

# Innovating for Improvement

Improving pressure damage detection in the community using continuous pressure monitoring of patients

**Cornwall Partnership Foundation NHS Trust**



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## About the project

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**Project title:** Improving pressure damage detection in the community using continuous pressure monitoring of patients

**Lead organisation:** Cornwall Partnership Foundation NHS Trust

**Partner organisation:** Plymouth University

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## Part 1: Abstract

**“This is amazing and given me control and stopped the guess work”**

***Patient***

**This patient can now attend hydrotherapy and is able to sleep due to improved comfort.**

Each year approximately half a million people in the UK will develop at least one pressure ulcer, with the majority of research and technology focusing on the hospital setting. Pressure ulcers usually affect people with:

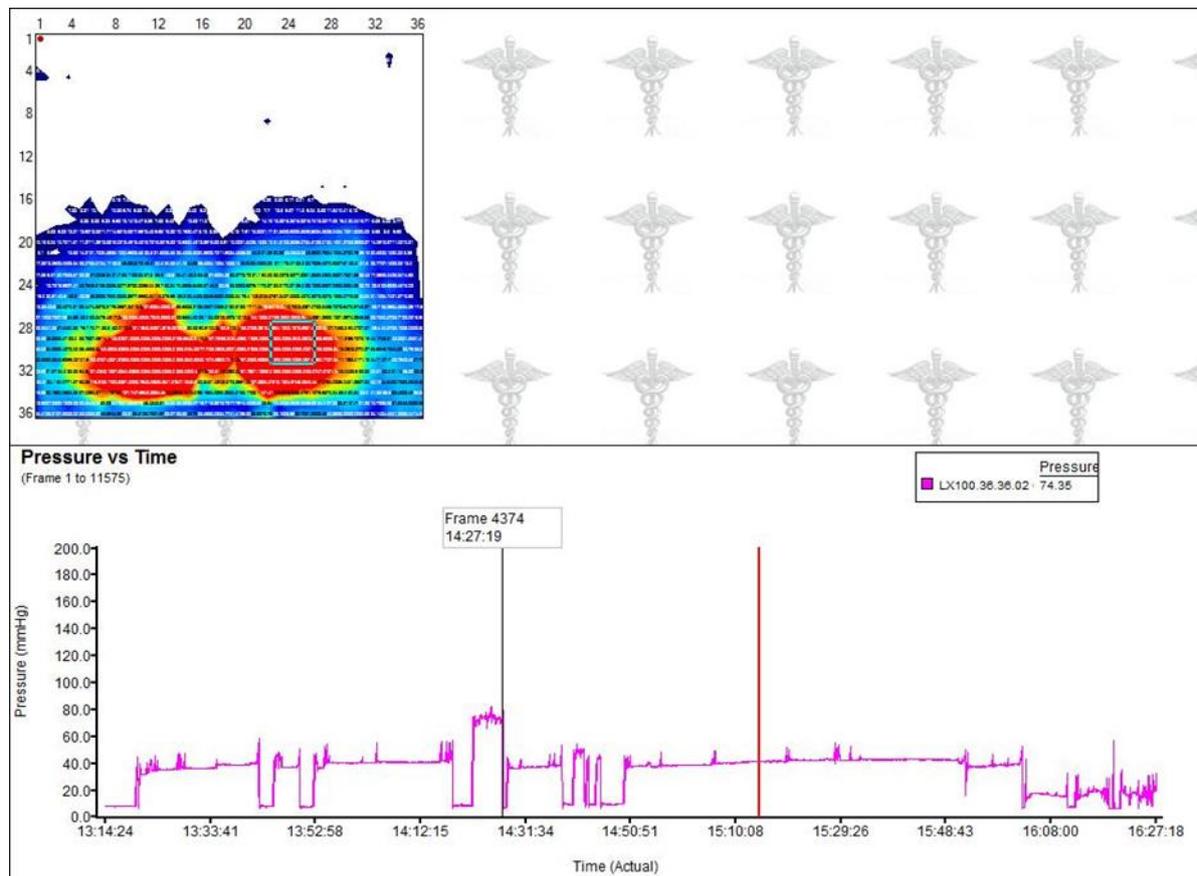
- An underlying health condition
- High levels of frailty and dependant on carers
- Developing when patients are in their own homes.
- Patients sleeping in chairs or spending large amounts of time in chairs unable to move

Cornwall has a higher than average elderly population, when compared to the rest of the UK. Around 154 pressure ulcers are acquired whilst in the care of Cornwall Partnership NHS Foundation Trust (CFT) each month, with 5-7 of these being severe (Grade 5-7). Relieving the pressure is a vital part of the healing process; however, some patients have said they are reluctant to use pressure-relieving equipment as it can be uncomfortable, hot and noisy. These patients have been classed by practitioners, rightly or wrongly, as non-concordant (which means not agreeing with treatment decisions).

This project focused on frail people living in the community in Cornwall. By introducing continuous pressure monitoring, coupled with patient and carer education, we have been successful in enabling these people to self-manage their pressure ulcer risk. Our project used the Fore Site PT pressure monitor to more accurately detect pressure ulcer risk, aid healing and to determine if the technology could influence patient and carer decision making. This technology consists of a chair-sized pressure map, made up of hundreds of pressure sensors, developed specifically for the project, connecting to a monitor recording real-world data. Continuous pressure monitoring technology identifies ‘hot-spots’ of pressure, generated when the patient sits in one position for long periods.

The project objectives were to demonstrate healing for existing pressure ulcers or prevention of pressure ulcers, determine the acceptability of the equipment by patients and carers whilst assessing its usability. In addition to capturing positions that are compatible with healing, associated interface pressures over long periods of time in the chair and equipment which is not fit for purpose for patient use in their own homes were also identified.

Forty four patients were recruited to the project via referral to the local Tissue Viability services. Following assessment, the monitoring equipment was put in place and, in association with education about the system, left in situ for an agreed period of time. The results were then fed back to the patient and carers and amendments to care or equipment agreed as required. Further visits were arranged to review the changes and monitor the outcomes. An example of the data generated can be seen in Figure 1.



**Figure 1:** An example of the data generated by the mapping technology

The technology was used to monitor patients both whilst in bed and in the chair. We concluded that an individual approach to care is needed and that no assumptions can be made with regards to the suitability of a particular pressure relieving mattress or cushion to provide the best interface pressures needed to prevent or heal pressure injury.

The information obtained has challenged previously held beliefs with regards to pressure ulcer prevention and patient non-concordance. The analyses have resulted in alternative equipment being sought for patients sleeping in the upright position whilst in bed. These have demonstrated the high number of patients that are affected and that similarly high peak pressures are being reached to those that arise from sleeping in the chair all day. It has highlighted that a large number of cushions and mattresses are not fit for purpose for community use by patients who are quite immobile and who change their position minimally during the day or night. The analyses also suggest that the usual practice of advising the patient to

remain in bed to alleviate the pressure, and not sit out in a chair if they have a pressure injury, is not necessarily the best strategy.

