Breast Milk Management

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Executive Summary

Since 1964, Children’s Hospital of Orange County (CHOC Children’s) has been steadfastly committed to providing the highest quality medical care to children. Affiliated with the University of California, Irvine, our regional pediatric healthcare network includes a state-of-the-art 279-bed main hospital facility in the City of Orange, and a 54-bed hospital-within-a-hospital in Mission Viejo. CHOC also offers many primary and specialty care clinics in Orange County and beyond; more than 100 additional programs and services; residency programs in pediatrics, pharmacy, nursing, and dietetics; support for several fellowship programs; and four “Institutes” in cardiovascular care, neurosciences, orthopedics and pediatric cancer.

CHOC Children’s Hospital began its journey to a fully-implemented Cerner Millennium EMR in 2002. The Hospital’s dedication to patient safety was evident in the acronym chosen for CHOC’s EMR, “CUBS,” which stands for Connecting Users and Building Safety. Today, CHOC Children’s dedication to safety, quality, and the patient experience is supported by over fourteen ensuing years of patient-centered Healthcare IT design. These efforts led to our recognition as a Stage 7 HIMSS Analytics Inpatient awardee in 2015 and support this case study.

Breastmilk misadministration (when the wrong milk reaches the wrong patient) is considered a bodily fluid exposure, which is concerning from both a medical and economic standpoint. Between May 2010 and May 2012, CHOC Children’s reported 3 incidents of the wrong breastmilk reaching
the wrong patient and 16 incidents where breastmilk was labeled incorrectly but did not reach the patient.

A process improvement team identified inadequate double checks at key points in the breastmilk administration process as the primary cause of misadministration. In response, leadership decided to centralize breastmilk preparation and implement the Timeless breastmilk barcoding system. The Timeless system’s full functionality and customization capabilities allowed CHOC Children’s to ensure the system fit the workflow, instead of the workflow fitting the system. The system would automate all calculations and use the barcodes for positive patient identification. All decisions were made to reduce breastmilk errors, but also increase staff efficiency.

The implementation of centralized breastmilk preparation reduced reports of wrong milk being fed from 3 to 0 in fiscal year 2013. Wrong labels on bottles lowered from 16 to 4 during the same year. The Phase II implementation of barcode scanning, reduced wrong labels on bottles from 4 to 1 in fiscal year 2014 and prevented 110 incidences of the wrong milk being fed (near misses). The frequency of near misses identified by the Timeless system suggests the initial baseline errors recorded between 2010 and 2012 were higher than reported, which would make the error reduction even greater. The implementation of the system also saved one hour per day in tech time spent handling breastmilk (which was allocated to other patient care duties) and eliminated the need to staff two techs at all times. This resulted in a 20-hour per week shift to being eliminated, saving ~$30,000 annually in salary, benefits, and related costs³.

Local Problem

The use of breastmilk is common on the CHOC Children’s campus. While the majority of breastmilk use is within the 67 bed level IV NICU, infants receiving breastmilk may be admitted to any unit within the facility. Safe handling and preparation of breastmilk within the hospital setting is often taken for granted and, as with many performance improvement initiatives, the process is not scrutinized until problems arise¹. Historically, the handling of infant feedings has not received the same level of attention as that of medications¹. However, the concept of using quality improvement measures with regards to safe breastmilk handling is not new and current emphasis throughout the industry has been focused on preventing breastmilk misadministration (when the wrong milk reaches the wrong patient). Such errors are considered bodily fluid exposures, which are concerning
from a medical standpoint as well as an economic standpoint because such exposures are reportable to the state and can result in fines to the organization\textsuperscript{2}.

The primary concern of a breastmilk administration error is the health of the infant. While the risk of infection is low, breastmilk is a bodily fluid and concerns about transmission of Hepatitis B, Hepatitis C, and HIV exist. In addition, breastmilk could result in an infant being exposed to medications or illicit drugs from another mother.

In addition to the medical concerns, bodily fluid exposures are reportable to the California Department of Public Health (CDPH) and may result in an onsite visit—particularly if the same problem occurs multiple times. Citations for patient harm or bodily fluid exposures during a survey from The Joint Commission (TJC) could result in delay of accreditation or require a detailed action plan. Furthermore, if a breastmilk error occurs in a manner in which a parent of one baby sees the patient name, medical record number (MRN), and other information for another baby, it could be considered a HIPAA breach and may result in fines up to $25,000 per incident.

Following a breastmilk exposure, laboratory testing for Hepatitis B, Hepatitis C, and HIV must be conducted on the recipient baby and his mother as well as the donor mother. If the baby is positive for one of the viruses, the medical team must be able to determine if the baby is positive due to receiving the virus from his own mother or because of exposure to the virus in the wrong milk he received which is the rationale for testing both mothers. Cost of the blood work for the 3 individuals is typically greater than $500. In addition, hepatitis vaccines and/or antiretroviral prophylaxis for HIV may be required depending on test results leading to additional costs.

