

# The Effectiveness of Dolphin Therapy Fluid Immersion Simulation Support Surface

*Outcomes for Over 3,000 Highly Complex Patients*



**medstrom<sup>+</sup>**

Improved Patient Outcomes

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# Abstract

## Introduction:

Between November 2015 and January 2023 outcome data was collected for 3,226 highly complex patients nursed on a Dolphin Therapy support surface. The main outcomes recorded were skin integrity/healing, comfort, pain management, sleep, turning frequency and compliance with care. Patients were grouped at the start of placement as either “prevention” (no skin damage) or “treatment” (existing skin damage).



## Method:

Patient data was collected using a bespoke electronic data capture form. A study identity number was allocated to each patient to anonymise the data.



## Results:

In the prevention group, 98% of patients' skin remained intact (no visible damage) whilst nursed on Dolphin Therapy. In the treatment group, 58% of skin damage healed or improved whilst on Dolphin Therapy, including wounds nursed directly on the surface, and 3% of skin damage deteriorated. An analysis of skin healing rates demonstrated Category IV pressure ulcers healed faster on Dolphin Therapy in comparison to published studies.

For the other outcomes, the percentages where they were fully or partially met were as follows: Improved comfort, pain management and sleep: > 99%; reduced turning frequency: 98%; improved compliance with care: 94%.



## Discussion:

Given the complexity of the patients nursed on Dolphin Therapy, the results were outstanding for all outcomes. It proved highly beneficial for many complex patients both with and without skin damage. Results suggest that early adoption can help reduce patient suffering, prevent complications such as skin damage, improve efficiency and reduce costs.

# Introduction

**Over the last 15 years, the phrase “complex patient” has been used with increasing frequency across all healthcare settings. The definition, however, is often unclear and highly variable.<sup>1</sup> Therefore, what makes a patient complex and what is the context?**

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A literature review<sup>1</sup> identified a consistent theme with complex patients was the presence of concurrent conditions, with terms like “comorbidity,” “multimorbidity,” “polypathology,” “dual diagnosis,” and “multiple chronic conditions” commonly used. In practice, it is generally accepted that complex patients often have multiple comorbidities, or the potential to develop them rapidly due to unpredictable fluctuations in their physiological status.

In England, the biggest growth in emergency hospital admissions has come from patients with multiple conditions (complex patients). In 2006-7, one in 10 patients admitted to hospital as an emergency had five or more conditions. In 2015-16, the number had increased to one in three.<sup>2</sup> Complex patients stay longer in hospital and are more likely to be readmitted.<sup>3</sup> Increased nursing vacancy rates<sup>4</sup>, coupled with unprecedented post-pandemic pressures, means

“In England, the biggest growth in emergency hospital admissions has come from patients with multiple conditions.”

the need for equipment which can assist staff in treating complex patients has never been greater. An example is the choice of support surface, which can play a critical role in clinical outcomes. Many complex patients spend extended time nursed in bed, presenting a high risk of pressure ulcers.

However, the choice of mattress is not solely based on pressure ulcer risk; patients require sleep, comfort, rest, and pain management as part of their holistic care,<sup>5</sup> and the mattress can have a positive or negative impact on all of these.

Dolphin Therapy is a unique reactive support surface that simulates a fluid environment. Using technology initially developed by the United States Navy to keep dolphins buoyant during lengthy out-of-water transportation, it enables full immersion and envelopment of the patient. Research has demonstrated that it maintains tissue symmetry,<sup>6</sup> minimises vascular occlusion<sup>7</sup> and prevents tissue ischaemia,<sup>8</sup> even when the patient is nursed directly on a wound.

Dolphin Therapy has a wealth of established qualitative and quantitative evidence, confirming its credibility for providing an effective solution for pressure area care and other challenging aspects surrounding highly complex patients. The growing evidence base now includes a quantitative data-set of 3,226 patients, which are analysed and presented in this report. This evaluates factors including skin integrity, comfort, pain management, turning frequency and compliance with care.