Furthermore, the evidence is indicating that posture has a major impact on the development of pressure ulcers particularly for the frail person who is sitting in the chair, often for 24 hours. Nurses are rarely taught about the posture of patients and the increased risk posed on the development of pressure ulcers. Our data are facilitating the pictorial demonstration of the effect that posture and positioning have on pressure, and skin damage. Thus this project is challenging misconceptions and facilitating the re-education of practitioners.

Qualitative data were also recorded; clinicians were supportive of the use of the technology and found that, in general, it was easy to use and had high levels of user acceptability. Frail people have been very positive about the use of the monitor seeing beneficial clinical outcomes and improvements in patient centred care.

Following the review of the pressure monitor data and wishes of the patient, six patients had pressure relieving mattresses upgraded and 11 cushions; 21 patients remained on the same mattresses with 15 remaining on the same cushions, requiring alteration to the equipment, education of the carers and a further 9 patients mattresses and 10 cushions needed to be downgraded, resulting in a cost saving.

**Of the 44 patients who took place in the project, four patients died and these were removed from the data analysis. Of the 40 remaining patients 32 (80%) healed or are healing. The net annualised savings (assuming worst case scenario, using Department of Health (DOH) costing data associated with category 4 pressure injury of £14,000 for a year's treatment) totalling £99,281 was achieved.**

#### **The key challenges:**

- Geography of Cornwall and the spread of patients across a vast geographical area. This was addressed by purchasing an external hard drive for each monitor, along with access to the analyser software available on a central server.
- Amount of time needed to assess and monitor patients; this may involve several visits to ensure the correct equipment is in place. This has been addressed by working closely with the loan equipment department to have an array of equipment available for evaluation.

#### **Improvements have been:**

- Redefining non-concordance
- Patient involvement in pressure injury management in their own homes

- Matching the equipment to the patient as opposed to matching the patient to the equipment

In summary: the project has demonstrated that healing rates can be improved, pressure injury can be prevented and user acceptability of the technology is good. The use of this technology saw a reduction in potential treatment costs.

The use of this pre-post approach in a real world setting, working with people living in their own homes in the community, stretched the technology, which had been developed for hospital use. Following referral to the Tissue Viability service, these vulnerable people were able to be assessed more thoroughly than usual through the insertion of the technology to determine normal sitting or lying positions and pressures. Challenges were identified and addressed and it is clear that this technology is now ready for wider application. Education and training are needed to assist with the dissemination of the findings of the project, so that other patients will be able to experience this advanced mapping technology.

## Part 2: Progress and outcomes

Patients were recruited (following Plymouth university ethics approval and Trust registration for service improvement) after referral to the Tissue Viability service, predominately by the District Nursing service. Referrals consisted of patients with deteriorating pressure ulcers or patients reluctant to use pressure relieving equipment. However, as the knowledge of the project has spread, referrals were received from a wider range of the multi-disciplinary team such as Occupational Therapists, Wheelchair Services and Nursing homes.

Quantitative data were collected prospectively with each visit and entered into the database. Qualitative data were collected via patient questionnaires to capture brief details of their experience with the use of the pressure mapping system. This occurred through the use of Meridian, a web based system that allows the information to be collated electronically.

In total, 44 patients were included in the project between February 2016 and December 2016. A small proportion of these people lived in nursing/residential homes (n =8) with the majority being seen in their own homes (n = 36). Their ages ranged from 18-94 years (S.D 16.8years). Patients were predominantly bedbound, chair bound or wheelchair bound (79%) and unable to move independently. This is in line with the majority of patients having a frailty index of 7 and above (measured on the Rockwood Frailty Index<sup>1</sup>). Patients suffered from Neurological conditions, which were grouped into Multiple Sclerosis, Cerebral Vascular Event and Parkinson Disease. Patients who suffered from end stage dementia made up the second highest disease category.

Pressure injury ranged from no injury to grade 4, with the majority having grade 3 pressure injuries (see figure 2). Healing rates are presented in figure 3. Demographic results are summarised in tables 2-6

The feedback from the patients indicates that they found the pressure monitoring and mapping system invaluable, with some patients refusing to change to alternative equipment until the pressure map was used to show that it was safe to use. This appears particularly useful for spinal injury patients who do not have the ability to detect pain or comfort levels.

Where possible, additional quality measurements were captured including: reduction in pain, increase in sleep and the ability to sit out for longer periods of time, in addition to healing rates and the ability to prevent pressure injury as some patients did not have pressure injuries but had been reluctant to use equipment because of the above issues. The data collected were incomplete due to some patients' inability to respond to the patient questions i.e. due to dementia or end of life.

### a) Sources of the data and how easy it is to access

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<sup>1</sup> K. Rockwood et al. A global clinical measure of fitness and frailty in elderly people. CMAJ 2005;173:489-495.

The pressure monitor data from each patient were downloaded onto an external hard drive in order to upload to the software programme located on the NHS Trust's network server. This took some time to achieve but significantly reduced travel time and decision time with regards to patient management. The tissue viability team were educated in the use of the software programme to decrease the time to treatment and thus improve patient outcomes. Patient demographic data were obtained from routinely collected data in the patient notes in nursing homes and electronic records, to which the lead clinician normally had access. The results of the interventions and pressure monitor data were recorded in the electronic records and nursing home notes. Patient questionnaires have been collected using the Meridian survey system. The questionnaires were then coded using NVivo software.

#### **b) Validity and reliability of the data**

To ensure validity, reliability and avoidance of bias, the data downloaded from the monitor were reviewed using a pre-agreed format, which consisted of identifying the areas of concern i.e. sacrum, ischial tuberosity, etc. The highest pressure points were identified via the software analyser (taking into account patient movement and carer handling). The interface pressures were recorded for Peak Pressure, Peak Pressure Index over a 10cm<sup>2</sup> area (3x3 sensels) and gradient between the Peak Pressure and lowest pressure within this area, which represented the possibility of shear damage(2014)<sup>2</sup>. The codes generated the analysis of the qualitative data in the questionnaires were reviewed by a second reviewer in order to minimise bias.

#### **c) Information on how satisfactory your baseline numbers are in terms of data quality**

As this project was based in a real-world setting, with the majority of patients being assessed in their own homes in uncontrolled situations, the data were found to be incomplete. Patients were not always willing to use the map for a second time resulting in no comparison data. However, the fact that the patient was more comfortable, sleeping much better and that the wound healed or were healing, these reflect the success of the change of position or equipment. Equally the length of time the patient remained on the map varied, with some being short due to safety issues with leaving the patient on the map unattended. This resulted in the map being used for a snap shot in time as opposed to the intention of the project, which was to monitor for a long period. A risk assessment was undertaken to ensure the patient safety; this resulted in longer face to face contact or increased visits on the same day to remove the map when carers were available to help with moving the patient or alternatively remaining with the patient for longer periods than normal to ensure reliable data were obtained.

