure ulcer (PU) prevention. Two district nursing bases enrolled 17 palliative care patients, who received SoC and preventive interventions. Patients with Waterlow scores 10–19 who were able to be scanned for three consecutive days were included. Broken skin was not scanned, and visual skin checks were documented after SEM scans. Patients with SEM delta ≥0.6 were considered at high risk and preventive interventions were escalated using a clinical decision matrix aligning with SoC. The study found that implementing the SEM Scanner in an existing PU prevention pathway resulted in a reduction in community-acquired PU (CAPU) incidence by 26.7% from 16.1% to 11.8%; 88% (n=15) of patients remained PU free. Furthermore, clinical judgement informed by SEM deltas resulted in 82% (n=14/17) of nurses reporting that the SEM delta had changed their clinical decision-making.

KEYWORDS:
- SEM Scanner
- Delta readings
- Pressure ulcer
- Incidence reduction
- Standard of care
- Clinical decision matrix

Prevention, treatment, and management of pressure ulcers (PUs) is a key indicator of quality, safety, and patient care experience. In the UK, the National Health Service Safety Thermometer (NHS-ST) reports 8.4 million PU-related data points added 2011–2018 (NHS Improvement, 2018). However, deep-dive analysis of the NHS-ST data suggests that the largest numbers of new cases of PUs developed in nursing homes and/or community settings, contributing to national PU incidence and prevalence.

The cost burden of PU treatment is high. Guest et al (2018) estimated mean NHS cost of PU care over 12 months at £8,700 per PU (£1,400 category 1; £8,500 categories 2–4). While district nurse visits driven by PU treatment accounted for ≥80% of the cost burden, approximately 98% of this cost was associated with PU care in community settings (Guest et al, 2018). A cost comparative case study illustrated the significant cost implications of treatment versus prevention. While prevention is not free, the study demonstrated that costs of treatment far exceed those of prevention, suggesting that more effort needs to be made to address the latter (Gelen et al, 2020).

The patient care experience, including pain, loss of function and mobility, depression, and social isolation (Charalambous et al, 2018) are far less reported, thereby confounding the true cost of treatment. Preventing PUs improves care, which impacts the overall wellbeing of patients (Moore and Patton, 2019).

The cost burden in community care settings has encouraged NHS trusts to develop multiple initiatives to achieve PU incidence reduction (Guest et al, 2018). However, despite awareness campaigns, such as React to Red, education, increased use of risk assessment tools (RATs), improved protocols and guidelines and utilising the SSKIN bundle to improve care, PUs remain a significant healthcare problem. A review investigating the use of PU risk assessment tools found ‘low’ or ‘very low’ certainty of evidence that such tools reduce the incidence or severity of pressure injury (PI)/PU (Moore and Patton, 2019).

To align with NHS objectives in reducing PU incidence, Mersey Care NHS Foundation Trust (MCFT), a community care provider, implemented a pilot study as part of their PU reduction strategy. The aim was that the objective data collected would inform targeted clinical interventions to improve their PU prevention practices.

MERSEY CARE NHS FOUNDATION TRUST (MCFT)

MCFT serves a population of over 11 million in North West England, providing high secure adult specialist mental health, addiction, learning
disability and community health services. In 2017, MCFT prioritised reduction in community-acquired PUs (CAPU) as one of their trust-wide primary objectives (MCFT, 2017–2018).

This included:
- Zero deterioration of category 2 and 3 PUs
- Awareness training for managing PUs in the mental health inpatient wards
- Reduction plans with a target trajectory for reduction of category 2 and 3 PUs
- Zero category 4 PUs

Prevention and management of PUs was highlighted by the trust board as one of the highest clinical risks within the MCFT community services division, and as an issue across the national health economy, due to the increasing complexity of patients who remain at home or in residential/nursing homes. Team, locality, and division level PU dashboards were implemented to support monitoring of PU risk patients. All PUs were monitored and recorded weekly via an incidence reporting software system (Datix Inc). Despite embedding this incidence reporting software system and recording weekly via an incidence reporting software system (Datix Inc). Despite embedding this PU reduction strategy, incidence continued to be an issue and quality targets remained unmet (MCFT 2018–2019).

Palliative care patients in community care represented approximately 40–55% of the caseload:
- 50% had been on the caseload for more than four years
- 50% for between four and eight months.

Two district nursing bases, Sefton and South Liverpool, reported CAPU incidence between September 2017 and August 2018 of 13.5% (n=19/141) and 20.2% (n=18/89) respectively, an overall incidence of 16.1% (n=37/230) (Figure 1). These incidence rates were higher than those reported in the literature (6.7–13.1%) (Hendrichova et al, 2010; Artico et al, 2018). From December 2018 to February 2019, Sefton and South Liverpool evaluated their ability to reduce the incidence of PUs in their in-home palliative care population by implementing the SEM Scanner as an adjunct to their standard of care (SoC).