Finally, studies have also suggested that such errors may result in reduced family satisfaction and loss of confidence in the care provided by the medical team\textsuperscript{4,5,6}. Improved family satisfaction helps ensure families do not seek care elsewhere.

Between May 2010 and May 2012, Children’s Hospital of Orange County (CHOC Children’s) reported 3 incidents of the wrong breastmilk reaching the wrong patient and 16 incidents where the breastmilk was labeled incorrectly but did not reach the patient. The NICU and Lactation teams were particularly concerned about these incidents because the organization was in the middle of a campaign to increase the availability of breastmilk for the very-low-birth-weight (VLBW) patients in the NICU by encouraging more mothers to pump milk for their infants. Consequently, as a result of these errors, a four stage process improvement project was initiated as outlined in Figure 1.
During stage 1, the Failure Mode Effects & Analysis (FMEA) Team identified 282 potential failure points associated with breastmilk management. Each potential failure point was scored on a scale of 1 to 10 for three areas: severity, likelihood of occurring, and detectability. The 3 scores were multiplied together to obtain a risk priority number (RPN). A natural break in the scores was used as a cut-off and root causes were identified for the top 85 potential failure points. The results of this FMEA were presented to the hospital Joint Leadership Committee with a request to form an official hospital Breastmilk Performance Improvement (PI) team (stage 2).
<table>
<thead>
<tr>
<th>Stage/Goals</th>
<th>Members</th>
<th>Time Commitment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stage 1:</strong> Failure Mode Effects &amp; Analysis (FMEA) Team</td>
<td>13 Team Members&lt;br&gt;• Risk Manager (Leader)&lt;br&gt;• Nurse Managers from NICU, PICU, Medical/Surgical, Oncology&lt;br&gt;• Clinical Nurse Specialists (CNS) from NICU, PICU, Medical/Surgical&lt;br&gt;• Director, Clinical Nutrition &amp; Lactation&lt;br&gt;• Risk Management Advisor&lt;br&gt;• Staff Nurses from NICU &amp; PICU&lt;br&gt;• Emergency Transport Nurse</td>
<td>October-December 2011&lt;br&gt;• 7 meetings&lt;br&gt;• 18 hours</td>
</tr>
<tr>
<td><strong>Goals:</strong> Determine potential failure points &amp; their root causes.</td>
<td></td>
<td></td>
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<td><strong>Stage 2:</strong> Breastmilk PI Team</td>
<td>12 Team Members&lt;br&gt;• Director, Clinical Nutrition &amp; Lactation (Co-chair)&lt;br&gt;• Neonatologist (Co-chair)&lt;br&gt;• Risk Manager&lt;br&gt;• NICU Nurse Managers&lt;br&gt;• CNS from NICU and Medical/Surgical&lt;br&gt;• NICU Staff Nurses&lt;br&gt;• PICU Nurse Educator&lt;br&gt;• Dietetic Technician&lt;br&gt;• Former NICU Parent</td>
<td>February-June 2012&lt;br&gt;• 4 meetings&lt;br&gt;• 8 hours</td>
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<td><strong>Goals:</strong> Address the FMEA identified potential failure points and determine a course of action.</td>
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<td><strong>Stage 3:</strong> Breastmilk Handling Implementation Team</td>
<td>16 Team Members&lt;br&gt;• Director, Clinical Nutrition &amp; Lactation (Co-chair)&lt;br&gt;• Neonatologist (Co-chair)&lt;br&gt;• Risk Manager&lt;br&gt;• NICU Nurse Managers&lt;br&gt;• CNS from NICU, oncology, and Medical/Surgical&lt;br&gt;• Staff Nurses from NICU, PICU, CVICU, &amp; Medical/Surgical&lt;br&gt;• Nurse Educators from NICU, PICU, Medical/Surgical, Oncology&lt;br&gt;• Dietetic Technician</td>
<td>November-December 2012&lt;br&gt;• 5 meetings&lt;br&gt;• 10 hours</td>
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<td><strong>Goals:</strong> Implement phase I of the action plan (Centralized Breastmilk Handling) including training and policy development.</td>
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<td><strong>Stage 4:</strong> Breastmilk Bar Code Scanning Team</td>
<td>5 core team members:&lt;br&gt;• IT Project Manager (Co-Chair)&lt;br&gt;• Director of Clinical Nutrition &amp; Lactation (Co-Chair)&lt;br&gt;• NICU Nurse Manager&lt;br&gt;• Dietetic Technician&lt;br&gt;• Nurse Educator</td>
<td>March-November 2013&lt;br&gt;• 1 hour weekly for core team&lt;br&gt;• 1 hour weekly for co-chairs and scanning vendor</td>
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<td><strong>Goals:</strong> Identify scanning system, customize &amp; integrate the system with current EMR, and facilitate the bar code scanning launch.</td>
<td>Variety of ad hoc members who attended depending on the phase of the project and specific technical needs. Ad hoc members included various IT staff (interface specialist, application programmer, nurse informaticists, systems analysts, web administrator, etc.)</td>
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**Figure 1:** Four Stage Breastmilk Performance Improvement (PI) Project
Design and Implementation

