

Preparing for Discharge From the Neonatal Intensive Care Unit

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BACKGROUND: Discharge readiness is a key determinant of outcomes for families in the NICU. Since 2003, using a broad set of outcome and process measures, we have conducted an ongoing quality improvement initiative to improve the discharge preparation process in our NICU and readiness of families being discharged from the NICU.

METHODS: Iterative improvements to the discharge preparation process were made by a multidisciplinary committee. Discharge readiness was measured by using a parental and nurse survey for all families discharged from our NICU. Primary outcome measures included parental self-assessment of discharge readiness and nurse assessment of the family's emotional and technical discharge readiness. Secondary outcome measures included assessment of specific technical skills and emotional factors. Process measures included nursing familiarity with family at discharge. Improvement over time was analyzed by using statistical process control charts.

RESULTS: Significant improvement was seen in all primary outcome measures. Family self-assessment of discharge readiness increased from 85.1% to 89.1%; nurse assessment of the family's emotional discharge readiness increased from 81.2% to 90.5%, and technical discharge readiness increased from 81.4% to 87.7%. Several secondary outcome measures revealed significant improvement, whereas most remained stable. Nurse familiarity with the family at discharge increased over time.

CONCLUSIONS: Quality improvement methodology can be used to measure and improve discharge readiness of families with an infant in the NICU. This model can provide the necessary framework for a structured approach to systematically evaluating and improving the discharge preparation process in a NICU.

In 2015, >9% of the ~4 million births in the United States were preterm.¹ Many of these nearly 400 000 preterm infants required care in the NICU, and for their families, specialized preparation was needed to enable them to provide proper care to the infant after discharge. Guidelines exist on appropriate preparation of families with an infant in the NICU for discharge and subsequent follow-up.²⁻⁴

The importance of ensuring that families are ready for NICU discharge has been shown. Families that are

perceived either by themselves or by their providers as less prepared experience more adversity after discharge.⁵⁻⁸ Mothers who felt less prepared for discharge reported less confidence with self-care management abilities, with coping with challenging family-related issues, with obtaining necessary help and emotional support, and with more difficulties in overall adjustment in the first 3 weeks after discharge.⁹ Similar results have been seen in families with an infant in the NICU; although most report receiving

abstract

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Dr Gupta conceptualized and designed the study, performed the data analyses, and drafted and revised the initial manuscript; Dr Pursley supervised the conception and design of the study and critically reviewed and revised the manuscript; Dr Smith conceptualized and designed the study, supervised the data and study progress, and drafted and revised the initial manuscript; and all authors approved the final manuscript as submitted.

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TABLE 1 Technical and Emotional Items on Parent Discharge Readiness Survey

Items on Parent Discharge Readiness Survey	
Technical items	Bottle-feeding Breastfeeding Infant care skills such as dressing, diapering, and bathing What to expect for wet diapers and bowel movements per day What medicines and/or vitamins my infant will take when she or he is at home How to give these medicines and/or vitamins What to do if my infant has a fever or gets sick at home Selecting a doctor for my infant to go to after she or he goes home Understanding enrollment in special programs for premature infants Preparing a crib, bassinette, or bed at home for my infant Arranging for the help I may need at home
Emotional items	I feel confident that my infant's heart and breathing are safe. I feel confident that my infant is healthy and mature now. I am ready for my infant to come home.

the preparation needed to be ready for discharge, a higher frequency of postdischarge problems were seen in those families that were not prepared compared with those that were.^{10,11}

NICU discharge readiness has been defined as the masterful attainment of technical skills and knowledge, emotional comfort, and confidence with infant care by the primary caregivers at the time of discharge, and NICU discharge preparation has been defined as the process of facilitating discharge readiness to successfully make the transition from the NICU to home.² Discharge readiness is the desired outcome, and discharge preparation is the process undertaken to achieve the desired outcome. Currently, limited

information exists regarding how processes for discharge preparation can be improved.

Since 2003, we have conducted a systematic effort to measure discharge readiness and improve discharge preparation in families with an infant in our NICU. We believe this is the first report of a structured quality improvement (QI) initiative in this area, and we believe that the tools that we have developed will be of use to other centers conducting similar initiatives.

METHODS

Study Design, Setting, and Population

This initiative was launched in October 2003; in this analysis, we

include data from January 2004 to June 2017. For this effort, we examined families of infants discharged from the NICU; families of infants transferred to other institutions and families whose only infant died were not included. Our hospital has ~5000 deliveries per year. The NICU currently has 48 intermediate and intensive care beds, with an average daily census of between 40 to 45 and 900 to 1000 admissions per year. The NICU is a level III unit, as defined by the American Academy of Pediatrics, that provides full medical services to term and preterm infants; infants with acute surgical needs are transferred to a local level IV facility.¹² Approximately 20% of admissions to our NICU are very preterm at <33 weeks' gestation, and an additional 40% are preterm at between 33 and 36 weeks' gestation. Changes to the NICU population over the time period of the initiative included an increase in NICU admissions from 800 to 900 per year in 2004–2015 to ~1000 per year in 2016 and 2017, an increase in the percentage of admissions who are out-born infants from <1% per year before 2013 to ~10% in 2016, and an increase in the percentage of NICU admissions discharged home from the hospital from 40% to 45% in 2004–2010 to 50% to 55%

TABLE 2 Timeline of Discharge Planning Process Improvements

Date	Improvement	Label ^a
October 2003	Launch of discharge readiness assessment through family and nurse surveys	A
October 2003	Addition of discharge readiness metrics to NICU quality dashboard	B
May 2008	Follow-up phone calls to families after discharge by using structured scripts	C
January 2010	Launch of NICU discharge planning committee	D
October 2010	Creation of a nursing discharge preparation checklist	E
October 2010	Creation of hospitalization timelines for families	F
November 2010	Initiation of nurse-led formal discharge planning meetings	G
January 2011	Creation of standardized discharge information packets	H
September 2011	Standardization of discharge medication information	I
April 2012	Addition of former NICU parents to discharge planning committee	J
January 2013	Regular publicizing of comments on discharge process from families obtained during follow-up phone calls	K
September 2013	Discharge material made available electronically on internal Web site	L

^a Labels are used to indicate the timing of interventions in Figs 1–4.