**PILOT PRESSURE ULCER REDUCTION PROGRAMME IN COMMUNITY CARE SETTINGS**

In 2014, Bruin Biometrics Europe Limited (BBI) introduced a real-world evidence (RWE) PU reduction programme to complement evaluation of the SEM Scanner. The cornerstone of a pragmatic study is the ability to evaluate an intervention’s effectiveness in the ‘real-world’ and to be able to generalise the results to multiple care settings (Patsopoulos, 2011). This approach was taken to examine the impact of the SEM scanner on PU incidence rates and cost-savings.

The objective of the RWE pragmatic study was to evaluate the:
- Clinical impact of using the SEM Scanner: pre and post PU incidence rates were compared
- Clinician’s experience: descriptive statistics demonstrate the change in clinical decision-making
- Financial impact: health economic modelling was used to demonstrate cost-savings and returns on investment

During the programme, SoC remained completely unchanged. This included Waterlow risk assessment, visual skin assessment (VSA) and, if indicated for PU prevention, a turning regimen, use of support surfaces, heel off-loading and mobilisation. The only exception was the adjunct of the SEM Scanner. It is important to note that no new equipment or staff were deployed in the RWE programme.

**Materials and methods**

Only palliative care patients from the two nursing bases were included in the evaluation to reflect the community nurse caseload. Preventive interventions, care and treatment were provided to all patients in compliance with facility protocols, standard care guidelines and NHS trust-wide clinical policies, which are based on the National Institute for Health and Care Excellence guidelines (NICE, 2014).

**Standard of care (SoC)**

Standard of care included:
- Relevant training and education in PU risk assessment and prevention
- Waterlow risk assessments at the first face-to-face visit, or within six hours of admission on all individuals
- Complete skin assessments undertaken at first face-to-face visit and on an ongoing basis
- Thorough skin inspection as per policy
- Reassessments on planned review dates set out in the care plan or sooner if there was a change in an individual’s condition which increased the risk of developing PUs
- PU category was recorded using the National Pressure Ulcer Advisory Panel/European Pressure Ulcer Advisory Panel/Pan Pacific Pressure Injury Alliance guidelines (NPUAP/EPUAP/PPPIA, 2014).

![Figure 1](https://example.com/figure1.png)

*Figure 1.* Pre-study heel and sacral PU incidence (September 2017–August 2018).
PU prevention and treatment strategies comprised:
- Specialised support surfaces
- Positioning and repositioning
- Wound management strategies aided by risk assessments in conjunction with clinical judgement.

The district nursing bases’ PU action plan, including increased awareness, team level dashboards, 72-hour PU monitoring and review process, was embedded into care protocols and the SoC, thereby aligning with the trust’s priority objective in reducing CAPUs for 2018/2019.

**Study procedure**
Training was supported by BBI; all nursing staff were fully trained in the correct procedure for using the SEM Scanner, the relevance of recognising a raised delta, and the need to adjust clinical interventions accordingly.

All patients underwent holistic assessment within 48 hours of admission to the caseload. Patients at risk of PUs were identified by completing appropriate risk assessment tools. Those with a Waterlow score of >10+ with unbroken skin and able to be scanned for 5–7 consecutive days were enrolled in the study population (n=17). Patients for whom the device was contraindicated, i.e. patients with broken skin in the anatomical area of the PU and paediatric patients, and, or, with a Waterlow score of ≤10 were excluded. Patients within residential/care homes were also excluded.

All enrolled patients received a patient information leaflet describing the study and device-related procedures. This was discussed with them and informed consent obtained by staff members. For each patient, healthcare professionals took six readings for the sacrum and four for both heels at each scan. The SEM Scanner was cleaned as per instructions for use and in compliance with local protocols. Each patient was scanned for an average of 12 days (range 1–26 days). A clinical decision matrix was used to determine care planning according to both scanner readings and clinical judgement (Figure 2).

Patients with an SEM delta ≥0.6 were considered at high risk and preventative interventions, based on SoC protocols, were escalated.

Where at least 2–3 SEM delta were ≥0.6 within a consecutive three-day scanning period, SEM scanning and risk assessment frequency was reassessed as per clinical judgement. Patients with an initial SEM delta <0.6 were considered at low risk for developing PUs. If a subsequent SEM delta ≥0.6 was recorded, patients were moved to the high-risk category and interventions were provided as per protocol and clinical decision matrix.

