Thawing Human Milk for Hospitalized Infants: Use of a Laboratory Bead Bath May Be an Effective Method for Large Quantities

HUMAN MILK FOR HOSPITALized infants in the neonatal intensive care unit (NICU) is often stored frozen and must be thawed before use. Frozen milk must be properly thawed, ensuring that no ice crystals remain, while minimizing overheating, to reduce risk of microbial growth and prevent nutrient loss.[1,2] Although frozen milk may be thawed in the refrigerator over 8 to 12 hours, such a process may not be as effective for thawing large volumes for multiple patients or may result in human milk waste if orders change frequently. Therefore, some facilities may require a more rapid thawing method.[1] Such methods include holding the bottle under lukewarm running water or placing it in a container of warm water with the water level below the lid to prevent contamination.[1] However, research has shown that hospital tap water is one potential source of pathogenic organisms in the patient care environment and can cause nosocomial infections.[3,4] Commercial bottle warmers that use tap water also have been reportedly linked with *Pseudomonas aeruginosa* infections in one NICU.[5] Such data have consequently led some experts to recommend that hospitalized patients at high risk for infection avoid all exposure to hospital tap water.[4]

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Human milk bottle warmers that do not use tap water are commercially available in the United States. Such warmers are able to thaw 120- to 270-mL volumes in approximately 12 to 25 minutes and allow for a regulated temperature.[6,7] However, each warmer only accommodates up to 270 mL at a time. For hospitals that use centralized human milk preparation and prepare feedings for large numbers of patients, thawing such small volumes at a time would not be feasible, nor would having an individual warmer for each patient's milk to be thawed.

The Children's Hospital of Orange County (CHOC) has high rates of human milk use, with more than 80% of very-low-birth-weight infants discharging home still on human milk. To ensure proper handling and tracking, CHOC employs centralized human milk handling in its Nutrition Lab. Mothers are provided with 2-oz human milk storage containers for milk collection. The Nutrition Lab receives all human milk brought to the facility and tracks it using a bar code scanning system. Human milk feedings are prepared per physician order (including the addition of fortifiers or other additives) and unit dosed into individual feeding syringes or bottles twice daily with 12-hour volumes prepared at each preparation time. Typically, the Nutrition Lab prepares human milk feeds for 45 to 50 individual patients at a time. Depending on the patient's clinical status and ability to initiate or advance feedings, much of the milk may be frozen, necessitating thawing of approximately 8,500 mL breast milk daily. The number of 2-oz bottles per patient at each preparation time varies from one to six bottles, depending on the volume ordered and the volume per container. In an attempt to reduce potential exposure to tap water within the NICU, CHOC converted from human milk bottle warmers that used water to waterless warmers at the bedside in February 2016. However, the practice of thawing milk using warm water baths in the Nutrition Lab was continued, because using individual bottle warmers to thaw that volume of milk was not feasible. Subsequently, a goal was set to identify a waterless thawing option.

Medical laboratories often use both water baths and bead baths to warm samples before analysis. Bead baths consist of a metal basin that is plugged in and filled with small metal beads that heat to the specified temperature. They were designed for laboratory use to allow for better control of contamination. A bead bath was proposed as an effective method of thawing human milk without water. At the time of study initiation, CHOC was aware of one facility potentially using the bead bath for this purpose, but was unable to reach them for further information until after study data were collected. A literature search on the use of bead baths for thawing human milk did not result in any information; therefore, a study was initiated on the effectiveness of using a bead bath for human milk thawing in a centralized preparation setting. We hypothesized that human milk thawed in the bead bath would thaw faster and have reduced potential exposure to tap water microorganisms without increasing the internal temperature of the milk compared with milk thawed in a water bath.