# Method

**A bespoke electronic data capture form was developed for use on an iPad. A systematic and structured set of questions allowed data to be collected to provide a comprehensive history and journey for each patient.**

Data was collected by Medstrom Clinical Advisors working within Trusts/Health Boards with permission granted prior to submission. It was anonymised by allocating an identity number to each patient which had no relation to their hospital number, NHS number or any other personal details. Some of the key data collected included:

- + *Date of admission*
- + *Patient age, gender and pressure ulcer risk score*
- + *Past medical history and current clinical conditions*
- + *Date Dolphin Therapy commenced*
- + *Reason for Dolphin Therapy placement*
- + *Skin damage – category, number and location(s)*
- + *Objectives for the patient*
- + *Reason and date Dolphin Therapy placement ended*
- + *Outcomes*

# Results

**Data was collected for a total of 3,226 patients from over 100 sites including hospitals, nursing homes, hospices, and private homes. Due to everyday pressures and challenges in caring for highly complex patients, it was not always possible to collect complete data sets for every patient.**

The numbers and/or percentages reported in each section below represent the total number of patients where data was recorded, available and collected.

1. **First, the data for the 3,226 patients collected from 2015 to 2023 will be examined.**
2. **This will be followed by additional data analysis from 2021 onwards for 1,470 patients.**



## Patient Overview

### Demographic:

The average age of the patients was 57 years old. **The oldest was 101 years old and the youngest less than one year old.** Of these, 1,504 (47%) were female and 1,707 (53%) were male.

The patients had highly complex needs, with many having multiple life-limiting or life-threatening debilitating conditions (Figure 1).

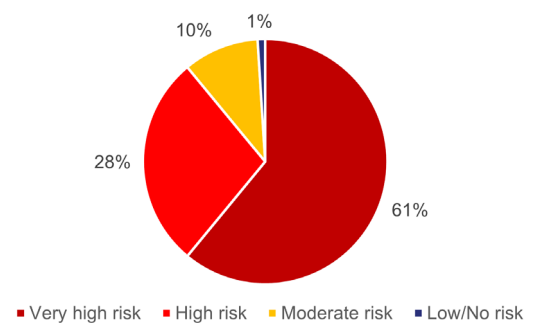
### Prevention vs. treatment:

Patients were classified into one of two groups when Dolphin Therapy placement commenced so outcomes could be more accurately tracked and monitored:

- + **Prevention:** Patients without existing skin damage
- + **Treatment:** Patients with existing skin damage

### Pressure ulcer risk score:

The risk scores of 3,050 out of 3,226 patients were recorded using a combination of Waterlow, Braden, Glamorgan and Traffic Light (including Purpose T) assessment tools. **A total of 2,715 patients (89%) had a risk score of high or very high (Figure 2).**



**Figure 2.** Percentage of patients with very high, high, moderate, and low/no risk scores.



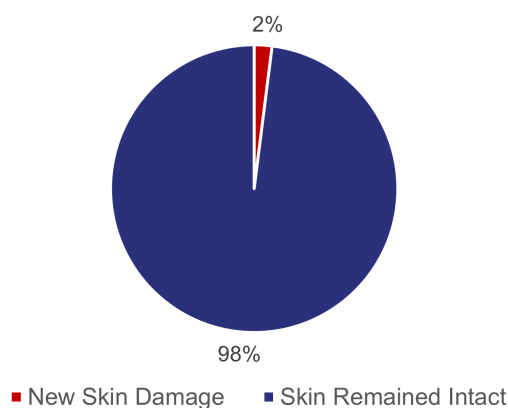
**Figure 1.** Frequent and multiple clinical conditions commonly observed in Dolphin Therapy users.



# Prevention Patients

A total of 1,036 patients out of 3,226 (32%) had intact skin when Dolphin Therapy was commenced. Common reasons for placement in this patient group included: clinical condition didn't allow repositioning, extended periods in surgery, patient deterioration, pain management and patients at end-of-life.

