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Surface Performance Comparison: **Envella** bed vs. **Dolphin FIS** surface

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ABSTRACT

Clinitron Air Fluidized Therapy (AFT) surfaces have been shown in clinical studies to be extremely effective in both the prevention and treatment of pressure injuries. One particular study concluded that Group III surfaces according to the CMS categorization (which includes only AFT) were able to heal pressure injuries four times as quickly as Group II (powered air) mattresses. Other products have occasionally capitalized on these findings. One such product, which the manufacturer has described as a "Fluid Immersion Simulation"(FIS) surface, is the **Dolphin FIS** surface. No such category has been recognized by the NPIAP / S3I committee nor by CMS, which simply designates it as a Group II product. The performance differences between the products can be demonstrated conclusively using the NPIAP/S3I tests that have been validated by experts: Horizontal Stiffness/ Shear Stress: **Dolphin FIS**: 22.4 N vs **Envella**: 1.5 N (93% better shear stress performance); Evaporative Capactiy: **Dolphin FIS**: 17.7 g/m^2-hr vs. **Envella**: 1038.7 g/m^2-hr (5,753% or 58x's greater); and Peak Sacral Interface Pressure using Hillrom state-of-the-art sensor indentors: **Dolphin FIS**: 48.3 mmHg vs. **Envella**: 26.6 mmHG (45% better pressure redistribution). Although the **Dolphin FIS** surface is frequently presented as a substitute for AFT, the objective data strongly suggest that this is not the case.

INTRODUCTION

The therapeutic effectiveness of Air-fluidized therapy (AFT) products such as **Hillrom's Envella** bed is widely recognized in the clinical community. Wound healing has been shown to occur four times as rapidly on AFT as on Group II (Powered Air) support surfaces.[1] In addition, the same fluid support properties have also been shown to provide significant benefits for pressure injury prevention. In a clinical study of AFT products on high risk cardiovascular patients vs. the existing standard of care (typically powered air), pressure injury rates were reduced by 97.7%.[2] A relatively small study also suggests that AFT may be highly effective in a niche that is rapidly growing in importance: the resolution of Deep Tissue Injury.[3] It is not surprising that other products want to promote similarities compared to AFT.

A recent example is the **Dolphin FIS** (Fluid Immersion Simulation) surface. From the website:

"Designed to provide state-of-the-art pressure redistribution by simulating the effects of a body immersed in a fluid medium. The **Dolphin FIS** technology provides minimal tissue deformation, while maintaining normal blood flow leading to improved tissue perfusion and wound healing."[4]

It is important to note that the National Pressure Injury Advisory Panel's Support Surface Standards Initiative (NPIAP/ S3I) which is tasked with developing standard industry categories and terms, has not recognized a Fluid Immersion Simulation category. Similarly, despite the **FIS** name, it falls not in the group III (Fluid Support) category but within the standard group II category (powered air products).

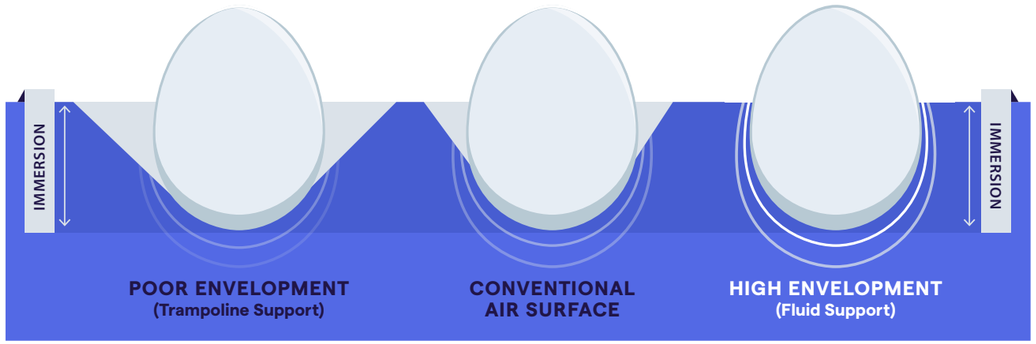

Figure 1: Identical Levels of Immersion (penetration depth into the surface) but different levels of Envelopment (conformability and contact area). LEFT: Trampoline-like support (Poor Envelopment) such that pressure is concentrated at the apex, increasing Peak Interface Pressure. RIGHT: Fluid support (High envelopment); pressure is broadly distributed across the contact area and peak pressure is minimized.

ENVELOPMENT AND PEAK INTERFACE PRESSURE

An essential characteristic of fluid support is the ability to conform to the irregularities of the body. This is known as Envelopment.[5] Fluid support is characteristic of the highest levels of envelopment **(Figure 1)** resulting in less pressure on the tissue.

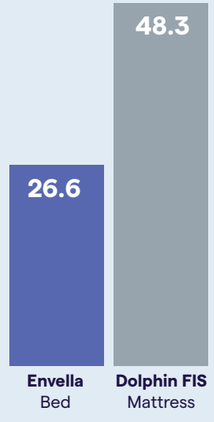

Figure 2: 45% better pressure redistribution.[8]

The greater the envelopment for a given level of immersion the higher the contact area and the lower the interface pressure **(Figure 1)**. Peak sacral interface pressures on **Dolphin FIS** surface and **Envella** bed are shown in **Figure 2** for 180 lb. patient loading at 30° head of bed angle. The result is the mean of 10 measurements. The peak pressure on the **Envella** Bed (26.6 mmHg) was 45% lower than on the **Dolphin FIS** surface (48.3 mmHg).

