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# Foam mattresses: improving protection

A new, clinically proven, high performance mattress cover

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# Foam mattresses: improving protection

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discusses the steps taken by one Trust, in partnership with industry, to address the issues of poor durability and performance of high-quality foam mattress covers.

The Newcastle-upon-Tyne Hospitals NHS Foundation Trust (NUTH) consists of two main acute hospitals offering regional tertiary care as well as providing community services to the population of Newcastle.

In common with many other Trusts in the UK, in 2010 it highlighted foam mattresses being a risk of infection as the covers allowed ingress of bodily fluid onto the foam. It soon became clear that the yearly mattress audit was no longer sufficient and mattresses were then checked after each patient episode. In response to these issues of poor durability and performance of high-quality foam mattress covers, NUTH started to work alongside industry to develop a new cover material.

Since 2010, a number of different types of cover materials were clinically tested, none of which satisfied the requirement of a cover that could withstand the rigours of acute care with its stringent cleaning regime and continue to offer pressure redistribution. However, since September of 2011, a new type of cover* material was introduced. To date, 270 covers ($n$=270) have been trialled in acute wards and clinical areas throughout the Trust, replacing failed covers. Over this extended period there have been no product failures due to delamination and subsequent fluid ingress.

## Potential risk to patients

The Hospital Infection Society stated that at up to 9% of hospitalised patients are potentially at risk of acquiring an infection related to their hospital stay.[1] This underlined the importance of strict decontamination and cleaning regimes in hospitals which includes all mattresses and therapy beds. When a mattress cover is breached, the inside can very quickly become contaminated following episodes of incontinence, bleeding or any other loss of bodily fluids. Bacteria held within the mattress can multiply and cause infection to the patient laying on it.

Hypochlorites are the most commonly used disinfectants to decontaminate mattresses as they have a broad spectrum of antimicrobial activity and are inexpensive. Concentrations of 1:1000 are used to clean spillages of bodily fluids and, if not rinsed appropriately and then dried, it can cause 'delamination' of mattress covers, which over time, allow for strikethrough of fluids. Mattresses are cleaned in between each patient and, at times, the same mattress could be cleaned three or four times per day – sometimes even more depending on patient turnover.

Manufacturers of mattresses, just like clinicians, were slow to realise the daily assault mattress covers were subjected to from this new decontamination regime. Ironically, the very act of decontaminating mattresses made them porous to bodily fluids, increasing the risks of contaminating patients with infections.

> 'In acute care, a mattress and its cover should last five years and a yearly failure rate of more than 1% should be deemed unacceptable.'

Large amounts of hospital mattresses began to fail due to strikethrough; leaking bodily fluid through the outer cover without the aid of any puncture or obvious traumatic damage, placing patients at risk of cross infection from fluid ingress into the core of the mattresses.[2]

Manufacturers struggled with the amount of complaints and guarantee breaches. A less than open culture among the industry fuelled recrimination and accusations until finally it became clear that it was the change in decontamination practices that had caused the problem.

Unfortunately, the industry was not ready to provide a cover that was fit for the new cleaning regimes. In January 2010, a Medical Device Alert was released (MDA/2010/002) regarding the failing of the covers. The British Healthcare Trades Association (BHTA) responded on behalf of the industry with the recommendations that, if mattresses were to be cleaned with chlorine solution, the solution had to be rinsed off and the cover thoroughly dried.[3] However, this three-stage application is labour intensive and time-constraining, especially given the pressure of an acute ward environment.

