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Meeting report: pressure injury prevention: clinical outcomes explained by robust scientific evidence: a panel discussion

This meeting report summarises the proceedings of a panel-led symposium that took place at the European Wound Management Association (EWMA) Conference, Amsterdam in May 2017. It looks at the crucial role of pressure injury prevention and the importance of robust clinical data in proving the positive impact — for patients, clinicians and the healthcare economy — of implementing strategies that include the use of prophylactic dressings, positioners, and turning and positioning systems. The expert panel provided guidance on how to implement changes in line with evidence-based consensus, and highlighted the importance of delivering optimal care to at-risk patients.

Symposium

Chair: **Paulo Alves**

Panel members: Sue Creehan, Amit Gefen, Nick Santamaria and Chenel Trevellini

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Pressure injuries (PIs) [Box 1] pose multiple clinical, economic and patient-centric challenges and there is an increasing need to drive down their numbers as research suggests that 95% of PIs are known to be preventable (Hibbs, 1989; Hibbs, 1998).

The success of prevention programmes depends on an understanding that different patients in different hospital settings can have very different needs. When patients are admitted to hospital, risk assessments should be undertaken to identify susceptibility to PI and preventive interventions should be put in place for the duration of their hospital stay. Interventions should be escalated as the patient's risk increases and likewise may be adjusted as risk decreases.

The key to establishing a comprehensive prevention programme is through thorough understanding of evidence-based strategies that can be translated and embedded into practice, and that are instilled throughout the organisation from the boardroom to the bedside.

Everything possible should be done to prevent PI in patient populations and/or those in specific clinical settings regarded as being at a relatively high risk; for example, bariatric, critically ill, older or paediatric patients; individuals in the operating room (OR); patients with spinal cord injuries; and patients in palliative care.

Drivers to improving clinical outcomes

Sue Creehan opened the symposium by reminding the audience of the current pressures that healthcare organisations face in delivering optimal care to patients. Currently, healthcare organisations are driven to improve clinical outcomes while at the same time remaining financially solvent in a competitive healthcare arena.

There is now a focus on becoming what is commonly known in the USA as a 'high reliability organisation' (HRO) — and, while the term may not be widely used elsewhere in the world, there is a need for 'high reliability' healthcare providers. These organisations must now focus on safety, quality and patient satisfaction in every service they provide. Excellence comes when safety, quality and patient satisfaction are embedded into the care delivered, Sue asserted.

Most healthcare organisations are undergoing significant change to meet these standards, thanks to demands from several groups including external stakeholders (public, government, advocacy groups and health insurers) and internal stakeholders (clinical practitioners, executives, and research, quality improvement and finance departments). Gone are the days when hospitals can expect to be paid for poor performance.

Box 1. Changing terminology of “pressure injury”.

The terminology is evolving to recognise that pressure damage does not always manifest as an open wound and to emphasise preventability. The term “pressure injury” is used by the Pan Pacific Pressure Injury Alliance (PPPIA) and has recently been adopted by the National Pressure Ulcer Advisory Panel (NPUAP) (WUWH, 2016). NHS Improvement recently held a consensus event where clinicians voted strongly in favour of using the term “pressure ulcer” in England, the UK.

Box 2. Implementing best practice guidance.

Implementing best practice guidance means becoming familiar with all the guidelines available for clinical experts, such as the NPUAP, EPUAP and PPPIA Clinical Guideline (NPUAP, EPUAP and PPPIA, 2014). This information needs to be digested, translated and customised to align with the evidence-based practice standards for each organisation.

The guidelines instruct clinicians to instigate patient-specific and organisational best practice.

The role of leadership in implementing change

Healthcare organisation leaders are, or should be, driving the changes needed to improve standards and, in doing so, need to gain buy-in from clinical staff throughout the organisation; PI prevention programmes are no exception. They too are a safety, quality and customer service issue.

Getting staff on board requires organisational culture change. Aligning a PI prevention programme with the organisation’s mission and strategy to become a HRO provides leaders with an opportunity to gain internal support.

It is crucial for leaders not only to stay connected to the key organisational goals, but also to create a thread that links work in PI prevention with the *focus du jour* (i.e. throughput, avoiding readmissions, decreasing length of stay).