#### **Patient/Carer/Health care worker views:**

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<sup>2</sup> C Lung et al. Investigation of Peak Pressure Index Parameters for People with Spinal Cord Injury Using Wheelchair Tilt-in-Space and Recline: Methodology and Preliminary Report. Biomed Research International <http://dx.doi.org/10.1155/2014/508583>

A total of 50 questionnaires were submitted by 34 patients, 13 carers and three health care workers associated with a total of 44 patients. In some cases, patients were unable to respond, and in others the patient only responded (no carer involvement). The main themes arising from the carers were 'the ability to visualise the pressure points on the monitor using the colours as a guide in identifying high pressure points', 'ease of use of the technology', including any technical difficulties, 'understanding position change' using the colours as a guide and 'the request for the monitor and pressure map to be removed due to the map being slippery'. Two carers identified that the monitor became 'very hot', 'the lead became detached twice' and they remarked on the lack of portability of the monitor. 100% of patients, carers and health care workers found the technology useful for identifying high pressure points. Further results can be seen in Appendix 1. The most significant observation from the questionnaire comments was that the family were actively involved in using the colours on the monitor to identify high areas of pressure and react accordingly.

***Person Centred Care/Patient Safety:***

**“Gran children were very interested and kept saying "don't worry there are no red spots nanny"”**

**“Interesting, able to see when to turn and what happened when on side. Has enabled me to see pressures increase to hip and feet if completely on side”**

***Efficiency and Equity:***

**“Amazing to have this new technology available in Cornwall”**

**“Portability of monitor. Short lead. Monitor gets very hot.”**

***Effectiveness:***

**“Visual colours that help to quickly identify areas of the body which are vulnerable”**

***Timeliness:***

**“BEING ABLE TO VISUALISE OPTIMUM INTERVAL OF TIME FOR POSITION CHANGE”**

## Tables and Figures

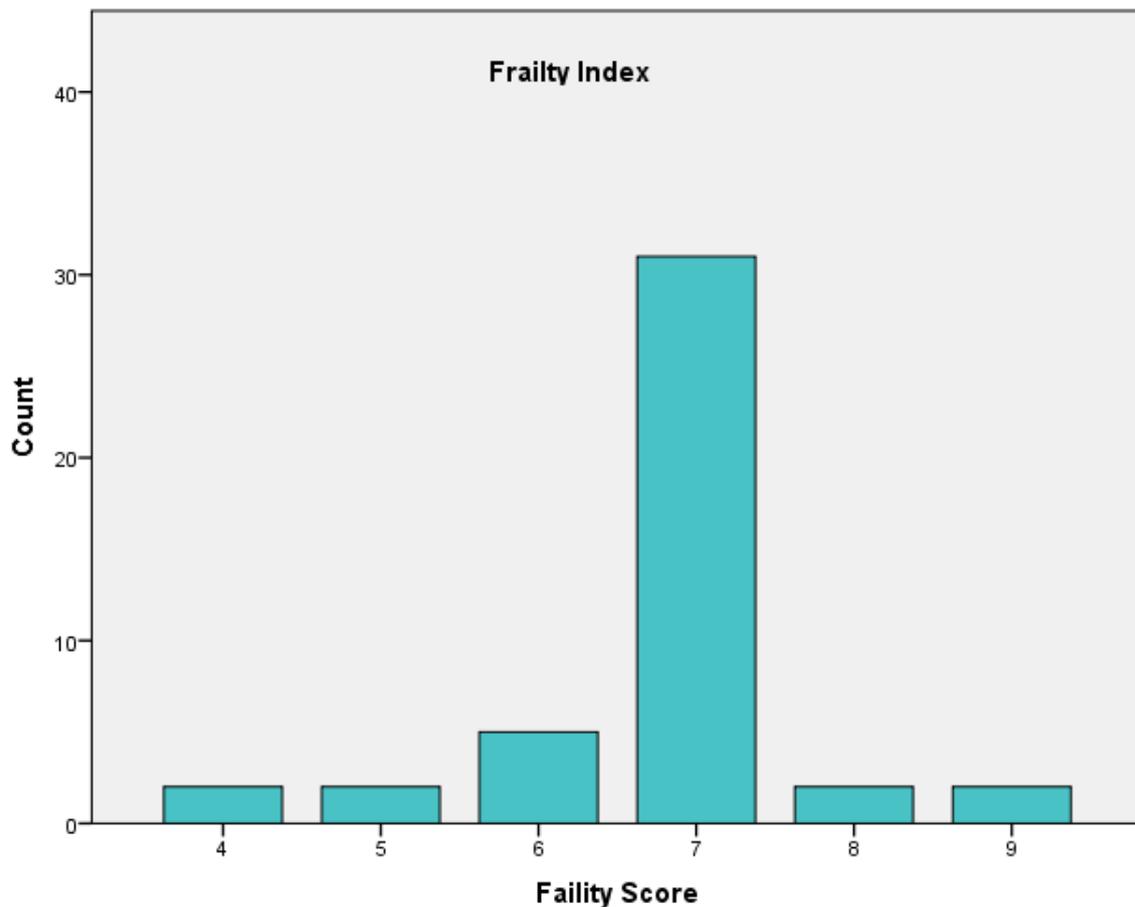
**Table 1: Percentage of responses in each coding area identified from questionnaires**

Source	Patient	Carer	Healthcare worker
Colour	31.03%	49.78%	36.89%
Comfort	30.62%	0%	0%
Removal	15.51%	0%	0%
Technology	4.4%	36.24%	56.44%
Understanding	21.88%	58.37%	36.89%

Source: Patient, Carer, Healthcare Worker Questionnaires

**Table 2: Demographic Data**

Demographic Data					
	N	Minimum	Maximum	Mean	Std. Deviation
Age	44	18.0	94.0	70.932	16.8777
Frailty Score	44	4	9	6.80	.954



**Figure 2: Frailty of the patients (using Rockwood Frailty Index)**

**Table 3: Demographic Data/ Gender**

	Frequency	Percent
Female	28	63.6
Male	16	36.4
Total	44	100.0

**Table 4: Location of Study Participant**

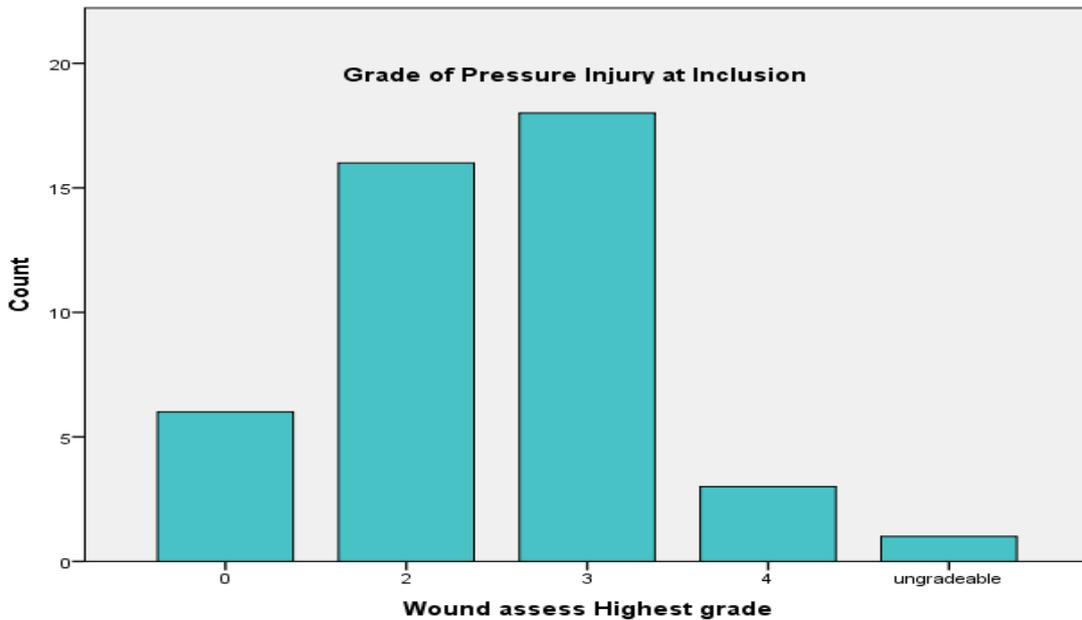
Location	Frequency	Percent
Home	36	81.8
Nursing Home	7	15.9
Residential Home	1	2.3
Total	44	100.0