Of these, 25 patients (2%) developed new skin damage whilst on Dolphin Therapy and 1,011 (98%) did not (Figure 3). **Dolphin Therapy was therefore 98% effective at preventing skin damage.**



**Figure 3.** Percentage of prevention patients who developed new skin damage versus skin remaining intact.

The notes of the 25 patients who acquired new skin damage included:

- + Clinical condition deteriorated
- + Patient at end-of-life
- + Nutritional status deteriorated
- + Damage caused by other equipment (e.g. pillows placed between the patient's legs, oxygen mask, patient sitting out of bed but not on a cushion)
- + Patient non-compliant with repositioning
- + Mattress deflated during resuscitation

## Prevention Statistics

32%

Patients with intact skin when placed on Dolphin Therapy

1,011

Number of patients with intact skin who did not develop any new skin damage

98%

Effectiveness at preventing skin damage

# Treatment Statistics



Had existing skin damage before being placed on Dolphin Therapy



Areas of skin damage recorded



Skin damage healed, improved or remained static

Figure 5 (adjacent). Skin condition at the end of Dolphin Therapy placement for treatment patients.

# Treatment Patients

A total of 2,190 patients out of 3,226 (68%) had existing skin damage before being placed on Dolphin Therapy. They were classified by pressure ulcer Category (I to IV, unstageable and deep tissue injury) or moisture-associated skin damage (MASD) (Figure 4).

There were 4,745 areas of skin damage recorded altogether, indicating that many patients had multiple wounds. Other skin damage not shown in Figure 4 included burns, flaps and grafts.

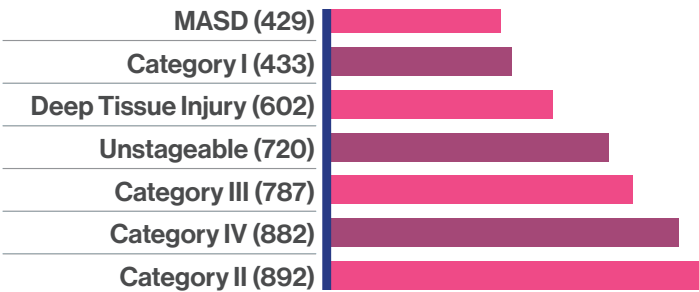
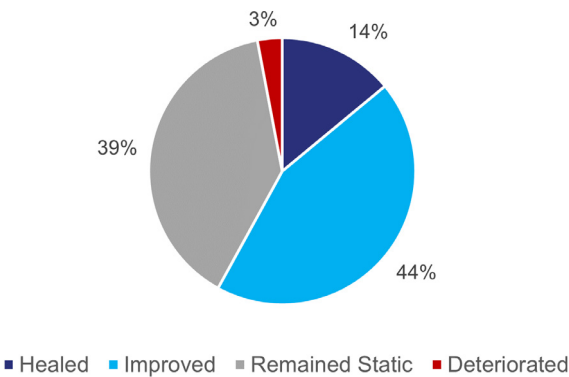


Figure 4. Breakdown of skin damage in treatment patients by category of pressure ulcer and MASD.

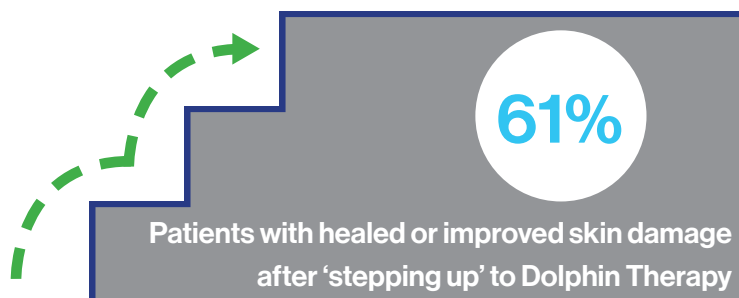
In the treatment patient group, 58% of skin damage had healed or improved at the end of Dolphin Therapy placement and 39% remained static (Figure 5). Notes of the patients whose skin had deteriorated included:

- + Tissue necrosis, unable to debride
- + Patient condition deteriorated
- + Patient refused nursing intervention
- + Patient at end-of-life
- + Worsening nutritional status
- + Vascular insufficiency



# 'Stepping Up' Patients

Of the patients previously nursed on a traditional alternating mattress who were 'stepped up' to Dolphin Therapy, 61% had healed or improved skin damage at the end of the placement.



## Other Outcomes

Upon first placement of Dolphin Therapy, nursing staff were asked to identify additional objectives for a patient. This included comfort, pain management, sleep, reduced turning frequency and compliance with care.

The number of patients who had these objectives with completed outcomes are shown in Figure 6.