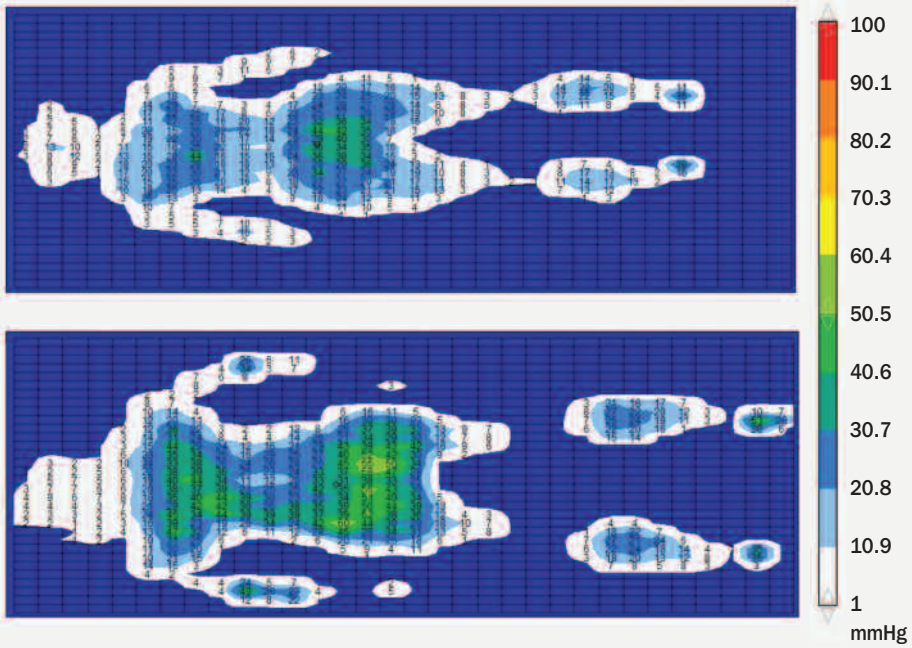
The two main NUTH acute hospitals offer regional tertiary care as well as providing community services to the population of Newcastle. The Trust has over 1,800 beds. Mattresses are replaced if the foam becomes contaminated, otherwise only the cover is replaced.

The Trust had a robust yearly audit and replacement process; as the Medicines and Healthcare products Regulatory Agency (MHRA) guidance (2010) was released, these checks were increased to quarterly intervals. However, as more covers were failing, it became clear that these checks were not sufficient. Since 2011, all foam mattresses are checked after each patient episode, resulting in some mattresses being

**Pressure mapping with Mercury original cover.**

| Female lying down – 56 kg. | |
|---|---|
| Minimum | 0.00 mmHg |
| Maximum | 44.31 mmHg |
| Average | 13.61 mmHg |
| Variance | 98.33 mmHg$^2$ |
| Standard deviation | 9.92 mmHg |
| Coefficient of variation | 72.87 % |
| Horizontal centre | 31.86 cm |
| Vertical centre | 74.76 cm |
| Sensing area | 3,920.34 cm$^2$ |
| Regional distribution | 100.00 % |

| Male lying down – 108 kg. | |
|---|---|
| Minimum | 0.00 mmHg |
| Maximum | 59.98 mmHg |
| Average | 19.14 mmHg |
| Variance | 210.08 mmHg$^2$ |
| Standard deviation | 14.49 mmHg |
| Coefficient of variation | 75.72 % |
| Horizontal centre | 35.85 cm |
| Vertical centre | 79.20 cm |
| Sensing area | 4,575.83 cm$^2$ |




checked up to five times per day. This was unsustainable and a better quality cover was required to allow for a return to quarterly checks which are deemed as an acceptable time span.

It was not just a question of swapping suppliers, because all suppliers of foam mattresses were in the same situation. Having very quickly understood the predicament of the industry, NUTH believed that the best way forward was to collaborate with industry to develop a cover that would be fit for purpose and withstand the regimes of acute care decontamination. To achieve this goal, it started to work with Direct Healthcare Services.

During the course of 2010, a number of different covers were trialled – all of which failed. Some covers were too soft and scratched easily, allowing bodily fluids to ingress; others stained when in contact with Iodine Povodone, becoming unsightly and looking dirty. Finally, in March 2011, a new batch of covers were trialled that seemed to offer a solution. These new covers are made with a fabric that has three layers of high-quality polyurethane laminated to a robust, 'stretch engineered' textile.

Traditionally, polyurethane swells when exposed to moisture, especially when the cover is washed with chlorine and the material becomes less resistant to scratches. However, the new cover uses a textile combined with a higher modulus matt surface polyurethane coating, which increases its waterproofing performance. This combination reduces polyurethane swell. Therefore, when exposed to moisture, surface friction is reduced and, ultimately, the likelihood of snagging or surface damage is also reduced.

Adopting the BHTA recommendations, in March 2012, the Trust's local infection control policies introduced the 'Wash, Rinse and Dry' regime. 'Mattress Champions' attended a teaching session to reinforce this change in policy.

This cover is slightly tougher with less stretch but it retains pressure redistribution qualities and pressure mapping of the new cover were surprising and unexpected. The pressures were improved compared to the more stretchy ordinary cover, possibly because with the old cover, its stretchiness caused an increased 'hammocking' effect compared to the less stretchy material.

