

# Real-world evidence from a large-scale multisite evaluation of a hybrid mattress

## KEY WORDS

- ▶ Dyna-Form® Mercury Advance
- ▶ Hybrid mattress
- ▶ Pressure ulcers
- ▶ Real-world review

Preventing pressure ulcers in an acute hospital setting is a complex activity. The multiple comorbidities and increased acuity of the at risk patient result in many conflicting care priorities and the current changes in healthcare provision make delivering high quality, evidence-based care challenging. Within the field of pressure ulcer prevention, high level randomised controlled trials are difficult to undertake; an alternative to the prospective RCT is a real world review, in this case a retrospective analysis of the incidence of pressure ulcer occurrence pre and post implementation of a powered hybrid mattress the Dyna-Form® Mercury Advance (Direct Healthcare Services). This is the first review of this scale which examines the implementation of one technology and the impact that this has had on pressure ulcer occurrence, use of clinical resources and operational effectiveness. While it is acknowledged that the provision of specialist equipment forms only one part of pressure ulcer prevention, the size and number of sites included suggest that the equipment implementation — which is the constant — has played a significant role in driving down the number and severity of pressure ulcers.

Preventing pressure ulcers (PUs) in an acute hospital setting is a complex activity. It clearly sits within the definition of implementing complex care to a complex group of patients in a complex setting (Raine et al, 2016). The multiple comorbidities and increased acuity of the at risk patient result in many conflicting care priorities. In addition there are many changes in healthcare provision. Healthcare services are constantly adapting and evolving to meet changes in demand driven by demography, disease, evidence and lifestyles. Changes in available capacity as workforce supply, capability, regulation and expectations change (NHS Scotland, 2011) makes delivering care in a standard way challenging. In itself delivering evidence based PU prevention is complicated as high level randomised controlled trials (RCTs) are difficult to achieve requiring significant numbers of patients and long time scales — in an area where technology changes rapidly this is frequently not a viable option.

An alternative to the prospective RCT is to consider a real world review, in this case a

retrospective analysis of the incidence of PU occurrence pre and post implementation of a powered hybrid mattress. The scale of the review – eight hospitals and over 650,000 patient admissions coupled with the rigorous improvement methodology gives significance to the result of overall reduction in the number of PUs of 56% (a 93% reduction in incidence) across the reference sites. This is the first review of this scale that examines the impact of implementation of one technology and the impact that this has had on PU occurrence. Whilst it is acknowledged that the provision of specialist equipment forms only one part of PU prevention, the size and number of sites included suggest that the equipment implementation (which is the constant) has played a significant role in driving down the number and severity of PUs.

## BACKGROUND INFORMATION

Across the UK strategic documents (NHS Scotland, 2014; NHS Wales, 2014; Department of Health [DH], 2016) emphasise the importance

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of ensuring staff are not losing clinical time performing unnecessary tasks and are allowed to concentrate on delivering high quality evidence based care.

The Carter Report (DH, 2016) clearly states that an achievable goal of all NHS England Trusts should be to improve operational activity whilst improving patient care. Furthermore, the Triple Aim first put forward in the Five Year Forward View (NHS England, 2014) focuses on how high quality care is intimately related to better use of resources (including both staff and equipment) which will result in a better patient experience and ultimately lead to better outcomes. NHS Scotland (2014) emphasise that quality initiatives should ensure that clinical decision making takes precedence over short-term financial gains or achievement of targets. These initiatives jointly emphasise that prudently applied high quality care will result in better clinical and cost outcomes.

Staff working in the field of PU prevention are facing the simultaneous challenge of heightened awareness of PUs and therefore an increased drive to prevent their occurrence whilst at the same time being required to both evidence their use of high value preventative equipment and reduce the related spend. Despite intensive investment and activity many organisations have now reached a plateau in the PU figures with little or no improvement being seen in the last 12 months (NHS Digital, 2016).

A previous study (Jones and Tite, 2013) on the supply of support surfaces to patients highlighted the complexity of the process. Whilst patients were risk assessed and the support surface ordered and delivered in a timely way, the main crux of the intervention – placing the equipment under the patient – was frequently delayed leaving the patient at risk of pressure ulceration and therefore the staff at risk of litigation. They concluded that earlier intervention had a major impact on clinical outcomes, and that delays in getting equipment to patients was a significant factor in harm occurring, something that has been highlighted in many organisations’ RCA reviews (Greenwood and McGinnis, 2016).