	Outcomes				
	Improved Comfort	Improved Pain Management	Improved Sleep	Reduced Turning Frequency	Improved Compliance with Care
Total Patients with Objective and Outcome Completed	1,852	1,444	955	1,085	876
Outcome Fully or Partially Met	1,846 (>99%)	1,441 (>99%)	948 (>99%)	1,059 (98%)	827 (94%)
Outcome Not Met	6 (<1%)	3 (<1%)	7 (<1%)	26 (2%)	49 (6%)

Figure 6. Outcome results by number of patients and expressed as percentages.





## Patient Overview

In 2021, an upgrade was made to the electronic data capture form, allowing extra data to be collected which could be further analysed. The data collected on this new form comprised of 1,470 patients.

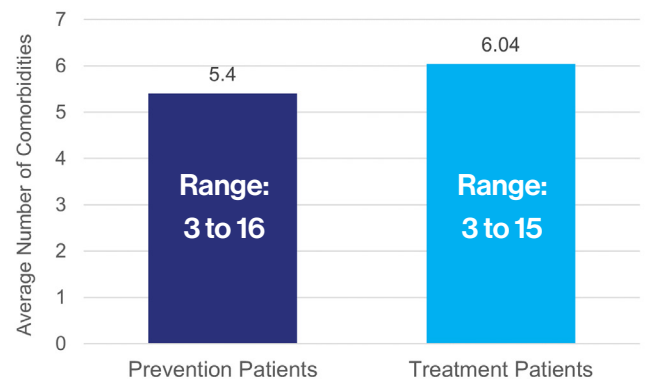
### Number of comorbidities:

The new form allowed the number of comorbidities to be counted, allowing patient complexities to be analysed in more detail. **A total of 1,181 patients had sufficient clinical condition information recorded.** In this group (also see Figure 7):

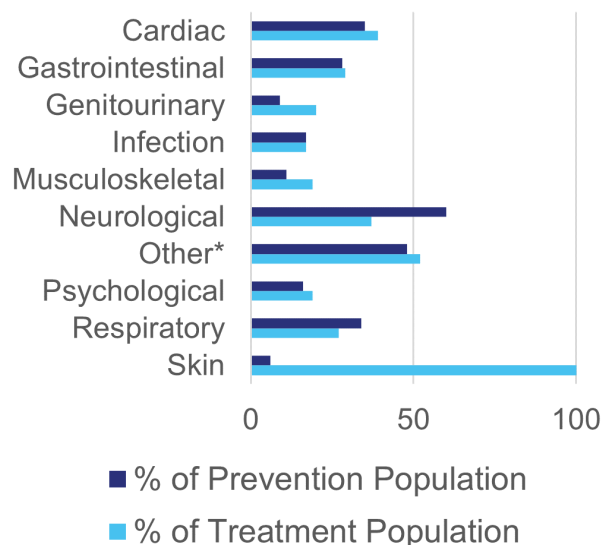
- + The **prevention patients** (398) had a total of 2,151 clinical conditions. The mean was 5.40 conditions/comorbidities per patient. The smallest number was three and the largest 16.
- + The **treatment patients** (783) had a total of 4,731 clinical conditions. The mean was 6.04 conditions/comorbidities per patient. The smallest number recorded was three and the largest 15.

### Clinical conditions categorised:

Clinical conditions were categorised into 10 groups. A simple count was performed where each patient was given a score of 1 if they had at least one condition within a category, and a score of 0 if they did not. Percentages of patients with at least one clinical condition in each category were calculated (Figure 8). The most common category in treatment patients was skin, and neurological in prevention patients.



**Figure 7.** Mean number of clinical conditions (comorbidities) per patient, and the number range.



**Figure 8.** Percentage of patients with at least one clinical condition in each category. \*Common conditions that featured within the 'Other' category included: amputee, end-of-life, diabetes, extended surgery and trauma.

# Nursing Directly on the Wound

Another upgrade to the 2021 form was to collect richer details in regards to skin damage, including specific location and whether patients were nursed directly on their wound.

A total of 1,400 wounds (82%) were directly nursed on Dolphin Therapy and 312 (18%) were not. At the end of their placement, 58% of wounds nursed directly on the surface had healed or improved, and only 2% had deteriorated (Figure 9).