All category 2–4 PUs, unstageable and deep tissue injuries (DTIs) were recorded to calculate incidence during the study period. Healthcare professionals were trained to monitor and act on SEM delta readings in conjunction with clinical judgement, and interventions were appropriately escalated as per the trust’s SoC.

**SEM Scanner**
The SEM Scanner is a portable, wireless, non-invasive, hand-held device that identifies increased risk of PU five days earlier than visual skin assessment (VSA) (Okonkwo, 2020) (Figure 3). Readings are taken at the site of suspected injury and at contiguous locations to gauge the relative difference in sub-epidermal moisture, an indicator of the inflammatory response triggered by the potential injury (Gefen, 2020). The difference between the highest and lowest readings, the delta ≥0.6, indicates increased risk of PU at specific anatomical locations (Ross and Gefen, 2019).

**Data analysis**
Data recorded included:
- Pre-study PI/PU incidence
- Risk assessment tool used and scores (Waterlow)
- Results of VSA
- Clinical interventions actioned as a result of SEM reading
- Post-study incidence.

Descriptive statistics were produced for the pre-study period compared to the study period. For the change in incidence endpoint, a comparison was made between

<table>
<thead>
<tr>
<th>Clinical decision matrix</th>
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<tbody>
<tr>
<td>• Review patient holistically</td>
</tr>
<tr>
<td>• Implement action plan based on risk factors</td>
</tr>
<tr>
<td>• Document all actions taken, including actions taken to prevent skin damage</td>
</tr>
<tr>
<td>• Review Waterlow as indicated</td>
</tr>
<tr>
<td>• Provide patient advice/education</td>
</tr>
<tr>
<td>• Review patient holistically</td>
</tr>
<tr>
<td>• Review frequent repositioning/movement</td>
</tr>
<tr>
<td>• Assess all pressure-relieving equipment and upgrade as needed</td>
</tr>
<tr>
<td>• Implement action plan based on risk factors</td>
</tr>
<tr>
<td>• Implement/review plan care</td>
</tr>
<tr>
<td>• Review Waterlow as indicated</td>
</tr>
<tr>
<td>• Provide patient advice/education</td>
</tr>
<tr>
<td>• Consider assessment by equipment specialist team (EST) for equipment/seating assessment</td>
</tr>
</tbody>
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**Deviations**

<table>
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<tr>
<th>Deviation (highest scanner reading)</th>
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<td>Less than 0.6 (normal reading)</td>
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Review scanning frequency if clinical concerns/deterioration of condition

Figure 2.
Clinical decision matrix (Ore et al, 2019).
An assumption of one (1) PU per patient was made after historical incident report system data in consultation with ward managers.

Cumulative PU incidence for the two centres was 16.1% (37 PUs in 230 palliative care patients) before the study.

The study enrolled 17 patients (10 Sefton, seven South Liverpool) who had their heels and sacrum scanned over a period of 12 weeks, capturing 2,788 data points from 697 SEM delta readings, of which:
- 67% (n=466/697) SEM delta were ≥0.6
- 55% (n=386/697) of delta readings that were ≥0.6 had no associated visible discolouration

Among the 17 patients, two developed category 2 PUs, an incidence of 11.8% [95% CI 1.5%, 36.4%].

Patient examples
- **Patient A**: Sacral delta values ≥0.6 recorded on days 16 (delta=0.9) and 17 (delta=1.8), with category 1 visual discolouration noted on day 20.
- **Patient B**: Delta values ≥0.6 at the sacrum were recorded on days 15 (delta=1.2) and 16 (delta=1.2) and were provided and recorded per protocol and clinical decision matrix.
- All subsequent sacral delta values were ≥0.6 except on day 31 (delta=0.4).
- A delta of 0.8 was noted on day 32.
- On day 33, a category 2 PU was diagnosed.

During the study period, CAPU incidence rate was 11.8%. A total reduction compared to the previous period (incidence of 16.1%) of 26.7% was achieved. Fifteen of the 17 patients (88%) remained PU free.

**DISCUSSION**

Data from the National Safety Thermometer attribute PU prevalence and incidence rates across the UK primarily to community healthcare settings (Smith et al, 2016). To support the efforts of PU prevention in community care settings, MCFT prioritised reduction of CAPUs as one of their primary objectives. Clinically implementing the SEM Scanner, an adjunctive device to existing SoC in PU prevention, was key to developing and implementing action plans to reduce PUs in trust-wide community care settings.