There are currently no large scale studies identifying if hybrid mattresses perform effectively as part of a PU prevention strategy. Performing a large randomised controlled trial of mattresses is widely acknowledged to be difficult due to the massive variation in the patient population alongside the complexity of the myriad other interventions involved in a PU prevention strategy. Therefore, in order to evaluate the impact of hybrid mattresses in daily clinical practice, a large-scale review of sites that have implemented the solution was proposed.

**METHODOLOGY**

This study is a large-scale multi-centre retrospective evaluation of the implementation of powered hybrid mattresses across 8 acute trusts in England. The sites have approximately ¾ (75.8%) of their beds using the powered hybrid (Box 1).

Data relating to new PU occurrence and monthly admissions for 6 months prior to hybrid installation (as a baseline measure) and then a minimum of 6 months post installation was examined. A standard PU reporting format was used.

The PU occurrence data for each site was analysed and plotted on an SPC chart (Box 2). As there were varying hybrid implementation dates in order to effectively align the data for a standardised view, data were configured against a week 0 – implementation with a standard 6 month pre- and post view.

**Box 1. The Dyna-Form® Mercury Advance**

Consisting of a series of foam and air cells, the Dyna-Form® Mercury Advance is a powered hybrid mattress replacement system. The attachment of the pump effectively provides a layer of alternating cells above the foam. This allows the patient to be upgraded from a high specification foam replacement to an alternating mattress simply by attaching the pump (Fletcher et al, 2015).



The Tissue Viability Nurse Specialist from each Trust provided information on the real life challenges and experiences of implementing the powered hybrid solution. They identified additional strategies implemented alongside the powered hybrids and the time line so that this could also be mapped against their PU data.

**RESULTS**

Across the eight sites totalling 5,580 beds, 4,230 hybrid mattresses have been installed (most sites retained their alternating mattresses in Intensive Care). All organisations ran a variety of initiatives including education and awareness days alongside the hybrid implementation.

**REAL LIFE CHALLENGES IMPACTING CARE DELIVERY**

The TVN interviews gave insight into the real life challenges and behaviours impacting every day care delivery. All identified that whilst some of the challenges related to behaviours of clinical staff, e.g. holding on to equipment ‘just in case’ or not stepping patients down as their condition improves, the majority of the issues related to processes and organisational behaviours or constraints (Box 3).

**IMPROVING CLINICAL OUTCOMES: PU OCCURRENCE**

Not all sites were able to provide all of the required data over the minimum 12 month time period, therefore SPC analysis was performed across the five sites that were able to provide robust data over the minimum required time period.

Figure 1 shows the combined result post-implementation from the five sites. The analysis presents an overall reduction of 56% (t-test result  $p < 0.001$ ) in the number of pressure ulcers for the 6 months immediately post installation. The combined result represents a throughput of 165,993 admissions over post installation period. The 56% reduction equates to a 93% reduction in the incidence rates. This change is not only significant but, as can be seen in the data, it has been sustained.

It was identified that the TVNs believed the size and severity of the PU had reduced, furthermore two of the TVNs believed that

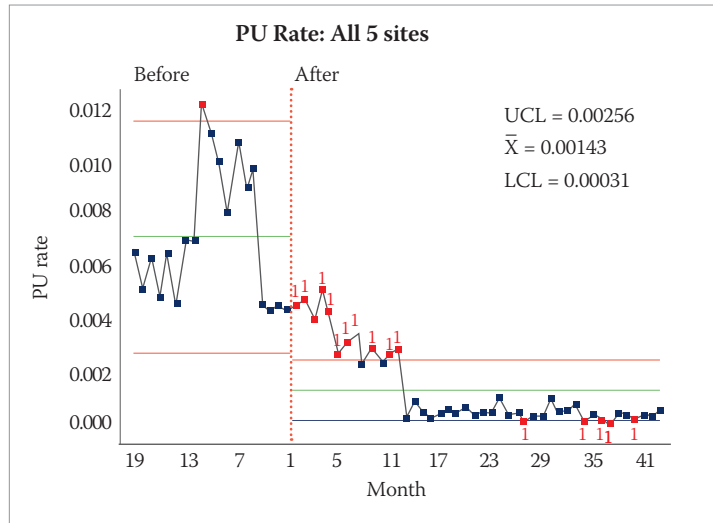


Figure 1. Summary of the improvement across the five sites

**Box 2. Statistical Process Control explained**

Walter Shewart created PDSA (Plan, Do, Study & Act) cycles and SPC (Statistical Process Control) in 1931. SPC charts allow the user to plot data over time determining common and special cause variation. SPC calculates the upper and lower control limits on an SPC chart from the variation within the data. Using some simple ‘rules’ users can link PDSAs (changes) to improvement. The most commonly used rule to spot improvement is a run of 7 consecutive data points all above or below the average (the chance of this happening by chance is 1 in 128).

