

A 100 patient clinical evaluation of an alternating pressure replacement mattress in a home-based setting

The development of pressure ulcers is a common occurrence and is a concern nationally and internationally because of their significant clinical and financial impact. A review of epidemiological studies reported that the prevalence of pressure ulcers in European hospitals ranged from 8.3% to 23% (Vanderwee, 2007). A European study involving nearly 6000 patients in five countries reported that approximately 18% of patients admitted to hospital had a pressure ulcer (EPUAP et al, 2014).

NHS England has set a target of eliminating avoidable pressure ulcers (McIntyre et al, 2012) and, in 2013, reported a 45% reduction in grade 2–4 pressure ulcers compared to the previous year (McIntyre, 2013). Significant achievements have been made and are important as pressure ulcers have profound effects on individuals (Langemo, 2005). Additionally, pressure ulcers are expensive to the health economy, with the daily cost of treating a pressure ulcer in the UK estimated to range from £43 to £374 (Dealey, 2012).

Pressure ulcers are caused by a number of factors, which means a multiprofessional disciplinary approach is needed in both prevention and management. While there has been an emphasis on skin assessment, surface assessment, keeping the patient moving, management of incontinence, and making sure patients' nutritional status is maintained and monitored regularly (the SSKIN approach) (NHS Midlands and East, 2013), the provision of pressure-redistributing equipment remains paramount.

The UK national pressure ulcer prevention guidelines (NICE, 2014) and European guidelines (EPUAP et al, 2014) offer a consensus in relation to pressure ulcer prevention and management. This concludes that healthcare provision should include the provision of appropriate equipment, including bed bases and specialist pressure redistributing surfaces, according to clinical need.

It is imperative that pressure care equipment supports the promotion of skin integrity with adequate reduction of pressure and/or shearing forces present on 'at risk' areas of the body, including all the bony prominences including the heels and sacrum. Sufficient tissue perfusion is paramount for the successful prevention and/or management of pressure ulcers.

Alternating pressure air mattresses

Alternating pressure air mattresses (APAMs) offer pressure-reducing or pressure-relieving properties to support the prevention and management of pressure ulcers.

ABSTRACT

Background: alternating pressure air mattresses (APAMs) support the prevention and management of pressure ulcers. A health and care NHS trust was seeking an APAM that would improve clinical outcomes in relation to pressure ulcers while considering financial cost. An APAM existed that could meet the trust's needs but there was a lack of evidence over its use in a community/home setting. This study examined the effect of using the Dual Professional (IQ Medical) APAM for patients at a high risk of pressure ulceration. It also determined patient and family satisfaction, and the views of clinicians in relation to clinical outcomes. Additionally, infection prevention and control, servicing, maintenance and electrical biomechanical engineer input were considered. **Method:** a prospective observational study was undertaken of 100 patients in their own homes following a pilot study of 10 patients. The period of the evaluation was from one day up to 295 days, with a mean average of 83 days, and a total of 5809 bed days. **Results:** with a regimen of regular repositioning of patients and a good diet, the APAM was effective in preventing pressure ulceration in the 100 patients who were at a high or very high risk of skin breakdown and pressure ulceration. **Conclusion:** selection of pressure redistributing surfaces should be based on holistic patient assessment, including risk assessment, mobility levels, grade of pressure damage and clinical judgment.

Key words: Pressure ulcers ■ Pressure-relieving mattress ■ Alternating pressure air mattresses ■ Home care ■ Community

APAMs with cells that sequentially inflate and deflate support the redistribution of pressure and are used in both the prevention and treatment of pressure ulcers, in conjunction with a structured approach to care. The selection of any APAM should be guided by the evidence for its clinical use with consideration given to the financial cost.

Rationale for study

A health and care NHS trust was exploring the options for an APAM because the system it used was being discontinued. The trust was seeking alternating pressure air mattresses that would contribute to positive clinical outcomes in relation to the prevention and management of pressure ulcers.

