With the size of the problem posed by pressure ulcers remaining apparently unchanged and the associated treatment costs continuing to rise, it is important to ensure that products aimed at the marketplace for prevention and treatment provide appropriate levels of pressure redistribution and relief to patients.

While it is widely accepted that clinical outcomes represent the best method of proving clinical efficacy for a medical device, laboratory measurements still play an important role when assessing pressure care equipment. Such measurements typically take the form of Interface Pressure tests.

What is pressure mapping?

A pressure map is a computerized clinical tool for assessing pressure distribution. To use it, you place a thin sensor mat on a mattress surface or wheelchair seat. When your patient lies on the mat, a computer screen displays a map of pressures, using colours, numbers and a graphic image of the patient. Typically, the hotter colours (the reds and oranges) indicate areas of higher pressures and the cooler colours (the blues and greens) indicate areas of lower pressures. The display usually has several options including a three-dimensional display of peak pressures and a statistical analysis.

Pressure mapping does have some drawbacks, including inconsistencies in the way manufacturers report and display the pressures, differences in measurable peak pressures among manufacturers and sensor accuracy and drift. Still, these visual displays provide key data that can augment nursing assessment of the areas of potential tissue damage.
Pressure mapping accuracy – the facts

The historical definition for a ‘pressure reducing’ or ‘pressure relieving’ support surface was one that yielded pressure readings of 32mmHg or lower on most bony prominences most of the time. This ‘gold standard’ for optimal pressure (32mmHg), however, is not realistically possible. The number 32mmHg is capillary pressure at heart level. The capillary pressure is much greater than this down by the feet and research shows that 60mmHg is probably a much better number to use as capillary pressure.

In the early 1990’s, many organisations important to wound care such as the Wound Ostomy Continence Nurses Association (WOCN) and the National Pressure Ulcer Advisory Panel (NPUAP) defined pressure relief as “reduction of interface pressure below the level required to close capillaries, ie capillary closing pressure.” Pressure relief was defined as “reduction of interface pressure, not necessarily below the level required to reduce as ‘reduction of interface pressure, and many other factors. The definitions are impossible to apply when subjects vary so widely in their pressure readings. This applies to nearly all support surface products on the market.

Pressure mapping systems only measure uniaxial pressure (vertical or straight down) and do not measure shear forces at all.

Pressure alone is not a reliable indicator of risk for skin breakdown. Pressure is not the only factor in pressure ulcer development. Heat, moisture from perspiration or urine, poor nutrition, sensory loss, age-related connective tissue changes, friction or shear and poor circulation all contribute to pressure ulcers.

Aim

The aim of this project was to examine the sacral interface pressures of a subject resting supine on the Aeria 8 Pro Mattress Replacement System.

Methodology

All Interface Pressure measurements were taken using the Force Sensing Array (FSA) from Verg Inc. The FSA is composed of a large bed sized pressure mapping mat with a grid of 32x16 individual pressure sensors. Pressure range was 0–100mmHg and interface pressure maps were saved at intervals of 5 seconds.

The Aeria 8 Pro was set up according to the manufacturer’s instructions on a standard hospital bed frame with a steel mesh bed base. The mattress replacement and FSA mat were placed directly onto the bed base and the system left to operate for a minimum of 60 minutes at maximum pressure before testing commenced.

The mattress pump was then set to a cycle time of 10 minutes and a cell pressure setting of 60mmHg.

A single healthy volunteer subject was used to test the support surface. The test subject was a 31 year old male, weight 183 lb 83 kg, height 5’ 6” 172 cm and Body Mass index (BMI) of 27.7.

All tests took place with the subject placed in a standardized supine position (lying flat on their back, legs shoulder width apart, arms resting by their side, head resting on static pillow cells). The subject was positioned with the sacrum over the apex of an inflated cell. The subject was left to rest over two complete cycles, allowing the system to stabilize, before data was taken over the complete third and fourth cycle. Cycle 3 and 4 was compared to confirm stability.

Data was analyzed to report maximum and minimum pressure measurements and also the time spent at or below interface pressure thresholds of Zero, 10, 20 and 30 mmHg.
Results

Aeria 8 Pro Dynamic Mattress Replacement System

**Maximum/Minimum Sacral Interface Pressures**

| Maximum Sacral Interface Pressure* | 100 mmHg |
| Minimum Sacral Interface Pressure  | 0 mmHg   |

* The FSA mat had a ceiling of 100mmHg maximum pressure; therefore pressures above this threshold could not be read by the system.