## Method

Following discussion between the NUTH and Direct Healthcare, it was agreed that all trial products would be purchased by the Trust at the same price as the standard cover. Any product failures would be replaced by Direct Healthcare free of charge. In fact, at the beginning of the process, large numbers of covers (>100) failed as the two parties struggled to find a suitable material. Direct Healthcare replaced all of these with a standard cover at no further cost. All these early samples were sent back to the company for further testing, to establish exactly what was going wrong with them.

In March 2011, a new cover was introduced. Again, the Trust negotiated with Direct Healthcare to purchase these new covers at the same price as the standard cover, and the company agreed to replace all that failed.

## Audit

Every year, Tissue Viability leads a mattress audit. The purpose of this audit is twofold – to ensure that Mattress Champions are undertaking their checks (for ingress) and to ensure that mattresses have not 'bottomed out' (i.e. that the foam is still fit for purpose and retains pressure relieving properties). Mattresses rarely fail for this reason, as the cover weaknesses of recent years meant that they would be replaced well before the foam had deteriorated to such an extent that it would need replacement.

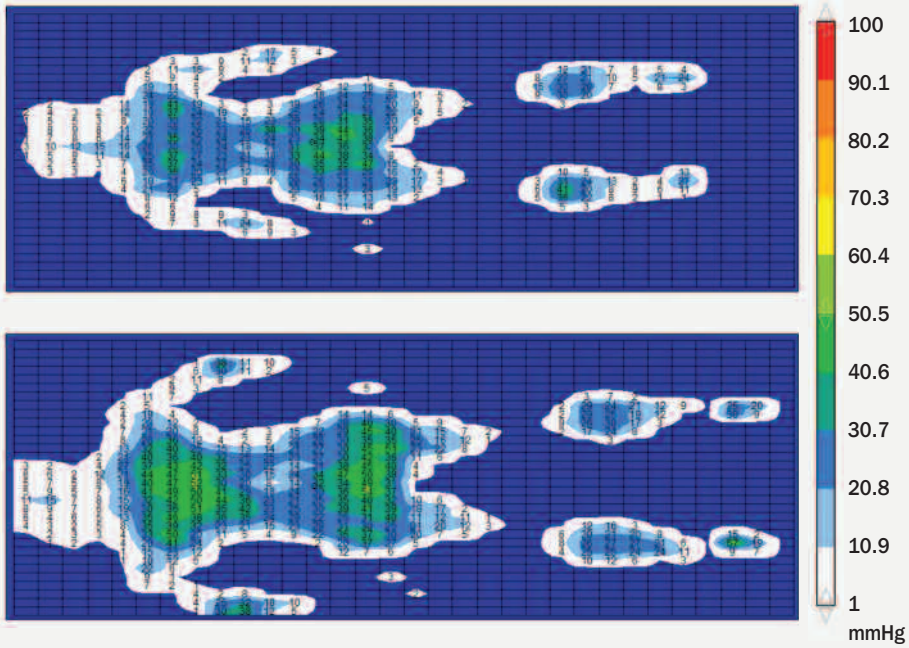
In November 2012, a full audit of all acute mattresses took place. This audit differs from the regular checks undertaken by the wards, as it is led by Tissue Viability. Under its direction, a team of auditors (which include staff from Direct Healthcare) performs the audit. The auditing team, which consisted of the nurse consultant, the nurse specialist, the healthcare assistant, a student nurse, as

'Ironically, the very fact of decontaminating mattresses made them porous to bodily fluids, increasing the risks of contaminating patients with infections.'

**Pressure mapping with Mercury new cover.**

| Female lying down – 56 kg. | |
|---|---|
| Minimum | 0.00 mmHg |
| Maximum | 46.68 mmHg |
| Average | 15.70 mmHg |
| Variance | 127.53 mmHg$^2$ |
| Standard deviation | 11.29 mmHg |
| Coefficient of variation | 71.92 % |
| Horizontal centre | 31.49 cm |
| Vertical centre | 73.19 cm |
| Sensing area | 3,605.20 cm$^2$ |
| Regional distribution | 100.00 % |

| Male lying down – 108 kg. | |
|---|---|
| Minimum | 0.00 mmHg |
| Maximum | 56.50 mmHg |
| Average | 19.25 mmHg |
| Variance | 198.83 mmHg$^2$ |
| Standard deviation | 14.10 mmHg |
| Coefficient of variation | 73.23 % |
| Horizontal centre | 35.60 cm |
| Vertical centre | 73.83 cm |
| Sensing area | 4,512.81 cm$^2$ |




well as six members of Direct Healthcare, audited just under 1,600 mattresses.

