JOGNN

IN FOCUS

Best Practices to Limit Contamination of Donor Milk in a Milk Bank

Elizabeth B. Froh, Jill Vanderpool, and Diane L. Spatz

Q7

Correspondence
Elizabeth B. Froh, PhD, RN, The Children's Hospital of Philadelphia, 3401 Civic Center Blvd., Office 2NW83, Philadelphia, PA 19104.
frohe@email.chop.edu

Keywords
Bacillus cereus
donor human milk
milk banking
pasteurization

ABSTRACT

Human milk donated to a milk bank can become contaminated in a number of ways, but processes exist to eradicate pathogenic bacterial growth. Donor human milk may be cultured before or after pasteurization or both. The purpose of this article is to describe standard operations of the Mothers' Milk Bank of the Children's Hospital of Philadelphia, best practices to limit the bacterial contamination of donor human milk, and implications for future research.

JOGNN, ■, ■–■; 2017. https://doi.org/10.1016/j.jogn.2017.12.002

Accepted December 2017

Elizabeth B. Froh, PhD, RN, is the Clinical Supervisor for the CHOP Lactation Program and Human Milk Management Center, Children's Hospital of Philadelphia, Philadelphia, PA and adjunct assistant professor at the University of Pennsylvania, Philadelphia, PA.

Jill Vanderpool, RN, CPN, CLC, is a regional care coordinator, Children's Hospital of Philadelphia, Philadelphia, PA.

Diane L. Spatz, PhD, RN-BC, FAAN, is a professor of perinatal nursing and Helen M. Shearer Professor of Nutrition, at the University of Pennsylvania School of Nursing, Philadelphia, PA and the Director of the CHOP Lactation Program, Children's Hospital of Philadelphia, Philadelphia, PA.

The Human Milk Banking Association of North America (HMBANA) provides oversight for all nonprofit milk banks in North America and works collaboratively with them to dispense pasteurized donor human milk (PDHM). The HMBANA provides guidelines to establish and operate milk banks, and each bank must pass initial accreditation and re-accreditation to ensure compliance with these guidelines and operating principles (HMBANA, 2015). The HMBANA recommends Holder pasteurization as a safe and effective means to eradicate pathogenic bacterial growth in donor human milk (DHM; HMBANA, 2015). Although Holder pasteurization is effective, some bacteria can survive the pasteurization process. One such genus of bacteria is *Bacillus*. The *Bacilllus* genus has more than 250 identified species, some of which have been reported as pathogenic in case studies (Boo, Nordiah, Alfizah, Nor-Rohaini, & Lim, 2001; John, Razak, Razak, Al-Naqeeb, & Dhar, 2007; Pawlik et al., 2009; Ramarao et al., 2014). The purpose of this article is to describe standard operations of a model milk bank (Mothers' Milk Bank [MMB] of the Children's Hospital of Philadelphia [CHOP]), best practices to limit the bacterial contamination of donor human milk, and implications for future research.

Background

Donor human milk can become contaminated in a number of ways. Possible vectors of *Bacillus cereus* include food, linen, and/or disposable single-use items. Therefore, bacteria can be introduced during collection, storage, or processing. In case reports, researchers reported *Bacillus cereus* as a pathogenic bacterium that affects immunocompromised, critically ill, and low-birth-weight infants (John et al., 2007; Pawlik et al., 2009; Ramarao et al., 2014). *Bacillus cereus* is a mobile, spore-forming, aerobic or facultative anaerobic, Gram-positive or Gram-variable rod that is commonly found in soil, dust, air, and water. Sepsis caused by *Bacillus cereus* in the neonatal population can lead to meningitis (Patrick, Langston, & Baker, 1989; Tokieda et al., 1999), bacteremia (Decousser et al., 2013; Hilliard, Schelonka, & Waites, 2003; John et al., 2007; Patrick, Langston, & Baker, 1989; Tuladhar, Ratole, Koh, Norton, & Whitehall, 2000), respiratory tract infections (Gray et al., 1999; Jevon, Dunne, & Hicks, 1993), and intestinal perforations (Decousser et al., 2013; Girisch et al., 2003). Most cases of *Bacillus cereus*–related infections have been reported in preterm infants who had predisposing risk factors such as mechanical ventilation and indwelling central catheters (Decousser et al., 2013; Hilliard et al., 2003).

Haiden and colleagues (2016) investigated two infection control regimens for women who pumped for infants in a NICU in Vienna, Austria. They found that the regimen was not associated with

The authors report no conflict of interest or relevant financial relationships.