Based on the analysis of potential failure points in breastmilk handling, the PI team determined the safest course of action would be to change processes in two phases. Phase I would consist of changing to a model of centralized breastmilk handling where dedicated milk technicians would do all of the thawing, fortifying, and labeling of breastmilk and deliver the prepared feedings to the bedside nurse. This phase would include a two-person double check at every step in the preparation process as lack of adequate double check at key points was identified as a primary concern. Phase II would involve implementation of breastmilk bar code scanning. There were two benefits of this two phased approach: (1) it would allow for immediate change while the team took time to customize and test the bar code scanning system, (2) it would solidify a more standardized process and identify the key points where a double check was needed so that the scanning system could be built around this improved workflow.

The Breastmilk Handling Implementation Team (stage 3) was assembled to formally review the entire breastmilk handling process within the hospital. The team identified the need for a complete process redesign for all steps of breastmilk handling. One of the primary concerns was the inadequate double checks at key points in the process, which could allow a patient to receive the wrong breastmilk. Additionally, of the top identified potential failure points, 55% were unlikely to be detected by systems in place\(^2\). Because CHOC Children’s administers approximately 7,000 individual breastmilk feeds per month, addressing these concerns was deemed extremely important. Phase I (centralized breastmilk handling) was launched in January 2013. Education for bedside staff including promotional posters and events ensured a smooth go-live. Nurses on all shifts were invited to “Milk and Cookies” events to tour the centralized preparation room and get to know technicians. This was designed to build confidence in the staff and help the nurses verbalize the process to families.

During phase I, special attention was given to workflow and evaluation of key steps in the process that were vulnerable to errors and where double checks were crucial. While the team was confident that centralized handling would reduce errors and improve safety, it was understood that technology would further reduce the risk of human error and confirmation bias. This assumption was supported by research from other facilities that found having a dedicated breastmilk handling technician in addition to using bar code scanning resulted in fewer errors\(^7\).
Phase II (breastmilk bar code scanning) began with the Director of Clinical Nutrition & Lactation, NICU Nurse Director, and Director of Nursing Informatics conducting a thorough evaluation of available breastmilk bar code scanning systems. The goal was to obtain a system that could be fully customized to meet the current workflow which was already considered a best practice and to eliminate manual input and calculations to reduce risk of error and optimize patient safety. Demonstrations were provided by a variety of vendors and staff input regarding ease of use was obtained. Based on the demonstrations and information from the vendors regarding the ability to customize the system, two potential systems were identified. The Director of Clinical Nutrition & Lactation and the Director of Nursing Informatics then conducted conference calls with five different hospitals utilizing each of the two systems (total of 10 calls) to determine the pros and cons of each. Through careful evaluation of processes and automated systems, it was determined that the breastmilk bar code system from Timeless Medical Systems (Prince Edward Island, Canada) would reduce the risk of breastmilk misadministration and would put safeguards in place to detect potential failure points, improving patient safety through three primary areas. One, the system would automatically calculate the exact amounts of breastmilk and additives for each 12 hour batch eliminating the need to manually calculate, thus decreasing the risk of human calculation error. Two, it would use bar code scanning to replace the two-person double check (to ensure the correct patient) at the time of preparation, feeding, and discharge, again reducing the risk of human error and improving efficiency. Finally, it would automate the labeling process reducing the risk of human error with regards to the handwritten expiration dates and times. Furthermore, the system was fully customizable to meet the complex needs of CHOC Children’s including ability to: automatically calculate all recipes (including complex ratios involving breastmilk and formula mixtures); track breastmilk inventory and provide automatic text message notifications in both English and Spanish to mothers when more breastmilk was needed; use the system for infant and enteral formulas as well as breastmilk; and create customized tracking reports.

Once a system was identified and costs for hardware and software were outlined, the Director of Clinical Nutrition and Lactation worked with the CHOC Foundation to seek grant funding opportunities. A grant focusing on patient safety was identified and ultimately funding was secured to launch phase II of the process.

In March 2013 a breastmilk bar code scanning project team (stage 4), led by the Director of Clinical Nutrition & Lactation and an Information Technology (IT) Project Manager – also including a variety of clinical and IT team members – was created. This team evaluated existing breastmilk bar code
scanning systems to determine capabilities and features. Because the clinical team had implemented an efficient centralized breastmilk handling workflow, the goal was to customize the system to enhance the current workflow rather than requiring major process changes to fit the system.