TABLE 3 Descriptive Characteristics

	All Discharges	All Discharges With Discharge Readiness Data Available
<i>N</i>	5815	4797
Maternal age, mean (SD), y	33 (5)	33 (5)
Nulliparous, <i>n</i> (%)	3450 (59)	2957 (62)
Maternal race, <i>n</i> (%)		
White non-Hispanic	3145 (54)	2519 (53)
African American non-Hispanic	688 (12)	568 (12)
Asian American	572 (10)	452 (9)
Hispanic	262 (5)	210 (4)
Other	534 (9)	409 (9)
Unknown	614 (11)	639 (13)
GA, mean (SD), wk	34 (4)	34 (4)
BW, mean (SD), g	2278 (867)	2211 (845)
Male sex, <i>n</i> (%)	2905 (50)	2492 (52)

BW, birth weight; GA, gestational age.

between 2011 and 2017; the gestational age distribution of NICU admissions did not notably change.

The institutional review board determined this project to be QI and not subject to institutional review board review.

Measures
Our primary aim for this effort was to improve the discharge readiness of families of infants being discharged

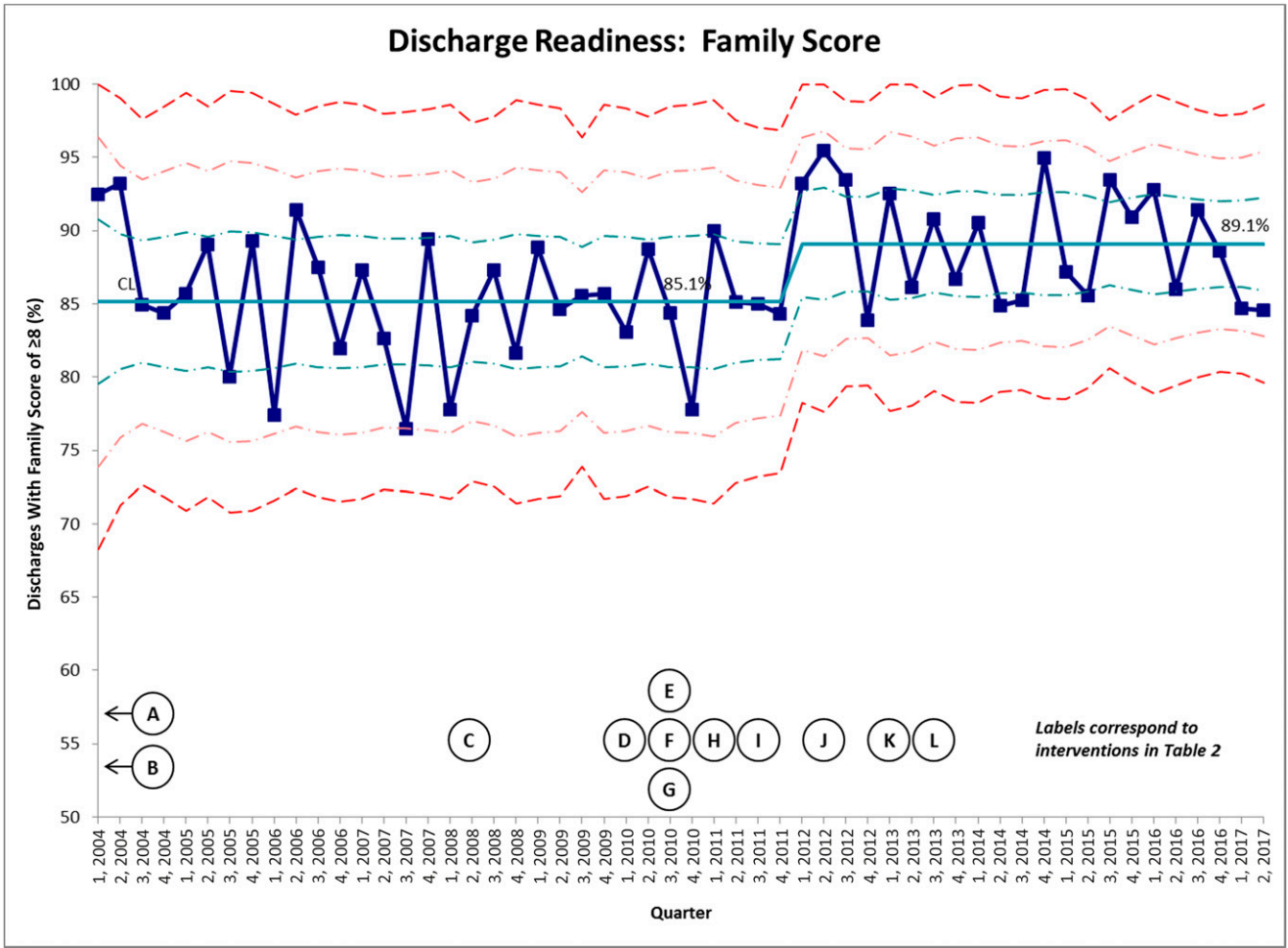


FIGURE 1
Family self-assessment of discharge readiness, P-chart. CL, centerline.