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Table 1. Published articles on APAM evaluations

Author	Date published	Place of research	Number evaluated	Place of evaluation
Chamanga and Butcher	2016	UK	3 (2 completed)	Care home
Newton	2015	UK	Unspecified	Acute
Fletcher and Evans	2015	UK	383	Acute: coronary care
Meaume and Marty	2015	UK	92	Hospital care at home
Gleeson	2015	UK	8	Acute
Manzano et al	2013	Belgium	221	Acute
Baker	2012	UK	1	Acute
Vermette et al	2012	USA	8	Acute

Additionally, the trust was exploring options for a mattress that would need servicing once every 2 years as opposed to annually, which would reduce the overall cost.

An APAM existed that could fulfil the trust's needs; its use was supported by evidence but only from a community inpatient evaluation. There was a lack of evidence about the APAM in a community/home setting, which supported the decision to evaluate the APAM.

This aim of this study was to examine the impact of an APAM for people with a high risk of pressure ulceration and those with a pressure ulcer of up to grade 4 (EPUAP et al, 2014) within a health and care NHS trust. The secondary aim was to determine the level of patient and family satisfaction with comfort and gain the views of the clinicians who provided care for patients using the APAM in relation to clinical outcomes. Additionally, infection prevention and control, servicing, maintenance and electrical biomechanical engineer (EBME) input were considered.

Literature

While evidence existed for the evaluated mattress within community inpatient settings, no evaluation had been undertaken within the home-care setting.

A systematic comparative effectiveness review of preventive interventions has been undertaken (Chou et al, 2013) and treatment strategies are guided by European and UK guidelines (EPUAP et al, 2014; NICE, 2014). A Cochrane review (McInnes et al, 2011) of support surfaces for pressure ulcer prevention concluded that it was not clear how effective APAMs were for hospitalised patients.

There is a need for further exploration and understanding of the devices and equipment to support high-value innovations in pressure ulcer prevention and there is an intention in the Five Year Forward Plan (NHS England, 2014:34) to work in conjunction with NICE over this issue.

As the risk factors are more prevalent in patients living at home than in a community care setting or hospital, particularly among older people (Keelaghan, 2008), it is essential that the effectiveness of APAMs is evaluated, particularly for patients living at home. Also, despite the lack of evidence, clinicians continue to use APAMs

inappropriately, which can be a poor use of resources (Stephen-Haynes et al, 2017).

A review of the literature published since the last Cochrane review (McInnes et al, 2011) identified eight publications—six in the UK, one in Belgium and one in the US (Table 1). Of the eight publications, six are set in acute care, one in care homes and one in a community hospital. None of the published articles report evaluations undertaken in the patients' own home. The previous research by Grothier and Bradley (2014) in relation to the Dual Professional was undertaken in inpatient community hospitals. This was the first published evaluation of this specific alternating pressure mattress within a community environment.

The objective of this observational study was to assess the impact of an alternating pressure air mattress (APAM) for patients who would be allocated an APAM using an algorithm based on their clinical need. It would include those at a high or very high risk of pressure ulceration and those with a pressure ulcer up to grade 4 (EPUAP et al, 2014) within a UK health and care NHS trust.

Pilot study

An initial 10-patient pilot evaluation was undertaken to determine the suitability and clinical effectiveness of an APAM in a community setting.

The pilot study indicated it was potentially suitable for the specific multiple and complex needs of clients within a community or home care environment, and a safe and cost-effective alternative system compared with the more expensive models currently in use (Stephen-Haynes et al, 2014). Only minor modifications were required following the pilot to make one question clearer.

Evaluation tool

The evaluation tool was developed by the tissue viability consultant nurse, with support from the integrated wheelchair equipment services manager, the infection prevention and control consultant nurse, electrical biomechanical engineers (EBME), data analysts and community nursing staff. It was designed to meet the needs of the trust and has not been subjected to any external verification.

