Microclimate Management
Frequently Asked Questions (FAQ)

Introduction:

Hill-Rom, as the leader in the therapy surface market, has one of the largest, global research and development teams focused on the treatment and prevention of pressure ulcers. One key factor in avoiding skin breakdown is maintaining optimal skin temperature and moisture balance at the patient and surface interface. Hill-Rom scientists, through evidence based science and testing have determined the optimal, thermal target zone to remove excess heat and moisture from surfaces while ensuring patient comfort. Following are questions and answers to explain how Hill-Rom achieved the optimal performance range for its Advanced Microclimate™ Technology surfaces and the desired microclimate management of skin to help prevent and control pressure ulcers.

Q. What causes skin to breakdown and pressure ulcers to form?

A. A pressure ulcer is an injury to the skin and the underlying tissue. These wounds generally appear on the shoulders, elbows, hips, buttocks, heels, and other areas of the body that sustain pressure when a patient is lying in a bed, or sitting for long periods of time. Pressure ulcers cause an estimated 60,000 [1]acute-care deaths from related complications annually.

Although pressure generally is believed to be the primary external factor contributing to the development of pressure ulcers, other causes such as shear, friction, heat and moisture also play significant roles. The levels of heat and moisture—more accurately humidity—are referred to as skin microclimate. Establishing the correct microclimate of the skin is a critical factor in deterring the formation of pressure ulcers.[2]

Q. What is skin microclimate management, and why is it important?

A. Heat and moisture levels at the skin surface—skin microclimate—play significant roles in preventing and controlling pressure ulcers. We know that skin temperature depends on a number of factors. For example, the skin on the lower back under normal, open-air [3]conditions typically ranges from 90 to 95 degrees F. In this environment, both heat and moisture released by the skin disburse rapidly into the atmosphere and are the primary means that the body uses to cool itself. This exposure to the atmosphere ensures that the microclimate at the skin surface is not appreciably different from the surrounding climate as a whole. These are the temperature and humidity conditions that the skin was designed to operate within normally. When a person lies on a mattress, the free outflow of heat and moisture is blocked, causing both heat and moisture to build up. Prolonged, high levels of moisture weaken skin making it susceptible to pressure and shear forces. Warm skin needs a greater supply of blood-borne nutrients and also is put at risk when blood flow is reduced by external pressure and shear forces. This condition is called maceration. It causes the skin to soften, turn white, and if the epidermis tears, become infected with bacteria or fungi.

Cooling skin slightly has shown to exert a protective effect in laboratory studies, reducing the likelihood of skin breakdown. Low air loss surfaces (LAL) were designed to help regulate and manage the microclimate of the skin, in effect, to reconnect the link with the atmosphere via a constant stream of air to control temperature and moisture similarly to what is found naturally in our environment.[4]

Q. Are there industry performance standards currently for low air loss surfaces?

A. No, current performance standards do not exist that are agreed upon by both the medical community and manufacturers alike. The National Pressure Ulcer Advisory Panel (NPUAP) is coordinating the development of standardized protocols which will provide measurements for comparing and evaluating the performance of LAL surfaces. However, as medical costs continue to increase and hospitals continue to search for the most effective and least costly methods for preventing pressure ulcers, standardized criteria, based on scientific evidence are necessary to assist clinicians in making informed decisions about the most appropriate LAL systems for patients.

Q. Don't all low air loss surfaces work alike to manage skin microclimate?

A. There are a number of design strategies employed with LAL surfaces to assist in the management of the microclimate, and, not surprisingly, there is a broad range in performance. Heavy toppers made of foam, or other insulating materials may prevent the surface from doing an appropriate level of cooling. Inadequate air flow or air flow that is too warm may cause the same problem. Conversely, with a micro-vent type of LAL surface, excessive airflow on the skin may result in an excessive level of heat withdrawal and uncomfortably cool patients. Additionally, many LAL support systems fail to eliminate sufficient levels of moisture due to the above factors, or because the ticking materials do not allow for sufficient transmission of water vapor away from the skin.

Q. Why is there so much concern about moisture generation and the ranges of performance?

A. As heat flows from a patient's body onto a cooler surface, it accumulates at that surface and warms the skin. The rate that heat is trapped in a surface determines how much accumulates and, therefore, determines how warm the skin becomes. When a patch of skin is warmed beyond a specific level sometimes referred to as the perspiration threshold—above 35 degrees C, or 95 degrees F—local perspiration in that region increases markedly, and the rate that this perspiration passes through a surface determines the amount of moisture accumulation. Over time, if the rate of perspiration rises beyond the ability of the surface to withdraw moisture from the skin, it becomes wet. The outer layer of the skin also may weaken and begin to break down, particularly in the areas subjected to mechanical forces at the heavily-loaded, weight-bearing bony prominences such as the heels or elbows.

Q. Is Hill-Rom the first manufacturer to establish a range of optimal performance to achieve the correct microclimate of the skin and is this technology incorporated into its Advanced Microclimate™ Technology surfaces?

A. Until now, no LAL manufacturer has been able to demonstrate how a surface should perform to achieve the correct microclimate of the skin—the physiological target temperature range that a body needs to maintain on a support surface to minimize the likelihood of skin breakdown. However, Hill-Rom scientists have conducted a number of internal studies to determine an optimal performance range for their Advanced Microclimate™ Technology surfaces to achieve what they believe to be is the desired microclimate management of skin. As a result, Hill-Rom, through a precise combination of airflow, air temperature and fabric technologies can effectively remove excess heat and moisture from a patient's skin to achieve a range of performance—between approximately 90 to 95.5 degrees F—which not only provides comfort, but also can help provide enhanced therapeutic performance. Achieving the appropriate microclimate of skin—the optimum ranges of temperature and humidity— is a vital factor in the prevention and control of pressure ulcers.

