



Clinical Research Reports

Technician Training Reduces Formula Preparation Errors

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Abstract: *Neonatal intensive care patients are at high risk of infection because of immature immune status. Cases of illness and death have been reported as a result of formula-related problems. Powdered formulas are discouraged due to potential bacterial contamination and sterile liquid products are not available in nutrient concentrations required to support growth and development of fragile neonates. An increased number of formula errors revealed the need for training of formula room technicians. Specific training targeted areas of formula preparation that would decrease errors and improve safety and accuracy of product delivered to high-risk neonates.*

Keywords: neonates; infection; powdered formula; training

Premature infants often require concentrated formulas, formula additives, and fortifiers to support growth.¹⁻³ Powdered additives are used to increase calories and protein and to fortify minerals. These infants are at high risk for infections, including

necrotizing enterocolitis.⁴⁻⁶ Powdered infant formulas are not sterile, and sterile liquid additives and fortifiers are not available commercially. The risk of transmission of *Enterobacter Sakazakii* and the potential contamination of powdered formula requires careful handling and mixing.⁷⁻⁹ Because there have been reports of illness and death associated with nonsterile powdered infant formula, it is recommended that formula preparation be centralized, and

Formula preparation orders for NICU patients increased from 50 to 75 per month in 2004 to more than 200 per month by the end of 2007. Audits of incident reports by Quality Management Services revealed a corresponding rise in the number of incident reports involving the formula room. Although the number of formula-associated problems was small, any error in product delivered to NICU patients was not acceptable. Analysis of formula room procedures suggested that errors

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guidelines for operation of the formula room have been published.^{10,11}

When the neonatal intensive care unit (NICU) at Nationwide Children’s Hospital increased its capacity to 120 beds with the addition of 4 off-site nurseries at Ohio Health System birthing hospitals, the number of requests for formula preparation by the technicians increased sharply.

were the result of an inadequate number of experienced technicians to staff the formula room relative to the number of requests.

A multidisciplinary team of dietitians, formula room management, nurses, and hospital leadership supported formal training for additional formula room technicians.

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Table 1.

Formula Room Technician Lessons

Class 1	Orientation to course, pretest
Class 2	Medical terminology and abbreviations
	Review of commercial formulas
Class 3	Customer service
Class 4	Aseptic formula preparation checklist
Class 5	Medication/formula errors
Class 6	Principles of inventory control
Class 7	Basic mathematics and practice problems
Class 8	Commonly used weights and measures, formula order review
Class 9	Preparation of formulas from powders with practice problems
Class 10	Percentages, dilutions, and ratios
Class 11	Practice problems and review
Class 12	Final exam
Class 13	Graduation

Methods

Nationwide Children's Hospital partnered with Columbus State Community College to develop formal instruction for the formula room technicians. The program was based on the Columbus State Pharmacy Technician program, and curriculum was developed using the American Dietetics Association's publication, *Infant Feedings: Guidelines for Preparation of Formula and Breastmilk in Health Care Facilities*.¹¹ Faculty from Columbus State Community College and dietitians from Nationwide Children's hospital provided 26 hours of classroom instruction. Lessons included medical terminology as related to nutrition services, principles of inventory control, use of aseptic technique, laminar flow principles, and quality improvement measures (Table 1). Participants met twice weekly for 2-hour classes based on the American Dietetics

Association publication and were given weekly quizzes and a final examination with 70% average required to pass the course. Hospital administration recognized employees with a graduation ceremony upon completion of the program, and they were awarded a Formula Technician Certificate. To monitor outcomes, incident reports continued to track the number of errors associated with the formula room. Employee turnover was also monitored.

Results

In the second quarter of 2004, formula-related errors were noted to increase to 0.9%. After technician training was completed, errors dropped sharply. Although there has been some natural variation over the 4-year reported period, errors continue to be infrequent (Figure 1). Training resulted in employee satisfaction and decreased employee turnover.

Of the 5 technicians who completed initial training, 4 have remained on staff and continue to work in the formula room. The fifth left her position because of illness. Four coordinators also received training, and 3 remain on staff.

Discussion

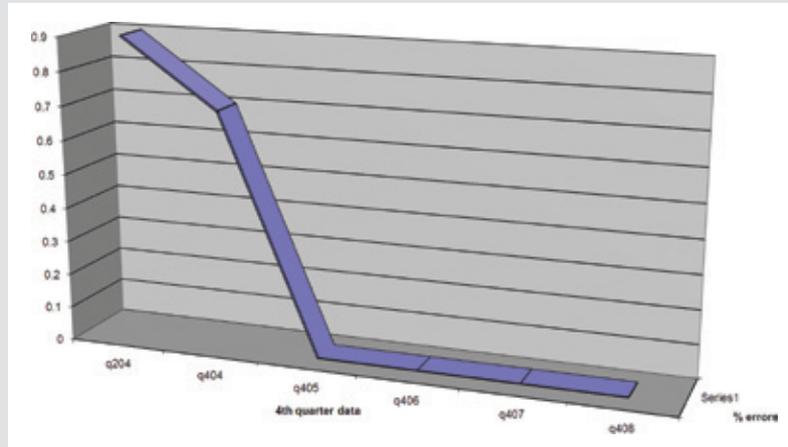
Nationwide Children's Hospital in Columbus, Ohio, operates level II and level III neonatal intensive care units with 65 tertiary referral beds and 48 beds in birthing centers. Leadership of neonatal services supports quality improvement initiatives and fosters a culture of collaboration and change that is necessary to achieve superior performance.^{12,13} As part of this process, staff complete incident reports, and the quality department analyzes trends to identify gaps in service delivery.