Leadership strategies to ensure best practice in PI prevention outcomes include:

- Connecting the boardroom to bedside
- Designing and articulating clear vision
- Ensuring efficient data management
- Setting goals and benchmarks
- Facilitating bi-directional flow of data
- Supplying adequate budgets: capital and human resources
- Enhancing multidisciplinary teamwork and collaboration
- Supporting evidence-based practice
- Identifying clinical expertise and champions
- Encouraging staff participation.



Figure 1. Implementing best practice across the organisation: a patient approach.

These strategies can only be achieved and sustained with support and alignment at board level. The clear vision for the organisation should come from here; and senior clinical staff should be involved in its creation. This vision should then be explained to staff across the organisation, providing context as to how implementing the PI prevention programme will help them in their work and improve patient outcomes [Figure 1; Box 2]. It is important to encourage staff participation in defining tactical requirements of the programme.

Baseline and ongoing data collection are necessary components of a comprehensive PI prevention programme. Staff should be informed about what data need to be collected and how often. Identified data collectors will need instruction on accurate assessment, staging and chart reviews, and targets should be set and benchmarking entities established. Equally, there will be concerns and questions around budget; what is available for prevention (e.g. mattresses, prophylactic Mepilex® Border [Mölnlycke Health Care] dressings, heel devices), and is there adequate staffing levels to provide care and implement the programme?

Most facilities now have a basic PI prevention programme, and simply implementing and embedding these practices yields a measure of success. But just telling clinicians what to do is not sustainable; organisational best practice programmes [Figure 2] must be in place to support what clinicians are being asked to do.

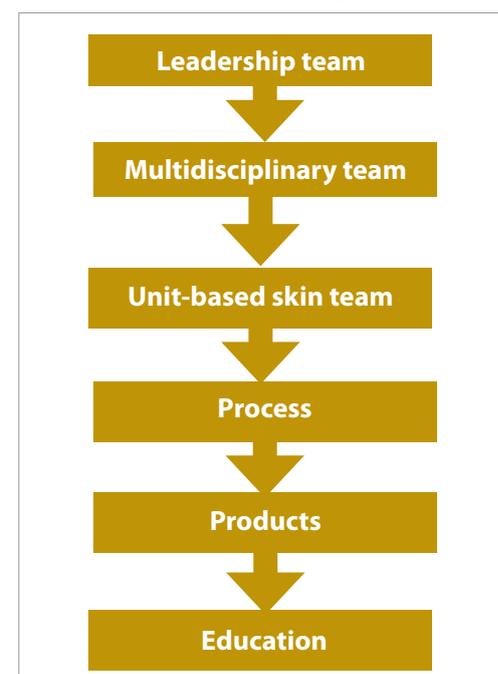


Figure 2. Implementing best practice across the organisation: an organisational approach.



Figure 3. Virginia Commonwealth University (VCU) Medical Center hospital-acquired pressure injury prevalence rates compared to mean USA rates reported in International Pressure Ulcer Prevalence (IPUP) Survey 2010 – 2016 (VCU, 2016).

Keeping current — the role of emerging research

Since the science of PI pathophysiology is still emerging, it is crucial to keep abreast with research and develop programmes that are nimble enough to incorporate new interventions as they come to light.

The current NPUAP, EPUAP and PPPIA Clinical Guideline on the prevention and treatment of PI includes an entire chapter dedicated to emerging therapies in which the use of prophylactic dressings are discussed and recommended (NPUAP, EPUAP and PPPIA, 2014).

Quality and performance improvement processes must be adaptable and flexible so that new guidance can be incorporated and adopted easily to avoid delays.

The cost of prevention: a value analysis

Delivering high-quality care is an investment and prevention comes at a price. Paying for mattresses and prophylactic dressings and compensating staff for meeting time and data collection time — it all costs. But prevention is much less expensive than treatment (Santamaria et al, 2015a).

Value analysis is the concept of allowing equal voice and value for both clinicians and the finance department in the organisation. Care must be taken to ensure that decisions to save money do not mean moving from evidence-based products to cheaper imitations: a move that would negatively impact outcomes.

It is critical that clinicians know the evidence behind a product selection — this is key to successful negotiations at the value analysis table. In using effective prevention methods, money is saved through PI avoidance — a point proven by data from Virginia Commonwealth University (VCU) Medical Center (Richmond, VA, USA) that Sue shared with the audience, which show a substantial reduction in PI prevalence rates at the facility over the period from 2010 to

2016, below the national benchmark for other academic medical centres in the USA [Figure 3]. Sue also revealed a continued downward trend by reporting a prevalence rate of 1.09% for 2017.