Q. Will this range be modified for different patient populations?

A. As more research is compiled, temperature ranges likely are to be modified for different target populations, for example, patients who are inactive, elderly or those suffering from stroke or spinal cord injuries. Suggested ranges also may have to be adjusted to accommodate patients with abnormal core temperatures or other factors such as obesity that could alter the perspiration threshold significantly.

Q. What evidence did Hill-Rom use to quantify its findings?

A. Besides the research collected from external literature, Hill-Rom scientists conducted a number of internal studies on moisture, heat and patient comfort to establish a logical target zone of optimal therapeutic performance for skin. Hill-Rom used these findings as a baseline for its Advanced Microclimate™ Technology and determined how this technology could best be optimized to prevent skin breakdown. Measurements were conducted on total heat withdrawal to determine the degree to which skin warming could be limited, keeping it relatively cool. Additionally, measurements were taken on evaporation capacity to determine the degree to which a surface could combat moisture accumulation on skin to keep it reasonably dry. From this research, Hill-Rom scientists, based on the best available evidence and using advanced thermal testing technology, have achieved what they believe to be is the optimum microclimate management of the skin .

Q. Why is the mild cooling of skin so critical to this process?

A. Warm skin requires a greater supply of blood-borne nutrients. When there is unrelieved, external pressure or shear forces on warm skin, blood flow is reduced. If the skin is deprived of oxygen and nutrients for too long, tissue dies and a pressure ulcer forms. Cooling skin slightly has been shown to exert a protective effect, reducing the likelihood of skin breakdown when exposed to external forces. There are many ways to achieve cooling of skin or the evaporation of moisture though various surface construction decisions. However, Hill-Rom using advanced thermal testing technology, has achieved what is considered to be the optimum microclimate management of the skin through a formula which includes a precise combination of airflow, air temperature, and fabric technologies to effectively remove excess heat and moisture from a patient's skin. Equally significant, this moderate cooling takes advantage of the protective effect provided by the skin's reduced need for nutrients while a temperature range is maintained that, according to Hill-Rom's internal studies, should be comfortable for the vast majority of patients.

Q. What Hill-Rom® products incorporate the skin microclimate management feature or have Advanced Microclimate™ Technology?

A. The Hill-Rom products listed below incorporate Advanced Microclimate™ Technology features.

- TotalCare SpO_2RT® Plus and TotalCare® Bariatric Plus
- Envision® E700 Wound Surface
- TC500 Wound Therapy Surface
- ClinActiv® Zephyr™ (Europe)

Q. What is the effect of using Advanced Microclimate™ Technology surfaces in a home environment where there may be very hot, cold, humid or dry conditions—extremes that are quite different from those found in a controlled hospital setting?

A. This points to the heart of what a microclimate management surface actually does; it restores the skin microclimate toward that of the open-air environment where skin was designed to function initially. By placing the body on a conventional support surface, we are blocking this natural exchange of moisture, heat, and fresh ambient air between the skin and its surroundings. By contrast, the intent of Advanced Microclimate™ Technology is to render the surface as transparent as possible to the natural exchanges between skin and its environment. Thus, the natural equilibrium that is typically disrupted by a conventional surface is, in large part, restored.

In less controlled settings, the equilibrium conditions of the skin will be somewhat different than in a typical hospital. If the environment is quite warm, the skin also will be warmer; if it is very humid, the skin's humidity will increase. Because the skin's temperature and moisture are brought into equilibrium with the stream of ambient air, as long as the air is cooler than the approximately 97 to 99 degrees F that the skin would reach without microclimate management, it will be cooler than normal. Similarly, because a non-microclimate management surface tends to cause the skin humidity to approach 100 percent, any ambient humidity conditions below this figure will result in lowering the skin humidity to reduce the risk of maceration.

Q. Will Advanced Microclimate™ Technology surfaces cause excessive drying of a patient's skin?

A. As discussed above, Advanced Microclimate™ Technology is designed to allow the skin to restore its natural equilibrium with the environment—an environment that is normally disrupted by the presence of the mattress surface. This means that under typical indoor conditions, the skin comes into equilibrium with an air stream that is close to 50 percent relative humidity. Thus, the surface can never cause the skin to become any drier than it would due to simple exposure to the surrounding room environment.

Q. Will Advanced Microclimate™ Technology help patients who are dealing with significant bouts of incontinence?

A. Microclimate management surfaces are not designed to dissipate large amounts of moisture. The greatest published evaporative capacity for a microclimate management surface that we are aware of is slightly less than 100 g/m^2-hr. Over the entire pelvis and low back, this amounts to approximately one-half ounce of moisture per hour, far too little to dry a significant amount of urine in a reasonable timeframe.

Endnotes

1 Ferguson, M., Cook, A., Rimmasch, H., Bender, S., Voss, A., "Pressure Ulcer Management," MedSurg Nursing, Aug. 2000.

2 National Institutes of Health, National Institute of Nursing Research, Significant Item in the House, Senate, and Conference Appropriations Committee Reports, FY 2001, House Appropriations Committee Report Language (H. Rpt. 106-645).

3 Nadel, E., Bullard, R., and Stolwijk, J., Importance of Skin Temperature in the Regulation of Sweating. J. Appl. Physiol. 1971:31(1): 0-87.

4 Iazzio, P., "Temperature Modulation of Pressure Ulcer Formation: Using a Swine Model. Medscape Today, (from WebMD): Wounds. Volume 18, posted Sept. 2004.

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