In the second quarter of 2004, there was an increase in the number of formula room-associated incidents. Because preterm infants have immature immune status and are at risk of necrotizing colitis, an increase in formula errors required follow-up. Errors included delivery of mislabeled and expired formula, suggesting the need for improved inventory control. Infants were sent incorrect formulas, which caused delays in feedings. It was also reported that upon visual inspection, formulas with equal nutrient densities had obviously different viscosities. A multidisciplinary team was formed to review formula room practices and target areas for improvement. The team included representation from hospital leadership, finance, nutrition services management, NICU dietitians, and quality management department.

Prior to the nursery expansion to include the units at birthing hospitals, the formula room had been staffed with a small group of tenured technicians who had been trained by supervisory staff. As neonatal services grew, the experienced technicians were unable to keep up with demand. In addition to formula preparation, technicians became responsible for packing and shipping daily formula

Figure 1.

Formula room errors as percentage of total incidents, 2004-2008.



deliveries to off-sites. Newly hired staff had experience in food service but lacked the technical background required for their new position. Appropriate use of the gram scale and laminar flow hood, as well as aseptic technique and basic mathematic skill, was acknowledged to be lacking. The multidisciplinary team identified the need to provide formal training to standardize formula room procedures and preparation of specialized formulas. Columbus State Community College offered a pharmacy technician training program that was adapted for the formula room, and the Business and Industry division coordinated the classroom instruction. Cost of the training was provided by hospital leadership. Classes were taught by Columbus State Community College pharmacy technician program faculty and Nationwide Children's NICU dietitians.

Ongoing monitoring confirmed that technical training resulted in stable formula preparation room staffing and

improved safety and quality of formulas. Similar training would be beneficial for any level III nursery that provides care for the most fragile NICU patients.

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References

1. Greer F, McCormick A. Improved bone mineralization and growth in premature infants fed fortified own mother's milk. *J Pediatr.* 1988;112-961.
2. Moyer-Mileur L, Chan GM, McInnes R, et al. Effect on growth and bone mineralization status of preterm infants fed enriched human milk for formulas. *Am J Clin Nutr.* 1988;47:779.
3. Arslanuglo S, Moro GE, Ziegler EE, et al. Adjustable fortification of human milk fed to preterm infants: does it make a difference? *J Perinatol.* 2006;26:614-621.

4. Mehall J, Kite C, Saltzman D, Walleit T, Jackson R, Smith S. Prospective study of the incidence and complications of bacterial contamination of enteral feedings in neonates. *J Pediatr Surg.* 2002;37:1177-1182.
5. Kliegman RM, Walsh MC. Neonatal necrotizing enterocolitis: pathogenesis, classification, and spectrum of illness. *Curr Probl Pediatr.* 1987;17:213.
6. Uauy R, Ranaroff A, Korones S, et al. Necrotizing enterocolitis (NEC) in VLBW infants: biodemographic and clinical correlates. *Pediatr Res.* 1990;27:228A.
7. Van Acker J, de Smet F, Muyltermans G, Bougateg A, Naessens A, Lauwers S. Outbreak of necrotizing enterocolitis associated with *Enterobacter sakazakii* in powdered milk formula. *J Clin Microbiol.* 2001;39:293-297.
8. Food and Drug Administration, Center for Food Safety and Applied Nutrition, Office of Nutritional Products, Labeling and Dietary Supplements. Health professional's letter on *Enterobacter sakazakii* infections associated with the use of powdered (dry) infant formulas in neonatal intensive care units. April 11, 2002; revised October 10, 2002. <http://www.cfsan.fda.gov/~dms/inf-ltr3.html>
9. European Food Standards Agency, Scientific Panel on Biological Hazards. Press statement on the risks of *Enterobacter sakazakii* and *Salmonella* in powdered infant formula, 2005. <http://www.food.gov.uk/news/newsarchive/2005/nov/infantformulastatementnov05>. Accessed September 17, 2008.
10. Steel S, Short R. Centralized infant formula preparation room in the neonatal intensive care unit reduces incidence of microbial contamination. *J Am Diet Assoc.* 2008;108:1700-1703.
11. American Dietetics Association. *Infant Feedings: Guidelines for Preparation of Formula and Breastmilk in Health Care Facilities.* Chicago, IL: American Dietetics Association; 2003.
12. Nelson EC, Batalden PB, Huber TP, et al. Microsystems in health care: Part 1. Learning from front-line units. *Jt Comm J Qual Saf.* 2002;28:472-493.
13. Keroack MA, Youngberg JD, Ceresse JL, Krsek C, Prellwitz LW, Trevelyan EW. Organizational factors associated with high performance in quality and safety in academic medical centers. *Acad Med.* 2007;82:1178-1186.