In sweet harmony – A study into how different types of polyurethane-coated covers impact the pressure redistribution properties of medical support surfaces

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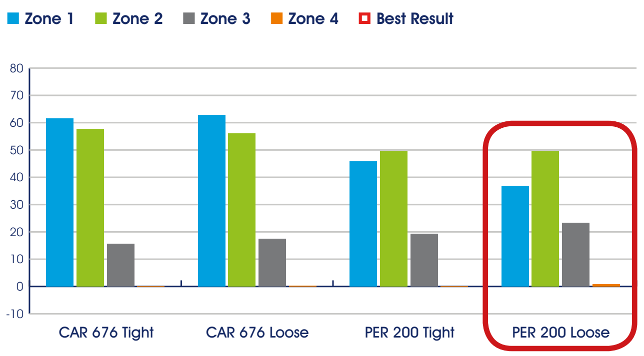
FLORENCE, ITALY WUWHS 2016

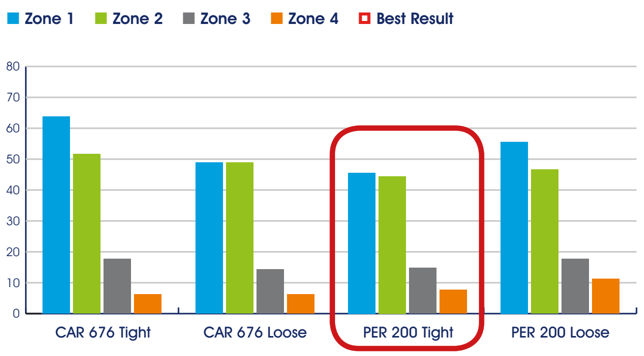
RESULTS 4

Envelopment: Mattress 2



Cover	Zone 1 (mm Hg)	Zone 2 (mm Hg)	Zone 3 (mm Hg)	Zone 4 (mm Hg)
CAR 676 Tight	61.62	57.74	15.61	-0.02
CAR 676 Loose	62.9	56.07	17.48	0.35
PER 200 Tight	45.75	49.65	19.26	0.06
PER 200 Loose	36.76	49.6	23.36	0.77

Envelopment: Mattress 3



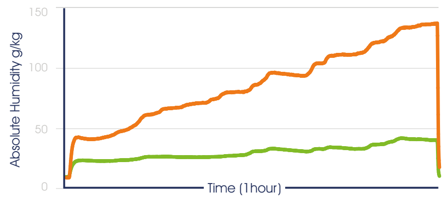
Cover	Zone 1 (mm Hg)	Zone 2 (mm Hg)	Zone 3 (mm Hg)	Zone 4 (mm Hg)
CAR 676 Tight	63.73	51.62	17.7	6.19
CAR 676 Loose	48.92	48.89	14.37	6.21
PER 200 Tight	45.58	44.47	14.75	7.73
PER 200 Loose	55.6	46.66	17.69	11.26

RESULTS 5

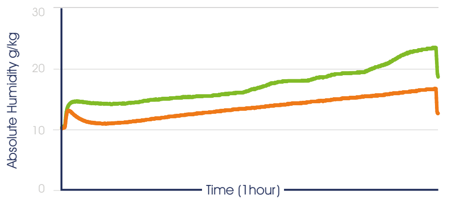
Microclimate Characteristics

The temperature profile was consistent, but the humidity levels in between skin and fabric (above) were significantly lower for the Microclimate fabric. When measuring absolute humidity below the fabric, a greater increase in humidity was recorded for the Microclimate fabric; demonstrating the increased movement of moisture vapour.

ABSOLUTE HUMIDITY MIC200 / PER200
(Above – Between skin and cushion)



ABSOLUTE HUMIDITY MIC200 / PER200
(Below – Under the cover)



CONCLUSIONS 6

The results infer that in the best medical devices, the support cover and core work harmoniously for the best patient outcome. Moreover, the performance of the support surface core will depend in its compatibility with the cover. Where these separate parts are designed together, the support surface will perform to its full potential. Therefore, it is important that a like-for-like cover replacement takes place if needed during its operational life – for material, fit and moisture handling properties - to ensure the integrity of the support surface system is retained. Choosing a fabric with high MVP can slow the humidity rise over time, keeping the patient feeling cooler and drier for longer. Further research is required to demonstrate the positive effects of the core and cover working together.