**Box 3. Challenges identified by the TVNs**

- ▶ Changes to make up of work force, with increasing number of overseas nurses who do not have English as a first language and who trained and worked in systems that operate differently to the UK system
- ▶ Reduction in actual nursing numbers
- ▶ An ongoing strategic focus on reduction of PU
- ▶ A plateau in the number of pressure ulcers
- ▶ Increased complexity of general patient care related to demographic changes
- ▶ Increased complexity of care delivery and choice of equipment
- ▶ Absence of high level evidence to aid in selection of pressure ulcer prevention equipment
- ▶ High levels of documentation and administration take clinical time away from care delivery
- ▶ Spend on equipment escalating — with no obvious patient benefits (defined by using a standard measure).

deterioration of PU admitted to hospital appeared much less. One TVN felt that even category IV PU had progressed whilst on the hybrid systems.

**COST SAVINGS**

All Trusts generated significant cost savings as a direct result of reductions in Alternating Pressure Air Mattresses (APAM) rentals. These costs resulted from reduction in the use of APAMs (Example 1) reduction in the administration of rental/leased systems (Example 2) and changes to patient pathways (Example 3).

**Example 1**

One Trust funded purchase of their hybrid mattress by investing the money they would have spent on APAMS in the following 12 months. They have had hybrids installed for 20 months with no additional need to hire APAMs therefore have effectively accrued cost savings equivalent to 8 months APAM rental.

The Trust project savings of £117,126.41 in the first year and £699,241 by December 2018.

**Example 2**

Two Trusts were able to redeploy human resource from the task of equipment management to other clinical support areas in need of resource following implementation of the hybrid system. For one Trust this represented a cost within the equipment budget of £30,000 per annum that was able to be more effectively re-allocated.

**Example 3**

One organisation reported a significant cost saving through the reduction in the use of APAMs, particularly in specific subgroups such as patients with a fractured neck of femur. For these patients a high specification-alternating mattress was part of the care pathway; since implementation of the hybrids no APAMs have been utilised and the PU incidence has reduced. Over 12 months this equated to 889 patients staying 8,022 patient-days at a cost of £5.75 per day for the hire of an APAM, resulting in a saving of £46,000.

Achieving a real a reduction in PU occurrence

also has implications for significant cost savings to be realised related to treatment costs and patient length of stay. The National Institute for Health and Care Excellence (NICE) costing statement for PUs (NICE, 2014) suggests that by reducing the incidence of PUs, commissioners could make savings from a reduction in excess bed day payments to hospitals where patients' length of stay exceeds the Healthcare Resource Group trim point. They state that patients with PUs stay in hospital an average of 5–8 days longer than other patients. The average per day payments for days exceeding the trim point is £236 (national tariff, 2014–15). Based on the data from one Trust in the study that showed a sustained reduction of 20 PUs per month this would equate to a saving of 100–160 bed days per month and £23,600–£37,760 per month (£283,200–£453,120 per annum). There would also be cost savings from the associated treatment costs — dressings, antibiotics etc as well as the release of more nursing time back to care.

**OPTIMISING CLINICAL RESOURCES: EQUIPMENT AVAILABILITY AND REDUCED ADMINISTRATION**

All organisations reported that the availability of appropriate equipment was no longer a recurring theme in their root cause analysis.

All organisations also reported consistent feedback on the ease of equipment availability and the related benefits of this in terms of delivering more responsive patient care and releasing nursing time to care (Example 4). These benefits include reducing the delays and complexity of obtaining equipment and a reduction in days-usage lost for service, maintenance and repair (Example 5).

**Example 4**

One Trust had a contract for APAM supply with the provider delivering to the site 3 times per week. Stock availability was often an issue and even when mattresses were available and in stock it usually took half a day from order to the mattress being underneath the patient. A dynamic patient population meant the equipment lists were often inaccurate so even if a request had been submitted, ward staff had to repeat and chase the request on the pre-