As auditing mattresses is physically heavy and time consuming, there is an incentive for the wards to be ready for the auditing team. The wards ensure that all the mattresses are stripped and ready for inspection and, if a ward is not ready, the auditing team moves to the next ward. As the auditing team is quite large, it then only takes around eight minutes to audit a full 30-bedded ward and the full Trust (acute site) is audited in just three mornings. The results are presented to the Trust board on a quarterly basis.

## Audit standards

- Each ward has a nominated Mattress Champion. This can be the ward house keeper, one of the healthcare assistants or indeed the link nurse of the ward. It is their responsibility to ensure that all their mattresses are fit for purpose.
- The wards check their mattresses (unzipping the cover and checking for ingress) between each patient episode.
- Every three months a formal mattress audit is undertaken, where all mattresses are unzipped and checked. A laminated A4 card, which has been placed inside the mattress, underneath the foam is then signed with the ward name and date, to ensure that the audit has been documented. Any required cover or mattress is requested via Tissue Viability and replaced within one week.

## Results

In November 2012, 100% compliance was achieved with 69 wards (1,499 mattresses) taking part in the audit. Three wards ($n$=3) were not audited as access was not allowed for infection control reasons. On average 85% of all mattresses are audited on each ward (some patients are too unwell to get out of bed), therefore 1,274 mattresses were checked.

A total of 199 ($n$=199) mattress failed (84% due to 'bottoming out'; 16% due to cover failure); 59 covers were changed due to ingress of fluids.

Out of the 270 in circulation, only one cover ($n$=1) made from the new Pro-Formance material failed and this was due to a mechanical 'injury' rather than delamination of the cover.

## Study limitations

The audit of all the mattress stock currently used in the Trust is a busy, time consuming and physically heavy task. Not all the patients can be moved out of bed for the mattress to be checked. Mattresses move from one ward to the other on a daily basis and monitoring performance is difficult as it is based on many variables. Reliability of the checks undertaken on the wards is not consistent, checks are not regular and disposal of perceived failed equipment is based on a personal viewpoint rather than clear set of competency based guidance. Double checking does not occur routinely but only on an *ad hoc* basis, due to the limited manpower within the Tissue Viability team.

The results of this audit can only describe what a team of experienced auditors have found and must be put in context. While there was a 13.1% failure rate on the foam, most of these mattresses were more than five years old. This figure offers a yearly failure rate, as Mattress Champions do not tend to test mattresses for 'bottoming out' but check them for ingress. The yearly failure rate of the covers remains high (16.5%) but it is known that the old type of cover material is not resistant to chlorine washes and the results do not offer any new evidence.

The audit results do, however, offer some evidence that the new cover is withstanding the rigours of acute care and its cleaning regimes. At the time of the audit, 92% of the new covers had been in use for a period of seven months or more, while the rest had been in use only for a few weeks. To undertake a complete evaluation of this new product will take five years or more: until that time, one can only conclude that these early findings suggest that the new material's effectiveness is very promising.

## Guarantee and life expectancy

Industry offers a standard eight years guarantee for the foam and four years on the cover. Even before the issue of the covers came to light, the eight years guarantee on the foam could, in fact, very rarely be enforced as Trusts would swap suppliers in search of the best deal. Returning failed mattress is a logistical nightmare and industry benefits from this in terms of warranty claims not being pursued. The 'failing covers' issue meant that, with the covers not lasting for more than 12 months (and fluid ingress staining the foam), many mattresses were changed well within the eight years of service warranted by the industry.

The issue of what constitutes a realistic length of time for a mattress to last before

'bottoming out' and for a cover to last should depend firstly on the care setting. The acute care environment is much more testing to a mattress than domiciliary care. Having undertaken yearly audits in acute care for the last ten years, experience and associated expectations recommends that a mattress is to last five years and that the cover must last the same length of time.

Experience and associated expectations also believe that it is acceptable to expect a failure rate of 1% (yearly rate) as, despite the introduction of the 'Wash, Rinse and Dry' policy, as well as making sure that clinical staff treat mattresses with respect, at times of busy workload some of these steps may be skipped and some damage from equipment does occur.

It is also recommended that Trusts should work with the same industry contractor for a longer period of time, consistent with the product warranty period, and therefore tender and contract for their required foam mattresses every five years in order to test the mattresses over the lengths of the contract. Offering longer-term contracts would, in fact, assist both parties in data collection, monitoring, reporting and problem fixing. If mattresses last less than five years (i.e. above the 1% 'accepted' failure rate), then as per contract, the mattress would be replaced at no charge. The Trust will therefore be able to budget for a rolling replacement scheme.