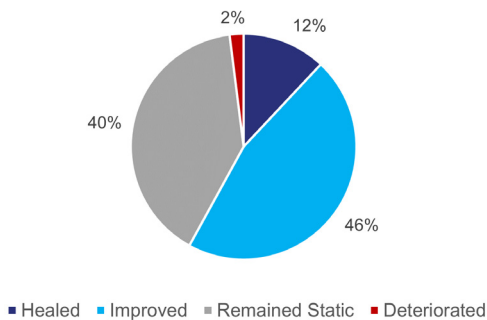


Figure 9. Directly nursed-on wound outcomes for treatment patients.

The top three locations of skin damage were the sacrum, buttock and heel (Figure 10).

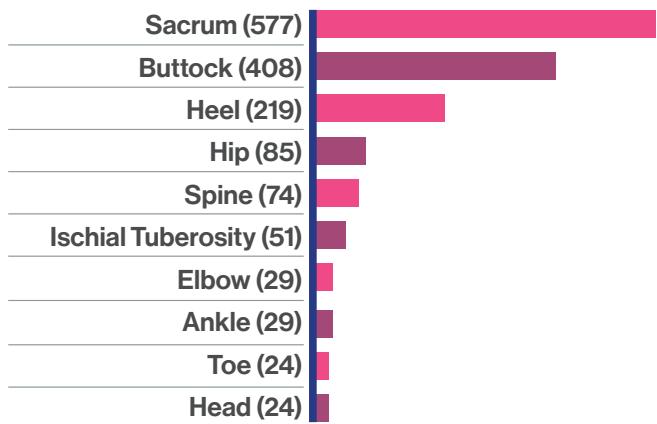


Figure 10. The 10 most common skin damage locations in treatment patients.

# Healing Time for Category IV Pressure Ulcers

For Category IV pressure ulcers that healed whilst the patient was on Dolphin Therapy, the average healing time was calculated. Precise dates where the wound was deemed to be healed were not available, therefore the time used was the total number of days spent on Dolphin Therapy.

This would give the “worst case scenario” for healing time because the wound was recorded as healed at the end of the placement.

The average healing time for a Category IV pressure ulcer was 41 days. Published minimum and maximum times to typically heal a Category IV pressure ulcer are 84 and 730 days respectively (Figure 11).<sup>9</sup>

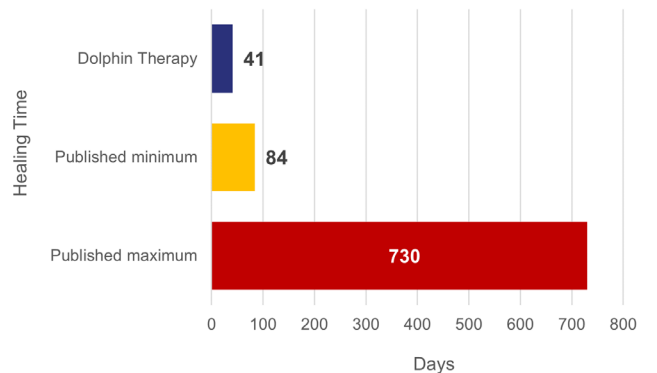


Figure 11. Healing time for Category IV pressure ulcers on Dolphin Therapy in comparison to published minimum and maximum healing times.

# Discussion

**The clinical conditions/comorbidities data collected clearly shows that patients nursed on Dolphin Therapy had particularly complex needs and were extremely unwell.**

**A 2018 study estimated that 8% of people in England had four or more comorbidities, and in the patient population admitted to hospital as an emergency, 33% had five or more.<sup>3</sup> In comparison, the data for patients on Dolphin Therapy shows that 88% had four or more comorbidities and 69% had five plus.<sup>10</sup>**

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## **Complex patients with multiple comorbidities:**

These patients had many severe problems to contend with. Notes for some indicated that they were in excruciating pain and couldn't tolerate repositioning. Others, for various reasons including pain, lack of sleep, discomfort and an altered mental state refused nursing interventions.