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1. PS1 Foam Mattresses: A comparative evaluation special issue (1993) Medical Services Directorate. **2.** British Healthcare Trades Association. (2012). BHTA guidance on the care, cleaning and inspection of healthcare mattresses. Available: http://www.bhta.net/sites/default/files/document-upload/Protect%2C%20Rinse%2C%20Dry%20v2.pdf. Last accessed 12th Aug 2016. **3.** Fisher SV, Szymke TE, Apte SY, Kosiak M. Wheelchair cushion effect on skin temperature. Arch Phys Med Rehabil 1978; 59(2): 68-72. **4.** Brienza DM, Geyer MJ. Using support surfaces to manage tissue integrity. Adv Skin Wound Care 2005; 18: 151-57.

BACKGROUND & AIM

Pressure redistribution has often been reported in relation to medical support surfaces. As far back as 1993, mattress covers were shown to have an impact[1]. To date, however, the attention surrounding mattress performance has focused almost exclusively on the mattress contents, such as the properties of foam, the type of air system utilized, etc. with minimal attention being paid to the cover, except in regards to cleaning and care[2]. Likewise, it is well documented that managing skin temperature and moisture levels is important for maintaining skin integrity; for example, Fisher, Szymke and Apte (1978) report that a 1°C increase in skin temperature leads to a 13% increase in metabolic demand[3]. Relative humidity also affects the strength of the stratum corneum: at a relative humidity of 100% the stratum corneum is 25 times weaker than at 50% relative humidity[4]. However, there appears to be little research in bringing these factors together to establish the cumulative impact they have when considering the properties of a medical support surface as a whole.

Aim

This study shows that not all fabrics are the same by demonstrating how properties of the support surface can be influenced when the fabric and core operate together.

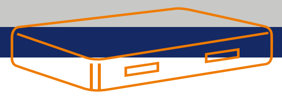
CLINICAL RELEVANCE

Pressure redistribution – demonstrating how the mattress cover can have an impact on the redistribution of pressure, depending on the structure of the fabric1.

Extent of immersion and envelopment influenced by the properties of fabric – e.g., the stretch properties in conjunction with the mattress core.

Microclimate characteristics – how different material structures perform in regards to maintaining or altering the moisture and temperature of the patient.

METHOD 1



Different types of support surface covers and cores were tested in a laboratory setting to measure the variances across a set of characteristics when the fabric selection is altered:

1. **Pressure redistribution** properties were measured by **pressure mapping** a volunteer lying on tight and loose covers made from a range of polyurethane-coated fabrics over three different mattress cores.

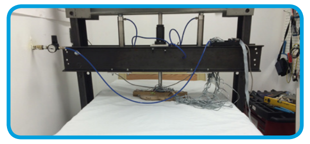
2. **Envelopment and immersion properties** were measured using a **bulbous indenter** over tight and loose polyurethane-coated fabric covers with three different mattress cores.

3. **Microclimate properties** were measured using **temperature and humidity sensors** with a seated volunteer on a molded seating cushion.

Fabric	Dartex Range	Property of Cover	Test Methods	Support Surface Care
CAR676	Care	Low stretch	Pressure mapping Immersion Envelopment	Mattress 1: High specification foam mattress Mattress 2: Castellated high specification foam mattress Mattress 3: Foam and gel hybrid mattress
PER200 Highly breathable fabric	Performance	2 way stretch (high stretch, low modulus)		
MIC200	Microclimate	1000g/24hr/m², ASTM D1653 (g/m2/24h) High breathability	Seated volunteer - temperature & humidity sensors	Molded foam cushion with MIC200 on the left hand side and PER200 on the right hand side
PER200 Typical polyurethane - coated fabric	Performance	500g/24hr/m², ASTM D1653 (g/m2/24h) Standard breathability		