There were two primary system end-user groups identified. The breastmilk technicians, while a small group, would actually be the individuals using the system for more than 50% of their workday and would use the majority of the system’s features. To determine and validate design decisions pre-implementation, the Clinical Nutrition & Lactation department obtained a demo version of the Timeless system to use in conjunction with mock breastmilk preparation. Specific changes that would enhance workflow and improve end-user satisfaction were identified. The IT Project Manager, the Director of Clinical Nutrition & Lactation, and one of the milk technicians then held weekly conference calls with the vendor to build and test the requested modifications. The second end-user group of bedside nurses, while larger, would primarily use the system to scan prepared feedings against a patient’s armband before administration, a process almost identical to the in-place barcode medication administration (BCMA). As such, it was determined those features in the system did not require significant modification; however, a few time saving opportunities were identified and also built into the system.

The project goals were to automate all calculations and use the barcode scanning for positive patient identification rather than the two-person double check. All changes were implemented to reduce the risk of human error with calculation and identity confirmation and, ultimately, improve patient safety. However, increased staff efficiency was an additional consideration and goal.

**How Health IT Was Utilized**

The workflow adopted when centralized breastmilk handling was implemented (Figure 2) was used to identify key double check and manual calculation points where the bar code scanning system would need to replace the manual process. Each double check step (shown in red in Figure 2) and calculation step (shown in orange) were converted to a step within the bar code scanning process. The system was set up so that the breastmilk orders interfaced directly between the hospital EMR and the bar code scanning system, reducing risk and improving patient safety through three primary areas: (1) this allowed the system to automatically calculate the exact amounts of breastmilk and additives needed which eliminated the need to manually calculate, thus decreasing the risk of
human calculation error; (2) it used bar code scanning to replace the two person double check at
the time of preparation and feeding, again reducing the risk of human error and as well as improving
efficiency; (3) it automatically calculated and tracked expiration dates/times to reduce risk of human
error.

Figure 2: Expressed Breastmilk (EBM) Collection Preparation and Administration
The bar code scanning program (Timeless Medical Systems) helps ensure proper patient identification at each step of the process by using a patient specific bar code found on the baby’s armband and breastmilk labels. Multiples are linked in the system so that siblings may both receive the same mother’s milk. However, once a feeding is prepared, it is designated for a specific infant and may not be scanned and fed to a sibling. This was a custom feature we requested due to multiples frequently receiving different additives or volumes. Even though it would be safe to feed the breastmilk itself to a sibling, we felt that receiving the wrong volume or additive could result in medical consequences.

The system is used bedside to confirm proper identification of the correct patient by scanning the baby’s armband prior to printing labels for pumping mothers or prior to scanning the label on a prepared feeding. In the centralized preparation room, pumped milk is scanned into inventory, which allows for tracking of the volume, location, and expiration for each patient’s milk. Scanning also confirms the patient’s identification prior to preparation, eliminating the need for a two technician double check. Finally, the scanning system automates the calculation of expiration dates and times for stored milk and prepared feeds eliminating the need to manually calculate these time frames and reducing the risk of human error.

Breastmilk orders from EMR (Figure 3) were designed to interface with Timeless. Discrete data fields were used so that the system could automatically calculate volumes and additives based on the order, eliminating manual calculations (Figure 4). Internal IT resources (including an interface resource) worked with Timeless Medical Systems to build the aliases and ensure proper interface between the two systems.

![Figure 3. Breastmilk Order in EMR](image)
If at any point in time (including preparation or feeding) a bottle is scanned for the wrong patient, the system alerts the user that the bottle scanned does not belong to that patient (Figure 5). This alert is in red to cue the staff person to STOP. Correct breastmilk scans provide confirmation in green to cue the staff person that it is acceptable to proceed (Figure 6).

As noted, during the design and build, careful attention was paid to opportunities to reduce steps and improve efficiencies. Such improvements would not only save time, but would impact end user satisfaction. Some customization examples to improve efficiency included:
Eliminating the need to click the “next” button during various steps of the process.

- At the time of feeding, the nurse scans the baby’s armband. Rather than having to then click “next,” the system was customized to automatically go to the next screen to scan the feeding.

- After scanning the feeding, the screen then automatically moves to identify if this is the correct patient rather than having to click “next” again.

Defaulting fields within the receiving process.

- Fields circled in red in Figure 6 show fields that automatically default

- The ability to track milk that is hindmilk or foremilk was a customization. However, because this isn’t used the majority of the time, those fields default to “no” rather than the technician having to choose “no” regularly.

- The majority of milk is received either frozen or will be frozen upon receiving. Therefore, the pumped date and time default to the current date and time. Any milk that was pumped less than 48 hours before receiving, is entered as the current date/time.

- Most milk is received into the centralized preparation room; therefore, the location of the received milk defaults to that freezer.

![Figure 6: Defaulted Fields in the Receiving Process](image-url)
Defaulting fields within the preparation process.

- To prevent additional manual steps, if milk was received as hindmilk or fresh milk, that information would be pre-checked in the preparation process (as shown in Figure 7) which would also result in it showing up on the label.

- The number of containers needed would default based on the feeding order. Example shown in Figure 4: The baby has an order for 20 mL every 3 hours. Feedings for 12 hours are prepared at one time. Therefore, a total of 4 feedings are prepared. The technician does not need to choose 4 containers, this information defaults from the interface with the order.