**Table 5: Type of Monitoring**

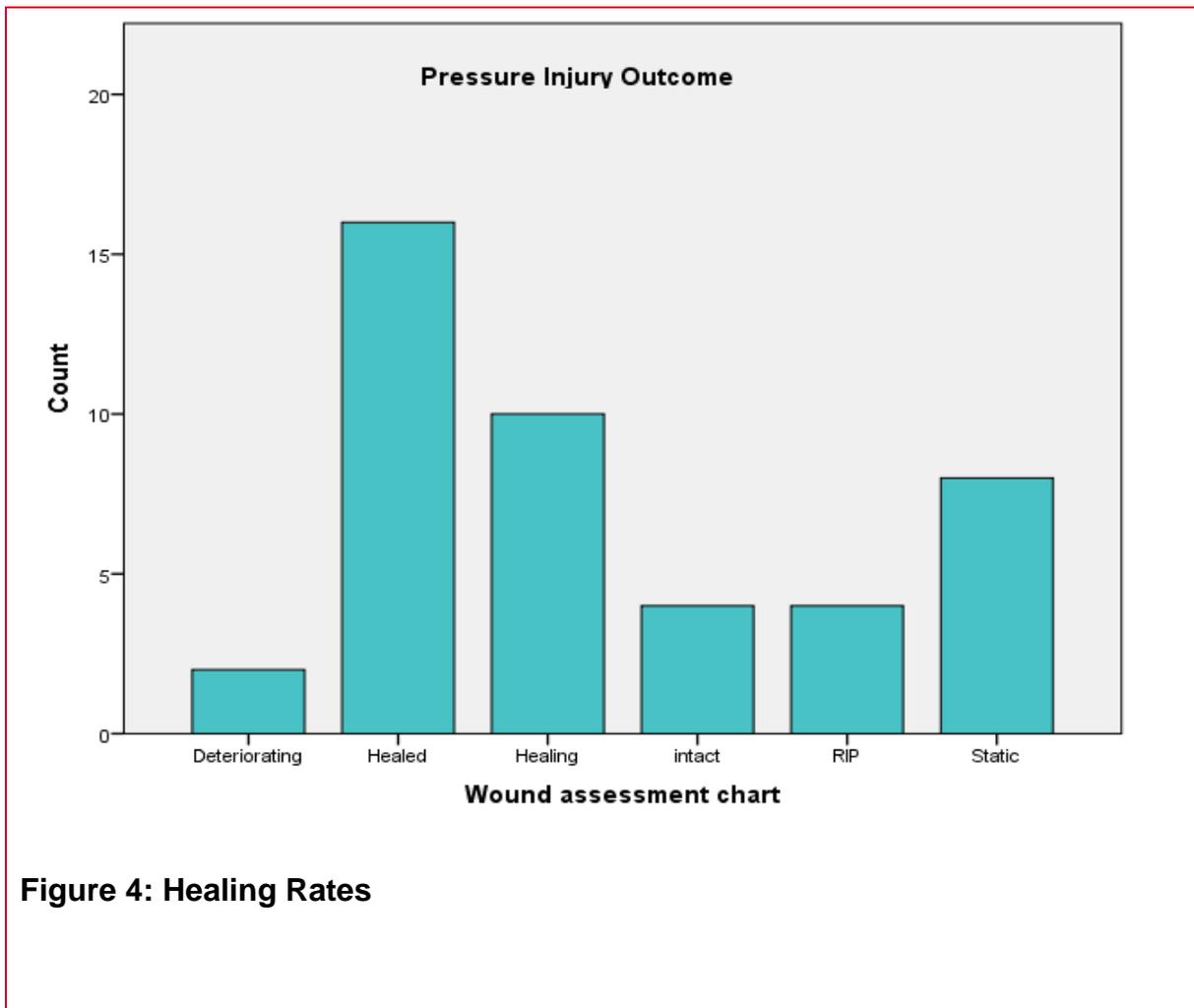
Monitoring type	Frequency	Percent
Mattress	8	18.2
Seat	7	15.9
Seat & Mattress	29	65.9
Total	44	100.0

**Table 6: Co-morbidity /Mobility**

Co-Morbidity	Mobility							Total
		Bedbound	Chair bound	Mobile +2	Mobile +aide	Needs prompting	Wheelchair	
	1	0	0	0	0	0	0	1
Arthritis	0	0	2	0	2	0	0	4
Cancer	0	0	1	1	2	0	0	4
Cardiac	0	1	0	0	0	0	0	1
Cardiac	0	1	0	0	0	1	1	3
Circulatory	0	0	1	0	0	0	0	1
Dementia	0	4	1	0	0	1	2	8
Diabetes	0	1	0	0	2	0	0	3
Neurological	0	4	4	0	0	0	5	13
Other	0	0	1	0	0	0	1	2
SCI	0	0	1	0	0	0	4	5
<b>Total</b>	<b>1</b>	<b>11</b>	<b>11</b>	<b>1</b>	<b>6</b>	<b>2</b>	<b>13</b>	<b>45</b>