Sample

Potential participants were identified. All patients who were eligible for an APAM according to risk, mobility and grade of pressure ulcer were invited to take part. The inclusion criteria were that patients:

- Were aged over 18 years
- Lived in their own home
- Had capacity to consent
- Were at a high risk of pressure ulcers (Waterlow, 2005) or had an existing deep pressure ulcer
- Required an alternating pressure mattress using the trust equipment selection algorithm.

One hundred participants were invited to take part in the study and allocated the alternating pressure mattress if the algorithm for equipment selection indicated they should be included. The algorithm is based on risk assessment, mobility level and grade of pressure ulcers as recommended by NICE (2014).

An alternative plan for those declining to take part in the study was to provide them with a piece of the existing alternating pressure mattress, but this was not necessary because none declined to take part.

Data collection

The data collection tool was designed to support the primary and secondary aims of the study. The primary aim included the effect of the alternating pressure air mattress (APAM) on people at high or very high risk of pressure ulceration and those with a pressure ulcer; the secondary aim was to assess comfort and satisfaction. A hundred data sets were collected by staff who provided care according to the local clinical guidelines. Analysis of the data was undertaken by the authors.

All patients received comprehensive information about the study and provided informed consent. The trust gained approval from the clinical governance department for the evaluation and the mattresses were bought by the trust.

The data collection tool included the covered areas within the primary and secondary objectives.

Primary objectives

- Biographical data, including age, gender, diagnosis, mobility, continence, weight and nutritional status
- Waterlow risk assessment score
- Category of pressure ulcer (if any) and the impact of the mattress
- Hours spent in bed
- Period of time the Dual Professional mattress was evaluated for each client.

Secondary objective: patients and carers

- Clients' comment on mattress comfort and noise compared with previous products.

Secondary objectives: clinicians

- Ease of getting in and out of bed
- Pump noise
- Ease of mattress cleaning in clinical practice
- Ease of maintenance, cleaning and storage
- EBME, servicing
- Clinical use by practitioners
- Manufacturers' education and support.

The care provided by the trust is based on guidance from NICE (2014) and EPUAP et al (2014), local guidelines and staff who are trained to provide care based upon the structured approach outlined in the SSKIN bundle. Clinicians all receive education in selecting pressure redistributing equipment and the use of the evaluated mattress by the consultant nurse and tissue viability team.

The skin was examined at each visit during the study by staff who had received education and training and achieved competencies in the assessment of skin and grading of pressure ulcers in line with the trust recommendations.

Follow-up visits were scheduled throughout the study depending on clinical need. They were carried out weekly if an APAM had been allocated for treatment and monthly for patients who had been allocated an APAM for prevention, in line with current care delivery.

At the end of the study, the views of the patients and their families on mattress comfort and the opinions of the care team on the mattress were recorded using a numeric five-point rating scale by the investigator. All adverse events were recorded.

Dual Professional mattress

All patients were cared for on a Dual Professional mattress (IQ Medical Ltd). This is a dynamic, alternating air mattress replacement system that provides both alternating and low pressure static modes with a microprocessor-driven digital power unit. The therapy system is designed for patients at a very high risk with the aim of supporting pressure ulcer prevention and treatment up to category 4.

This system fabric includes multi-way stretch, breathable, vapour permeable polyurethane coated nylon cover (Dartex). The mattress is 900 mm wide, 2000 mm long and 230 mm deep, and can take a patient with a maximum weight of 180 kg. It can be cleaned and decontaminated in accordance with HSG(95)18 guidelines.

Period of evaluation

The mattress was used for a total of 5809 days (829 weeks) during the evaluation. The average time for each person using the mattress was 83 days. The shortest allocation was one day and the longest was 295 days.

Electrical biomechanical engineers

The mattresses were all commissioned by EBME before clinical use. They require servicing every 2 years, which offers an advantage over alternative products, which need servicing once a year.