- The location where feedings will be delivered defaults from the ADT interface from the EHR.

Figure 7: Defaulted Fields in the Preparation Process
Creating a Quick Feed option for milk that did not need to be fortified.

- Occasionally, there is a need for a mother to pump milk and feed it to the infant almost immediately afterward.

- It may not be efficient or feasible to take this milk to the centralized preparation room, have it received into inventory, re-label the milk, and deliver it back to the patient.

- For such circumstances, CHOC Children’s requested a Quick Feed option which would allow the nurse to scan the baby’s arm band and the label the mother placed on the freshly pumped milk. This scan would perform the double check to ensure the milk was going to the proper patient, but would not have any other information about that milk.

- The nurse would then need to manually validate that the milk had not yet expired and was safe to use (Figure 8).

### FEED BABY

**QUICK FEED CONFIRMATION**

- By checking the box below, you are verifying the following:
  - The bottle being fed is fresh and was pumped no more than 48 hours ago
  - OR
  - The bottle being fed was defrosted no more than 24 hours ago.

- I verify that one of the above conditions is true and accurate.

![Quick Feed Confirmation Screen](image)

**Figure 8:** Quick Feed Confirmation Screen

Since the time of implementation, ongoing analysis of the processes and monitoring of reports has occurred to identify potential opportunities to further leverage the technology through additional customization, potential breaches in policy, and educational gaps among staff using the system. Desired changes identified are referred to pertinent members of the stage 4 Breastmilk Bar Code Scanning Team for evaluation, design, and testing with the vendor. The Director of Clinical Nutrition & Lactation reviews a variety of reports within the Timeless system weekly, including the User Error
Report and the Bottles No Longer Needed Report. The User Error Report identifies any bottle scanned for the wrong baby and any expired milk scanned at any point in the process (receiving, preparation, feeding, or discharge). This information is provided in aggregate to all of the hospital nursing units on a quarterly basis to help reinforce the frequency at which these errors occur with the goal of emphasizing the importance of remaining vigilant and the importance of scanning at all of the required steps. If trends are noted for a specific end user (such as a specific person having an abnormally higher number of scanning errors), the information is provided to that person’s manager for individual follow up and additional education if needed. The Bottles No Longer Needed Report identifies milk that was not scanned out at discharge. This either means that the milk has not yet been sent home (which at times occurs when a parent is working on securing enough space to store the milk at home) or the milk was sent home and not scanned. If milk is sent home and not scanned, the details are provided to the manager of that unit so that he/she may follow up with the discharging nurse and provide education or counseling regarding not following the process.

**Value Derived**

Undoubtedly, the change from bedside to centralized handling of breastmilk offered positive results and improved patient safety as shown in Figure 9 (comparison of baseline data vs. fiscal year 2013 data); however, it was suspected that patients would still be at risk for misadministration due to unavoidable human error. Furthermore, while we did not have a mechanism to quantify calculation errors (since we might never know a calculation error had occurred), anecdotally we had found times where the handwritten calculation of additives was incorrect. Therefore, we felt that automating these calculations would improve patient safety.
As shown in Figure 9 as Phase II, one-year post scanning outcome data showed total breastmilk errors decreased to 1 (which was a labeling error). There were no incidents of breastmilk reaching the wrong patient. However, the system caught 110 “near misses” where the wrong milk was scanned to the wrong baby. The system alerted the staff and prevented a misadministration from occurring. The frequency of near misses suggested that the reported baseline errors were likely much lower than actual misadministration occurrences. As previously noted, 55% of potential failure points with breastmilk handling were unlikely to be detected through the systems prior to bar code scanning; therefore, it is very likely that the number of breastmilk errors prior to implementation was significantly higher than reported. Because of potential medical complications, in addition to regulatory citations, potential fines, and loss of parent confidence/satisfaction, preventing 110 incidences from occurring is quite significant. Additionally, the system prevented 193 incidents of expired breastmilk being fed to a baby. Prior to bar code scanning, there were no reported incidents of expired breastmilk being administered; however, there were no monitoring systems in place to detect such issues. Thus, implementation of bar code scanning highlighted a problem area that was not adequately monitored under previous processes.