**Figure 3: Pressure injury**

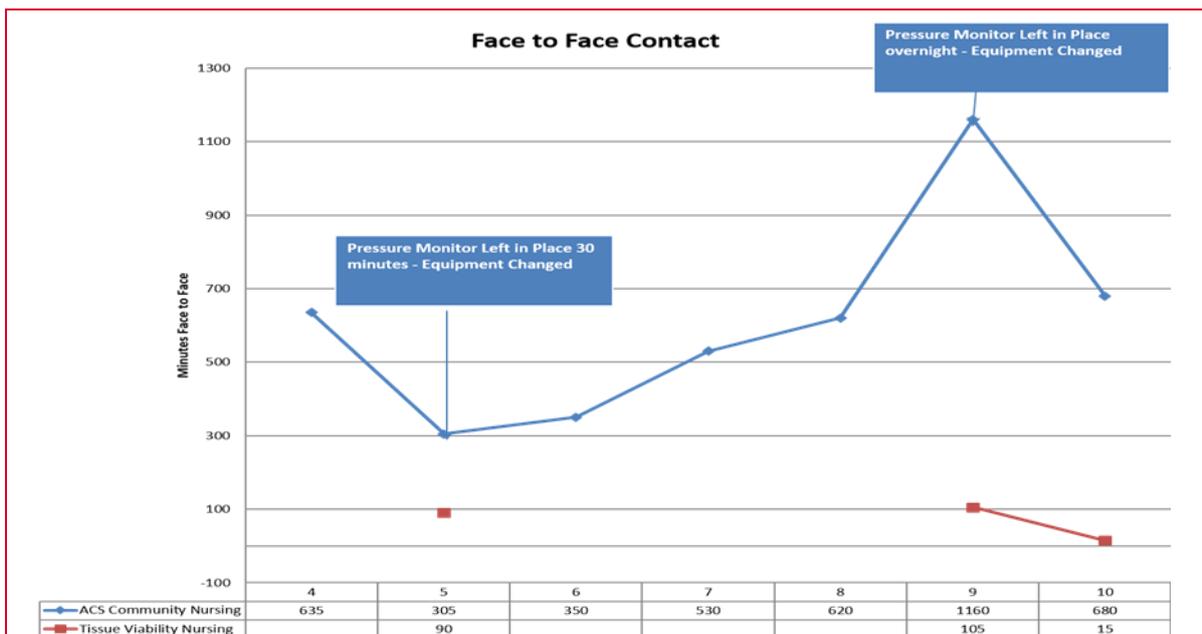


### Part 3: Cost impact

The principal costs related to this project were the capital costs for the technology and the specialist nursing time; with the savings associated with a reduction in prescribing of dressings and antibiotics, pressure relieving equipment, bed days, reduction in pain relief and reduction of community nurses visits along with a reduction in tissue viability specialist nurse contacts.

#### Service Delivery:

The project involved care being delivered by health carers graded bands 4-8 from the Tissue Viability Service, band 5-6 District Nurses, nursing home carers and registered nurses, domiciliary care workers patients, their carers and relatives. Figure 4 presents the changes in nursing and tissue viability nurse visits with 1 patient who was recruited to the study. There was a total of 100 hours of extra tissue viability nurse visits available as the result of the project. However, it is possible that had these patients not been recruited to the project additional visits would have been required from the tissue viability service for deteriorating pressure ulcers.



**Figure 5: Patient Face to Face Contact**

**Tissue Viability Time:**

The project was supported financially for 2 days each week from the tissue viability team, who spent an average of 136 minutes per patient on pressure monitoring. Not taken into account was the time required to analyse the data generated from the monitor or the time required to feed back to patients, relatives and carers.

**District Nursing Time/Nursing home RN and Carers/Domiciliary Carers:**

This was not funded through the project, however we identified that patients frequently required additional time from these services, particularly related to domiciliary carers when the patient required equipment to be changed and remonitored. This would need to be taken into account for future work.

**Financial Saving:**

The savings have been annualised in line with the DOH productivity calculator (2010)<sup>3</sup>. The grades of pressure injury of patients on inclusion to the study for the 40 patients recruited were entered into the productivity calculator. Four patients were excluded from the pre and post study cost calculations as they died shortly after inclusion into the study; these deaths were expected. One patient had an ungradable pressure injury debrided to a grade 3 pressure injury. The 40 patients generated costs of £285,000 using central estimated costs (Table 7), however post intervention these costs reduced to £177,000 using central estimated costs (Table 8). This resulted in a **gross saving of £108,000** plus an additional £1,281.00 savings for the year from the result of equipment changes required. £10,000/yr for capital costs were removed, assuming a life expectancy of 3-5 years for the

pressure maps, **resulting in a net saving of £99,281/yr.** There are a further 12 patients whose pressure injury is in the process of healing, with the potential that savings will increase still further; these have not been included in the above calculations.

It should also be noted that the number of grade 3 and 4 pressure injuries has reduced in Cornwall community setting from 75 in 2014-15 to 35 in 2015-16/17. Other interventions have also taken place therefore savings costs have not been calculated. However, it should be noted that the pilot project, which preceded this project, used the bed pressure monitor with patients in the community, took place in 2015-16.

**The final estimated costs for the year are £99,281 prior to the achievement of further healing occurring.**

**Table 7: Department of Health Productivity Calculator Pre-Intervention**

**Section A: Total number of pressure ulcers**  
 How many pressure ulcers does your organisation treat? (enter a number and press ENTER)  [Click to estimate section B](#)

**Section B: Pressure ulcers by grade**  
 How many pressure ulcers of each grade does your organisation treat?  
 The default numbers are based on percentages from the academic research study. Please overwrite if you are confident your numbers are different.

Grade 1	<input type="text" value="6"/>
Grade 2	<input type="text" value="18"/>
Grade 3	<input type="text" value="14"/>
Grade 4	<input type="text" value="2"/>
<b>Total</b>	<input type="text" value="40"/> (Total of section B must be the same as the number in section A)

[Click here to print](#)

**Section C: Results: Estimated cost of pressure ulcer care at 2008/09 prices (rounded to the nearest thousand £s)**

	Central	Lower range	Higher range
Grade 1	9,000	7,000	10,000
Grade 2	108,000	87,000	130,000
Grade 3	139,000	113,000	168,000
Grade 4	29,000	23,000	35,000
<b>Total</b>	<b>285,000</b>	<b>230,000</b>	<b>343,000</b>

**Section D: Potential savings if the number of pressure ulcers is reduced**  
 Enter a planned percentage reduction in the green box, to see the impact on number of ulcers, and cost pressures: %  
*A reduction of 0% in pressure ulcers would mean 0 fewer pressure ulcers and a potential cost saving of £0k*

**Table 8: Department of Health Productivity Calculator Post Intervention:**

**Section A: Total number of pressure ulcers**  
 How many pressure ulcers does your organisation treat?  
 (enter a number and press ENTER)  [Click to estimate section B](#)

**Section B: Pressure ulcers by grade**  
 How many pressure ulcers of each grade does your organisation treat?  
 The default numbers are based on percentages from the academic research study. Please overwrite if you are confident your numbers are different.

Grade 1	<input type="text" value="0"/>
Grade 2	<input type="text" value="4"/>
Grade 3	<input type="text" value="14"/>
Grade 4	<input type="text" value="1"/>
Total	<input type="text" value="19"/>

[Click here to print](#) (Total of section B must be the same as the number in section A)

**Section C: Results: Estimated cost of pressure ulcer care at 2008/09 prices (rounded to the nearest thousand £s)**

	Central	Lower range	Higher range
Grade 1	-	-	-
Grade 2	24,000	19,000	29,000
Grade 3	139,000	113,000	168,000
Grade 4	14,000	12,000	17,000
<b>Total</b>	<b>177,000</b>	<b>144,000</b>	<b>214,000</b>