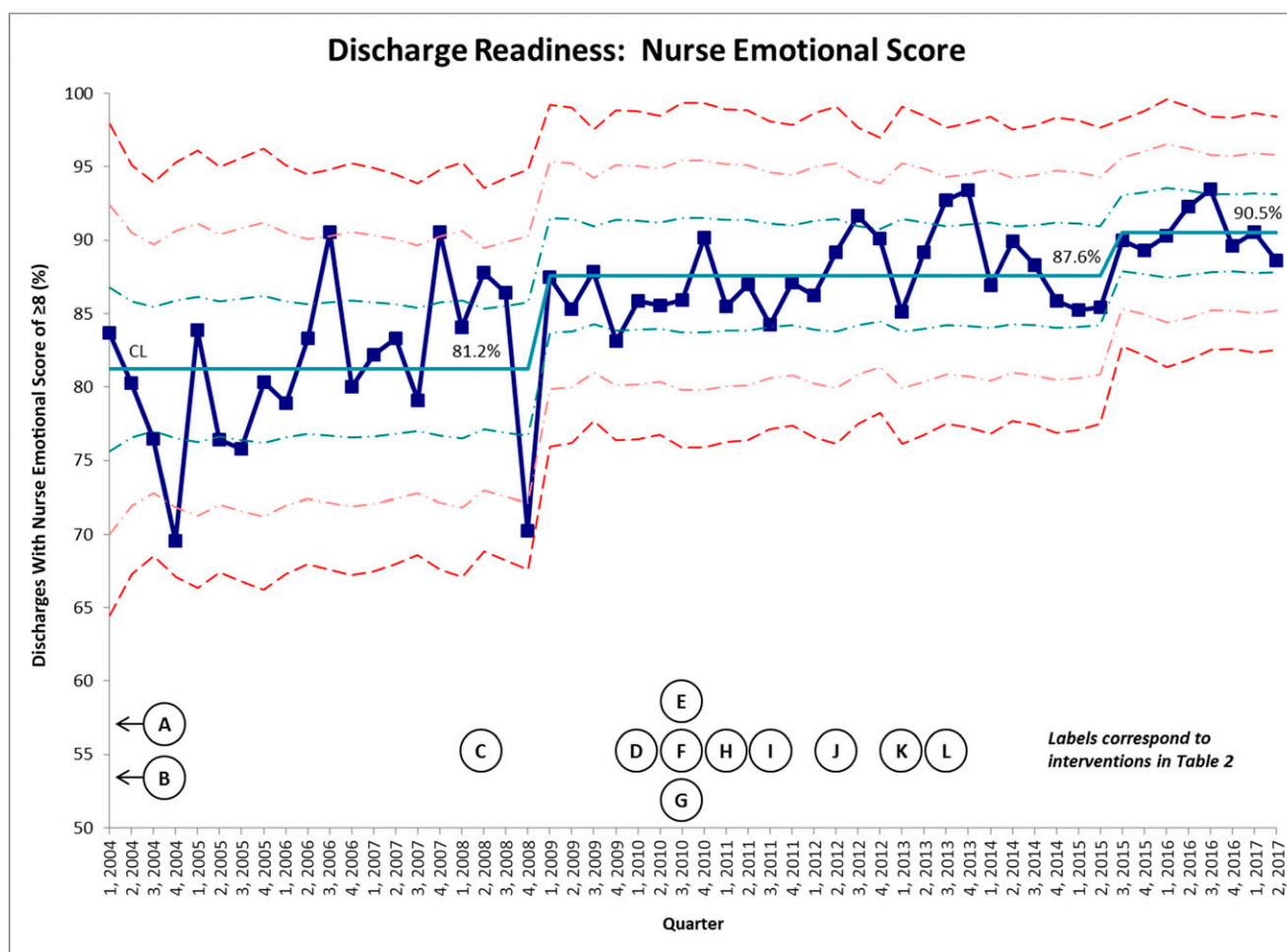


FIGURE 2

Nurse assessment of family's emotional readiness, *P*-chart. CL, centerline.

from our NICU through stepwise changes to our discharge preparation process. The assessment of discharge readiness has been described in detail elsewhere.^{10,11} Briefly, on the discharge day, families rated their overall discharge preparedness as well as specific questions regarding technical skills and emotional preparedness. The discharging nurse independently evaluated the family's overall emotional and technical discharge preparedness. Families and nurses were blinded to each other's responses. The development of the assessment tool, the derivation of the definitions of readiness, and the association of discharge readiness measured by this tool with subsequent infant care have been described elsewhere.^{10,11}

Our primary outcome measures were overall readiness for discharge, as reported by the family; overall technical readiness for discharge, as assessed by the nurse; and overall emotional readiness for discharge, as assessed by the nurse. All 3 measures were scored on a 9-point Likert scale (with the anchors "not at all prepared" and "very prepared"), with readiness for discharge considered as a score of 8 or 9. In addition, we examined overall assessment for readiness, defined as all 3 measures rated as 8 or 9.

Additional outcome measures included family-reported readiness with specific technical and emotional items; these are listed in Table 1. Eleven technical questions were

focused on infant care skills and specific needs of preterm infants; there were 4 response categories allowed: "This does not apply," "Not at all prepared," "Somewhat prepared," and "Prepared." Three questions were used to address emotional readiness for discharge, with a focus on confidence in ability and skills; there were 3 response categories allowed: "Not at all," "Somewhat," and "Very." Readiness for discharge was defined as an answer of "prepared" on technical questions and "very" on emotional questions. Discharges with blank responses or "this does not apply" responses were excluded from the denominator.

