

Do barcode medication administration systems reduce expressed breast milk administration errors? A Rapid Review

Corey Joseph & Angela Melder. 24/08/2017. Do barcode medication administration systems in neonates reduce expressed breast milk administration errors? A Rapid Review. Centre for Clinical Effectiveness, Monash Health, Melbourne, Australia.

Background

Breastmilk errors, such as feeding an infant the wrong breastmilk, are a concern to any healthcare service. There have been a small number of interventions designed to reduce breastmilk administration errors and contaminations, and some of these interventions include the use of a barcode system. As a result, the aim of this review was to search the evidence to answer the following objectives:

Objectives

- Do barcode medication administration systems in neonates reduce expressed breast milk administration errors?
- What barcoding identification systems in neonates reduce expressed breast milk errors?

Search strategy

The following information details the criteria used to find the evidence for this report, and the sources used to find the evidence.

Inclusion/Exclusion Criteria

Table 1. Inclusion/Exclusion criteria

Population	Include: Breast milk
Interventions	Include: Barcode management systems
Outcomes	Include: Misdelivery or administration errors
Context	Include: Neonatal Exclude: Adult
Types of evidence	Include: Systematic Review Exclude: All other qualitative or experimental studies.
Limits	Date: No limit. Language: Publications in English.

Database searching

The following sources were searched with respect to the evidence around barcode management of breast milk (Table 2). Keywords were selected based on a systematic review known to the authors¹.

Table 2. Summary of databases searched, keywords and results.

Source	Keywords	Results
Pubmed	"breast milk" OR breastmilk OR "human milk" OR breastfeeding OR "breast feeding" OR express* AND admin* AND/OR error AND barcode OR bar-code OR "bar code"	849 studies.
PROSPERO	"breastmilk"	0 studies
TRIP database	"breastmilk" "error" "neonate"	1 study.
Cochrane Library	"breastmilk"	0 studies

Study Selection

Titles and abstracts identified were exported from Pubmed to EndNote X7 (Thompson, Reuters, Carlsbad, California, USA). Papers identified were screened using inclusion and exclusion criteria established *a priori*. Searches of PROSPERO TRIP database and Cochrane Library were screened by one reviewer (CJ) in consultation with colleagues as necessary. Literature was included based on the above criteria (Table 1).

Quality Appraisal

Included reviews are appraised by the AMSTAR checklist² by one author (CJ).

Search Results

The below figure (Figure 1) indicates the flow of identified and included articles from the different sources searched. A total of one study was included in this review.