The evaluation was undertaken over 10 months, during which time there was only one report of malfunction. This was because the clinician did not set the weight accurately for the patient.

Another area that has been highlighted is the need to ensure the CPR seal has been secured before using the mattress. The manufacturers have been informed and amendments have been made to the user guide.

Patients

All 100 patients were cared for in their own homes. They were allocated the APAM using an NHS trust equipment selection algorithm based upon the NICE (2014) recommendations for equipment selection, including risk assessment, mobility and pressure ulcer grade.

Patients were in an age range of 33–100 years, with a mean age of 78.4 years; 36% ($n=36$) were male and 64% ($n=64$) female. This is a typical representation within the trust of patients receiving pressure care products.

The weight range was 32 kg–143 kg with a mean weight of 67.4 kg. Dietary intake was adequate in 58% ($n=58$) of patients, inadequate in 34% ($n=34$) and unrecorded in 8% ($n=8$).

Pressure ulcers

The grade of pressure ulcer was recorded at the start of the study. Of the 100 patients, 5% ($n=5$) had a grade 1 pressure ulcer, 22% ($n=22$) had a grade 2 ulcer, 21% ($n=21$) had a

grade 3 and 5% ($n=5$) had a grade 4 ulcer, 44% ($n=44$) had intact skin and 3% ($n=3$) were unrecorded (NPUAP, 2014).

A history of pressure ulcers was recorded in 86% ($n=86$) of patients; 45% ($n=45$) of all patients had a previous history of pressure ulceration and 41% ($n=41$) did not.

Waterlow risk assessment

The Waterlow scores ranged from 14 to 39 with 72% ($n=72$) being very high risk, 20% ($n=20$) being high risk and 4% ($n=4$) being at risk; the risk of 4% ($n=4$) was not recorded. Therefore, 92% ($n=92$) of the patients nursed on the alternating pressure air mattress were at high risk or very high risk of pressure ulcers (Waterlow, 2005).

In addition, 22% ($n=22$) patients were at the end of life and 10% ($n=10$) were receiving palliative care.

Mobility levels

Mobility levels were measured using the Waterlow (2005) risk assessment tool: 52% ($n=52$) of patients were confined to bed, 27% ($n=27$) were chair bound, 13% ($n=13$) had restricted mobility, 1% ($n=1$) were restless and 4% ($n=4$) were fully mobile; mobility levels in 3% ($n=3$) were not recorded. In 96% ($n=96$) of patients, mobility levels were affected.

Incontinence

Urinary incontinence was reported in 12% ($n=12$) of women and 9% ($n=9$) of men. Double incontinence was found in 31% ($n=31$) of women and 9% of men ($n=9$). Overall, 61% were affected by incontinence.

Diagnosis

The principle diagnoses where specified were dementia 18% ($n=18$), cancer 14% ($n=14$), cerebrovascular accident 12% ($n=12$), multiple sclerosis 11% ($n=11$), Parkinson's disease 6% ($n=6$), heart failure 4% ($n=4$) and end of life 4% ($n=4$). Of those with a diagnosis, 22% ($n=22$) were reported as nearing the end of life.

Hours spent in bed

Patients spent between 8 and 24 hours per day in bed. Fifty two percent ($n=52$) were confined to bed, 9% ($n=9$) spent 22–23 hours a day in bed, 21% ($n=21$) stayed in bed for 20–22 hours a day, 8% ($n=8$) spent 18–20 hours a day in bed and 10% ($n=10$) stayed in bed for 16–18 hours per day.

Repositioning

All patients had a repositioning regimen based upon their clinical need; 27% ($n=27$) were able to reposition themselves, 9% ($n=9$) needed to be repositioned every 1–2 hours, 29% ($n=29$) every 2–4 hours, 27% ($n=27$) every 4–6 hours and 8% ($n=8$) every 6–8 hours.

