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Implementation of a New Traceability Process for Breast Milk Feeding

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Abstract. Many newborns at the neonatal intensive care unit are unable to feed themselves, and receive human milk through enteric nutrition devices such as orogastric or nasogastric probes. The mothers extract their milk, and the nursing staff is responsible for the fractionation, storage and administration when prescribed by physicians. It is very important to remind that it is a bodily fluid that carries the risk of disease transmission if misused. Health information technologies can enhance patient safety by avoiding preventable adverse events. Barcoding technology could track every step of the milk manipulation. Many processes must be addressed to implement it. Our goal is to explain our planning and implementation process in an academic tertiary hospital.

Keywords. Breast feeding, barcoding, patient safety

1. Introduction

After heart diseases and cancer, medical errors are the third leading cause of death in the United States. Adverse events related to inpatient medication errors have an incidence of 6.5% [1]. One third of them take place during prescription and another third occur during medication administration [2].

Joint Commission International (JCI) accreditation may help health systems enhance the ability to prevent medication adverse events and achieve successful quality improvements [3]. Furthermore, health information technology (HIT) can be a useful tool to improve patient safety, collaborating with medication processes and care coordination. Some studies suggest that the use of bar coded medication administration (BCMA) technology diminish errors, and prove to be cost effective [4].

It is very important to promote breast milk manual or mechanical extraction for baby feeding newborns are premature, ill or away from their mother for any reason [5]. The nursing staff is responsible for the fractionation, conservation and administration of the human milk in the Neonatal Intensive Care Unit (NICU). The "5 rights" rule recalls each element that should be verified before administration: the right patient, the right medicine, the right dose, the right path, at the right time, but we must help practitioners achieve these goals by establishing strong support systems that encourage safe practices [6]. Barcode is a simple but very useful technology inherited from commercial industry that is used in healthcare to check meaningful information required in diagnostic tests or

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during treatment administrations. Centralized breast milk handling and barcode scanning has proved to improve safety and reduce administration errors[7]. Nevertheless, as any other introduction of HIT into clinical settings, it can be associated with unintended negative consequences. Therefore, we should develop robust systems to detect and manage these issues [1]. The objective of the present paper is to describe the former process of the breast milk circuit in our hospital, and the subsequent steps taken to design and implement the barcode verification technology.

2. Materials and Methods

The Hospital Italiano de Buenos Aires (HIBA) is a non-profit health care academic center founded in 1853, has a network of two hospitals with 750 beds (200 for intensive care), 41 operating rooms, 800 homecare beds, 25 outpatient clinics and 150 associated private practices located in Buenos Aires city and its suburban area. Since 1998, the HIBA runs an in-house developed health information system, which includes clinical and administrative data [8]. The HIBA achieved Joint Commission International safety and quality certification in 2015 [9]. One major addressed issue was the right identification of patients, using bracelets with bar-coding technology.

The neonatal intensive care unit (NICU) is divided into three different areas: the Intensive Care Unit (22 beds), the Hospitalization Unit and the Follow-up Clinic for premature and high-risk newborns (25 beds). Direct mother breastfeeding does not need patient-substance verification, but alternative routes for enteric nutrition requires special assistance from nurses [5]. Our team was in charge of the breast milk BCMA circuit in these areas.

We analyzed and modeled the processes and workflows involved in the prescription, extraction, fractionation, and administration of the breast milk in our institution. We collected the data following a three stage methodology proposed by Granja et al [10]: Initially, we performed database queries to collect quantitative and qualitative historical data of breast milk prescriptions from the last 6 months, supported by bibliographical evidence. We subsequently carried out field observations in the different areas involved in the processes, including unstructured interviews. We evaluated the lactorium (lactation room), the milk fractionation room and the neonatal intensive care unit (NICU) by reviewing the whole circuit. We lastly conducted in-depth interviews with key stakeholders (physicians, nurses and mothers).

This work was guided with project management methodology [11]. Each process was plotted with flowcharts. The collected information was used to define new processes, including barcoding technology. We designed and developed new software interfaces applying user centered design methodologies. We used a big bang approach to implement the new systems. We previously have trained the mothers, and nursing and medical staff involved.

After 3 months, as a preliminary analysis, we measured the number of human milk prescriptions and compared it to the number of labels printed by the mothers during extraction.

3. Results

The former circuit started with the feeding prescription by pediatricians using a computerized provider order entry (CPOE) but in plain text (unstructured posology data). Nurses read the instructions and labeled the milk manually.

In order to adapt CPOE for structured breast milk feeding prescription, we searched the data warehouse for general orders containing milk prescriptions from the last 6 months, looking for examples and patterns. We defined the basic dataset for the posology: type of milk (human), dose, route, infusion method, infusion speed and frequency. Using this information, we sketched initial pen and paper prototypes and validated them with end-users. Afterwards we made high fidelity prototypes emulating the interface for medication prescription, which were finally developed by our technical staff.

Regarding the milk process, we plotted the results of field observations and interviews in a flowchart using all the information collected during the study. Afterwards, we draw a journey map highlighting risk and opportunities (Figure 1).