Process measures included whether the discharging nurse was a member

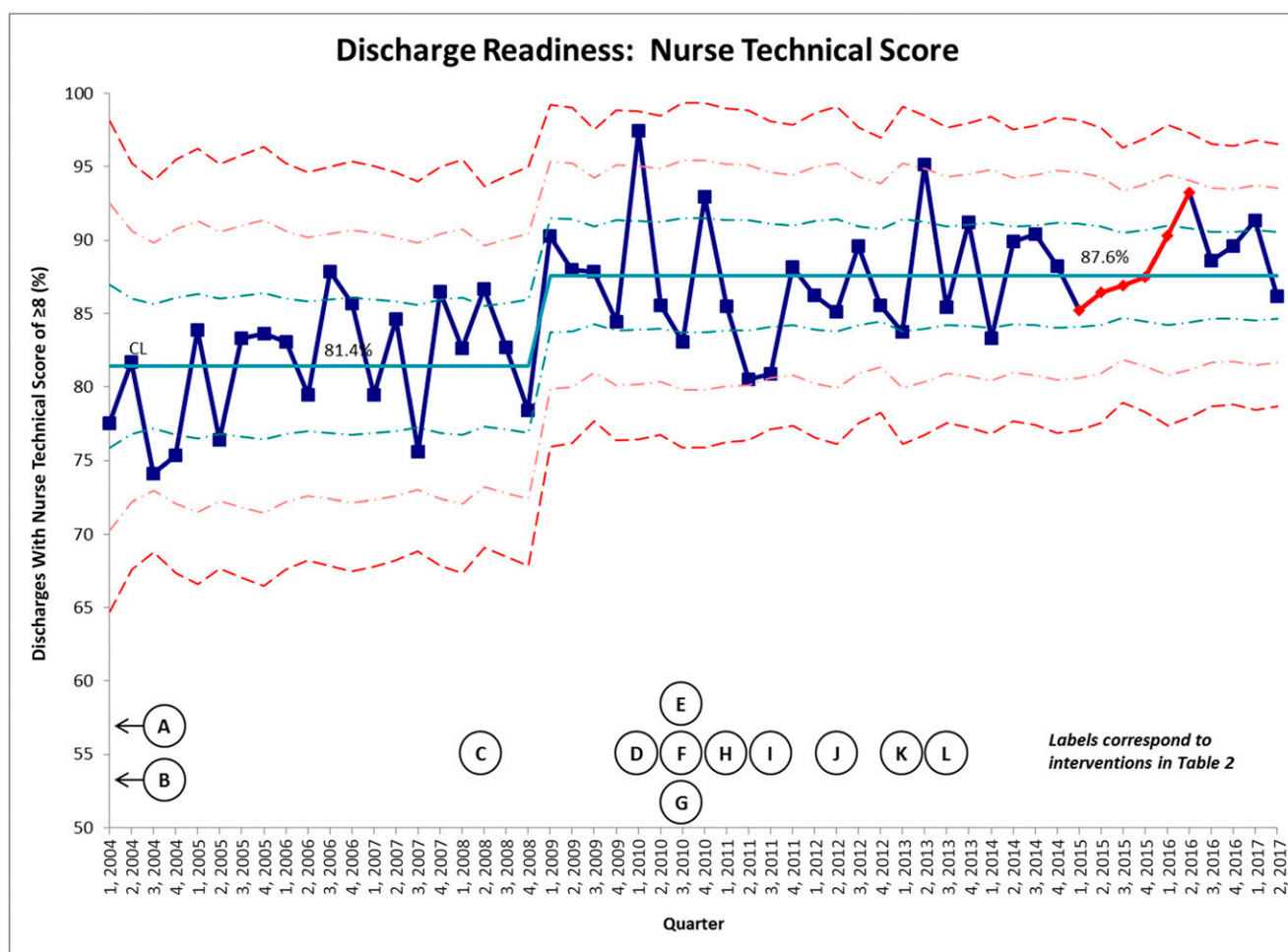


FIGURE 3

Nurse assessment of family's technical readiness, P-chart. CL, centerline.

of the infant's primary nursing team and whether the discharging nurse was familiar with the family. Both of these questions were asked on the nurse survey.

Analysis

Measures over time were analyzed by using established statistical process control methods.^{13,14} Because outcome and process measures were all categorical variables, P-charts were used for analysis. Data were analyzed quarterly to allow for adequate sample sizes per period. Control charts were created by using QI Macros (QI Macros for Excel, version 2015; KnowWare International, Inc, Denver, CO). Special cause variation was defined by using common published rules.¹⁴

Centerline means were calculated after 24 data points; if no special cause variation was seen, then the centerline mean was extended. When special cause variation was seen with change that was expected to persist, means were adjusted accordingly. When a mean was adjusted, it was again recalculated after 24 data points, and if no special cause variation was seen, that mean was then extended. Outcome and process measures were examined for all infants discharged from the NICU.

Interventions

Discharge readiness measurement was begun in October 2003 and was routinely performed beginning in January 2004. From 2003 to 2009, improvement efforts were

coordinated by our overarching NICU leadership committee; at its monthly meetings, the NICU leadership committee reviewed performance on discharge readiness quality measures, discussed potential improvements, and then implemented changes through members of the NICU leadership team. In 2010, a multidisciplinary NICU discharge planning committee was created to systematically review and improve the discharge preparation process. This committee was cochaired by a physician and nurse; members included nurses, physicians, nurse practitioners, social workers, and the NICU family advisor. Additional NICU parent representatives were added in 2012. Interventions and improvements to