In addition to error rates, we also monitored staff efficiency. Upon moving to centralized breastmilk handling (Phase I), an additional 20-40 hours per week were staffed to handle the workload. To quantify time savings for centralized breastmilk preparation in the Nutrition Lab with bar code

**Figure 9:** Baseline Breastmilk Errors vs. Post Implementation Errors

<table>
<thead>
<tr>
<th></th>
<th>Wrong Baby’s Milk</th>
<th>Wrong labels on bottles noted when milk dropped off</th>
<th>Expired Breastmilk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wrong milk reported as being fed</td>
<td>Wrong milk scanned (near misses)</td>
<td>Expired milk reported as being fed</td>
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<tr>
<td><strong>Baseline Data</strong></td>
<td>3</td>
<td>N/A</td>
<td>16</td>
</tr>
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<td><em>May 2010-Dec 2012</em></td>
<td></td>
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<td><em>Bedside Prep</em></td>
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<td></td>
<td></td>
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<tr>
<td><em>Manual Double Check</em></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>FY 2013 (Phase I)</strong></td>
<td>0</td>
<td>N/A</td>
<td>4</td>
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<tr>
<td><em>Centralized Prep</em></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><em>Manual Double Check</em></td>
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<tr>
<td><strong>FY 2014 (Phase II)</strong></td>
<td>0</td>
<td>110</td>
<td>1</td>
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<td><em>Centralized Prep</em></td>
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<tr>
<td><em>Bar Code Scanning</em></td>
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scanning, a 24-day time study was conducted at three time points: prior to bar code scanning, three weeks after scanning implementation, and three months after scanning implementation. Statistical analyses included calculation of the mean time and standard deviation for each duty as well as total time per day for each of the three time points.

Bar code scanning resulted in a statistically significant reduction in technician time spent directly handling breastmilk\(^3\) (Figure 10). The total time saved (approximately one hour per day) was reallocated for other direct patient care duties.

In addition, scanning eliminated the need to staff two technicians at all times. By staffing with one only technician at non-peak times, one 20-hour per week shift was eliminated, resulting in direct yearly savings of \(~\$30,000\) in salary, benefits, and related costs\(^3\). It was anticipated that the time savings would be greater at the second post implementation time study due to greater comfort with the bar code scanning program; however, this was not the case\(^3\). The fact that the time efficiency benefits were realized at three weeks post implementation suggested a short learning curve for proficiency of the system.
In addition to the direct time savings for the technicians measured in the time study, scanning resulted in other noticeable improvements in efficiency. The bedside nurse was able to save time by not having to locate a second nurse when the parent was not available for the double check. Furthermore, the interface between the bar code system and the EMR resulted in data automatically being charted upon scanning, instead of the nurse having to manually enter this information.

The value obtained in regards to reducing calculation errors and breastmilk administration errors as well as the time savings were particularly impactful because of the significant increases in the amount of breastmilk being handled within the facility. It is often difficult for a mother to continue pumping milk for her infant during a hospital course that may extend for months. Many mothers initiate pumping, but are unable to sustain throughout the hospital stay until discharge. One method of measuring success of a lactation program is to determine the percentage of infants whose mothers are still pumping and providing breastmilk at hospital discharge. Because VLBW infants often have much longer and more complicated hospital courses than larger babies, CHOC is particularly concerned with these babies continuing to receive breastmilk. In 2011 when the 4 stage process was initiated, 58.7% of VLBW infants at CHOC had breastmilk still available at the time of hospital discharge. This increased to 80% by 2013 when bar code scanning was implemented (Figure 11). The increase in number of babies receiving breastmilk and associated increased volumes of breastmilk made the risk of errors much more likely had centralized preparation and bar code scanning not been implemented.

![Figure 11: Percentage of CHOC VLBW Infants with Breastmilk Available at Hospital Discharge](image-url)
Lessons Learned

**Breastmilk administration errors are likely much more common**

Discussions with other hospitals at the onset of the project suggested that many organizations estimate their breastmilk administration errors to be one or two per year (similar to the number reported at our facility prior to this effort). The biggest lesson we learned from this project was that breastmilk administration errors are likely much more common than organizations realize. At the onset of the project, our PI team did recognize that 55% of errors were unlikely to be detected by the previous systems in place; however, 110 wrong milk to wrong baby near misses and 193 expired breastmilk near misses during the first year post scanning implementation far exceeded the suspected numbers. Concrete data supports that errors are likely more common and unlikely to be detected without automated systems. Therefore, automated systems should prove very helpful to the industry as a whole and help improve the safety for all babies. An international consensus statement published in 2015 recommended the use of breastmilk bar code scanning in all NICUs to improve safety. The outcome data in this study has been presented and published via lectures, posters, professional meetings, medical journals etc. with the hopes of encouraging other facilities to take a critical look at their own safety processes in place.

**Regularly reinforce and educate to ensure safety and compliance**

Because of the success of the project, it was easy to get lulled into the belief that the current system removed all risk and – because the process was easier and saved time – staff would always follow the defined steps. However, we found that 16 months post-scanning implementation some staff had developed inconsistent scanning practices. For example, some bedside staff were scanning before warming the milk instead of following the policy to always scan immediately before feeding, thus increasing the risk of error. This inconsistency in practice resulted in two breastmilk administration errors in fiscal year 2015 (as denoted in Figure 12). As a result of these two errors, the PI team reconvened and conducted a root cause analysis. Based on the two errors, the team created signs which were secured to bedside milk warmers reminding both staff and parents that the milk in the warmer has not yet been scanned and that it should be scanned prior to feeding (Figure 13). However, staff expressed concern that they might accidentally warm the wrong milk and then have to discard it which was leading them to scan before placing the milk in the warmer. To address their concerns while continuing scanning immediately before feeding (which is the safest for the patient),
the PI team created a “breastmilk time out” step allowing staff to validate the patient name on the bottle before warming. The new process was outlined on a poster (Figure 14) and education was provided to bedside staff.

