GE HealthCare

Snug as a bug

Your guide to evaluating newborn hybrid incubators for thermal management.

Third party studies and publications related to Giraffe™ OmniBed™ Carestation™ Hybrid Incubator have stated:

"Using the Giraffe OmniBed with environmental humidification appears to deliver improvements of at least 15% in clinical outcomes such as body temperature, growth velocity, ventilator use, chronic lung disease, weight stabilization, and electrolyte balance."

– Oxford Analytica healthymagination validation citing data from Brigham and Women's Hospital NICU study of traditional and hybrid incubator.[1]

"Provides thermal and physiological stability across bed states which may help to reduce the risk of infant stress as a result of bed transitions between open and closed bed modes."

– An Evaluation of a New Device in Maintaining Thermal and Physiological Homeostasis in Human Newborns[2]

"Resulted in an average temperature of 0.49°C higher than infants transported with conventional transport incubators."

– Risk Factors for Intra-hospital Transport of Newborn Patients: A New Solution to an Old Problem[3]

Newborn thermoregulation

From birth to discharge, caregivers have a big job to do. Maintaining stable thermoregulation in newborns is critical because babies lose heat readily and are susceptible to temperature changes. The smaller and more premature the baby, the greater the risk. Also, the wet newborn starts losing heat immediately after birth and unless heat loss is prevented, hypothermia will develop.[4]

And it doesn't take much heat loss to create cause for concern in newborns. According to the World Health Organization (WHO), there is cause for concern if the baby's temperature drops below 36.5°C (97.7°F).[4] With the advanced healthcare available today in much of the world, it may seem hard to believe that hypothermia in newborns is a real issue. However, hypothermia of the newborn occurs throughout the world, in all climates and is more common than believed.[4] For example, the Vermont Oxford Network data found that 38.2% of very low birth weight infants were admitted to Network NICUs with temperatures <36.5°C.[5] The Vermont Oxford data states that from 2009 to 2016, rates of admission temperatures <36.5°C decreased from 52.6% to 38.2%. However, despite the decrease, about 4 out of 10 infants are still cold when admitted to the NICU.[5]

Why infant heat loss is a concern

Beyond hypothermia, there are additional reasons to minimize heat loss in micropreemies, particularly in the case of the Extremely Low Gestational Age Neonate (ELGAN). For newborns delivered between 24 to 29 weeks gestational age, for each 1°C decrease in admission temperature, late-onset sepsis is increased by 11%, decreasing their chance of survival by up to 28%[6]. It has been shown that strategies to prevent heat loss during the Golden Hour (the first hour after birth) can significantly improve mortality and morbidity for the ELGANs.[7]

How newborns lose heat

Newborns lose heat in four ways after they are born. One is through evaporation of amniotic fluid from the baby's body. Evaporation accounts for 60% of heat loss in preterm infants during the first week of life[8]. Evaporative heat loss is inversely related to gestational age, therefore the lower the gestational age the higher the evaporative loss is. Convection, the second major mode of heat loss in both term and preterm infants[8] occurs if the naked baby is exposed to cooler surrounding air. Loss of heat can also occur by conduction if the baby is placed on a cold surface. And radiation can come into play, from the baby to cooler objects, even if the baby is not actually touching them. While that sounds complex, there's more. Heat balance is important for all newborns, but with ELGANs, macroenvironmental factors such as ambient air temperature, air velocity, and relative humidity become critically important. For the ELGANs in the first days to weeks, heat balance is achieved by maintaining skin integrity, decreasing insensible and transepidermal water loss, and minimizing energy expenditures all of which can be achieved by, the use of humidity. In trying to keep babies warm, it's important to make sure they do not become overheated. The variables above can work in reverse and result in hyperthermia.[9] With so many variables, is it possible to manage the newborn heat chain to ensure target temperature management from the delivery room, through transport and admission practices (both the microenvironment and the macroenvironment) and keep the baby at an optimal temperature?

Managing the microenvironment – walls and all

It is possible to manage the infant's microenvironment, and one common way of doing that is with the incubator or a hybrid thermal device. The objective of these devices is to provide a clean, warm environment, where the temperature and humidity can be controlled. While some of these devices are equipped with convective heaters, radiant warmers and may include a heated mattress, it is important to make sure the device being used has wall insulation. Proper wall insulation works to decrease convective heat loss and provide thermal stability required for the growth of newborns. The Giraffe OmniBed Carestation is a richly-featured neonatal microenvironment that combines the thermal advantages of a double walled incubator with the access advantages of an open bed radiant warmer. The open bed warmer uses an advanced, patented heating algorithm to cascade heat and minimize temperature swings. It provides a feature called "Comfort Zone" thermal[10] guidance for setting and activating the desired admission air temperature.