Changing practice

The evidence strongly supports the use of prophylactic dressings to reduce the risk of PI. The key challenge in prevention is to ensure changes are implemented into routine clinical practice as Sue detailed; sentiments echoed by the symposium's second speaker, Nick Santamaria.

Nick emphasised that organisations must be able to show the need for change (i.e. incidence and prevalence of PIs within a facility), the effectiveness of proposed interventions (only clinically proven prophylactic dressings will ensure expected clinical and financial outcomes; it would be wrong to assume that all dressings will show the same results) and any savings that might result from the change. They must also have a clear plan for implementation, covering staff education, infrastructure support, and organisation-wide monitoring and evaluation.

Nick went on to describe the implementation of a five-year PI prevention project at The Royal Melbourne Hospital (RMH) in Australia which resulted in the prevalence of hospital-acquired PIs decreasing from 6.6% in 2010 to 2.5% in 2014 (Santamaria et al, 2015b). Surveys also revealed the following:

- The sacrum and heels are the most common PI sites
- There was poor documentation of risk assessment and PI development
- There was variable PI prevention practice across the emergency department (ED), OR and onwards.

Transformation of hospital policy was needed so the following changes were introduced, supporting a decrease in PI numbers and prevalence (Santamaria et al, 2015b):

- All patients assessed as 'high risk' for PI development, and patients with peripheral vascular disease, neuropathic/neuroischaemic foot disease or having major surgery, had Mepilex Border Sacrum/Heel dressings applied on admission
 - All patients had a risk assessment undertaken and documented within 4 hours of admission
 - Appropriate interventions based on risk level were implemented and documented:
 - Repositioning schedule
 - Surfaces
 - Referrals
 - Mandatory education was implemented for all clinical staff, including annual online training relating to PI prevention
 - Every ward had an allocated wound resource nurse who assessed whether the policy was being adequately implemented
 - Communications were colour-coded orange to match national policy and a local PI prevention slogan was developed (Check, Detect, Act), which was used in all PI prevention documents
 - Adhesive labels were added to patient histories to support clinical coders.
- The strategy was underpinned by policy change: change in education, wound nurse

resourcing and monthly reporting. All clinical staff and clinical coders were educated on the benefits of the new strategy and use of Mepilex Border dressings in PI prevention. Online education remains an annual requirement for all staff at RMH and current uptake is 100%.

In each clinical area, wound nurse resource was harnessed to promote the new policy. Some 70 registered nurses across clinical areas:

- Completed five Wounds West online modules and RMH education
- Were responsible for education and support of the ward in all aspects of wound management and PI prevention
- Conducted monthly PI policy adherence audits
- Designed local support/activities to match characteristics of the clinical area and patient population
- Were supported by wound clinical nurse consultants.

Nick stressed that clinicians should demand evidence to change practices and influence budget holders, finance managers and payers.

Effectiveness of dressings

A randomised controlled trial (RCT) (Santamaria et al, 2015c) and a cost/benefit

Table 1. Cost benefits of Mepilex® Border/Heel dressings in the prevention of hospital-acquired pressure injuries (Santamaria et al, 2015a).