**Sacral Pressure Relief Indices (PRI)**

The results to the right detail the time the test subjects’ sacrum spent at or below specific Interface Pressure thresholds.

The test subject did experience a period of time with zero sacral interface pressure when resting supine on the Aeria 8 Pro. The test subjects' interface pressures were below a threshold of 10mmHg for almost one fifth (17%; 2 minutes) of the 12 minute cycle. With the PRI threshold set at 30mmHg the test subject recorded sacral pressure equal to or less than 30mmHg for more than a quarter (27%; 3 minutes; 12 seconds) of the 12 minute cycle time (see Table 1).

Figure 1 demonstrates the rapid pressure drop off experienced at the sacrum as the air cell directly under the sacrum deflates. Interface pressure begins to build again as the cell is re-inflated with air.

Refer to Appendix A for whole body interface pressure maps of the test subject resting supine on the Aeria 8 Pro.

### Table 1. Sacral PRI results for a subject resting supine on the Aeria 8 Pro.

<table>
<thead>
<tr>
<th>PRI threshold mmHg</th>
<th>Time (min:sec)</th>
<th>Percentage of overall 12 minute cycle at or below pressure threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1:00</td>
<td>8%</td>
</tr>
<tr>
<td>&lt; 10</td>
<td>2:00</td>
<td>17%</td>
</tr>
<tr>
<td>&lt; 20</td>
<td>2:30</td>
<td>21%</td>
</tr>
<tr>
<td>&lt; 30</td>
<td>3:12</td>
<td>27%</td>
</tr>
</tbody>
</table>

### Figure 1. Actual Interface pressure at sacrum

![Figure 1. Actual Interface pressure at sacrum](image-url)
Discussion

It is evident from the results reported above that the Aeria 8 Pro (dynamic mattress replacement system) is able to relieve and redistribute interface pressures effectively across the body/support surface interface every 10 to 12 minutes. With a subject in the supine position, the Aeria 8 Pro has the ability to reduce the sacral interface pressure to 0mmHg and the results of the Pressure Relief Indices (PRI) indicate that this dynamic support surface is regularly capable of providing the human body with several minutes of low pressure which may help with the prevention and management of pressure induced wounds.

While on the Aeria 8 Pro the subject in this test experienced sacral interface pressures in excess of 100mmHg, however, it should be noted that such pressures are rapidly relieved on a regular basis as the product runs through its cycle (refer Appendix A). It is this regular and rapid pressure relief that helps promote the normal physiological response of ‘reactive hyperemia’ which can help maintain and promote tissue viability.

There is continued debate both nationally and internationally about how useful interface pressure measurements are and furthermore how they should be measured and analyzed. In spite of working groups composed of representatives from the European Pressure Ulcer Advisory Panel (EPUAP) and the National Pressure Ulcer Advisory Panel (NPUAP) it is worth noting that even with the academic backing of both Advisory Panels behind this topic, some of the statements made are somewhat conflicting.

With regard to the performance of support surfaces the following statements are made:

“Lower mean pressures over time are preferable”

“Greater percentage of time at low pressures and prolonged continuous intervals below selected thresholds [10, 20, 30mmHg] should be preferable to the opposite”

“Probable that a high amplitude cycle is preferable to a low amplitude cycle”

“Probable that a surface providing lower lows is preferable to one that off loads to a lesser extent”

Such conflicting statements indicate a degree of confusion and disagreement surrounding current interface pressure measurement practices. This level of discordance amongst healthcare academics makes it particularly difficult to ensure all appropriate aspects of test methodology and results presentation are covered when undertaking this work. With no clear resolution of these issues currently in sight, it is imperative that companies such as Aeda Healthcare Limited continue to undertake in house testing and report the results of these tests to healthcare professionals to enable them to make a more informed decision when providing this type of support surface to their patients.

The one point that all academics are agreed upon is that different data sets should never be used to make direct product comparisons as they will have been generated using different test methodologies, equipment, test subjects and/or data analysis techniques thereby making it inappropriate to compare products reported in different tests.

Conclusion

In this test it is evident that the Aeria 8 Pro dynamic mattress replacement system has the ability to regularly redistribute pressure across the patient support surface interface (refer Appendix A).

This regular pressure redistribution is likely to help benefit the patients who may be at risk of pressure ulcer development, or to treat patients suffering from pressure ulcers, provided that these products are provided in conjunction with a dedicated patient specific care plan for their pressure area care requirements.

References

APPENDIX

Aeria 8 Pro
interface pressure maps

All cells inflated

'Zone A' cells deflated

'Zone B' cells deflated

'Zone C' cells deflated