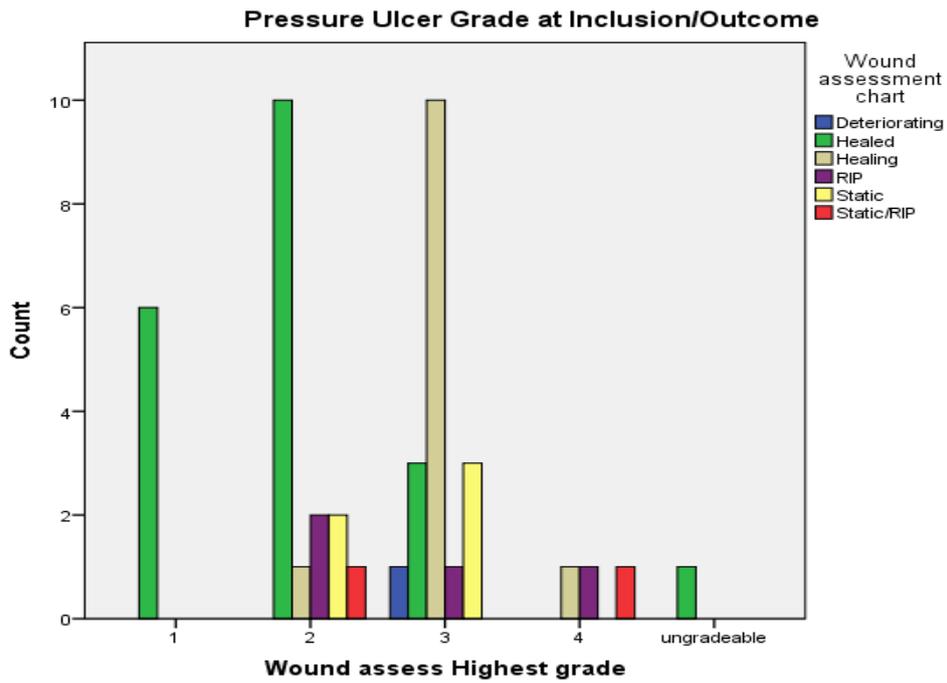
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 Enter a planned percentage reduction in the green box, to see the impact on number of ulcers, and cost pressures:  
%  
*A reduction of 0% in pressure ulcers would mean 0 fewer pressure ulcers and a potential cost saving of £0k*

**Health Economic Evaluation:**

It was the intention during the study to use the EQ-5L quality of life health economic calculator, unfortunately this proved unsuccessful due to the high number of patients with dementia. Further economic analyses are required for any future studies in this area.

**Confidence in measures:**

The DOH (2010) productivity calculator was used to estimate the savings related to the project to reduce the possibility of bias. The savings projected assume 1 year duration of the pressure injury. However, in many cases the pressure injury had been present for longer than a year. Figure 5 presents the outcomes achieved against the grade of pressure injury.



**Figure 6: Patient Outcome at End of project**

## Part 4: Learning from your project

The project has successfully achieved its objectives and, in many cases, far exceeded the expected outcomes.

The Knowledge to Action Cycle

(<http://ktclearinghouse.ca/knowledgebase/knowledgetoaction>) was the framework used during this project to guide the closure of the implementation loop thus leading to sustainability of the change in practice.

### **Identify Problem:**

It had been identified that large numbers of patients with grade 3 and 4 pressure injury were labelled as non-concordant and either refusing to or unable to use pressure relieving equipment.

### **Adapt Knowledge to local context:**

The technology used designed specifically for this project and adapted from a previous project to be able to monitor patients who were spending a large amount of their time sitting or sleeping in chairs.

It became apparent during the study period that patients' apparent 'non-concordance' was due to various medical pathologies, i.e. difficulty in breathing resulting patients unable to turn or lie down whilst in bed. This resulted in further adaptation required for community use and a change in understanding that bed rest was not necessarily the best thing for the patient when they would remain in the sitting position despite being in bed.

### **Assess Barriers to Knowledge Use:**

It became clear following data analysis that very few patients were actually non-concordant. 100% of patients agreed to changes in their treatment during the study, provided their lifestyle could be considered to enable them to fulfil a good quality of life and maintain as much as possible their independence.

### **Select, Tailor, Implement Interventions:**

Following discussion and agreement, patient centred care was achieved. Appropriate equipment was selected, resulting in the equipment suiting the needs of the patient as opposed to the patient conforming to a piece of pressure relieving equipment which did not enable this to happen.

Equipment companies do not appear to develop equipment with community patients in mind, resulting in patients having to alter or medicalise their homes to achieve adequate pressure relief. By using the monitor, we were able to enable patients to continue to sit out in their chairs for 12 hours with existing grade 3 pressure damage; this goes against current practice guidelines. It is therefore proposed that the use of the pressure monitor will enable a review of the evidence base.

### Monitor Knowledge Use:

The patients in the study have been monitored on a continuous basis for short periods to see if changes have been maintained. Initial agreements were only changed during the life of the project if the patients' condition improved or deteriorated and only with further use of the pressure monitor to ensure correct selection of equipment. In some cases, this resulted in patients trying up to 5-6 mattresses/cushions to ensure the safety of the patient and that their needs were met.

### Evaluation of Outcomes:

The outcomes are those demonstrated in figure 6.

### Sustain Knowledge Use:

Following use of the monitor it became clear the study group had become divided into two distinct arms; i) medical device relating pressure injuries, ii) non-concordant patients, with the overarching group of patients obtaining pressure injuries being classed as unavoidable (see Table 9).

**Table 9: Participant Outcome**

	Unavoidable Pressure Injury			
	Static/Deteriorating	Healed/Healing	Preventative	RIP
Medical device related	3	13	2	1
Non-Concordant	7	13	2	3
Total	10	26	4	4

During the project, knowledge tools were developed to aid the selection of the equipment according to patients' needs. This has resulted in the elimination of certain products from use in Cornwall and the utilisation of an equipment matrix, which is still in the process of being evaluated. This information will further inform the knowledge generation part of the model (the Knowledge Funnel of the KTA).

Initially there had been recruitment issues and so future work would need to focus on generating greater buy in from stakeholders. Full utilisation of focus groups was not achieved during the project period.

The geography of Cornwall did prove a challenge initially. This was resolved by having the software loaded onto a central NHS server, allowing review of the data by all members of the team, from anywhere in the county without the need for increased travel time incurred by getting back to base. The resolution of this issue has resulted in a reduction in travel time and increase in speed to decision making and future management of the patient. On reflection, the IT department should have been part of the original stakeholder group.

It also became apparent that patients in nursing homes had access to a narrower range of equipment resulting in it not always being possible to find the most

suitable equipment that provided the best level of interface pressures. Equally patients in their homes, despite changes to equipment, would still remain in the seated position or in a sleeping position for 12 hours at a time due to the social support provided.

## Part 5: Sustainability and spread

We have successfully achieved significant contributions to the existing body of evidence related to unavoidable pressure injuries and healing pressure injuries in the community which I believe will result in changes nationally, generating much greater and positive impacts. Further work is required to gain greater understanding in this area and determine if this can be achieved with a much greater patient population to investigate its generalizability.

### Activities to Date:

We have been spreading the knowledge obtained from the project since the beginning:

- I won the BJN Tissue Viability Nurse of the Year Award 2016 in March 2016
- I presented at EPUPA in September 2016
- I presented at Wounds UK 2016 and won the Award of Excellence
- I presented to the CCG executive boards in 2016

### Future Plans:

We have been discussing collaborative projects with Southampton University to extend and enhance the research in this area. The intention is to:

- Apply for Spreading the improvement – Health Foundation Bid in March of this year to enable spreading of learning from this project to the wider community across Cornwall.
- Apply for further capital bids to enable further purchasing of pressure monitors to increase availability in the community.
- Applying for Scaling up – Health Foundation Bid in Autumn of 2017 to determine generalizability of the project across a wider health care arena.
- Publication of findings in national journals.
- Further presentations at EPUAP 2017 to disseminate findings.