It is also recommended that all mattresses failures (above the 1% 'accepted' failure rate) are reported to the MHRA to ensure that standards are monitored and reported nationally.

## Conclusion

The issue of the covers delaminating and subsequent over-replacement of mattresses in NHS acute Trusts has been controversial, after a MHRA alert was raised which brought to the attention of NHS staff and industry alike, the risk of cross contamination from the bodily fluids ingressed through the delaminated cover. The NUTH has worked with industry to develop and test a cover that would be breathable, provide pressure redistribution but be tough enough to withstand the rigours of today's NHS cleaning regime. After a number of false starts, a new cover material was introduced in September 2011 and, following a Trust wide audit, the results appear to be very promising. However, all mattresses and covers need to be used in clinical practice for a number years, before a true picture emerges.

There are a number of other companies within the industry who have developed covers with new materials and time will tell which ones will withstand the test of 'mattress life expectancy'. In acute care a mattress and its cover should last five years and a yearly failure rate of more than 1% should be deemed unacceptable. Trusts should tender for mattresses and enter into a contract with industry for the life expectancy of the mattress. Any failure rates above the accepted 1% should be reported to the MHRA for investigation.

A mattress is not just a consumable but is the foundation of hospital care. It is a piece of medical equipment and, as such, needs accurate specifications and associated life expectancy.

This article was written independently, with no company input, incentives or funding. Its recommendations reflect the author's sole beliefs and clinical experiences.

## Pressure mapping system reduces ulcers

**New research presented at the National Pressure Ulcer Advisory Panel Biennial Conference demonstrates improvement in the prevention of pressure ulcers with the use of Wellsense's MAP System – a continuous bedside pressure mapping system.**

**Two poster presentations: "Dynamic Physiologic Skin Monitoring to Enhance a Pressure Ulcer Prevention Programme" and "Biofeedback of Continuous Bedside Pressure Mapping to Optimise Effective Patient Repositioning", were presented by Dr Ronald G. Scott, director of wound care at a North Dallas long-term acute care hospital, at the NPUAP meeting, held in Houston, Texas, US.**

**The results of the first study showed a significant reduction in pressure ulcer occurrence when using the MAP System over a six month period in 2012. During this period, zero hospital-acquired pressure ulcers occurred, in comparison to 16 pressure ulcers in the same timeframe in 2011.**

**"For decades, in an effort to prevent pressure ulcers, caregivers have been repositioning patients in bed but, until now, they haven't had any feedback to confirm that their adjustments are effective," said Dr Scott. "New continuous bedside pressure mapping technology now offers caregivers a visual image of where pressures exist beneath patients, taking the guesswork out of how to best redistribute pressure. By incorporating these monitors, we were able to achieve our prevention programme goal of zero pressure ulcers."**

**The MAP System's pressure sensing mat is made of an intelligent textile, which constantly measures pressure from thousands of discrete points. The variations in pressure across a patient's**

**body are depicted on a monitor, using a colour scheme to help caregivers visualise high (red) to low (blue) pressure points, which enables them to easily identify and minimise areas of high pressure. The MAP System serves as a supportive tool for caregivers by providing live, visual feedback as they reposition patients.**

**In the second study, bedside caregivers were able to reposition patients to alleviate areas of high pressures more effectively when provided feedback from the MAP System.**

**"There is a huge unmet need to decrease the incidence of bed sores and reduce the human suffering and enormous cost associated with their treatment," continued Dr Scott. "Our pressure ulcer prevention programme was enhanced by the visual validation from this continuous bedside pressure mapping technology, which showed caregivers how to effectively reposition, rather than blindly turn patients to prevent bed sores."**

## References


1 Hospital Infection Society (2007). *Third prevalence survey of healthcare associated infections in acute hospitals in England 2006*. DH, London.

2 Fraise A, Bradley C (2009). Decontamination of equipment, the environment and skin. In Ayliffes Control of Healthcare-Associated Infection. Hodder Arnold, London.

3 BHTA (2012). Protect, Rinse and Dry. BHTA guidance on the care, cleaning and inspection of healthcare mattresses, British Healthcare Trades Association London.


* Dyna-Form Pro-Formance, Direct Healthcare Services, Caerphilly. The material for the cover was developed in conjunction by Dartex Coatings Inc, US.

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