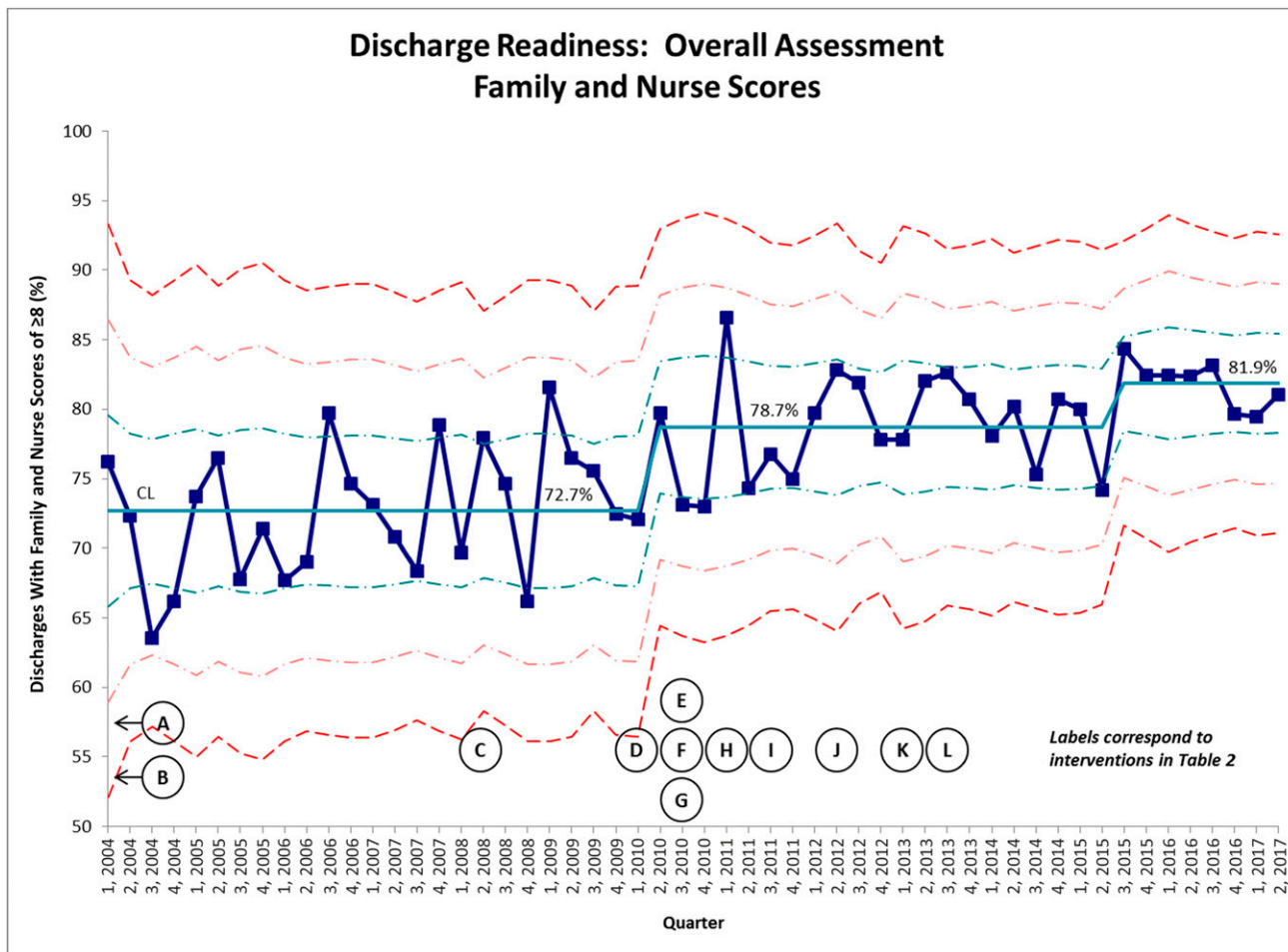


FIGURE 4
Overall assessment of discharge readiness, P-chart. CL, centerline.

the discharge planning process are listed in Table 2.

Throughout this initiative, discharge readiness metrics and family survey results were reviewed regularly and used to identify potential areas for practice improvement. Practice changes over this period that were driven, at least in part, by the discharge readiness initiative included increases in breastfeeding support services and efforts to improve continuity of nursing care. Of note, these types of changes targeting specific practices were not systematically captured as interventions within the discharge readiness improvement initiative and are thus not included in the table of interventions above.

RESULTS

From January 2004 to June 2017, 5815 infants were discharged from our NICU; 4797 (82%) had a discharge readiness survey returned by either the nurse or the family. Additional information on these groups is shown in Table 3.

Primary Outcome Measures

Figures 1–4 reveal the results of our primary outcome measures. The graphs reveal the percentage of families considered ready for discharge, with better performance indicated by an increase in the measure. For all measures, significant improvement was seen. The percentage of families rating

themselves as prepared for discharge increased from 85.1% to 89.1% (Fig 1). The percentage of families rated by the nurse as emotionally prepared for discharge increased from 81.2% to 90.5% (Fig 2). The percentage of families rated by the nurse as technically prepared for discharge increased from 81.4% to 87.6% (Fig 3). The percentage of families rated as prepared for discharge by the overall assessment for readiness increased from 72.7% to 81.9% (Fig 4).

Secondary Outcome Measures

Among the secondary outcomes, in which we examined technical skills and emotional readiness, 2 sample measures are shown in Figs 5 and 6.

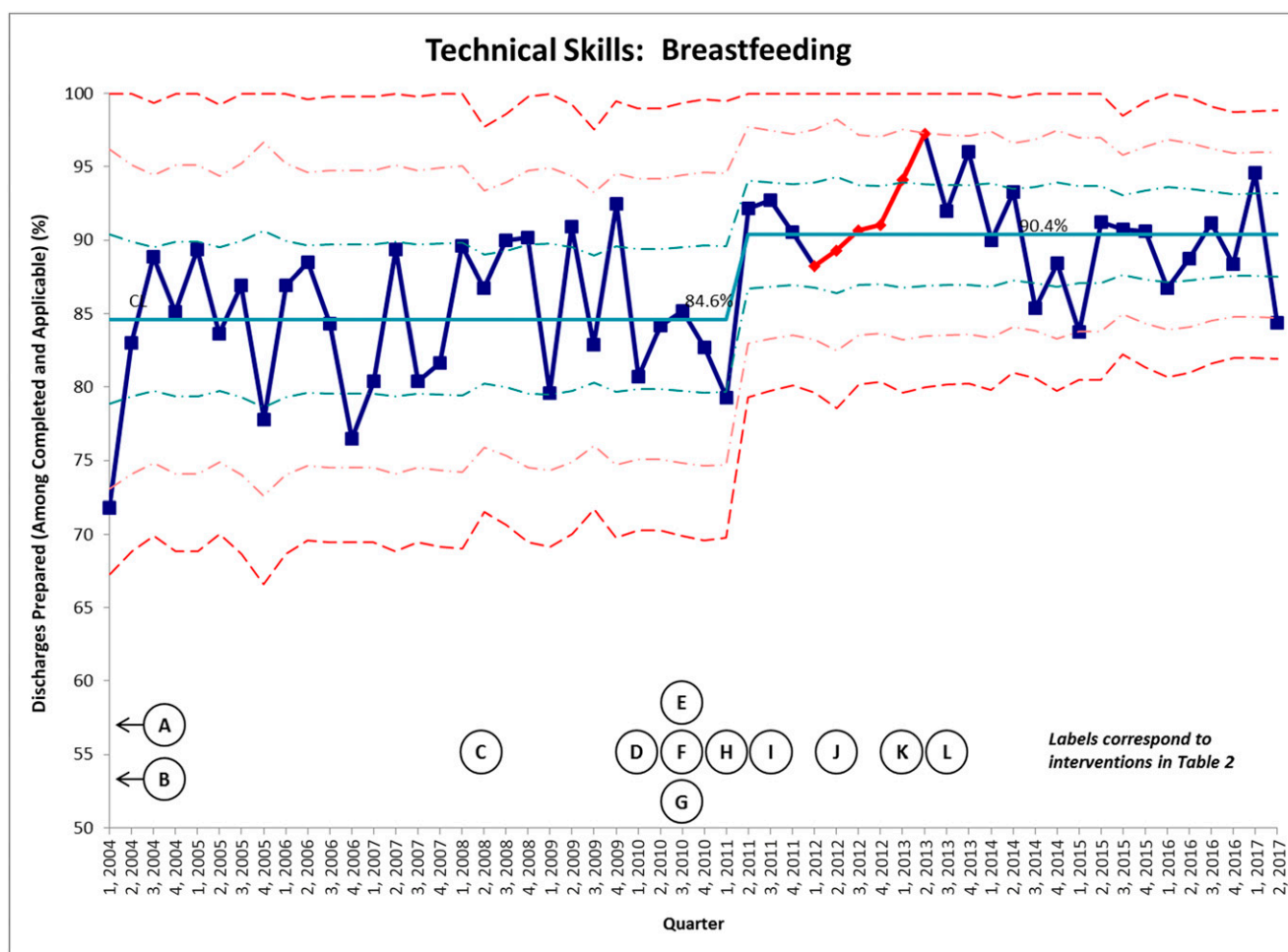


FIGURE 5
Breastfeeding technical skill, P-chart. CL, centerline.