<table>
<thead>
<tr>
<th></th>
<th>Wrong Baby’s Milk</th>
<th>Wrong labels on bottles noted when milk dropped off</th>
<th>Expired Breastmilk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wrong milk reported as being fed</td>
<td>Wrong milk scanned (near misses)</td>
<td>Expired milk reported as being fed</td>
</tr>
<tr>
<td><strong>Baseline Data</strong></td>
<td>3</td>
<td>N/A</td>
<td>16</td>
</tr>
<tr>
<td><strong>FY 2013 (Phase I)</strong></td>
<td>0</td>
<td>N/A</td>
<td>4</td>
</tr>
<tr>
<td><strong>FY 2014 (Phase II)</strong></td>
<td>0</td>
<td>110</td>
<td>1</td>
</tr>
<tr>
<td><strong>FY 2015</strong></td>
<td>2</td>
<td>163</td>
<td>0</td>
</tr>
</tbody>
</table>

**Figure 12:** Ongoing Tracking of Breastmilk Errors and Near Misses

**Figure 13:** Breastmilk Warmer Signs

PARENTS PLEASE READ
For your baby’s safety, milk is always scanned immediately before feeding. Milk in the warmer has **NOT** been scanned.
If you are ready to feed your baby, let your nurse know so that the milk may be scanned.

PADRES FAVOR DE LEER
Para la seguridad de su bebé, el código de barras de la leche se escanea inmediatamente antes de alimentar.
Cuando la leche está en el calentador, todavía no se ha escaneado su código de barras.
Si usted está lista para alimentar a su bebé, por favor informe a su enfermera para que se pueda escanear el código de barras de la leche.
Following those errors, the PI team also determined that it was important to do more regular follow up with staff. We believed that if staff understood the frequency of scanning errors, it would help reinforce the importance of following all steps. Therefore, the Director of Clinical Nutrition and Lactation identifies scanning near misses monthly using the Error Audit Report within the Timeless system (Figure 15). Aggregate error rates are communicated to the nurse managers, nurse educators, and clinical nurse specialists for each of the units. That information is shared with bedside staff through their regular unit communications (newsletters, e-mail, etc.) to ensure staff understand the frequency of near misses and continue to be diligent about the process. Patterns in specific units or with specific staff are identified for additional training and follow up. Breaches in protocol (such as not scanning at the correct steps in the process or not scanning at all) are reported through the hospital safety reporting system. The Breastmilk PI Team (team identified as stage 2 above) reconvenes whenever there are serious breaches in process, errors, or issues identified with the current processes. The team then conducts a root cause analysis on the near miss, error, or
breach of protocol to determine next steps which may include a change in process, re-education of staff, and/or need for additional monitoring.

![Error Audit Report](image)

**Figure 15:** Sample Error Audit Report

**Change Management**

Overtime, the Clinical Nutrition and Lactation interventions with patients have become more sophisticated for a variety of reasons: (1) New nutritional products have become available, (2) The presence of a centralized preparation room allows for more complex recipes and formulations, (3) Equipment including a breastmilk analyzer and a centrifuge allow us to change the composition of the breastmilk itself. Consequently, we have requested additional changes within the Timeless system since our go-live to ensure the technology is keeping up with our processes. The Director of Clinical Nutrition & Lactation is responsible for reviewing performance and making change requests to the vendor as additional needs are identified. All of the changes needed since initial implementation have come about based on clinical workflow and desire to optimize the system for efficiency and safety. The Director of Clinical Nutrition & Lactation submits change requests directly to Timeless Medical and has regular conference calls their team during any change requests. The CHOC IT team is alerted prior to any push to production. If a request requires a change in both Cerner and the bar code scanning system, the Director of Clinical Nutrition & Lactation logs a ticket for CHOC IT as well as with Timeless and works with resources from both teams to conduct testing prior to a push to production as well as post production testing.
Downtime Procedures

Because breastmilk bar code scanning involves two separate systems (Cerner and Timeless Medical), it is important to have well outlined processes for the three different types of downtime.

- **Scenario 1: Cerner is down, but Timeless Medical is still operational**
  - Order changes may be manually entered into Timeless
  - Bar code system used as usual

- **Scenario 2: Cerner is operational, but Timeless Medical is down**
  - Breastmilk order report is printed from Cerner
  - Labels for the feedings are printed from the report
  - Technicians manually calculate recipes
  - Two person double check is conducted at each step of the process where bar code scanning would normally occur (including at time of preparation and at bedside before feeding)

- **Scenario 3: Both systems are down**
  - The last printed breastmilk order report from Timeless and Cerner are used as a starting point
  - The physician or nurse can communicate order updates via phone
  - Technicians manually calculate recipes
  - Two person double check is conducted at each step of the process where bar code scanning would normally occur (including at time of preparation and at bedside before feeding)
  - Technicians manually write out labels for each feeding
Financial Considerations

Figure 16 outlines the initial and yearly costs for implementing the breastmilk bar code scanning system as well as cost savings realized with regards to reduction in staffing.