## Appendix 1: Resources and Appendixes

### Meridian Questionnaires and comment analysis



CARER.patient  
QUESTIONNAIRE MA:



Health Care Worker -Comment Analysis 6.2.17.pub

## Comments from Questionnaires

### Carers:

Comment
being able to see the red areas
understanding if mattress the right one
The plug became detached twice. I had to find out why the equipment switched off.
seeing the red areas
the monitor and the colours
seeing the red areas
Amazing to have this new technology available in Cornwall
Portability of monitor. Short lead. Monitor gets very hot.
Confirmed areas of high pressure. Reassuring to see pressures not as bad as thought would be
MONITOR VERY HOT
BEING ABLE TO VISUALISE OPTIMUM INTERVAL OF TIME FOR POSITION CHANGE
seeing the red areas
Able to see what areas of pressure when repositioned
Being able to pin point pressures to skin
INTERESTING WHAT IT SHOWED

### Health Care Worker:

Comment
Visual colours that help to quickly identify areas of the body which are vulnerable
The monitor switched off ? over heated
Ease of use
USB cable came out of the monitor which was possibly removed by the patient.

**Patient Comments:**

Comment
Unfortunately turning during the night is not practical as I cannot sleep on either side
Found I was slipping to the end of the bed
Unable to say why
4) Poor nights sleep
unable to be specific about why she disliked having the equipment in situ
Very clever. Liked to look at the pictures. fascinating watching it.
I felt the pressure mat was very uncomfortable and had difficulty in sleeping.
Gran children were very interested and kept saying "don't worry there are no red spots nanny"
5 Patient does not go to bed and sleeps in a chair
it was really good but found it very slippery
Its amazing
Good reminder for position changing Slippiness helped with stretching upwards, but caused slumping following stretch
Discussion with wife about the red areas on the monitor.
very good
Patient has been slipping down bed prior to pressure monitor going on.
Unhappy with the pressure map device, wanted it taken off, found it too slippery.
It will be helpful to find the right cushion
Happy mapping has been completed, hope it helps
<b>INTERESTING, BUT A BIT CONFUSING</b>
Interesting, able to see when to turn and what happened when on side. Has enabled me to see pressures increase to hip and feet if completely on side
Question 7 - I did not look at the monitor
7 - Could not see the monitor 6 - Question no applicable as I do not sleep in a bed
Used the seat map on perching stool. not safe to leave in place as too slippery
<b>VERY USEFUL TOOL TO SEE PRESSURES HELPED A LITTLE</b>

## Patient Information/ Photographic Consent Form/GP Letter/Appointment letter



APP28629012016 -  
Foresite Pressure Ma



Consent Form for  
Medical Photographs.



Pressure Mapping  
GP Letter.doc



Template Pressure  
Mapping Appointment

## The Health Foundation – Innovation for Improvement - Process – 15<sup>th</sup> Jan 2016



Conference Poster Presentation:

# Can pressure monitoring of interface pressures improve patient safety in the community?



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Bridie Kent  
Plymouth University, England

For the last two years, Nicci Aylward-Wotton has been trialling ForeSite PT – a system that constantly monitors and records interface pressures of a patient in bed. ForeSite PT also has a timer that reminds clinicians and carers when it's time to reposition a patient.



## Nicci Aylward-Wotton

Nicci Aylward-Wotton is a Tissue Viability Nurse Consultant for Peninsula Community Health, a not-for-profit company providing community-based health services to adults in Cornwall and the Isles of Scilly and NHS services through Community Hospitals, Minor Injuries Units and Community Nursing Teams.

## ForeSite PT

The ForeSite PT system consists of a fitted mattress cover embedded with thousands of sensor cells that continuously measure the patient's body surface pressures, and a touch screen monitor that displays real-time images of elevated pressures. ForeSite PT's software displays pressure markers that clearly identify areas of the body that have been under sustained pressure. The patient turn clock tracks the time since the last reposition, visually notifying the clinician that it's time to adjust the patient's body position.



## Phase 1. Community hospital evaluation study

### Methods

Patients assessed as high risk of developing pressure ulcers using an adapted Braden Scale were placed on ForeSite PT for 2-3 days. Care was in accordance with local pressure ulcer prevention policy.

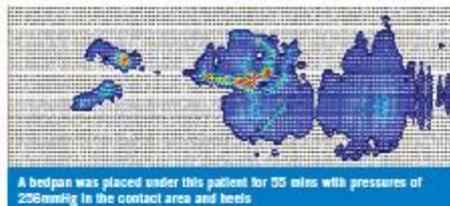
### Results

3 out of 6 patients with pressure ulcers healed with the remaining 3 improving over the 3 day period and continued to improve. No patients developed pressure ulcers whilst on the PT system.

### Nurses' comments

All were extremely favourable. Use of ForeSite PT resulted in changing attitudes towards pressure ulcer prevention. Patients were more aware of high pressure sites and it was useful to teach positioning to patients and other nurses.

### Undetected pressure points were revealed:



A bedpan was placed under this patient for 95 mins with pressures of 236mmHg in the contact area and heels

### Conclusion

This is a new system which enables clinicians to check the appropriateness of turn cycles and positions adopted. New information was gained about hidden pressure areas. Patients responded to the images on the monitor and requested to be turned in line with the turn clock. In some cases concordance improved.

## Phase 2. Non-concordant patients in a community setting

### Recruitment

Patients were non-concordant and at high risk of developing pressure ulcers. The patients were either refusing, reluctant to use equipment or current equipment was not effective or uncomfortable.

### Results

73% healed and 13% healing (46% within 12 weeks). Peak pressure reduced significantly from baseline. Average equipment costs were reduced from £204/pt to £186/pt saving £84,852.

### Conclusions

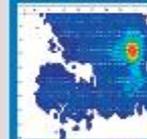
Monitoring of interface pressures in the patient's home appears to facilitate patients adjusting their positions according to the images on the screen.

### Case Study: 58 year old man with spinal cord injury



- Chair bound, unable to sleep in bed due to social situation
- Spends 24 hours in recliner chair
- Grade 3 pressure ulcer developed mid spine
- Repose chair cushion placed behind back following identification of increased pressure over spinal area with pressure monitor

Before Intervention:



Peak Pressure: 256 mmHg  
Average Pressure: 25.35 mmHg

After Intervention:



Peak Pressure: 47.12 mmHg  
Average Pressure: 23.96 mmHg  
After intervention with Repose cushion

## These findings suggest ForeSite PT can help to:

- Reduce incidence and healing time of pressure ulcers
- Reduce hospital admissions & community equipment costs
- Provide nurses with real time information
- Enhance quality of life for patients and their carers
- Identify potential reasons for non-concordance

# Can ForeSite PT facilitate patients and carers decision making in pressure injury detection in the community using continuous pressure monitoring?