The repositioning regimen for patients who were confined to bed was 6–8 hours for 2% of patients ($n=2$), 4–6 hours for 18% ($n=18$), 2–4 hours for 19% ($n=19$) and 1–2 hours for 6% ($n=6$). It was not recorded for 7% ($n=7$).

Mattress use

The average time for using the mattress was 83 days. The shortest allocation was 1 day and the longest was 295 days.

The frequency of review was influenced by the care delivery regimen within the community setting; this regimen is variable with the frequency depending on the clinician's judgement. All patients with existing pressure ulceration were reviewed at least weekly and those at risk of pressure ulceration were reviewed at least monthly.

Primary objectives: outcomes

The primary objective was to examine the impact of the APAM for those at high risk of pressure ulceration and those with a pressure ulcer up to grade 4 (EPUAP, 2014) over a period of from 3 weeks up to 1 year.

Outcome on ulcer condition

Taking into account that not all the patients had pressure ulceration, the number of patients whose pressure ulcers improved while using the APAM was 53% ($n=28$) and the number who stayed the same was 20% ($n=10$). The proportion of those who deteriorated was 5% ($n=3$); all of these deteriorated by one grade and all were at the end of life and the deterioration occurred during the last 7 days of life. The SCALE document (Sibbald et al, 2009) acknowledges that skin changes occur at the end of life, particularly during the final week, but this is not a reason for pressure ulcers to develop.

Outcome on skin condition

Clinicians were asked to consider the outcome on general skin condition. The skin remained the same in 50% ($n=50$) of patients, improved in 39% ($n=39$) and deteriorated in 7% ($n=7$); this assessment was not completed in 4% ($n=4$) of patients.

Secondary objective: patient-reported outcomes

Moving and handling

Regarding moving and handling on the Dual Professional, 77% ($n=77$) of carers said the experience remained the same and 14% ($n=14$) said it improved.

The carers found it easier to move the patients on this surface and the clients did not sink into it, which would make them more difficult to move.

One patient reported that 'the slide sheets were easy to put into place' and that they did not move down the bed when positioned in sitting position on the mattress.

Staff reported that moving and handling remained the same in 77% ($n=77$), improved in 14% ($n=14$) and was unchanged in 4% ($n=4$). Five per cent ($n=5$) did not comment.

Comfort as rated by patients and carers

Patient comfort is a particularly important area of this clinical evaluation as alternating pressure mattresses are frequently said to be being poorly tolerated.

Two patients expressed that they wanted to have their comments recorded. One found this mattress comfortable and slept very well on it; in the past, she had not liked or been able to tolerate an APAM, despite clinically needing one. Another who had used several APAMs in the past, noted that this one 'has not given me backache as I have had before with these mattresses'.

The number of patients reporting the mattress as more comfortable was 43% ($n=43$), with 28% ($n=28$) saying it was the same, and 5% ($n=5$) reported it as being less comfortable than previous foam mattress. In 17% ($n=17$), this not applicable as it was the first time they had used an APAM.

Noise level

The noise level was reported as not noticeable by 63% ($n=63$), acceptable by 30% ($n=30$), and noticeable by 3% ($n=3$). Additionally, one carer reported that the evaluated mattress was quieter and another carer noted he could not hear the APAM from the next room as he had with previous mattresses. Those sleeping in the same room as the patients noted that the system was much quieter than previous ones.

Patients were asked specifically about the how pump noise compared with any previous pressure mattress system as this is a reason for patients to dislike their APAM and to decline equipment. The proportion who said it was the same was 29% ($n=29$), while 42% ($n=42$) found it quieter and 4% ($n=4$) said it was noisier, with 25% ($n=25$) making no comment. Therefore, a significant number of those who had had a mattress before said the Dual Professional was quieter or the same.

Set-up and instructions

Staff acknowledged that they needed something that could be set up quickly; 82% ($n=82$) found the mattress quick to set up, 2% ($n=2$) did not and 16% ($n=16$) made no comment.