- Clinical judgement informed by skin and tissue assessments (STAs) and SEM deltas resulted in 94% (n=16) of patients, receiving interventions based on the algorithm shown in Figure 4. These included increased turning or mobilisation (71%, n=10), specialist mattress (71%, n=10), heel support or elevation (86%, n=12), and prophylactic dressing or barrier cream (60%, n=9).
- Clinical judgement informed by SEM deltas alone, where STAs did not show visible discoloration, resulted in changed clinical decision-making in 82% of patients (n=14/17).

Two patients developed category 2 PUs, an incidence of 11.8% [95% CI 1.5%, 36.4%].

**Patient examples**
- **Patient A**: Sacral delta values ≥0.6 recorded on days 16 (delta=0.9) and 17 (delta=1.8), with category 1 visual discolouration noted on day 20.
- PU prevention interventions were provided and recorded per protocol and clinical decision matrix.
- All subsequent sacral delta values were ≥0.6 except on day 31 (delta=0.4).
- A delta of 0.8 was noted on day 32.
- On day 33, a category 2 PU was diagnosed.

The impact of this pilot analysis enabled MCFT to directly correlate implementing SEM technology to their PU incidence reduction objectives. Improved clinical decision-making, early implementation of SoC interventions as a direct result of SEM delta readings, resulted in a reduction in CAPU incidence of 26.7%.

Additionally, implementing SEM technology into existing PU SoC...
pathways could reduce overall expenditure of CAPU prevention and management, including cost-intensive PU treatment, frequent STA expenditure, occupied bed days, increased nursing time, and PU litigation associated with PU incidence (Gefen et al, 2020).

Following the results of the pilot study, the MCFT team have implemented the SEM Scanner across 21 teams district nursing teams.

The 2019 Clinical Practice Guidelines (CPG; EPUAP/NPIAP/PPPIA, 2019) specifically highlight the importance of SEM as an adjunct to routine clinical PU assessments. Recommendation 2.6 states that healthcare professionals using their own qualified clinical judgement should ‘consider using a sub-epidermal moisture/oedema measurement device as an adjunct to routine clinical skin assessment’. Recommendation 2.7 states that healthcare professionals should use their own qualified clinical judgement when assessing darkly pigmented skin, ‘... consider assessment of skin temperature and sub-epidermal moisture as important adjunct assessment strategies’.

Results from this pilot study were limited by population sample and size. MCFT’s community care population includes patients who reside in both nursing and residential care homes, supported living or with relatives/family/friends, along with people who are not able to access community services and facilities for various reasons including long-term health conditions, disability, cognitive impairment, palliative diagnosis and frailty. The percentage of population ≥65 years of age is 16.25%. To avoid potential bias in sample population, the Sefton and South Liverpool (geographically opposite sides of the district) were specifically chosen for this study. The authors acknowledge the potential of behavioural changes termed as the Hawthorne Effect (HE) (Chen et al, 2015). Given the extensive prior PU initiatives, it is the authors’ opinion that behavioural changes did not impact on overall reduction in incidence.

CONCLUSION

CAPU incidence is a serious clinical and economic burden to the NHS. Current PU incidence reduction strategies implemented by the MCFT still rely on subjective clinical judgement. Although increased awareness in PU management, monitoring and extensive training were provided to nursing staff by the tissue viability team, before the pilot, the CAPU incidence reduction was still underachieved. However, since the pilot study, reduction has been seen. Results from this pilot study highlight the clinical significance of objective data from the SEM Scanner supporting clinical judgement in CAPU prevention. Data from the SEM Scanner, coupled with clinical skill and knowledge, supports decision-making, care planning and resource allocation.

MCFT successfully integrated SEM Scanner into everyday nursing practice as part of patient individual holistic assessment. It is conceivable that, coupled with a reduction in patient harm, SEM Scanner can fit perfectly into ongoing PU incidence reduction strategies.

Figure 4. MCFT intervention decision algorithm.


KEY POINTS

- Prevention, treatment, and management of pressure ulcers (PUs) is a key indicator of quality, safety, and patient care experience.

- The cost burden of PU treatment is high. Guest et al (2018) estimated mean NHS cost of PU care over 12 months at £8,700 per PU (£1,400 category 1; £8,500 categories 2–4). While district nurse visits driven by PU treatment accounted for ≥80% of the cost burden, approximately 98% of this cost was associated with PU care in community settings.

- The patient care experience, including pain, loss of function and mobility, depression, and social isolation (Charalambous et al, 2018) are far less reported, thereby confounding the true cost of treatment.

- Implementation of SEM Scanner, an adjunctive device to existing SoC in PU prevention, was key to developing and implementing action plans to reduce PUs in a trust-wide community care setting.

- Results from this pilot study highlight the clinical significance of objective data from the SEM Scanner supporting clinical judgement in CAPU prevention.