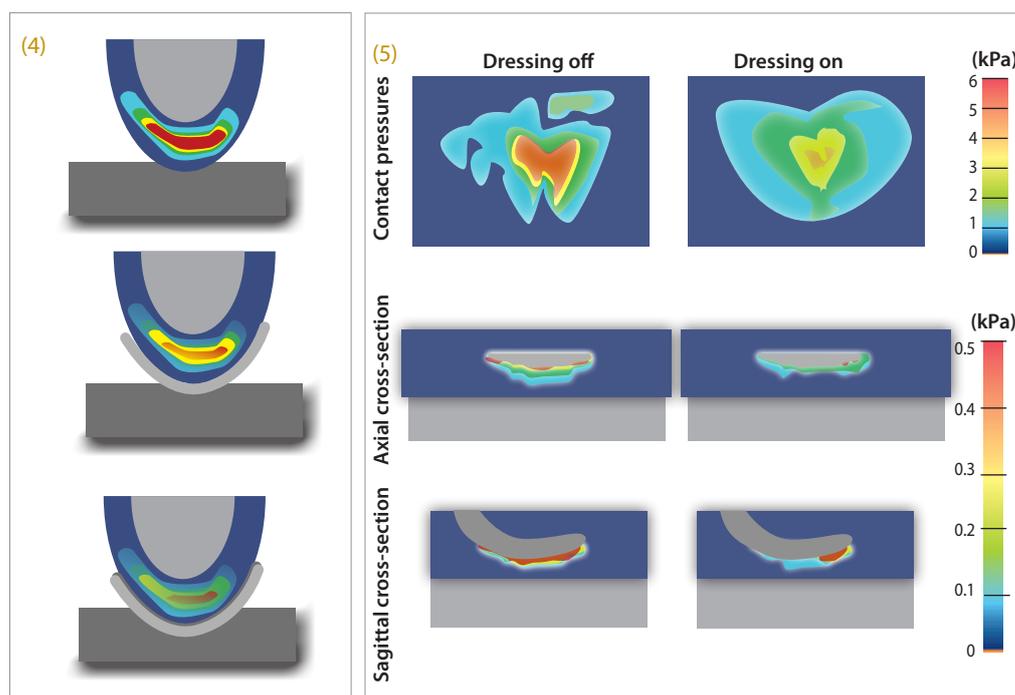
Cost components	Control (n=152)	Intervention (n=161)
Average treatment costs per PI	\$1,103.52	\$1,103.52
Weighted average treatment cost	\$144.56	\$34.21
Average marginal costs	—	\$36.61
Total average costs per patient	\$144.56	\$70.82
Total costs per group	\$25,173.20	\$6,920.20

Table 2. Clinical evidence in support of Mepilex® Border dressings for pressure injury prevention (ED, emergency department; ICU, intensive care unit; OR, operating room; PI, pressure injury; RCTs, randomised controlled trials).

Guidelines	<i>Prevention and Treatment of Pressure Ulcers: Clinical Practice Guideline</i> states: "Consider applying a polyurethane foam dressing to bony prominences (e.g. heels, sacrum) for the prevention of [PI] in anatomical areas frequently subjected to friction and shear. However, there is a lack of clarity around dressing structure, not all cited studies evaluated polyurethane foam, and many such dressings are available. It is vital to know how dressings work and if they can reduce pressure / shear and influence microclimate, focusing on available evidence. Moreover, prophylactic dressings should be used in addition to (not instead of) standard preventive measures". (NPUAP, EPUAP, PPIA, 2014).
Systematic reviews	Moore and Webster (2013) show the use of prophylactic dressings over bony prominences reduced the relative risk of PIs by 0.21 ($p=0.0006$). Clark et al (2014) reported similar results. More evidence is needed on quality of life and comparison between different dressings.
RCTs	Results from three RCTs showed just 6 of 371 patients assigned to the Mepilex Border dressing developed PIs, compared with 30 of 361 patients who were not assigned to the dressing (Santamaria et al, 2015c [ED/ICU]; Kalowes et al, 2016 [ICU]; Quili and Qiongyu, 2010 [acute care]).
Non-RCTs (with concurrent controls)	Results from six non-RCTs with concurrent controls (in ICU or general care) showed 6 of 137 patients assigned to the Mepilex Border dressing developed PIs, while 67 of 392 patients not assigned to dressings developed PIs (Thul et al, 2015 [ICU]; Park, 2014 [ICU]; Brindle and Wegelin, 2012 [OR/ICU]; Cubit et al, 2012 [acute medical care]; Brindle, 2010 [ICU]; Castelino et al, 2012 [ICU]).
Non-RCTs (without concurrent controls)	21 studies, predominantly involving patients in ICU (Davies, 2016).

Figure 4. Comparison of states of mechanical loading in the soft tissue of the heel on a 63kPa support (no dressing versus single-layer foam dressing versus multi-layer Mepilex® Border Heel) (Levy et al, 2015).