Some had life threatening conditions which resulted in surgery lasting over 12 hours and were trying to recover, often with large surgical wounds, infections and sometimes mechanically ventilated. Some had suffered multiple cardiac arrests. Others had severe

“Interestingly, from the 2,000 to 3,000 patient outcomes, the healed and improved wounds had increased from a total of 53% to 58%.”

COVID-19 infection, requiring inotropic support and non-invasive or invasive ventilation. Anxiety and/or depression were commonly noted, for obvious reasons. Whilst the skin of these patients was very vulnerable to damage/further damage, this was just one of many concurrent comorbidities and risks.

The mean number of comorbidities for the prevention group was slightly lower than the treatment group (Figure 7). However, if the prevention patients had developed skin damage (and therefore gained another comorbidity) their mean number would have overtaken that of treatment patients. This suggests the complexity of the two groups is comparable, and that the reason prevention patients' skin remained intact was not because they were less unwell.

Given the complexity of all patients, the outcomes were outstanding. They have also been very consistent, with similar outcome percentages for 500, 1,000, 2,000 and 3,000 patients. This demonstrates the reliability of Dolphin Therapy to deliver on outcomes which are key to reducing suffering and improving quality of life for patients with multiple acute and chronic conditions.

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## **Skin integrity:**

Overall, 98% of patients placed on Dolphin Therapy for prevention purposes did not develop skin damage (Figure 3), and 58% of skin damage for treatment patients healed or improved (Figure 5). Interestingly, the healed and improved wounds had increased from 13% and 40% respectively (total = 53%) in the 2,000 patient outcomes to 14% and 44% (total = 58%) in the 3,000 patient outcomes.



Earlier adoption of Dolphin Therapy could account for some of this improvement; some staff have reported that as they've gained more confidence in the mattress and its abilities, they can see the benefits of using it earlier.<sup>10</sup> Meanwhile, the fact that 39% of skin damage remained static, given the numerous patient and wound complexities, is an outstanding result to keep in consideration.

For patients nursed directly on their wound(s), 58% of those wounds healed or improved (Figure 9), which is the same as the overall healed and improved percentage (Figure 5). These results strengthen the evidence that wounds nursed directly on the Dolphin Therapy surface will heal or improve, supporting its ability to minimise vascular occlusion and maintain a near normal blood flow.

Skin damage developed in 2% of prevention patients, and 3% of treatment patients' skin deteriorated whilst on Dolphin Therapy. It is impossible to prevent all skin damage and deterioration; there will inevitably be some highly complex patients who, for various

reasons, will experience skin breakdown. Extracts from patient notes under Figures 3 and 4 in the results section shed light on some of the reasons for skin breakdown and deterioration. Despite this, the overall outcomes for Dolphin Therapy are remarkable and provide robust evidence that it is highly effective for both preservation of skin integrity and treatment of existing wounds.

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### **Holistic, patient-centred approach:**

The other outcome results were also outstanding. More than 99% of patients had objectives fully or partially met for improved comfort, pain management and sleep, and 98% for reduced turning frequency. The difference that these can make to a person's well-being and recovery shouldn't be underestimated. Research suggests it is critical for patients to have at least two uninterrupted sleep cycles of 2.5 to 4 hours for physical and psychological well-being and healing,<sup>5</sup> and sleep deprivation is known to negatively affect all body systems.<sup>11</sup>

Uninterrupted sleep in hospital is often very difficult to achieve; pain, discomfort, noise, lights, alarms and turning regimes can make a good sleep almost impossible. However, Dolphin Therapy can help patients sleep better through reduced pain, discomfort, frequency of turning (Figure 6) and noise. The benefits other than sleep are present round the clock, regardless of whether the patient is asleep or awake.

“Dolphin Therapy can help patients sleep better through reduced pain, discomfort, frequency of turning and noise.”