Clarity of instruction manual

In response to the clarity of the instruction manual, 90% ($n=90$) of staff said it was clear and 6% ($n=6$) said it was unclear, with 4% ($n=4$) not answering. Amendments were made to the manual following this evaluation to improve clarity.

Clinician opinion

Clinicians were asked whether they would recommend the evaluated APAM for use within the trust with 96% ($n=96$) of staff reporting that would recommend the use of the mattress.

Discussion

The provision of alternating pressure (dynamic) support surfaces is an important aspect of pressure ulcer prevention and management and is acknowledged by NICE (2014) to benefit those who cannot reposition independently.

The mattress is acceptable to staff and, more importantly, to patients and families. The alternating pressure mattress replacement system was evaluated as quiet, comfortable, easy to set up and use. Cleaning was not an issue.

The issues relating to the instruction manual have now been addressed and images of the set-up have been added to the instruction manual. The CPR seal issue has also been addressed, with more images added to the instruction manual. Staff and family found the cable management system, which enabled the cable to be tucked away and prevented damage to the cables from the hoist or even the vacuum cleaner, promoted safety during transfers and lowered the risk of harm to clients and carers.

The pump is not big or bulky and it fits on the clients' bed. This is important given the often small confines of clients'

homes. It has an easy to use transport connector and an integrated 2-inch foam base, which is essential in the community setting where in some rural areas where power failures are possible. The results indicate its application in clinical practice with positive clinical outcomes

The assessment and prevention of pressure ulceration remains the same as it focuses on SSKIN: skin assessment, surface assessment, keeping the patient moving, management of incontinence, and making sure patients' nutritional status is maintained and monitored regularly (NHS Midlands and East, 2013).

Support surfaces help to reduce or relieve pressure off the patient's body. The evaluation of this mattress has demonstrated that, combined with a regimen of regular repositioning of residents and a good diet, the support surfaces were an effective tool in preventing pressure ulceration in the 100 patients who were at a high risk/very high risk of skin breakdown and pressure ulceration.

It is essential to acknowledge that selection of a support surface is based on holistic patient assessment, risk assessment, mobility levels, grade of pressure damage and clinical judgment.

Clinical significance and limitations

The prevention and management of pressure ulceration in the community are potentially more challenging than in inpatient settings because there are long periods of time when no clinical staff are delivering care, and because of the additional time taken by patients' carers and clinical staff to complete data. In this study, staff had to complete the evaluation forms in addition to existing patient documentation. This is seen within this study where there is incomplete data and, while efforts were made to ensure all data was collected, this has not always been successful.

This is the first published article of an evaluation within a community environment with this specific alternating pressure mattress. The benefits of alternating pressure mattresses have been considered in a large group in the community setting. The results of the alternating pressure mattress indicate its application in clinical practice with positive clinical outcomes for those requiring alternating pressure.

The 'low pressure' setting was not used during this evaluation and warrants exploration.

Conclusion

The selection of appropriate alternating pressure mattresses should take account of risk factors for the development of pressure ulcers and clinical outcomes.

This 100-patient evaluation has highlighted the clinical effectiveness and tolerance of this mattress over a 12-month period. It showed it was effective for the prevention and maintenance of patients with pressure ulcers. **BJN**

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KEY POINTS

- Pressure ulcer prevention is a key within the NHS in all settings
- The use of appropriate equipment in conjunction with holistic care is essential for pressure ulcer prevention
- Patient comfort is important as alternating pressure mattresses can be poorly tolerated
- There are a limited range of published papers on APAMs in community setting

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CPD reflective questions

- How do alternating pressure air mattresses (APAMs) contribute to pressure ulcer prevention ?
- What factors influence the selection of APAMs?
- What factors are important for patients and carers in relation to APAMs?
- What factors do you need to consider when selecting APAMs for your patients?