West of England  
General Practitioner  
Foundation Trust, England  
Healthcare Research Institute  
Exeter City, in Living  
 Plymouth University, England

Corwall Partnership  
NHS  
www.nhs.uk

## Xsensor ForeSite PT

The ForeSite PT system consists of a fitted mattress cover embedded with thousands of sensor cells that continuously measure the patient's body surface pressure, and a touch screen monitor that displays real-time images of elevated pressure.



ForeSite PT displays pressure markers that clearly identify areas of potential pressure injury.

There is also a patient turn clock which tracks the time since the last reposition and notifies the clinician, carer or patient that it's time to change position.

## Aim

Identify if Xsensor ForeSite PT can assist patients in the community to manage their own pressure injury risks more effectively.

## Method

Patients recruited that were non-concordant and at high risk of developing pressure injury, or had existing non-healing pressure injury.

Data analysed at 3 time points:

- 1 hour after start of monitoring
  - Midpoint
  - 1 hour before the end of monitoring
- Changes agreed with patients following joint review of the findings.

## Clinical Relevance

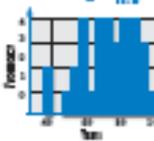
- Technology has the ability to:
- Influence patient and carer decision making
  - Achieve good clinical outcomes
  - Reduce costs
  - Visualise in real time the effects of pressure relieving equipment over a 24 hour period
  - Reduce the number of avoidable pressure injuries

## Preliminary results

### Patient gender



### Patient age

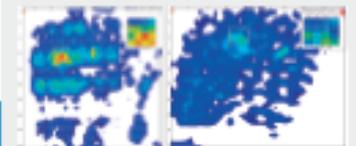
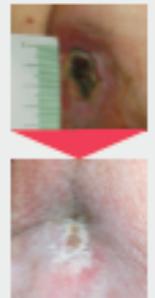


### Pressure Injuries

	HRP-RCAL-00 (n=12, 52%)	HRP-CORCORAL (n=20, 84%)
<b>HRP-RCAL-00</b>	0	2 (10%)
<b>HRP-CORCORAL</b>	3 (25%)	7 (35%)
<b>HRP-RCAL-00</b>	3 (25%)	9 (45%)
<b>HRP-CORCORAL</b>	0	1 (5%)
<b>DTI</b>	3 (25%)	3 (15%)
<b>HRP-RCAL-00</b>	3 (25%)	12 (60%)
<b>HRP-CORCORAL</b>	0	8 (40%)
<b>HRP-RCAL-00</b>	3 (25%)	1 (5%)
<b>HRP-CORCORAL</b>	3 (25%)	2 (10%)

## Case Study

- 75 year old lady with Parkinson's disease
- Pelvic rotation, leaning heavily to left
- Developed grade 2 IT pressure injury
- Reduced time sat out in chair (health care decision)
- Pressure monitor showed high pressure on 5 cushions with standard star recliner chair
- New chair with moulded cushion
- Eventually new chair with air flotation
- Healed in 5 weeks – sitting out for 12 hours (patient's choice)



**Conclusions.** The technology empowers patients and enables pressure ulcer prevention to be truly patient centered by fitting the equipment to the patient and not the patient to the equipment. Industry needs to work more with patients in their own homes to develop equipment which takes into account the reality of living at home with minimal support structures.

## Research aims to combat pressure ulcers



**Miss Amy McSweeney**

Media and Communications Officer

12 November 2015 A research project being conducted by a Plymouth University academic aims to reduce the likelihood of frail patients developing pressure ulcers by identifying pressure hot spots.

Professor Bridie Kent, Head of the institution's School of Nursing and Midwifery, is leading the research alongside **Nicci Aylward-Wotton** from Peninsula Community Health (PCH), entitled 'Improving pressure damage detection in the community using continuous pressure monitoring of patients'.

The project will involve using new technology, in partnership with developers Sumed, to identify hot-spots of pressure, generated when patients sit in one position for long periods. For people in the community who have limited mobility, this innovative technology can identify pressure ulcer risk much earlier, allowing the patient to adjust their position accordingly and so help prevent any actual damage occurring.

Funded by The Health Foundation, an independent health care charity, as part of its £1.5 million innovation programme, Innovating for Improvement, the project will focus on older people living in the community in Cornwall, but the technology could eventually be rolled out nationwide if its results are successful.

It is anticipated that over a 12-month period, around 50 patients from across the Duchy will be recruited to the project.

Professor Kent said: "Around half a million people every year develop at least one pressure ulcer, many with an underlying health condition or higher levels of frailty. Five to seven severe cases are reported each month in Cornwall and the county has a higher than average elderly population. That makes it the perfect place to conduct the research.

"Most pressure ulcers develop while patients are in their own homes, but research and technology has tended to focus on the hospital setting. Moreover some patients have said they are reluctant to use pressure relieving equipment as it can be uncomfortable, hot and noisy.

“By introducing continuous pressure monitoring, coupled with patient and carer education, it will be possible to determine if pressure ulcer risk can be self-managed by patients.

“It’s about preventing the ulcers, as well as curing them, which can only be a good thing for those who have limited mobility and are at greater risk.”

## Tissue Viability Nurse of the Year



### Nicci Aylward-Wotton

Tissue Viability Nurse Consultant  
Cornwall Partnership NHS Foundation Trust

#### Describe the work you have done which resulted in you winning a BJA award

The award was owing to the use of a pressure monitor in the community to enable patients, carers and practitioners to manage and prevent pressure ulcers. The pressure monitor provides a visual image of interface pressures, increasing awareness of the pressure points that increase the risk of pressure damage. Patients can then adjust their position and practitioners can change equipment to meet the needs of the patient. The images are recorded and analysed with the patient ensuring that the patient remains in control and living a full and normal life. The system has helped to ensure that pressure-relieving equipment is used to meet patients needs as opposed to patients changing their lives to suit equipment. The use of the monitor has resulted in 62% healed or healing wounds, with 100% change in equipment/position or behaviour in the Trust. [AQ1: what do you mean 100% change in position, please clarify?]

Sponsor:

Supported by:

#### How do you think winning this award will affect your practice in the future?

Winning this award has provided me with recognition of the work I am doing and increased my confidence and enthusiasm to continue pursuing improved patient outcomes. It has made me realise that other people value the work my team and I are doing in Cornwall by giving us national recognition.

#### How has winning this award changed people's perception of your role?

This award has increased the profile of the tissue viability team in my trust and will, I am sure, increase the level of support for tissue viability roles and the team in the future.

#### What is the most important aspect of your role and why?

To improve patients lives by giving them back control and enabling them to live a normal and fulfilling life.

#### What do you most enjoy about your role?

Spending time with patients and teaching practitioners to improve care and raise standards. Exploring new ways of working, pushing the boundaries and challenging practice to find new and improved ways of working.

#### What are your main concerns about your role?

Being given the time and support to change practice and implement changes that I know are needed.

#### What advice would you give to nurses aspiring to achieve positive change?

Persevere. Be positive about what you are trying to achieve. Be understanding about the challenges that practitioners face. Look together at alternative solutions. You will get there in the end.