The graphs reveal readiness for discharge on these specific measures, and better performance is indicated by an increase in the measure. Within technical skills, the overall rate of readiness for breastfeeding skills improved from 84.6% to 90.4% (Fig 5). The other 10 technical measures revealed overall rates of readiness between 83% and 99%, without significant variation throughout the study period (data not shown). Within emotional readiness, the percentage of families reporting being confident at time of discharge that their infant's heart and breathing were safe increased from 85.7% to 89.9% (Fig 6). Similar increases were also seen in families reporting being confident that their infant was healthy and mature and that they

were ready to bring their infant home (data not shown).

Process Measures

Results for the 2 process measures are shown in Figs 7 and 8. The graphs reveal the percentage of nurses reporting being on the infant's primary team and being familiar with the family at the time of discharge; better performance is indicated by an increase in the measure.

The percentage of nurses reporting being on the primary team increased from 36.4% to 49.7%, with the improvement seen early in the study period (Fig 7). The percentage of nurses reporting being familiar with the family increased from 56.3% to 65.7% (Fig 8).

DISCUSSION

In this article, we describe our efforts to improve the process of discharge preparation to improve the outcome of discharge readiness. Well-established frameworks are used to describe how specific local processes of care are necessary complements to generalizable scientific knowledge in patient care outcomes.^{15,16} Optimizing local processes of care is the domain of QI, whereas discovering new knowledge is the domain of research. Our work over the past decade to understand and systematically improve discharge readiness of families in our NICU has combined research and QI. Our research in this area has led to new knowledge regarding the importance

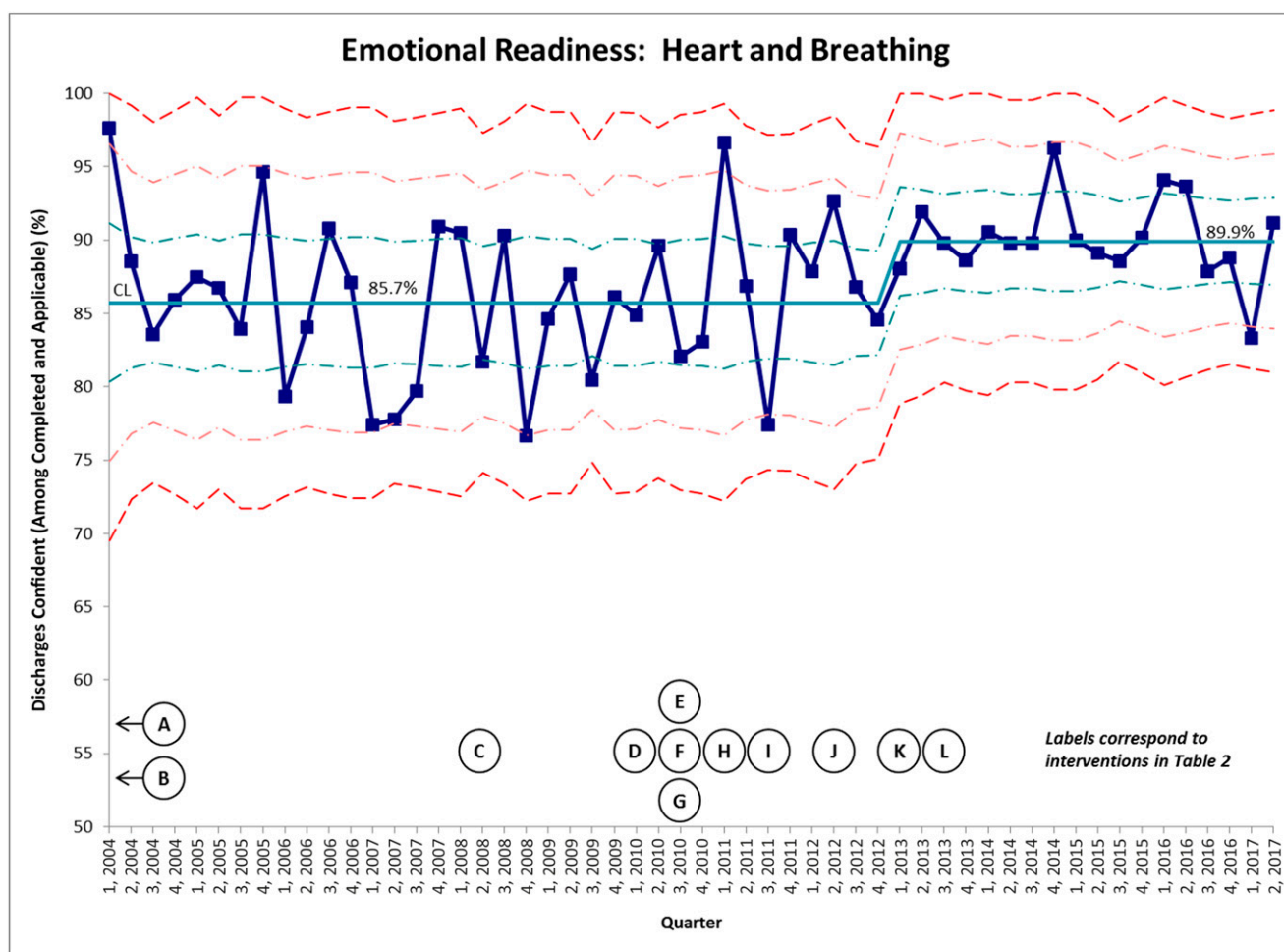


FIGURE 6
Heart and breathing emotional readiness, P-chart. CL, centerline.

of discharge readiness,¹¹ the consequences of inadequate readiness,¹⁰ and the identification of critical components of a NICU discharge readiness program.² The framework described in this article now offers resources for improving the discharge preparation process in local contexts.

Our initiative followed the core principles of the model for improvement, including the setting of specific aims, the development of appropriate measures, and the careful introduction of practice changes.¹⁷ In particular, we focused on developing a broad set of robust quality measures to describe discharge preparation and discharge readiness, including primary outcome measures,

secondary outcome measures, and process measures. We developed a sustainable system for collecting these data on an ongoing basis and included the core measures on our monthly NICU leadership dashboard.

