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PUBLISHED ABSTRACT

In Vitro Comparision of the Temperatures of Refrigerated, Room Temperature and Warmed Formula at Point of Delivery into the Newborn

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Background

Premature newborns are fed with expressed breast milk or formula (EBM/FOR) delivered by syringe pump via an orogastric tube. The EBM/FOR is often warmed prior to feeding. We hypothesized that heat exchange between the tubing carrying the EBM/FOR and the atmosphere would cause the temperature of the feed to approach that of the surrounding environment.

Methods

We utilized in vitro simulations of premature infant feeds based on best practices in the NICU. Simulation of 20 ml infusions were carried out over 3, 15 and 30 minutes. Incubator temperature within which simulation was run was set to either 31 or 37°C. A thermocouple measured formula temperature at the point that it would enter into a baby. We compared (ANOVA) the effects of the source of the formula in the syringe being refrigerated, room temperature or warmed.

Results

At the conclusion of the 3 min infusion mimicking OGT gavage feeding, into either a 31°C or 37°C incubator, there was a significant difference ($p > 0.001$) in the three formula sources' TPOE for cold, RT and warmed formula (**Figure 1**). For the 15 minute and 30 minute infusions into a 37°C incubator, there was a no significant difference in TPOE for the three formula sources either 1/3 of the way through ($p = 0.15$ and 0.2 respectively) or at the conclusion of the infusion ($p = 0.7$ and 0.3). The 15 minute infusion into the 31°C incubator showed a significant ($p < 0.01$) but functionally small difference in the 3 infusions on the order of 0.9°C at both 5 and 15 minutes (**Figure 2**).

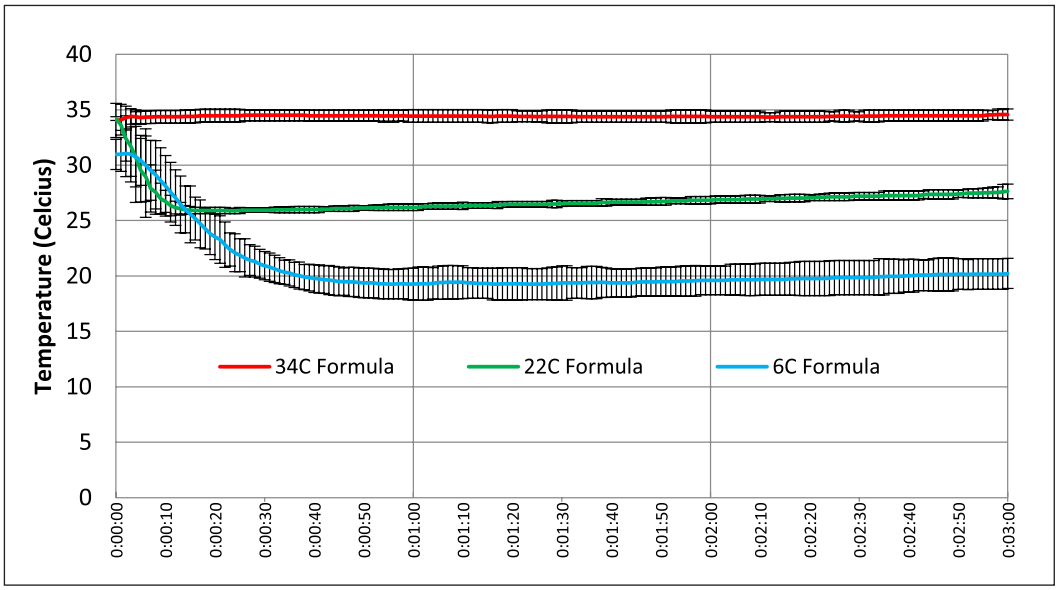

Figure 1: Graphical depiction of temperature of point of entry into the baby for a 20 mL gavage of warmed (34C), room temperature (22C) and refrigerated (6C) formula delivered over 3 minutes into an incubator set to 37C.

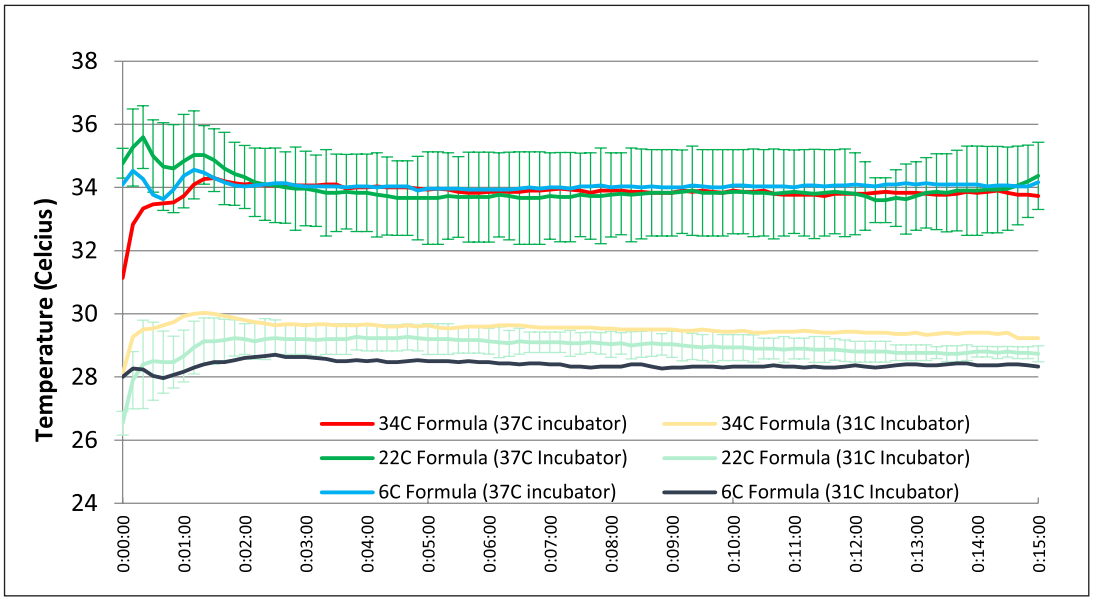

Figure 2: Graphical depiction of temperature of point of entry into the baby for a 15 minutes infusion of 20 mL of warmed (34C), room temperature (22C) and refrigerated (6C) formula. The top 3 lines show the infusions into a 37C incubator vs the bottom three into a 31C incubator. Comparison of the two groupings shows that environmental temperature has a much greater effect on the temperature of the delivered milk that the formula's starting temperature. 6C formula infused into a 37C incubator had a delivered temperature 5C higher than 34C formula infused into a 31C incubator.

Discussion

These results suggest that for gavage feedings by gravity, a feeding's source temperature will have a significant effect of the temperature delivered to the baby. For slower infusions, such as those over 15 minutes or longer, of volumes of 20 ml, the source temperature has no significant effect on delivered temperature. However, environmental temperatures, in this case represented by changes in incubator temperatures did significantly impact delivered formula's temperature.

Conclusions

If there is a benefit to delivering warm milk to premature babies, an issue which our study does not address, warming of milk is appropriate for gavage feedings but unnecessary for slowly infused feedings when the tubing is placed in the incubator. Therefore, any time and money spent warming slow feeds represents provider inefficiency that forces time away from bedside and unneeded expenditures on bottle warmers, their maintenance and their accessories.

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