

Infant Warmers

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Unlike incubators that provide a hygienic environment in which controlled temperature and humidity totally envelop the infant, infant warmers provide only heat to support the infant's thermal needs. Infant warmers have open sides and a top that both allows unobstructed direct observation, and gives providers virtually unobstructed access to critically ill infants, newborns, and infants undergoing treatments or therapies that would otherwise expose the patient to the relatively cooler room environment.

The secret, if you will, to their ability to provide both warmth and an open-work environment lies in their unusual method of heating the infant. Rather than heating the air and blowing it into an interior space to warm objects (as do forced-air home heating units and conventional incubators), infant warmers employ infrared (IR) light—energy with a wavelength greater than three microns to prevent damaging the infant's eyes—to warm the infant. One of the characteristics of the far IR region is the ability of the light to warm human skin without warming the intervening air. This warmth causes an increase in blood flow, which heats both the underlying blood and tissue surfaces. The warmed blood and tissue transfer this heat to the rest of the body. It is this use of overhead IR heating elements to provide uninterrupted warmth that distinguishes infant warmers from incubators. Several cautions apply to their use in infant warmers which will be mentioned later in this article.

Current Technology

Infant warmers are available in several basic configurations; some are wall or ceiling mounted, others are detachable, but most are freestanding self-contained units.



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Wall or ceiling units are mounted to the building's structure, usually with hardware that allows them to be raised and lowered. Sometimes models allow lateral positioning over a conventional bassinet or crib. Detachable units utilize a simple castered floorstand to hold the overhead heating element above a conventional bassinet or crib. Detachable units can be moved from bassinet or crib as needed. The most common models found in healthcare facilities are freestanding, self-contained infant warmers that include an integral bassinet or flat work surface upon which the patient can be placed for treatment. Often, they also connect to central oxygen and suction to bring (port) these utilities directly to the work area.

Freestanding units with an integral bassinet or a flat

working and treatment surface are mounted on a casted base for mobility, and often contain drawers or shelving for additional storage space. A canopy containing the IR heating element, usually enclosed in a single housing, is mounted over the working surface. The canopy contains a reflector that maximizes downward radiation and often includes a work light with apertures or slots to vent heat. In most designs, the canopy is suspended by a single vertical column at the “head” end of the infant warmer above the bassinet or working surface, but a common variant utilizes two smaller canopies suspended by the vertical column in the form of a Y. Typically, for safety reasons, the flat working surface contains three fold-down panels, one on each of the remaining sides, to keep the patient from falling off the working surface. Both wall-mounted and detachable warming units are designed in a similar manner, but lack the base and work surface, instead requiring the healthcare facility to provide a bassinet or treatment table to support the infant.

In addition to providing a place upon which to mount the canopy, many columns also contain the controls for heat and work lights, as well as controls and visual indicators for various alarm functions. Like IR heaters used in drafty work areas that lack a thermostat, infant warmers also lack a conventional thermostat since they do not heat the air. They heat the skin directly; a conventional thermostat would not work. While warming, the infant typically lies on the flat surface wearing only a diaper. This is counterintuitive to normal infant care since the protocol is to wrap the infant in one or more blankets to retain warmth. With infant warmers, wrapping the infant in a blanket, or merely laying a blanket over the infant, has the opposite effect because it blocks the IR rays from reaching the infant’s skin. Unless the rays strike the skin, the infant will not be warmed. Staff members must remember not to block the IR elements too long with their arms or head while caring for the infant. While injury to the staff member is unlikely, the blockage will prevent the rays from reaching and warming the infant.

Most infant warmers use two interconnected systems to maintain the infant’s temperature. The first is a servo system consisting of a thermistor probe applied to the infant’s abdomen or other exposed body area to detect the infant’s temperature. The thermistor is connected to an electronic control system that either cycles the heating element on and off, or proportionally adjusts the power supplied to the heating element. In either case, the temperature servo system provides just the correct

amount of IR light to maintain the infant’s temperature at the set point selected by the nursing staff. The second system uses a simple timer to provide a predetermined power level to the IR heating element for the set amount of time. On some units, once the time has expired, the heater simply shuts off. On other designs, time expiration initiates an audible alarm that alerts the staff to reassess the infant, but the heater stays on. After a minute or so, the alarm sounds again and the IR heating element turns off after an additional three and five minutes. In either case, resetting the timer reinitiates the manual heating sequence. Rarely will an infant warmer lack the temperature servo system and rely solely on a timer to maintain infant warmth. These units do exist, but their use is discouraged because of their tendency to either underheat or overheat the infant.