Overall, our primary outcome measures saw significant improvements in all assessments of discharge readiness. Of note, the improvements in nurse assessments of technical and emotional readiness were seen much earlier than the improvement in family self-assessment. This discrepancy between family self-reported readiness and nurse-reported readiness is notable and has been seen in other settings as well.⁶ In addition to revealing the importance

of using multiple viewpoints to measure discharge readiness, this discrepancy likely reflects different drivers of each measure. In our experience, improvements in nurse assessments occurred relatively early and before many of the planned changes in the discharge planning process; these improvements, thus, may have resulted from the increased generalized awareness of the importance of discharge planning associated with the launch of the initiative and from small changes in practice or education not captured as specific interventions. Improvement in family self-assessment occurred later and after substantial changes to the discharge process, including creation of hospitalization timelines and initiation of formal discharge

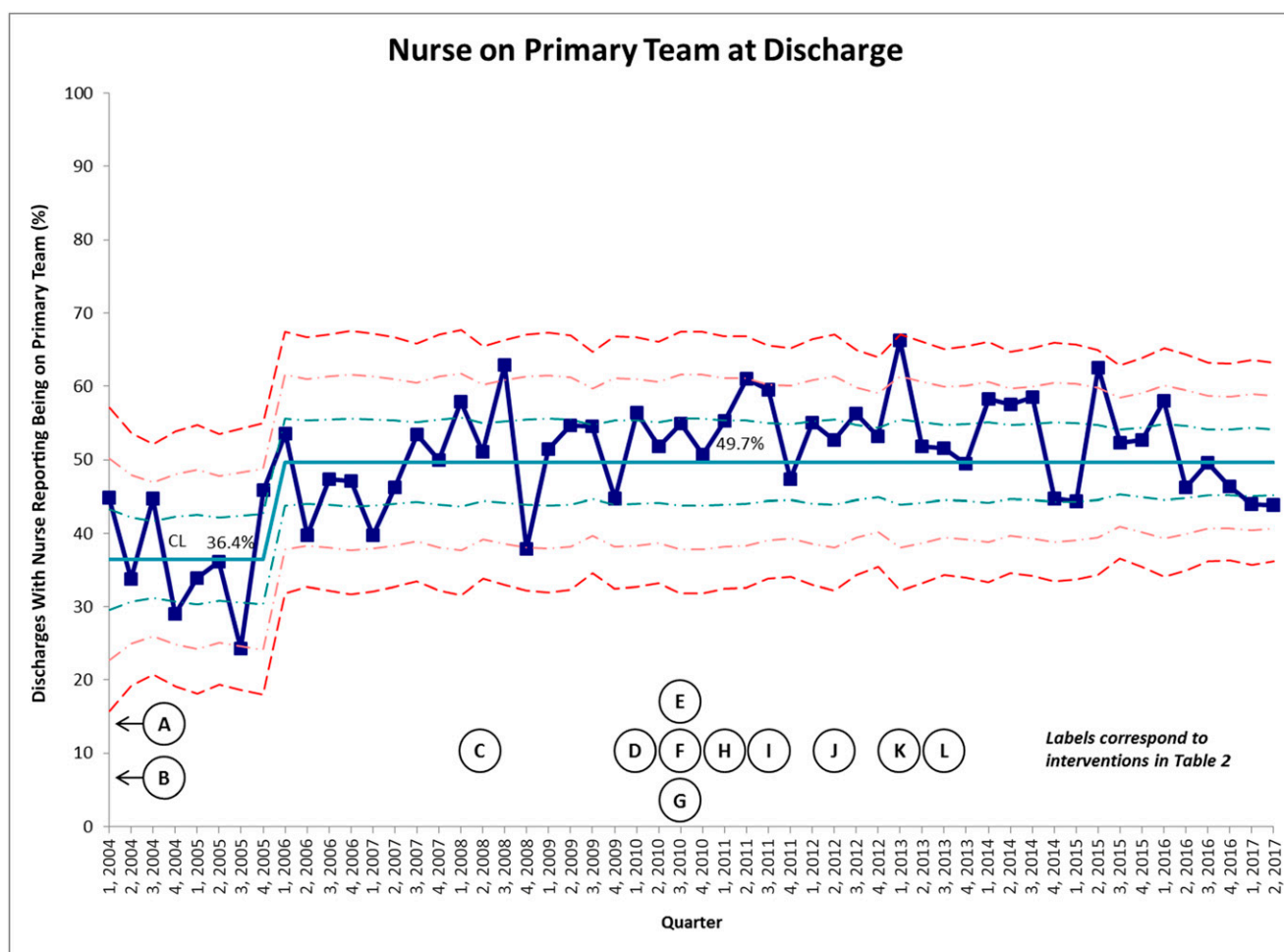


FIGURE 7
Nurse on primary team at discharge, P -chart. CL, centerline.

planning family meetings, suggesting that these types of family-targeted interventions can have an important impact.

Regarding secondary outcome measures, several measures of family self-reported readiness on technical skills and emotional items revealed significant improvements, including readiness for breastfeeding and for all of the emotional measures. These improvements were also seen after implementation of the family-targeted interventions in 2010 and 2011, suggesting again that family self-assessment of discharge readiness can be impacted with family-centered changes to the discharge preparation process.

Regarding the process measures, nurse familiarity with the family and nurse presence on the infant's primary team increased significantly; these increases were seen relatively early. The importance of continuity of nursing care was emphasized often during the early years of the initiative, and numerous adjustments to the nursing assignment process were made; however, these changes were not systematically recorded and thus are not able to be correlated to the improvements seen in our process measures.

Of note, and reflective of complex systems in general, not all of our practice changes have led to improvement. For example, although family readiness with breastfeeding

improved over the initiative, all of the other measures of technical readiness remained stable. Similarly, although nursing continuity has improved, overall performance is still modest, with only ~50% of nurses reporting being on the primary team and 65% reporting being familiar with the family at discharge despite a variety of improvement efforts in this area.