Figure 5. Comparison of states of mechanical loading in the soft tissue of the buttocks on a 63kPa support (no dressing versus multi-layer Mepilex® Border Sacrum) (Levy et al, 2017).



analysis (Santamaria et al, 2015a) of the use of Mepilex Border/Mepilex Heel dressings were undertaken as part of the prevention project at the University Hospital in Melbourne. In the RCT, 440 patients admitted to the intensive care unit (ICU) were randomised in the ED to either an intervention group that had Mepilex Border and Mepilex Heel applied to the sacrum and heels plus standard PI preventive measures or a control group that received just standard preventive measures. There were significantly fewer patients with PIs in the intervention group ($p=0.001$), representing a substantial difference in incidence between the two groups (3.1% versus 13.1%) (Santamaria et al, 2015c). The findings of the cost/benefit analysis, based on the data generated from the RCT, demonstrate that the use of Mepilex Border/Heel dressings for the prevention of PIs results in cost savings in the acute care setting [Table 1] (Santamaria et al, 2015a).

The results of the RCT and cost/benefit analysis provided the implementation team with strong evidence to support the addition of Mepilex Border Sacrum/Heel dressings to the PI prevention protocol.

More than 60 pieces of evidence, including three describing RCTs, refer to reductions in PI rates associated with the use of Mepilex Border dressings [Table 2]. Furthermore, economic analyses demonstrate the cost-effectiveness of using Mepilex Border dressings as a component of PI prevention strategies.

Mode of action of dressings

The scientific rationale for using Mepilex Border dressings was presented by Amit Gefen who explained the role of finite element modelling (FEM) in calculating internal mechanical loads (e.g. tissue deformations) in structures with complex shapes and multiple materials (Levy et al, 2015).

He went on to explain that, since most serious PIs are deep tissue injuries that develop internally, FEM can be used to create a map of how mechanical forces develop in the tissues, with mattresses and dressings added to represent real-world scenarios.

FEM reveals what is not always immediately obvious to the naked eye. The technology allows the ability to:

- Scan the vulnerable site
- Capture accurate anatomy
- Visualise the impact of using a prophylactic dressing and its effectiveness in reducing mechanical loads.

FEM has been used extensively across different medical fields, including recently examining the efficacy of multi-layer Mepilex Border dressings. For example, the compressive strain and maximal shear in the soft tissues of the heel were evaluated in both the presence and absence of a prophylactic Mepilex Border Heel dressing (Levy et al, 2015). With the dressing in place, internal mechanical loads were reduced substantially, including shear in the deep tissues. In comparison, individual pieces of foam cannot provide the same level of

Figure 6. Comparison of states of mechanical loading in the soft tissue of the buttocks on a 63kPa support (anisotropic Mepilex® Border Sacrum dressing versus isotropic dressing versus completely stiff dressing) (Levy et al, 2017).