AWHONN

FLA 5.5.0 DTD ■ JOGN305_proof ■ 2 January 2018 ■ 11:10 am ■ ce

Donated human milk may become contaminated in a number of ways.

bacterial growth; instead, where the mother expressed milk was associated with bacterial contamination. Milk expressed at home had 10% greater rates of bacterial growth than milk expressed in the hospital (standard regimen home vs. hospital: 17.9% vs. 6.1%, respectively; strict regimen home vs. hospital: 19.6% vs. 3.4%, respectively; $p < .001$). The investigators attributed the reuse of collection equipment at home as a strong contributing factor (Haiden et al., 2016). Additionally, Karimi et al. (2012) found that the main sources of bacterial contamination in the expressed milk of mothers of infants in the NICU were milk collection containers and pumps. However, educational strategies for these mothers were effective to reduce bacterial counts in expressed milk; the rate of bacterial contamination started at 25.4% before the intervention and fell to 8.2% after the intervention (Karimi et al., 2012).

Decousser and colleagues (2013) described the onset of severe intestinal infections in two preterm neonates (gestational ages of 29 and 30 weeks) in a NICU in France. The authors determined that the possible vectors in each case were the pasteurized donor pooled milk, the container or syringe, or the environment (area in which the milk syringes were prepared and/or administered). The two cases do not isolate the pasteurized donor milk as the vector of intestinal infection; however, it could not be ruled out.

Testing for Contamination

There are various ways to test DHM for bacterial growth; some milk banks obtain cultures before and after pasteurization, and others test only after pasteurization (see Table 1). When screening before pasteurization, milk banks may opt to discard any raw milk that contains organisms or potential pathogens that are capable of producing heat-stable enterotoxins, endotoxins, and spores (Almutawif, Hartmann, Lloyd, Erber, & Geddes, 2017). The practice of obtaining cultures before pasteurization is not followed consistently in milk banks globally for simple cost/benefit reasons. Milk banks may forego the prepasteurization testing to save time and money and to preserve a larger supply of raw milk. Milk banks that test only after pasteurization may yield more product because milk is not discarded unnecessarily before pasteurization.

Using the practice of culturing milk before and after pasteurization in a study conducted in France, Dewitte and colleagues (2015) reported positive postpasteurization bacterial growth rates of 0.5%. However, 10.8% of DHM in milk banks in France is discarded before pasteurization after initial bacteriologic screening (Dewitte et al., 2015). Similarly, the Taipei City Hospital Milk Bank in Taiwan reported that 0.63% of PDHM had positive test results after pasteurization. At that facility, 27.9% of DHM was discarded after prepasteurization screening (Chang, Cheng, Wu, & Fang, 2013). The Perron Rotary Express Milk Bank (King Edward Memorial Hospital, Perth, Australia) reported postpasteurization bacterial growth rates of 2.4%; 26.4% of raw DHM was discarded before pasteurization, and only 0.9% of the discarded DHM contained *Bacillus* species (Almutawif et al., 2017). Landers and Updegrove (2010) reported a postpasteurization bacterial growth rate of 7%, and *Bacillus* species was the predominant contaminant (5%) in DHM from the Austin Mothers' Milk Bank (Austin, Texas). Among their total sample of 17 batches of donor milk, 10 batches of donor milk had positive test results for *Bacillus* species before and after pasteurization, and the remaining 7 had positive test results only after pasteurization (Landers & Updegrove, 2010). Finally, Jang et al. (2016) cultured samples after pasteurization at the Gangdong Kyung Hee University Milk Bank (Seoul, Korea); they reported a bacterial growth rate of 12.6% and cataloged the majority as *Bacillus* species. These findings indicate low rates of positive results for postpasteurization milk cultures; however, a large volume of milk in each of the reports was discarded before pasteurization, which indicates a potential waste of milk.

Operations of the MMB

The MMB of CHOP is an internal milk bank located within a free-standing children's hospital. The DHM pasteurized by the MMB is provided to CHOP inpatients. The MMB was approved as a HMBANA milk bank in October 2015 and is housed in the CHOP main building. This model is unique because most HMBANA milk banks are free-standing facilities. At CHOP, there is a strong human milk and breastfeeding culture, and the pumping initiation rate is approximately 99% among mothers on the special delivery unit. As a whole, more than 80% of infants discharged

FLA 5.5.0 DTD ■ JOGN305_proof ■ 2 January 2018 ■ 11:10 am ■ ce