Our experience reveals several important themes within QI and reveals the value of applying improvement methodology to complex care practices within the NICU over other common approaches such as development and implementation of policies or guidelines. The core principles of QI include the use of clear statements of

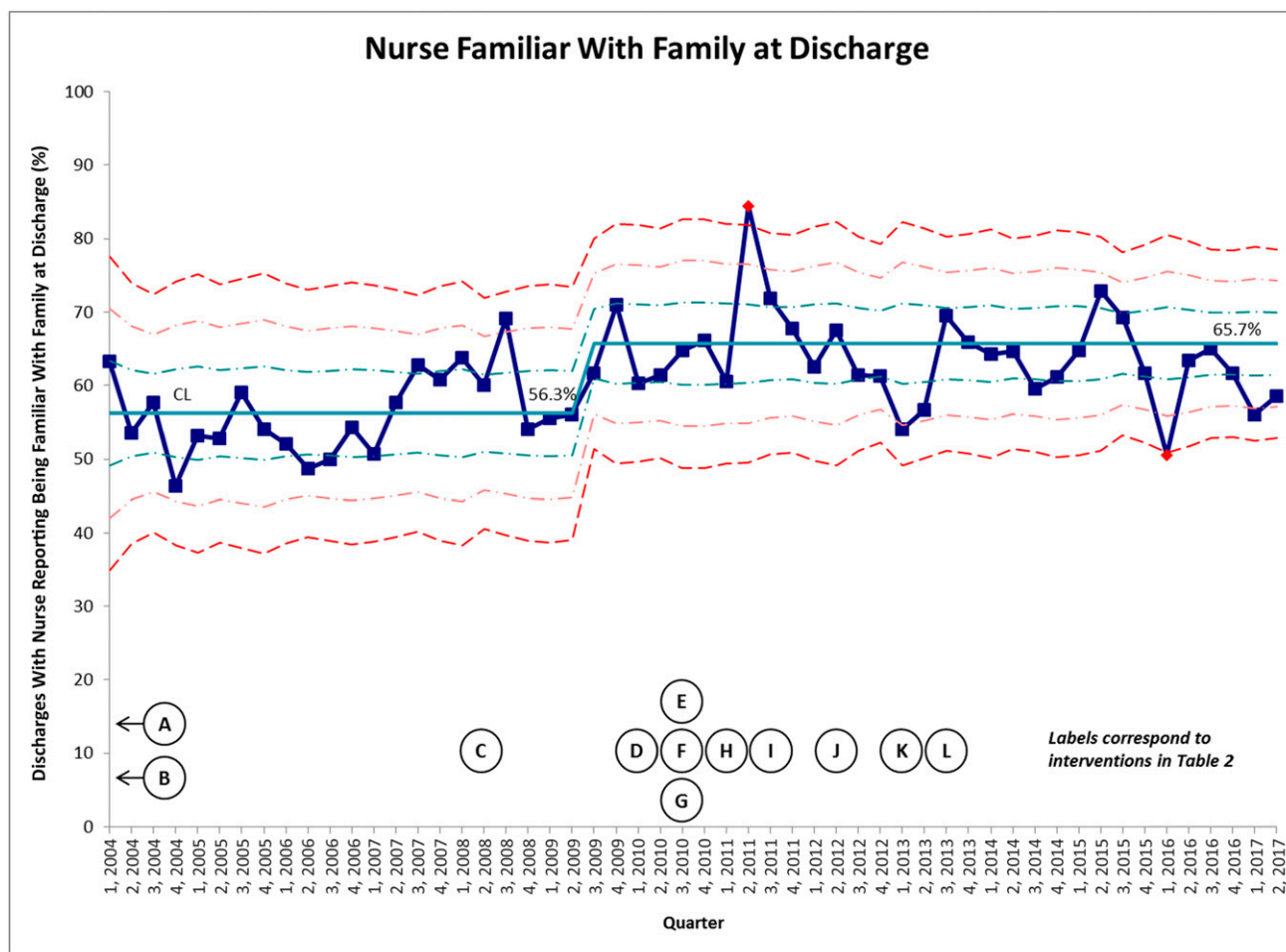


FIGURE 8
Nurse familiar with family at discharge, P-chart. CL, centerline.

aim; the development of appropriate outcome, process, and balancing measures; and the implementation of changes in practice after careful testing. In our initiative, our aims for the project were clearly defined from the start and served to align the efforts of leadership, the improvement team, and the NICU staff. Our aims for the initiative were continuously reinforced at team meetings and leadership reports and facilitated the dedication of new resources to the effort when necessary. On the other hand, our aim statements did not include specific quantitative and time-limited goals for the project, which could have strengthened our efforts.

Perhaps the most important principle revealed by our project is the use of

measures for improvement. Although quality metrics are commonly available for clinical outcomes, they are not often used for evaluating complex processes such as discharge planning. We developed a broad set of measures to evaluate numerous elements of discharge planning and discharge readiness, and generated performance reports that were updated monthly. These quantitative monthly reports have been critical to maintaining focus and enthusiasm for this initiative. Importantly, we incorporated the data collection for these measures into the regular workflow of the NICU rather than using a team member or research assistant; completion of the readiness surveys by nurses and families does require additional work, but the time

needed is fairly modest, and compliance with survey completion is high, with a survey return rate of >80% of all discharges.

Limitations of our measures include limited process measures and a lack of balancing measures. We did not measure potential process measures such as completion of the discharge preparation checklist or conduction of the formal discharge planning meeting. In addition, although the use of secondary outcome measures around technical and emotional skills allowed for the recognition and addressing of specific deficits, such as support of breastfeeding, family understanding of special follow-up programs, and nursing continuity, we did not measure changes implemented to address these

deficits, which could have been valuable process measures. Regarding balancing measures, we do not anticipate significant unexpected negative consequences of efforts to improve discharge readiness, but we did not measure other potential balancing measures such as the cost in staff time or dollars of the various interventions. These additional process and balancing measures would likely have added significant value to our initiative, particularly around describing specific interventions associated with the improvements seen. As with all QI efforts, the burden of data collection had to be carefully considered and limited.

Although the specific results and trends seen in our NICU as a result of our initiative are of interest, of larger value is the general QI framework that this initiative has revealed. Optimal discharge preparation processes are context specific and should be locally determined; the measurement system presented, on the other hand, should be broadly applicable. Insuring optimal discharge readiness is a critical responsibility of NICU providers, and it is clear that discharge preparation is a complex process. Our framework for the systematic evaluation and measurement of a NICU's performance regarding family discharge preparation and discharge readiness can provide the necessary support for a structured approach to improvement and should allow discharge readiness to become a target for improvement, much like more common clinical processes and outcomes.

ABBREVIATION

QI: quality improvement

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