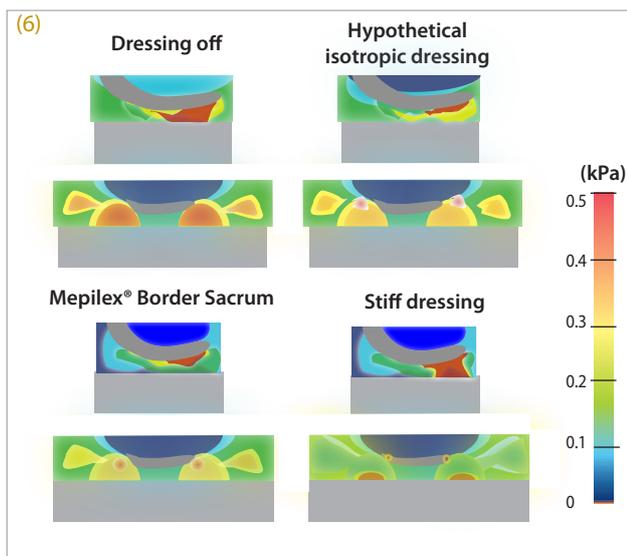
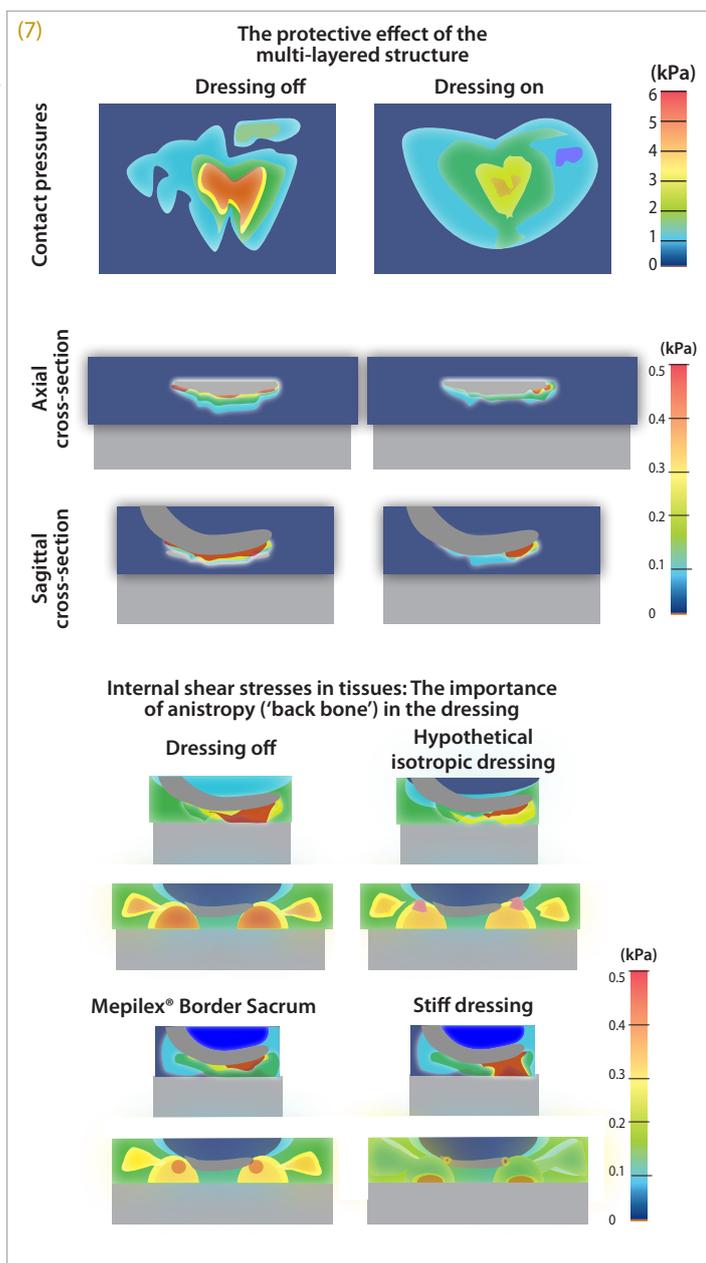


Figure 7. Modelling the Mepilex® Border Sacrum.



efficacy; the multi-layer structure of Mepilex Border Heel allows the shear (deformation) to be taken by the dressing rather than the tissue, which does not happen with a single-layer dressing [Figure 4].

The effect of Mepilex Border Sacrum on the soft tissues of the buttocks has been evaluated in a similar fashion. Findings to date are consistent with those reported for Mepilex Border Heel [Figure 5] (Levy et al, 2017).

Amit stated that the superior performance of Mepilex Border Sacrum over other prophylactic dressings can be attributed to its anisotropic properties, which allow the dressing to be more compliant in the lateral (buttock cheeks) direction than in the axial (spine) direction. Further FEM to evaluate the effects of different prophylactic dressings when used during supine lying on a standard foam mattress has shown that the anisotropic Mepilex Border Sacrum dressing decreases the exposure of the soft tissue to strain and shear forces more so than an isotropic dressing and a completely stiff dressing [Figure 6].

Amit explained that evidence for Mepilex Border dressings is not transferable to other products as the composition and structure of dressings vary considerably. "Only the use of clinically proven dressing interfaces will ensure expected clinical and financial outcomes. It would be wrong to assume that all dressings have the same level of efficacy," he said.

Responding to this, Nick Santamaria pointed out a number of factors that need to be taken into consideration when reviewing clinical studies of prophylactic dressings, including:

- Importance of wear time
- Inappropriateness of informal evaluations with short follow-up times
- Use of questionable methodology.

Role of positioners in PI prevention

Amit went on to describe to the audience the benefits of positioners as part of the PI prevention programme.

Repositioning of an individual is undertaken to reduce the duration and magnitude of pressure over vulnerable areas of the body and to contribute to comfort, hygiene, dignity and functional ability.

Positioners are designed to:

1. Maintain effective positioning and alignment. International Guidelines state, "When choosing a particular position for the individual, it is important to assess whether the pressure is actually relieved or redistributed."
2. Provide comfort.



Figure 8. Mölnlycke® Z-Flo™ Fluidised Positioner.