After noting the ways newborns can lose heat, it seems confounding that an incubator can preserve the thermal environment when the door is being opened and closed. But, the Giraffe OmniBed Carestation features Air Boost technology that works to maintain and sustain the appropriate level of heat to the infant during open door procedures. Air Boost is activated when doors are opened by the caregiver or technically activated upon start up or closing of the hood.

Table A				
Variable	**Radiant (R)**	**Transition R-C**	**Convection (C)**	**Transition C-R**
Mean Skin Temperature (degree C)	36.7	36.5	36.5	36.4
Mean Heart Rate (BPM)	138	136	140	129
Mean Respiratory Rate (RR)	44	41	45	46
Mean Blood Pressure (mmHg)	38	35	39	37
Mean SpO^2 (%)	98	98	96	97

M. Gaylord, L. Mefford, J. Stafano, K. Leef, L. Lynam. "An Evaluation of a New Device in Maintaining Thermal and Physiological Homeostasis in Human Newborns". Poster Presentation; National Association of Neonatal Nurses 2001.

Design/Methods: A convenience sample of 40 of the original sample of 77 sick newborns (mean gestational age = 29.4 + 4.0 weeks, BW = 1505.2 + 922.4 grams) were admitted into the Giraffe OmniBed Carestation during the first 24 hours after birth. All infants were admitted into the bed in warmer configuration and were enclosed in the incubator environment on the first day of life. After initial closure, the Giraffe OmniBed Carestation was opened an average of 2.85 times/24 hours for 12 minutes/opening. Skin temperature, device set temperature, device air temperature, device heater power, and physiological parameters were monitored before, during, and after transitions.

Results: A repeated-measures Multivariate analysis of variance (MANOVA) was performed on temperature and physiological measures. There were no differences found in mean skin temperature among the four test conditions (radiant, transition R to C, convection, transition C to R). Mean heart rate, respiratory rate, blood pressure, and oxygen saturation were not statistically different among the four test conditions. **Conclusion:** There were no significant differences in skin temperature or physiologic stability across bed conditions. These data suggest that the Giraffe OmniBed Carestation provides thermal and physiological stability across bed states minimizing the risk of infant stress as a result of bed transitions between open and closed bed modes.

Testing in open, closed and transition modes

A GE HealthCare internal study, in collaboration with University of Tennessee and Christiana Care Health Care, concluded that the Giraffe OmniBed Carestation can provide a stable and supportive macroenvironment for newborn growth and development. In the study, data was captured on 77 NICU babies admitted to the Giraffe OmniBed Carestation for the first 24 hours after birth. Data was captured in Open mode (radiant warmer), Closed mode (incubator), and transition conditions from Open to Closed care as well as Closed to Open care. The study's objective was to describe thermal and physiological responses of newborns admitted to the Giraffe OmniBed Carestation. No significant changes in the vital parameters of the newborns were observed during the transitions.[1] Vital parameters recorded included Respiratory Rate, Heart Rate, SPO_2, Blood Pressure, and Skin Temperature.

In the same study the Giraffe OmniBed Carestation was opened an average of 2.85 times every 24 hours for 12 minutes per opening. During these periods, there were no significant differences identified in skin temperature or physiologic stability across bed conditions (See Table A). The study concluded that the Giraffe OmniBed Carestation provides thermal and physiological stability across bed states, which may help to reduce the risk of infant stress as a result of bed transitions between Open and Closed bed modes.[2]

Minimizing transfers with one solution

Earlier, conduction, evaporation, radiation, and convection were listed as ways that babies can lose heat. Of course, these factors come into play when infants are transferred from one bed surface to another (e.g. radiant warmer to a scale, then to a transport incubator, to an incubator). Because body temperature and physiologic stability of the infant can be compromised during transfers, it's important especially in the care of the micropreemie, to keep bed transfers to a minimum. Minimizing transfers is another great advantage of the Giraffe OmniBed Carestation. From the delivery room to the NICU, and everywhere in between, the combination of the Giraffe OmniBed Carestation and the Giraffe™ Shuttle provides one baby, one bed, one solution. The solution enhances the continuity of care by eliminating bed transfers and providing the power necessary for thermal and physiologic stability during intrahospital transport.