A variant of the basic design takes advantage of the penetrating capabilities of the far IR light and combines it with an enclosure in an attempt to combine the best advantages of both incubators and warmers. These devices provide a stable environment for infants while they sleep and while the staff attends to their needs. Historically, these combination units have never achieved a high level of acceptance or popularity, so the average biomed will rarely encounter them in typical healthcare settings.

The risks associated with long-term use of infant warmers (underheating, potential dehydration, overheating, burns, etc.) can be mitigated by close monitoring of the infant, and are offset by the tremendous advantages afforded by simultaneous free access to the infant by several persons. Because of the need to maintain the infant’s warmth while the staff is rapidly cleaning, assessing, and otherwise caring for the immediate needs of the newly born infant, they are frequently used in the delivery room during the first few minutes of the infant’s life. It is here

Origin and Evolution

Infant warmers employing near infrared light/heating elements began appearing in healthcare facilities in the mid-1970s, so, unlike many other medical devices, they do not have a long history. Their physical design is relatively straightforward and has changed minimally since their introduction in healthcare. Over the years, there have been incremental improvements in temperature controls and alarms, but there is not a long history of research and development.

that infant warmers seem to have found their niche in the healthcare environment.

How to Manage the Device

Maintenance management of infant warmers, like that of their cousins the infant incubators, should be unique to the individual item. Preventive maintenance and electrical safety testing should be scheduled and performed in accordance with the manufacturer's literature and instructions. Additionally, individual item-unique maintenance histories should be maintained for the life of the equipment.

Regulations

Aside from the U.S. Food and Drug Administration (FDA) designation as medical devices, there is no national regulation of infant warmers.

Risk Management Issues

Infant warmers using radiant heat present several risks beyond those found in conventional incubators. The most obvious is the open top and sides with the radiant heating elements mounted above the infant. Experienced biomedics familiar with a recent product alert will remember the molten blobs falling from heating element connectors onto the work surface and infant below. To prevent a recurrence, staff members must be cautioned against placing things on top of the canopy, blocking the heat vents. This practice creates overheating of the upper unit, resulting in shortened heating element life, and can cause a similar recurrence of the safety hazard. Additionally, there is always the risk that whatever is placed on the canopy will ignite or fall off the canopy, striking the infant on the work surface.

From a clinical perspective, infants placed in infant warmers are exposed to the outside air, potentially causing dehydration in infants requiring high heat levels to maintain body temperature. Often, to reduce evaporative losses, clinicians will place a thin plastic blanket over the infant. In such cases, users must exercise extreme care and frequently assess the infant's condition for two reasons. First, because the blanket causes the infant to retain heat so well, there is the risk of fatal overheating. Second, there is the very real risk that the temperature sensor may detach from the infant and adhere to the blanket instead. This can cause fatal overheating because the heater, unable to warm the blanket, will run continuously and overheat the infant.

For More Information

ECRI Healthcare Product Comparison System for Warming Units, Radiant, Infant

ECRI Healthcare Product Comparison System for Incubators, Infant

"The Fundamentals of... Infant Incubators," *Bio-medical Instrumentation & Technology*. 2006;40(3):215-218.

Troubleshooting

Troubleshooting infant warmers is fairly routine since equipment design is typically straightforward and lacks complexity. As with most medical equipment, a service manual delineating preventive maintenance, and calibration requirements and procedures is required to properly maintain infant warmers. There do not appear to be any specific common problems with these devices.

Training and Equipment

Good basic biomedical skills are required to service infant warmers. With those skills and a good service manual that includes block diagrams and module functional descriptions, basic and mid-level biomedical electronics technicians should be able to perform all maintenance, both scheduled and remedial, on infant warmers. An electronic thermometer is essential to maintain infant warmers; every well-equipped biomedical maintenance facility should consider that a basic piece of test equipment, just as it would with a multimeter. Aside from the electronic thermometer, no special tools or test equipment are required to service infant warmers.

The basic technology of radiant heat infant warmers is well established in other areas and is considered mature. Research is continuing in an attempt to develop improved control, safety, and alarm circuitry. ■

References

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