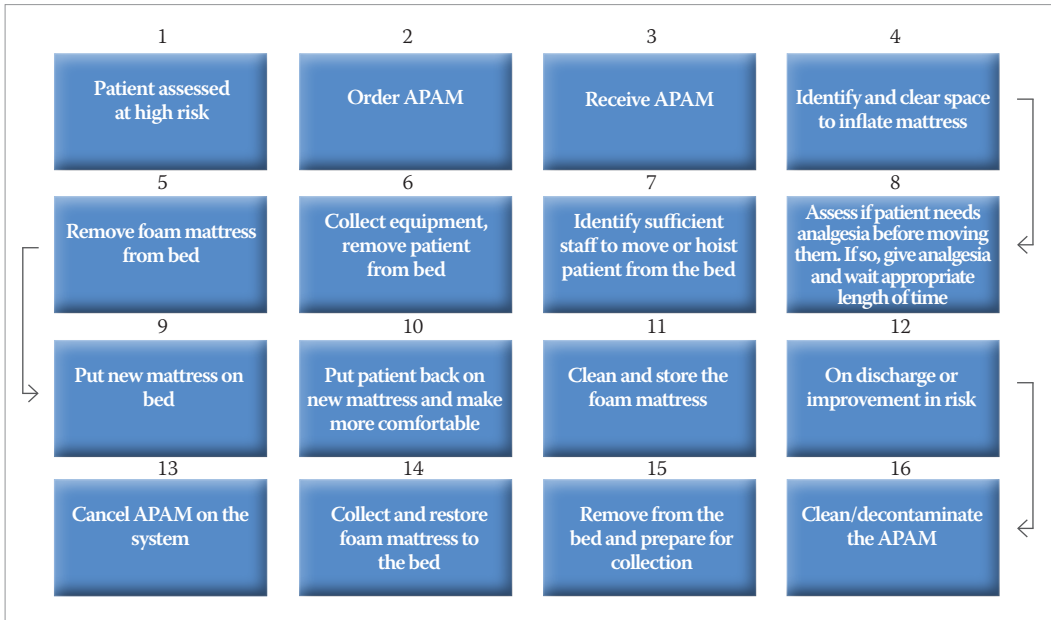


Figure 2a. Typical ordering process prior to use of hybrids as outlined in TVN interviews



Figure 2b. Ordering process after implementation of hybrids

planned delivery days. The implementation of the Dyna-Form® Mercury Advance eliminated all the delays associated with this process and dramatically reduced the administrative burden.

**Example 5**

The medical physics teams in several of the hospitals reported that far less equipment was held out of circulation with the hybrids as if a power unit required servicing or repair a spare unit could simply be used, or the mattress could simply be used in the non-powered mode. Previously if the power unit for an APAM required servicing or repair the whole mattress had to be removed from the clinical area.

**QUALITY AND EFFICIENCY ACROSS PATIENT PATHWAYS: SIMPLIFICATION OF PROCESSES**

All organisations were able to simplify their mattress selection criteria, for example one organisation reduced the protocol from 4 pages

of A4, to 1 page of A 4, making decision making much simpler for staff and also reducing the likelihood of inappropriate use of equipment.

In addition to the ease of upgrading the mattress to an APAM the use of hybrids simplified the mattress selection process removing layers of decision making from challenged ward level clinicians (Figure 2a and b)

Staff also noted the reduced amount of storage space used as they only needed to store spare power units and not whole mattresses. In addition there was a considerable time saving identified as should the patient’s risk increase and the mattress need to be upgraded to a powered system, because they remained on the same mattress not only was the time transferring the patient saved but also the time cleaning, decontaminating and at the end of the process returning the mattress (Figures 2a and 2b)