Figure 9. Mölnlycke® Tortoise™ Turning and Positioning system.

3. Avoid causing additional pressure.
4. Be user friendly/cost effective (return on investment).

Sue then told the audience of her own experience of using positioners at VCU; the resistance among staff to implementing new processes and the results of adopting a new strategy to reduce PIs.

Monthly prevalence data collection within Sue's organisation demonstrated that there was a problem with PI in the OR. Sue explained how, when she first approached the OR to discuss the use of positioners to reduce PIs, she got the cold shoulder: "PI prevention is not what we do here!" she was told. "We are busy performing complex procedures, stabilising patients and moving them out to the unit. Time is of the essence and PIs are not our focus," they said.

In 2012, VCU reported six (five adults, one child) occipital PIs resulting from prolonged OR procedures. All cases required plastic surgery consultation and healing by secondary intention, which led to alopecia. Although the anaesthesiology team rotated the patients' heads every 20 minutes using folded towels as a head pillow during surgery, this was not enough to relieve the pressure on the area.

Following a period of research into potential solutions to this problem, the decision was taken to implement the use of the Mölnlycke® Z-Flo™ Fluidised Positioner (Visscher et al, 2013) [Figure 8] in the OR. Since using the Mölnlycke Z-Flo Positioners, VCU has had no additional OR-related occipital PIs since 2013. Other prevention

interventions were also implemented as part of VCU's action plan to reduce hospital-acquired PIs. These included:

1. Pre-op/post-op positioning.
2. New OR table mattresses.
3. Float heels.
4. Anatomically appropriate prophylactic dressings.
5. Anaesthesia practice change — occipital offloading.
6. Positioners.
7. Use of appropriate bariatric equipment.
8. Handoff communication.
9. Staff education.

By changing the clinician experience, beliefs were changed and so were behaviours – in combination this resulted in significantly improved outcomes. As a result, in 2016 less than 5% of hospital-acquired PIs were linked to the ORs at VCU.

Positioning for better outcomes

Closing the symposium via a video link, Chenel Trevellini echoed the sentiments of her fellow speakers and was quick to reiterate the fundamental role that repositioning strategies play in the success of any PI programme.

Turning and positioning patients is a key component in PI prevention strategies, but this may result in repetitive injury to caregivers. Decreasing nursing workforce numbers and increased patient BMI are both key reasons, alongside PI reduction itself, for robust repositioning strategies, she said.

Chenel stressed the importance of offering caregivers a method of turning and positioning patients that maximises ergonomic efficiency and promotes proper body mechanics. She described how a 300+ bed acute care hospital identified patient-lifting-related staff injuries as a key problem. In 2012, there were 85 incidents related to patient handling, 31 involving workers' compensation claims.

In January 2013, the Mölnlycke® Tortoise™ Turning and Positioning system [Figure 9] was successfully piloted, then implemented across inpatient units. In 2013, incidents and claims related to patient handling were reduced by 55% compared with 2012, resulting in approximately \$222k cost avoidance. The 2013 bed rental usage was decreased by 66% compared with 2012, resulting in \$58k cost savings. This \$42k investment successfully reduced patient handling injuries (Trevellini, 2016).

Conclusion

Evidence for the effectiveness and efficacy of PI prevention strategies, including the use of multi-layer foam (e.g. prophylactic Mepilex Border) dressings, positioners and turning systems, continues to grow. As this evidence builds, clinicians are being given the data they need to change current protocol to minimise incidence and prevalence of PI, and to secure much-needed resources for prevention programmes.

Prevention strategies undoubtedly require increased upfront investment whether for dressings, equipment, resources and/or change management programmes to realign current prevention protocol or to develop new ones. However, as figures here suggest (Santamaria et al, 2015a) in the medium and longer term, such measures reduce cost significantly at the same time as improving patient outcomes and quality of life.