The result highlights the superior cradling properties of true fluid support and calls into question the **Dolphin FIS** surface claim that the product minimizes tissue deformation.[4] If the primary determinant of tissue deformation for a given patient is peak interface pressure and the peak pressure is nearly 45% lower on the **Envella** Bed, can the deformation truly be minimized on the **Dolphin FIS** surface?

SHEAR STRESS OR "PUSHBACK FORCE" ON THE BODY

Another fundamental aspect of fluid support is the shear stress or "pushback" force on the tissue when the body is moved across the surface. Conventional solid support surfaces behave like a lattice of springs. Any motion across the surface increases the compression of these springs and the resulting "pushback force" they exert on the tissue. In a fluid; the "pushback force" is negligible. The clinical implications are obvious for wounds, flaps, grafts, and even prevention of injury in healthy tissue.

One of the NPIAP/S3I approved tests is for measuring horizontal stiffness or "pushback force" on the body that occurs as a result of movement. In the Horizontal Stiffness Test, a pelvic-shaped device is weighted to match the pressure of 185 lb. patient and carefully pulled 10 mm toward the foot of the bed. The force tending to drive the device back towards its initial position is measured and recorded for a total of five minutes.

Sustained shear stress was measured on the **Envella** bed and **Dolphin FIS** surface using this method **(Figure 3)**. The result — the **Envella** bed resulted in 93% better shear stress performance against the **Dolphin FIS** surface. This illustrates the degree to which the two products differ in their approximation of fluid support.

The **Dolphin FIS** surface is composed of conventional air bladders that behave as one would expect when deformed: they push back. The bead bath of the **Envella** bed is truly fluidized in that the fine beads are supported by the air that flows between them. When the body is moved through the fluid bath, there is little push-back as the fluid is free to simply flow out of the way to accommodate the body's new position. And, as measured, the pushback force is negligible.

MICROCLIMATE MANAGEMENT: HEAT AND HUMIDITY ON THE SKIN

The primary additional factors shown to impact skin integrity are the heat and humidity of the skin, also known as the microclimate.[6] The ability of these two products to manage the skin microclimate was also compared using a standard NPIAP/S3I validated and approved test known as the Sweating Guarded Hot Plate method.[5]

The evaporative capacities of the two products are shown in **Figure 4.** The evaporative capacity of the **Envella** bed (1038.7 g/m²*hr) vs. that of **Dolphin FIS** surface (17.7 g/m²*hr) reflects a 5,753% (58x's) greater evaporative capacity to remove urine, sweat, exudate, and other damaging fluids from the skin.

The dry heat withdrawal comparison is shown in **Figure 5**. With the bead bath temperature set at 91° the **Envella** bed (**Dolphin FIS** surface has no temperature setting), the **Envella** bed is able to dissipate heat more freely with 108.6 W/m² vs. 53.7 W/m² for **Dolphin FIS** surface.

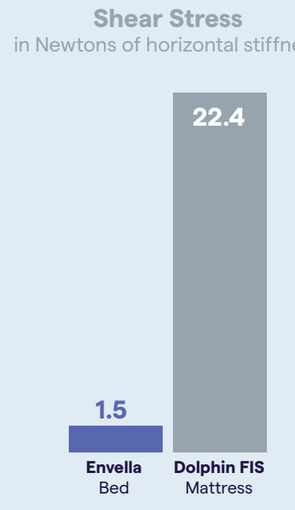

Figure 3: 93% better shear stress performance.[8*]

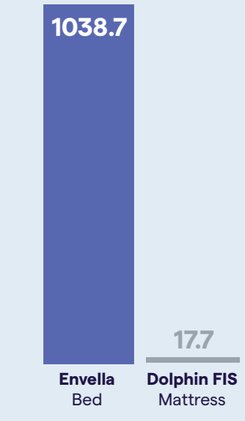

Figure 4: 5,753% (58x's) greater evaporative capacity.[8*]

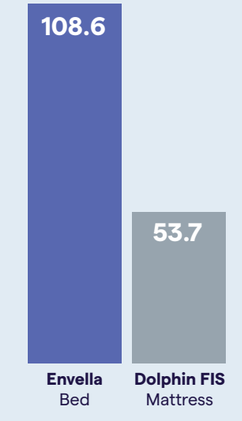

Figure 5: 102% greater heat withdrawal.[8*]

*Based on mechanical performance only.

Higher values are generally preferable as they reduce the possibility for heat build-up, and cooler skin needs less nutrients and is less likely to suffer ischemia when blood flow is reduced by pressure.[6-7] Obviously, the optimal level of heat withdrawal is subject to the personal comfort preferences of the patient. This is why the **Envella** bed, unlike **Dolphin FIS** surface, allows the caregiver to adjust the temperature to optimize both temperature and comfort simultaneously.

SUMMARY

The **Dolphin FIS** surface is frequently being presented as a suitable substitute for Air-Fluidized Therapy surfaces. Using tests that have been developed and validated by objective, third-party experts to assess risk factor management capabilities, the results suggest that this is not the case.

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