TESTING METHODS 2

STANDARD



IMMERSION & ENVELOPMENT

TEMPERATURE & HUMIDITY

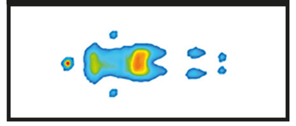
RESULTS 3

Pressure Redistribution

The difference between best and worst fabrics was greater for the more "technical" mattress. The "best" combination was different for each mattress. For the low stretch fabrics, loose covers gave lower peak pressure and lower average pressure. For the high-stretch fabrics, the results were very similar. The average pressure was largely independent of fabric.

5 15 25 35 45

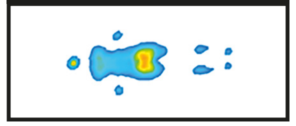
STANDARD



Coefficient of variation	162.22
Average (mmHg)	21.11
Peak (mmHg)	45.42
Area (cm²)	3377.01

5 15 25 35 45

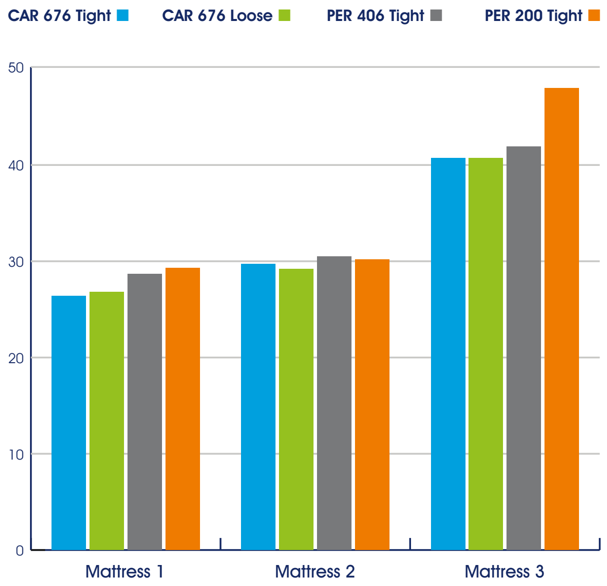
PER 200 TIGHT



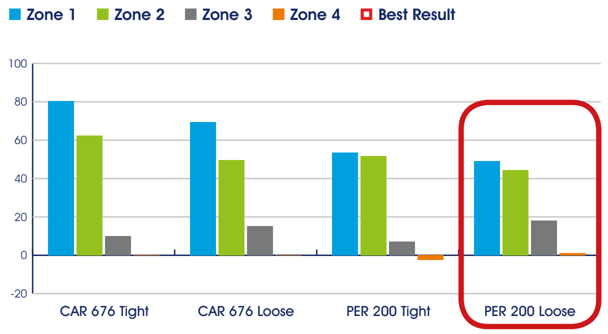
Coefficient of variation	130.47
Average (mmHg)	19.22
Peak (mmHg)	38.64
Area (cm²)	3044.35

RESULTS 4

Immersion



Envelopment: Mattress 1



Immersion and Envelopment

The absolute level of immersion achieved is primarily determined by the mattress core, but for a given core, the maximum immersion can be increased by choosing the right cover fabric.

For each mattress, changing the cover fabric influences both the maximum pressures recorded and the distribution of pressure across the indenter. The stretch properties of the fabric have a large influence on the way the support surface is able to envelop.

% Immersion	Mattress 1	Mattress 2	Mattress 3
CAR676 Tight	26.4	29.7	40.7
CAR676 Loose	26.8	29.2	40.7
PER200 Tight	28.7	30.5	41.9
PER200 Loose	29.3	30.2	48

Cover	Zone 1 (mm Hg)	Zone 2 (mm Hg)	Zone 3 (mm Hg)	Zone 4 (mm Hg)
CAR 676 Tight	80.39	62.45	10.08	0.16
CAR 676 Loose	69.43	49.56	15.36	-0.21
PER 200 Tight	53.57	51.8	7.19	-2.5
PER 200 Loose	49.24	44.44	17.98	1.16