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Declaration

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References

- Brindle CT (2010) Outliers to the Braden Scale: identifying high-risk ICU patients and the results of prophylactic dressing use. *World Council of Enterostomal Therapists Journal* 30(1): 11–8
- Brindle CT, Wegelin JA (2012) Prophylactic dressing application to reduce pressure ulcer formation in cardiac surgery patients. *J Wound Ostomy Continence Nurs* 39(2): 133–42
- Castelino I, Mercer D, Callard JF (2012) *Reducing peri-operative pressure ulcers in thoracic, cardiovascular, and spinal surgery patients: achieving zero incidence is possible!* Presented at: The Symposium on Advanced Wound Care (Spring) (Poster). Atlanta, GA, USA, 2012
- Clark M, Black J, Alves P et al (2014) Systematic review of the use of prophylactic dressings in the prevention of pressure ulcers. *Int Wound J* 11 (5): 460–71
- Cubit K, McNally B, Lopez V (2012) Taking the pressure off in the Emergency Department: evaluation of the prophylactic application of a low shear, soft silicon sacral dressing on high risk medical patients. *Int Wound J* 10(5): 579–84
- Davies P (2016) Role of multi-layer foam dressings with Safetac in the prevention of pressure ulcers: a review of the clinical and scientific data. *J Wound Care* 25(1): S1–S24
- Hibbs PJ (1988) *Economic benefits of a prevention plan for pressure sores*. Presentation at: 4th National Pressure Sore Symposium. Bath, United Kingdom
- Hibbs PJ (1998) The past politics of pressure sores. *J Tissue Viability* 8(4): 14–5
- Kalowes P, Messina V, Li M (2016) Five-layered soft silicone foam dressing to prevent pressure ulcers in the intensive care unit. *Am J Crit Care* 25(6): e108–e119
- Levy A, Ben-Or Frank M, Gefen A (2015) The biomechanical efficacy of dressings in preventing heel ulcers. *J Tissue Viability* 24(1): 1–11
- Levy A, Schwartz D, Gefen A (2017) *Multilayered prophylactic dressings are biomechanically effective provided that they are adequately designed*. Presented at: European Wound Management Association Conference (E-poster). Amsterdam, Netherlands, 3–5 May 2017
- Moore ZE, Webster J (2013) Dressings and topical agents for preventing pressure ulcers. *Cochrane Database Syst Rev* 18(8): CD009362
- National Pressure Ulcer Advisory Panel (NPUAP), European Pressure Ulcer Advisory Panel (EPUAP) and Pan Pacific Pressure Injury Alliance (PPPIA). *Prevention and Treatment of Pressure Ulcers: Clinical Practice Guideline*. Haesler E, ed. Cambridge Media: Perth, Australia, 2014
- Park KH (2014) The effect of a silicone border foam dressing for prevention of pressure ulcers and incontinence-associated dermatitis in intensive care unit patients. *J Wound Ostomy Continence Nurs* 41(5): 424–9
- Qiul B, Qiongyu J (2010) Observation on effect of Mepilex on the prevention and treatment of pressure sores. *Chinese J Med Nurs*
- Santamaria N, Liu W, Gerdtz M et al (2015a) The cost-benefit of using soft silicone multilayered foam dressings to prevent sacral and heel pressure ulcers in trauma and critically ill patients: a within-trial analysis of the Border Trial. *Int Wound J* 12(3): 344–50
- Santamaria N, O'Neil S, McCann J et al (2015b) Clinical innovation: results from a five-year pressure ulcer prevention project in an Australian university hospital. *Wounds Int* 6 (3): 6–10
- Santamaria N, Gerdtz M, Sage S et al (2015c) A randomized controlled trial of the effectiveness of soft silicone multilayered foam dressings in the prevention of sacral and heel pressure ulcers in trauma and critically ill patients: the border trial. *Int Wound J* 12(3): 302–8
- Thul J, Valero E (2015) *Sacral pressure ulcer prevention in trauma patients*. Presented at: Wound Ostomy and Continence Nurses' Society Conference (poster), San Antonio, TX, USA, 6–10 June
- Trevellini C (2016) *Position for better outcomes with new fluidized technology*. Oral presentation at: Wound Ostomy and Continence Nurses' Society Conference. Montreal, Canada, 4–8 June
- Virginia Commonwealth University. Date on file. 2016
- Visscher M, King A, Nie AM et al (2013) A quality-improvement collaborative project to reduce pressure ulcers in PICUs. *Pediatr* 131(6): e1950–e1960
- World Union of Wound Healing Societies (WUWHS) Consensus Document. Role of dressings in pressure ulcer prevention. *Wounds International*, 2016. Available at: <http://www.woundsinternational.com/wuwhs/view/consensus-document-role-of-dressings-in-pressure-ulcer-prevention> (accessed 04.07.2017)