A Novel High-Efficiency System for Infant Warming through Secondary Heating Mechanisms

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Each year, 15 million infants—one in every ten born worldwide—are susceptible to hypothermia. This makes thermal stability a necessity for infant survival, with negligence of a stable environment potentially leading to neurological complications and death. Yet, current methods to target infant hypothermia are inadequate; high-power transport incubators are expensive ($50,000-$150,000) and use forced-air heating, while warmers using less-expensive phase change materials can only supply heat for less than four hours. To create a portable, inexpensive, energy-efficient, reusable infant warming device, a two-dimensional, multi-power heating grid was embedded into a sodium acetate gel pack. The resistive heating-based grid was then powered by two rechargeable car batteries (12-volts each), and was prototyped to ensure consistent enthalpy change throughout each use. The developed warming mechanism used high and low power settings, operating at two separate equivalent resistances, to reach the optimal body temperature and then maintain that temperature. At steady-state, the warming device maintained consistent temperatures between 40-50˚C for over 30 hours as measured by a hand-held, infrared thermometer, thus outlasting the leading, low-cost infant warmer on the market, eight-fold. The implementation of embedded temperature sensors and temperature-based thermal cutouts in strategic locations, as well as in-line fuses, are works in progress intended to improve sensing and feedback, so as to prevent localized hot-spots and preserve infant, operator, and device safety. Overall, this inexpensive, reusable, portable, energy-efficient device is well-suited for ameliorating infant mortality, by warming the millions of at-risk infants facing moderate and severe hypothermia worldwide.

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