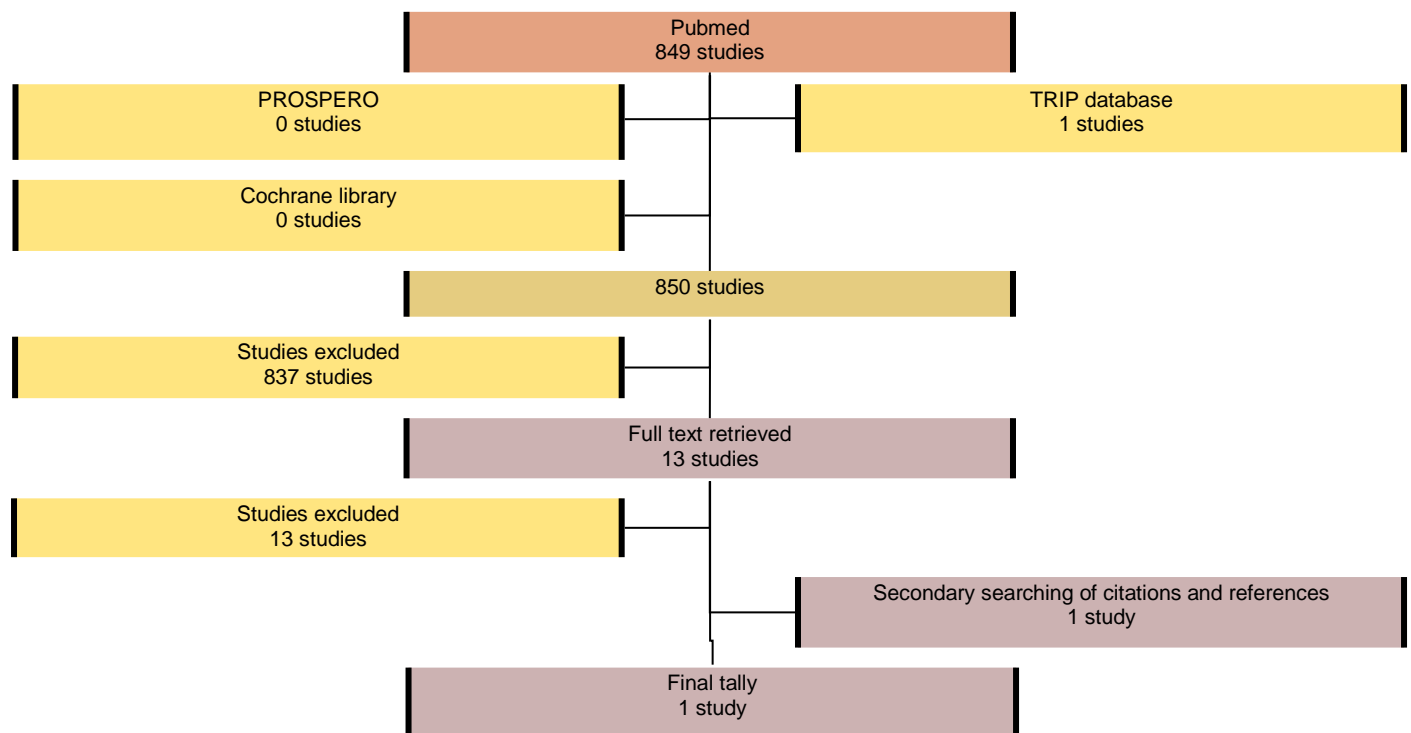


Figure 1. Flow of studies to inclusion.

Summary of Findings

The one study that was included was Melton *et al.*³, this study was a systematic review that investigated broad health information technology interventions to improve safety in neonatal care. Only 2 studies (Steele *et al.*⁴ and Dougherty *et al.*⁵) included in this review specifically addressed the impact of technology (bar-coding) to reduce breastmilk errors.

The section below summarises the findings of these two studies from Melton *et al.*³ (Further details in Table 3).

The overall quality of the Melton *et al.*³ review was low (4 out of 10) (Appendix 1).

Barcoded medication administration technology and reducing administration errors

Barcoded medication administration technology is a nurse-driven point-of-care process that uses bar-coding technology to accurately match in-hand medications with medication orders and patient identity immediately before administration. Some neonatal units have also adopted the use of a bar-coding system for breast milk administration. Two studies (Steele *et al.*⁴ and Dougherty *et al.*⁵) have reported the following:

- Steele *et al.*⁴ studied the effects of bar coding on breast milk administration errors and showed total breast milk errors dropped from a baseline of 45 to 4 in the first 6 months. The barcoding system assisted with identification and prevention of near-miss attempts to a) feed the wrong milk to the wrong infant; and b) to administer expired breast milk.
- Quality improvement efforts to decrease breast milk administration errors have also been explored. Dougherty *et al.*⁵ implemented a solution to improve their feeding management processes by using a barcoding system to identify patients for appropriate breast milk administration. The use of the system ultimately decreased the number of errors from 3% to 0.4% of breast milk administrations.

Overall, the literature suggests a beneficial role for barcoded medication administration technology in reducing errors associated with the administration of neonatal medications and fluids, but there is only a small number of existing studies evaluating patient outcomes.

Of the systems used, Timeless Medical Systems (<http://www.timelessmedical.com/products/womenandinfants/>) and Neoteric Technology Limited were products used in studies whereby barcoding has shown to be effective. Details regarding the design of the breastmilk system are provided in table 3. It should be noted that there are other breastmilk barcoding products and systems on the market however, they have not been identified in this review nor evaluated for their effectiveness.