**A STEP CHANGE IN CARE DELIVERY**

During the period post implementation across

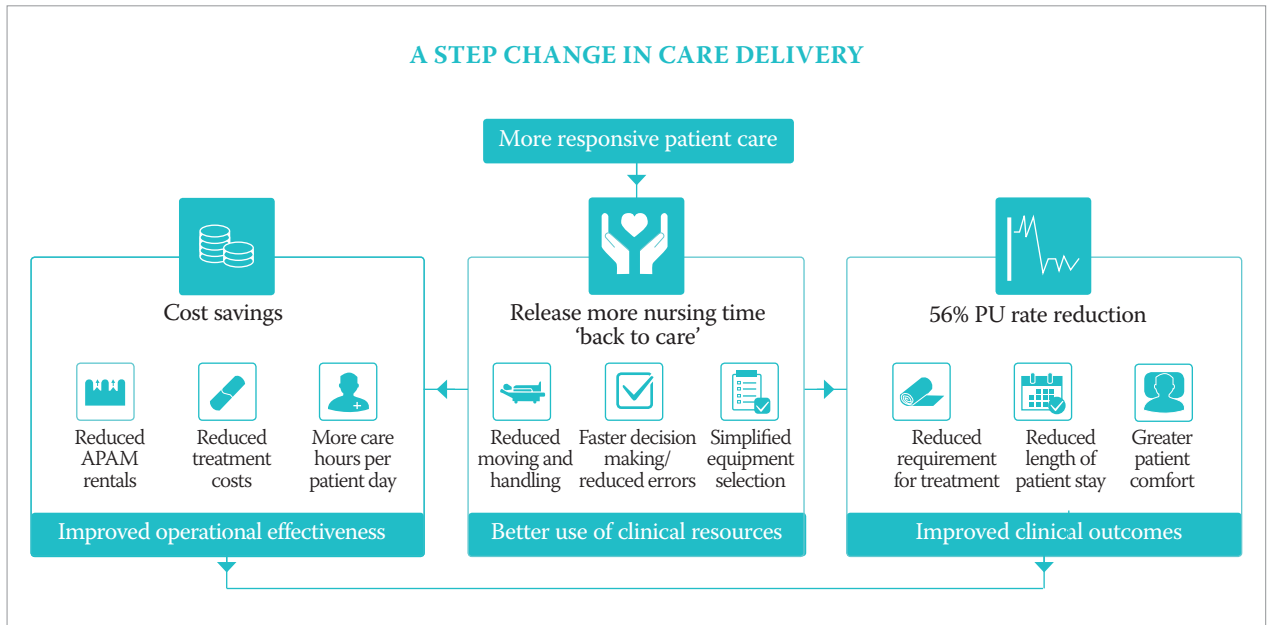


Figure 1. Summarising the improvements achieved

the 8 sites there have been a total of 650,260 patients admitted. With 75% coverage of beds with hybrid mattresses in place, this represents a significant number of patients being cared for on the system.

Following implementation of the powered hybrids, the data demonstrates a clear improvement in the number of PUs alongside this reduction the TVNs believed there was a reduction in the severity of damage occurring. Alongside this improvement all organisations have demonstrated better use of clinical resources that has resulted in both significant cost savings and improved operational effectiveness (Figure 3).

**DISCUSSION**

One of the key challenges in evaluating a complex multifaceted intervention such as PU prevention is the observation that outcomes are often only partially related to any single intervention itself. Contextual factors/processes play a key and often dominant role, it is therefore often impossible to estimate the inherent effectiveness of any single intervention such as the deployment of new equipment owing to the difficulty of separating the intervention from the context in which it is applied (Turner et al, 2016).

However, despite this, the organisations evaluated demonstrated a clear improvement in PU occurrence at a time when many others appear to be plateauing (based on Safety Thermometer data up to April 2016). In addition, observing the broader impact of implementation shows clear and consistent benefits across a multitude of areas including clinical, operational and financial domains.

The impact of the many other interventions put in place by the TVNs also contributed significantly to the improvements made. It seems therefore that the exercise of implementing the powered hybrid mattresses results in a step change in care delivery, focussing as much on the process of care delivery as the individual components.


Removing the complexity of decision making and delays in installation of the mattress ensures that patients receive the right care at the right time leading to better outcomes for the organisation and more importantly the patient. It is only by making these significant step changes that such improvement in outcomes can be both made and sustained. Given the political backdrop against which this care has been delivered and outcomes improved it is suggested that the use of powered hybrids could contribute

to Lord Carter's ideal of delivering best practice across organisations (DH, 2016).

### CONCLUSION

This evaluation represents a real world approach to evaluating large-scale change, whilst acknowledging the multifaceted approach that makes up PU prevention strategies. It differs from traditional PU equipment research in that by looking at a broad range of outcomes in real clinical settings it identifies that a products effectiveness is not just about its clinical efficacy but also its ability to alter the process of PUP/ care delivery.

It is important to note that there were no patients excluded and no research nurses collecting data. This evaluation is based on NHS data generated from the daily care of patients delivered by its nurses, no additional resources were allocated to the implementation projects other than those that would have normally been used. This is a real strength and gives the data generalisability to other organisations. The implementation of this product reflects the commitment to innovation by a small number of specialist nurses who had the vision to see that there was a different, better way and drove the business cases and implementation strategies to deliver it.

This review illustrates that where people are empowered to embrace available innovations it is very possible to deliver improved patient outcomes alongside improved operational effectiveness. It is clear that a powered hybrid mattress (Dyna-Form® Mercury Advance) is effective in part due to its ability to alter the process of PU prevention care delivery. The Carter Report focuses on what a model system should look like and how to identify what 'good' looks like. This evaluation because of its size and scale has been able to look at how staff have implemented massive changes and deliver good care, good processes and good outcomes. 

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