Improved compliance with care was fully or partially achieved for 94% of patients (Figure 6). Patient-centred care respects the patient's experience, values, needs and preferences when planning and implementing their care.<sup>12</sup> There is strong evidence that patients who are well-informed about their condition and options for care and treatment are more likely to follow an agreed treatment plan.<sup>13</sup> This in turn can improve health outcomes.<sup>14</sup>

Some patients prior to stepping up to Dolphin Therapy had been non-compliant with care because the previous surface they were on was uncomfortable and/or too noisy. In some cases, they couldn't tolerate the cell movement cycle of a traditional alternating dynamic mattress.<sup>10</sup> By stepping the patient up to Dolphin Therapy and solving these problems, with the patient's input and agreement, many became more co-operative with nursing and other interventions. For those that didn't, many had conditions such as delirium, dementia, brain tumour and cerebral palsy, and were unable to comprehend sufficiently to co-operate.<sup>10</sup>

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### Healthcare economics:

Pressure ulcers are the most costly chronic wound in the NHS, costing around £3.8 million per day.<sup>15</sup> The incremental cost of treating a pressure ulcer is up to £374 per day,<sup>16</sup> with a Category IV pressure ulcer as an example costing an average of £16,000 to treat.<sup>17</sup> The reduction in mean healing time on Dolphin Therapy (Figure 11) compared to the published standards for

“The total cost of treating all the Category I, II, III and IV pressure ulcers for all the treatment patients in this Dolphin Therapy study would have been £29,991,000.”

a Category IV pressure ulcer (41 days versus 84-730 days) could result in significant cost savings.

Using the NHS pressure ulcer productivity calculator,<sup>17</sup> the total cost of treating the Category I, II, III and IV pressure ulcers for all the treatment patients in this Dolphin Therapy study would be £29,991,000. This doesn't include costs for unstageable ulcers, deep tissue injuries or moisture-associated skin damage. Anything that can be done to reduce pressure ulcer incidence will help drive down costs, and the evidence from this study showed that adopting Dolphin Therapy for prevention of skin damage successfully achieved this in a very high percentage of patients.

A reduction in turning frequency, as well as benefitting patients, can also benefit staff through reduced manual handling and the freeing up of time. As an example, if it took three Band 5 nurses 30 minutes to





turn a patient, and the turning frequency was reduced with Dolphin Therapy from two- to four-hourly, the total amount of time saved in 24 hours would halve from six hours to three. As there are three nurses, the total amount of nursing time would reduce from 18 hours to nine.

Total cost data for 2022 (salary plus overheads) shows it costs £43 per hour to employ a Band 5 nurse.<sup>18</sup> The cost of turning the patient would therefore decrease from £774 to £387 per day. Obviously, the cost of employing the nurses doesn't go away, but it allows them more time for other tasks, helping to increase efficiency, improve patient experience and reduce stress. The reduction in turning frequency can be even more beneficial in community settings. Qualitative data of Dolphin Therapy shows one patient in the community was able to reduce nursing intervention considerably after placement on Dolphin Therapy (see Appendix 1).

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### Summary:

The high level objectives of the National Wound Care Strategy<sup>10</sup> are to improve patient care, reduce patient suffering, improve healing rates, prevent wounds occurring and reoccurring and increase productivity of staff. Dolphin Therapy was able to help achieve some or all of these objectives for very high numbers of patients in this study.

The quantitative data presented within this report in conjunction with the wealth of existing evidence, has proven Dolphin Therapy's effectiveness and when the cost of Dolphin Therapy is offset against pressure ulcer treatment costs, time and efficiency considerations and patient experience the benefits are clear.

## Dolphin Therapy in Summary



98%

**Patients placed on Dolphin Therapy for prevention purposes and did not develop skin damage**



99%

**Patients had objectives fully or partially met for improved comfort, pain management and sleep**



58%

**Wounds that healed or improved for patients who were nursed directly on their wounds**



50%

**Pressure ulcer healing time halved in conjunction with Dolphin Therapy**

# Appendix 1: Qualitative Testimonials

Scan the QR codes below to watch testimonials from various healthcare settings and the impact that Dolphin Therapy has had on patient outcomes.

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**Name:** Diane Hill

**Job Role:** Clinical Nurse Specialist

**Setting:** Community



**Name:** Julie Tyrer

**Job Role:** Tissue Viability Nurse Consultant

**Setting:** Critical Care



**Name:** Lauren O'Leary

**Job Role:** Deputy Ward Manager

**Setting:** Hospice / Palliative Care



**Name:** Martin Quinton

**Job Role:** Critical Care Practitioner

**Setting:** Paediatrics



**Name:** Claire O'Keeffe

**Job Role:** Ward Manager

**Setting:** Stroke Unit



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