DATA COLLECTION

Study data were collected between February 25 and April 28, 2016. Human milk being thawed by the usual process was tracked for two preparation periods to determine the current average thaw times and internal milk temperatures. Based on recommendations for formula preparation, our process was for thawed human milk not to exceed room temperature during the thawing process (21°C/70°F) and for the prepared human milk feedings to reach 2°C to 4°C (35° to 40°F) within 1 hour of preparation.[1] Routine audit data from CHOC (not shown here) have confirmed that feeds not exceeding 21°C at the time of preparation reach the desired temperature in the refrigerator within 1 hour. Therefore, the goal was to determine whether the study samples could also meet those parameters.

Based on the volume of milk to be thawed at each preparation time, CHOC purchased a 20-L capacity bead bath shown in the Figure (Lab Armor; Sheldon Manufacturing, Inc). Because no previous literature existed about using a bead bath for this purpose, the ideal temperature at which to set the bead bath was unknown. Setting the bead bath at too high a temperature could result in overheating the milk, potentially leading to loss of nutrients or anti-infective factors.[1,2] To prevent any adverse consequences to milk for patient use, frozen milk from a variety of mothers that was slated for disposal was saved for use as experimental samples.

To determine the proper bead bath temperature, thaw times for a few samples were evaluated before the study. At both 55°C and 65°C, thaw times significantly exceeded expectations (58 and 48 minutes, respectively). Therefore, the decision was made to conduct the study with the bead bath set at 80°C (its maximum temperature setting).

Study samples for two preparation periods were matched to the control group with regard to the number of individual patients, volume per patient, and volume per bottle. For sanitation, avoiding spills, and preventing mix-up of milk, all bottles for a given patient were placed into a plastic bag and then inserted into the beads to thaw. Bottles are positioned within the bags to maximize heat exposure, allowing the beads to be in contact with as much of the outside of each bottle as possible. If too many bottles are placed in a bag, the bottles in the middle would have less exposure to the beads and, consequently, take longer to thaw. Because of the quantity of bottles needed to be thawed for each feeding preparation time, the bead bath was filled to maximum capacity to determine whether the thaw times would be acceptable.

To assess risk of exposure to microorganisms from either the tap water or the beads, culture samples were taken from both mediums. Tap water used with each individual patient was collected for the first preparation period, pooled, and a 5-mL sample collected in a sterile specimen container. This process was repeated for the second preparation period. To assess potential microbial growth within the beads and to determine the appropriate sanitation schedule for the beads, a sample of eight beads was collected from the bead bath via a disposable spoon and placed in a sterile specimen container at baseline before use, on day 1 after beginning bead bath use, and weekly for 3 weeks. After 3 weeks, the beads were sanitized, and this process was repeated for the same periods. Samples were processed in the Microbiology Laboratory at CHOC. All samples were placed on blood and chocolate agar plates and thioglycolate broth. Samples were incubated at 37°C for 96 hours. The beads were sanitized with 70% isopropyl alcohol, which was distributed throughout the bead bath via a wooden spoon per manufacturer's instructions.

In addition, samples were collected at weeks 4 and 5 for the second preparation period to determine whether sanitization could be completed on a monthly basis.

Figure. Lab Armor Bead Bath (20 L capacity). (Image used with permission of Sheldon Manufacturing, Inc.)

FINDINGS

Thawing Times and Milk Temperatures

Samples for 52 patients totaling 128 bottles with an average bottle volume of 56.6 mL were analyzed for both the control group and the study group. Results for the average thaw time and average milk temperature for both groups are reported in Table 1. The control group had an average thaw time of 39.5 minutes, which was acceptable for the workflow, and an average milk temperature of 20.4°C, meeting internal process goals to not exceed 21°C. Although the study group did not offer a time saving advantage with the average thaw time of 38 minutes, from a practical standpoint, the timing was equivalent and, therefore, would not be a disadvantage of changing to this process. Average milk temperature in the study group was 17°C, 17% lower than the control group. Although the temperature reduction was not statistically significant (P=0.55 with 95% confidence interval), with the goal of maintaining temperatures of thawed milk at 21°C or less, even a modest reduction may be clinically relevant and would be considered a positive effect of process change.