Other Non-barcode Breastmilk Interventions³

Computerised Physician Order Entry (CPOE) is a healthcare information technology application that allows providers to directly enter medical orders into a computer system. It is the most investigated healthcare information technology intervention in neonates. CPOE has the potential to decrease prescribing errors by requiring information entry, constraining choices regarding medication dose or route, providing dosing decision support, and by performing calculations. Overall, there is a sizable body of evidence that evaluates the effect of CPOE on patient outcomes and demonstrates that CPOE is effective for reducing prescription errors and wrong-time/wrong-route administration errors in neonates. There is no evidence however, demonstrating a meaningful reduction in harm.

Additional Non-barcode Breastmilk interventions¹

A review¹ was not included in this report because it did not include any barcoded systems. Whilst not directly part of the request, there are some potentially relevant findings for systems other than barcodes. It should be noted that these studies were all low quality. This review found that:

- One Interdisciplinary team approach recommended that: (a) dedicated preparation spaces for expressed breastmilk (EBM), (b) staffing models that support the use of milk technicians, and (c) electronic medical record tracking for EBM feeding. In a neonatal intensive care unit (NICU), an assessment.
- Also, a Six Sigma quality improvement approach that audited a particular NICU revealed policies to guide staff in handling and distributing EBM were absent. Guidelines and information for parents were also absent. Changes to EBM collection, storage, preparation, distribution, and administration standards were then implemented. Education regarding the use of a new policy was provided to staff. The newly implemented policy was well accepted and after implementation, no further cases of EBM misdelivery were recorded.
- Another study took the approach of labelling bottles. The first approach introduced the name, date of birth, patient ID, case number, and bottle content. Previously, only a number for each baby was affixed. This change resulted in reductions to reported administration errors.
- A milk technician, which is a position trained and dedicated to freezer and refrigerator maintenance and proper labelling of EBM, was implemented to ensure optimal quality control of breastmilk. However, this study did not measure errors so the efficacy of this intervention is unknown.
- In another study, a 'milk lab' was established. This study involved a dedicated room, workspace, and technicians for storing EBM in terms of security, cooling, and ease for collecting and depositing EBM. The milk

lab also included barcoding and verification processes. Multiple scans of the barcode ensured that the correct baby received the correct milk throughout storage, preparation, and administration processes. The study found that while the milk lab and barcoding reduced errors in EBM administration, due to limited resources, barcoding may not be feasible in all settings.

Conclusions

Overall, the literature suggests there is an improvement in breastmilk errors using a barcoded medication administration technology. However, there are only a small number of low quality studies. Barcoding not only provides the ability to reduce errors through a verification and cross-checking mechanism, it provides a system for logging metrics such as administration times, volume, near-miss data, etc.

References

1. Peters, M. D., McArthur, A., & Munn, Z. (2016). Safe management of expressed breast milk: A systematic review. *Women and Birth, 29*(6), 473-481.
2. Shea, B. J., Grimshaw, J. M., Wells, G. A., Boers, M., Andersson, N., Hamel, C. & Bouter, L. M. (2007). Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews. *BMC Medical Research Methodology, 7*(1), 10.
3. Melton, K. R., Ni, Y., Tubbs-Cooley, H. L., & Walsh, K. E. (2017). Using Health Information Technology to Improve Safety in Neonatal Care: A Systematic Review of the Literature. *Clinics in Perinatology, 44*(3), 583-616.
4. Steele, C., & Bixby, C. (2014). Centralized breastmilk handling and bar code scanning improve safety and reduce breastmilk administration errors. *Breastfeeding Medicine, 9*(9), 426-429.
5. Dougherty, D., & Nash, A. (2009). Bar coding from breast to baby: A comprehensive breast milk management system for the NICU. *Neonatal Network, 28*(5), 321-328.

Table 3. Summary of barcoded breastmilk interventions (adapted from Melton et al.³)