When evaluating whether to implement breastmilk bar code scanning, we considered the potential costs of not implementing scanning. Those costs included:

- Regulatory citations for breastmilk errors
- HIPAA fines up to $25,000 per incidence for errors considered HIPAA breaches
- Lab costs of $500 per incident when a baby received the wrong breastmilk to test the donor mother and recipient baby
- Loss of family confidence or satisfaction which could result in families seeking care elsewhere

We considered that each misadministration error would cost anywhere from $500 to $25,500 and could lead to lost revenue if families turned to other organizations for care. Therefore, the initial start-up costs would be potentially less than 6 breastmilk administration errors. We felt the implementation costs were well justified to protect our patients as well as for avoidance of costs associated with breastmilk errors.

Once we decided to pursue breastmilk bar code scanning, we purposefully sought a system that was compatible with our current bedside hardwired and mobile computers with regards to the type of scanner and label printer. This resulted in only needing to purchase hardware for the centralized preparation area.

Furthermore, we were confident that scanning would improve efficiency in our centralized milk preparation room that could allow us to save money. As noted above, we were able to eliminate a 20-hour per week tech position saving ~$30,000 annually. Therefore, despite an annual licensing fee of $23,250, the net positive impact on the organization is a $6,750 per year savings.
<table>
<thead>
<tr>
<th>Item</th>
<th>Expenditure</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INITIAL COSTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breastmilk Tracking Software/License/Interfaces</td>
<td>$112,500</td>
<td></td>
</tr>
<tr>
<td><strong>Equipment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• MS Windows Server 2008R2 Standard (2)</td>
<td></td>
<td>$11,000</td>
</tr>
<tr>
<td>• Zebra GX430t Printer (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Motorola DS6707 Scanner/Cables (4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• All-in-One Touch Screen Computers (2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>o Including pole mount for one and under counter bracket mount for the other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staff Training</td>
<td>$18,000</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL INITIAL COSTS</strong></td>
<td>$141,500</td>
<td></td>
</tr>
<tr>
<td><strong>OPERATIONAL COSTS/YEAR</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Software Licensing/Interfaces</td>
<td>$23,250</td>
<td></td>
</tr>
<tr>
<td>Reduction in Staffing Needs</td>
<td></td>
<td>$30,000</td>
</tr>
<tr>
<td><strong>TOTAL YEARLY NET SAVINGS</strong></td>
<td></td>
<td>$6,750</td>
</tr>
</tbody>
</table>

**Figure 16:** Implementation and Ongoing Operational Costs of Breastmilk Bar Code Scanning

**Staff Training**

Staff training costs in preparation for the go-live were $18,000. All inpatient nurses in the organization needed to understand use of the system. However, the responsibilities for the nurse within the system are limited to scanning the baby’s armband to generate labels for a mother, scanning the individual feeding against the baby's armband to confirm identity prior to feeding, and scanning bottles of milk that have been bagged in preparation for discharge against the baby’s armband. These tasks did not require a significant amount of education because the bedside nurses were already familiar with bar code scanning of medications and the steps were very similar. To provide the education, all inpatient nursing staff received a mandatory online training module. The module took approximately 20 minutes to complete and could be completed by the nurse during regular work shifts. For hands-on training, the Director of Clinical Nutrition & Lactation and 3 nurse informaticists conducted “Cyber Cafes” on each of the units for several dates on both day and night shifts. The charge nurses ensured that each of the nurses on duty cycled through for training. Sample prepared feeds, bags of milk to be discharged, and sample patient arm bands were used to allow each nurse to practice each of the 3 tasks within the system. Hands-on training took approximately 10 minutes per group cycling through. Conversely, the 12 dietetic technicians (DTRs) working in the Nutrition Lab needed to have a complete understanding of the system. They were responsible for checking all milk into the system (~300 bottles per day), using the scanning system...
to prepare feeds (~350 per day), scanning bottles of milk into sealed bags in preparation for
discharge, and managing patients & feeding orders within the system. Therefore, the DTRs required
significantly more training. One DTR was on the bar code scanning committee and was very versed
in the use of the system. She became the department DTR trainer and conducted 4 hour training
sessions with each of the 11 remaining DTRs which included demonstrations and hands-on practice
with the test version of the system. DTRs were scheduled in groups of 2-3 for training sessions
independent of their regular shifts. Following the training sessions, each DTR was required to
complete an online training module which was done during regular work time. The trainer would
then also work with DTRs individually during their normal work shifts when there was a lull to provide
additional hands-on training on the bar code scanning system.

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