In 2012, the Giraffe OmniBed Carestation and Giraffe Shuttle were externally validated by Oxford Analytica external independent experts. The validation was based on data from a Brigham Women's study of the use of incubators in the NICU. Oxford Analytica stated that when caring for low birth weight infants, the Giraffe OmniBed Carestation, combined with the Giraffe shuttle has the potential to improve by 15% the continuity of care, thermoregulation and physiological stability.[3]

The Giraffe OmniBed Carestation delivers

Every technological component of the Giraffe OmniBed Carestation was crafted to meet the infant's needs, and when put to the test, these components deliver a safe and controllable microenvironment. Consider a study published by F. Loersch, University Children Hospital Mannheim, Germany which, documented the newborn journey from birth to NICU.[3] The study concluded that the use of the Giraffe OmniBed Carestation for intrahospital transport resulted in an average temperature of 0.49°C higher than infants transported with conventional transport incubators. In addition to higher admission temperatures, the data also showed that total transport time from labor and delivery to the NICU was less than 43 minutes with the Giraffe OmniBed Carestation vs. 56 minutes using conventional methods.[3] (See Table B).

The Giraffe OmniBed Carestation also includes a servo humidity system. As stated earlier, humidification has been shown to be very important in infant care. Citing the Brigham and Women's Hospital study, an Oxford Analytica analyst further concluded that using the Giraffe OmniBed Carestation with environmental humidification during the first weeks of life, appears to deliver "improvements of at least 15% in clinical outcomes such as body temperature, growth velocity, ventilator use, chronic lung disease, weight stabilization, and electrolyte balance."[1]

In addition, the study went on to conclude that using the Giraffe OmniBed Carestation with high humidity, showed "improved care for ELWB infants by making it possible to decrease fluid intake, improve electrolyte balance, and enhance growth velocity without disturbance of body temperature compared with conventional care."[1]

Consider technology, transfer and track record

Although there has been a recent surge of new infant incubators in the market claiming to provide better thermoregulation measures for newborns, it's important to evaluate incubators based on three criteria: technology, transfers, and track record. Relating to technology, the Giraffe OmniBed Carestation features double wall insulation, a patented heating algorithm, a servo humidity system, and Air Boost technology to help maintain temperatures in open, closed, and transition modes. And by combining the Giraffe OmniBed Carestation and the Giraffe shuttle, care teams now have a "one baby, one bed, one solution" approach to help eliminate transfers.

And finally, since 2000, the Giraffe OmniBed Carestation has been helping babies and families go home healthy. Today, over 40,000 of our hybrid incubators are being used across thousands of hospitals, in over 131 countries. More importantly, the oldest surviving children, who lived their first hours to months in a Giraffe Omnibed Carestation are now 23 years old. They are young adults, planning for college and potential careers. This proud history is something new hybrid incubators can only hope to one day achieve.

Table B

Characteristic (Range)	Traditional Transport (N=50)	Giraffe OmniBed Carestation Transport (N=50)
Total Transport Time (minutes, m) Team to DR; Returns with Baby	56.3 m (Preterms) 62.1 m (Others)	42.7 m (Preterms)* 46.8 m (Others)*
Birth to NICU Admission Time (minutes, m)	33.9 m (Preterms) 29.1 m (Others)	25.3 m (Preterms)* 27.7 m (Others)*
Admission Rectal Temperature (range)	36.22 °C (35.1-36.3 °C)	36.71 °C* (36.2-37.3 °C)

In summary: Use of the Giraffe OmniBed Carestation for stabilization, intrahospital transport, and NICU admission resulted in an average admission rectal temperature that was 0.49 °C higher in the Giraffe OmniBed Carestation group compared to the conventional transport incubator control group.

*p<0.0001, Welch-Satterthwaite t-test

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About GE HealthCare

GE HealthCare is a leading global medical technology, pharmaceutical diagnostics, and digital solutions innovator, dedicated to providing integrated solutions, services, and data analytics to make hospitals more efficient, clinicians more effective, therapies more precise, and patients healthier and happier. Serving patients and providers for more than 100 years, GE HealthCare is advancing personalized, connected, and compassionate care, while simplifying the patient's journey across the care pathway. Together our Imaging, Ultrasound, Patient Care Solutions, and Pharmaceutical Diagnostics businesses help improve patient care from prevention and screening to diagnosis, treatment, therapy, and monitoring. We are an $18 billion business with 51,000 employees working to create a world where healthcare has no limits.

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