Reference	Aim	Design	Sample	Results
Steele et al. ⁴	To describe changes in breast milk misadministration after implementation of breast milk bar code scanning	<p>Quality improvement (pre-post).</p> <p>Intervention: Centralized breastmilk preparation using registered dietetic technicians, was implemented. Quantities for 12 hours' worth of feedings were prepared twice daily and unit-dosed into enteral syringes for those receiving tube feedings or bottles for those receiving oral feeds. Orders were reviewed via the electronic medical record before each batch preparation time. The technician would calculate the amount of breastmilk and each additive to make the desired 12-hour volume of feedings, which included a hospital standard overfill. This was documented on the individual patient's breastmilk preparation sheet, which also included patient information, the current order, and specifics as to what was prepared at each batch. Labels with the current breastmilk order were generated directly from the electronic medical record. To ensure proper identification, two technicians were required to read aloud the patient's first and last name along with the medical record number from every bottle being used to prepare the current batch and compare this with the labels printed to be placed on the prepared feedings. Documentation of this double check was done at every preparation, with each technician initialing the patient's individual breastmilk preparation sheet. The technician would then prepare the feeding per the order, use the printed labels, and manually write in the correct expiration date and time on each label.</p> <p>The other double check steps occurred either before feeding or at discharge – this was later removed and replaced by scanning the barcodes. The existing policy required the nurse to have another person validate the patient's identity using the name and medical record number prior to feeding breastmilk and prior to sending any breastmilk home with a family. To streamline the process for the nurse at the time of discharge, two technicians would provide a double check of each bottle for an individual patient and place the bottles into sealed bags (again – later replaced by barcode scanning). The sealed bags were then labeled on the outside with a patient label including the initials of the two technicians who had conducted the double check. Upon releasing the bags of milk to the parent, the nurse would then just double check the patient label on the outside of the sealed bag with another associate or the parent rather than having to double check each bottle (double-checking replaced by barcode scanning).</p> <p>Scanning of the baby's identification armband and the breastmilk was performed. The system was used bedside to confirm proper identification of the correct patient by scanning the baby's armband before printing labels for pumping mothers or before scanning the label on a prepared feeding. In the Nutrition Lab, pumped milk was scanned into inventory, which allowed for tracking of the volume, location, and expiration for all milk for an individual patient. Scanning also confirmed the patient's identification before preparation, eliminating the need for a two technician double check. Finally, the scanning system automated the process of calculating breast milk volumes and additives based on the order in the electronic medical record, and the printing of labels for the unit-dosed feedings. Barcode scanning program developed was by Timeless Medical Systems.</p>	7000 breast milk feedings per month evaluated over 16 months	Breast milk Administration errors decreased to zero; during first 6 months after bar coding, 55 attempts to feed the wrong milk to the wrong infant occurred and 127 attempts to feed expired breast milk were prevented
Dougherty et al. ⁵	To evaluate reductions in breast milk administration errors after introduction of a barcoding system for breast milk	<p>Quality improvement (pre-post).</p> <p>Intervention: Before the intervention, mothers took fresh or frozen breastmilk to a standard fridge/freezer located in a clean utility room of the NICU. Mothers were responsible for labelling each container and the bedside nurse prepared the milk (thawing and fortifying as required).</p> <p>The barcode system encompasses labelling of the breastmilk by mothers when it is pumped, direct order entry of individualised feedings at the bedside, safety tracking of patient identification during both preparation by technicians of breastmilk and formula feedings, and provision of those feedings to the infant by the nurse or parent. The barcode software is designed to work in a systematic, sequential order that prevents users from circumventing steps and causing errors. Staff all have personal assistive devices (PDAs) that are used to scan according to the following sequence: 1. They must scan their personal staff barcode; 2. They must scan the infants barcode; 3. They must follow the prompts on the PDA (specifically written for the particular procedure). The electronic technology was developed by Neoteric Technology Limited.</p>	All breast milk administrations over a 3-year period	NICU breast milk errors decreased from 3% to 0.4% of administrations; number of errors decreased from 11 per year to 1.3 per year

Appendix 1

AMSTAR checklist score for Melton et al.

Item	Answer
1. Was an 'a priori' design provided?	No
2. Was there duplicate study selection and data extraction?	Yes
3. Was a comprehensive literature search performed?	Yes
4. Was the status of publication (i.e. grey literature) used as an inclusion criterion?	No
5. Was a list of studies (included and excluded) provided?	No
6. Were the characteristics of the included studies provided?	Yes
7. Was the scientific quality of the included studies assessed and documented?	No
8. Was the scientific quality of the included studies used appropriately in formulating conclusions?	Not applicable
9. Were the methods used to combine the findings of studies appropriate?	Yes
10. Was the likelihood of publication bias assessed?	No
11. Was the conflict of interest included?	No
Total	4/11