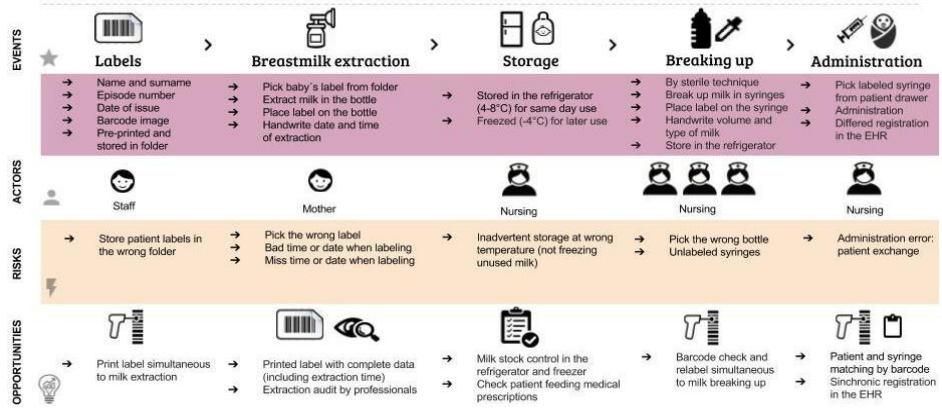

Figure 1. Breast milk process journey map.

The lactorium is a specially equipped room for the extraction and storage of human milk, where a breastfeeding woman can use a breast pump in private. It is supervised by specialized staffs. Previous to our implementation, the mothers put their milk in labeled sterile flasks, and then handwrite date and time for cold storage.

Now we used barcoding to corroborate the mother´s identity. We placed a PC with a label printer and a barcode scanner in the lactorium, and developed a new software interface for their access. They must carry an identification bracelet with their personal information and code. If the bracelet code matches with the newborn inpatient data, a label is printed. It includes the baby's basic hospitalization data, a timestamp and an estimated expiration date according to storage temperature [7]. In this way, the container for the extracted milk is identified synchronously.

The nursing staff is responsible for the storage and fractionation of the milk. With the new system, the nurse check that the milk belongs to the correct patient by reading the container label previous to fractionation. Therefore, the system prints a new label containing a detailed description (patient name and ID, type and amount of milk, route and frequency) with a data matrix code for each syringe.

Afterwards, the nurses pick the milk syringe from the refrigerator and go to the patient bedside. After checking the "five rights" visually, a third barcoding verification was implemented to check the right patient identity and prescription (milk sample, dose, route, time). Finally, the administration is recorded in the EHR.

As an initial approach, after 3 months we measured the number of human milk prescriptions: first month we counted 1,228 prescriptions; second month 1,874 prescriptions; third month 1,178 prescriptions. We also measured the number of labels printed by the mothers after bracelet verification, for each month: first 1,321; second 1,333; third 1,606 (Figure 2).

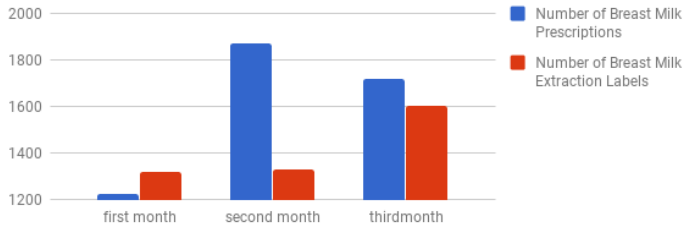

Figure 2. Number of human milk prescriptions and labels.

4. Discussion

We reviewed, designed and implemented a reliable system for closed loop breast milk feeding. Barcoding technology can enhance patient safety by verifying the identification at the time of the extraction, storage, fractionation and administration of human milk, and establishing a physical barrier that can decrease the errors due to human factors in every stage of the circuit [7,12].

The barcoding of breast milk provides a simple technological solution to improve safety in the preparation and management of the product because it acts as a barrier that can prevent adverse events. As HIT adoption is a sociotechnical issue, it is necessary to create change management approach strategies to encourage end-user participation and leadership. The successful implementation of the barcode in the human milk is affected by the improvement of the process before they start the automation, overcoming the barriers such as the time and expense of training, the costs of software and hardware, the workflow and avoid temporary solutions that can weaken the security of the processes [13].

Computer systems, while having the potential to improve security, can create new types of errors if not accompanied by properly designed and implemented verification processes. The safety culture must be reinforced so that human vigilance is not lost when implementing these technologies [14]. Health professionals often blame newly introduced technologies for undesirable consequences and failures in implementation. Although technical defects often cause problems, many detrimental or undesirable results from the implementation of a Health Information System arise from socio-technical interactions (the interaction between new information technology and existing social and technical systems in the provider organization), workflows, culture, social interactions and technologies, and should be taken into account [15].

Even though we only have preliminary data after the first implementation period, we can see an upward trend in CPOE use for breast milk. The fast increase in mother's

bracelet identification (almost equal to the number of prescriptions during the third month) can be associated with their strong engagement with their children safety. We are currently analyzing barcoding match and mismatch rates for implementation evaluation and future research.

5. Conclusions

In this article we described the former process, the planning and implementation of barcoding in the circuit of extraction, fractionation and administration of human milk, adapted to our local workflow. This allows the traceability of the milk from the time of removal until the administration. Further research is needed to address compliance with the new system. A culture of safety involves users, structural elements, processes, instruments and methodologies based on evidence that minimize the risk of adverse events.

6. References

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