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ORIGINAL ARTICLE Effects of a transition home program on preterm infant emergency room visits within 90 days of discharge

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OBJECTIVE: To evaluate effects of a transition home program (THP) and risk factors on emergency room (ER) use within 90 days of discharge for preterm (PT) infants < 37 weeks gestation.

STUDY DESIGN: This is a prospective 3-year cohort study of 804 mothers and 954 PT infants. Mothers received enhanced neonatal intensive care unit transition support services until 90 days postdischarge. Regression models were run to identify the effects of THP implementation year and risk factors on ER visits.

RESULTS: Of the 954 infants, 181 (19%) had ER visits and 83/181 (46%) had an admission. In regression analysis, THP year 3 vs year 1 and human milk at discharge were associated with decreased risk of ER visits, whereas increased odds was associated with non-English speaking, maternal mental health disorders and bronchopulmonary dysplasia.

CONCLUSION: Enhanced THP services were associated with a 33% decreased risk of all ER visits by year 3. Social and environmental risk factors contribute to preventable ER visits.

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INTRODUCTION

Very preterm (PT) infants, particularly those with neonatal morbidities, including bronchopulmonary dysplasia (BPD), are at increased risk of emergency room (ER) utilization.^{1,2} Recent data indicate that increased risk of neonatal morbidities and postdischarge resource utilization associated with prematurity extend to moderate and late PT infants.^{3–6} Data from Kaiser Permanente Northern California population identified rates of ER visits at 30 days of 5.4% for moderate PT and 4.7% for late PT.⁴ A study of all infants with Medicaid insurance born in Delaware between January 2009 and December 2012 identified that 41% used an ER by 6 months of age.² Medicaid and poverty are known to be risk factors for rehospitalization.^{2,7} It is also known that women from disadvantaged social environments are at greater risk to give birth prematurely⁸ and that experiencing a PT birth and the subsequent hospital course can create psychological distress for these families.⁹

There are limited data, however, on specific maternal and family risk factors for ER visits of early, moderate and late PT infants and potential interventions to minimize the risk.

Mother/infant dyads in this study were participants in a 3-year transition home program (THP; partnering with parents).⁷ The primary objective was to examine the association of enhanced transition care and support for high-risk mother–infant dyads over the 3-year period with ER use. A secondary objective was to examine the effects of infant medical morbidities and maternal social and environmental and psychosocial risk factors on the use of ER. It was hypothesized that the THP would result in a decrease in ER utilization over the 3-year period and that social and environmental risk factors would be associated with ER utilization.

METHODS

Institutional Review Board approval and informed consent were obtained for all subjects. The cohort consisted of 954 (74%) of 1294 eligible PT infants cared for in the neonatal intensive care unit (NICU) for > 5 days. All families were invited to enroll in Current Care (www.currentcareri.org), the Rhode Island secure health information exchange which provided real-time computer notification of ER visits and rehospitalizations to the study staff. A separate Current Care informed consent was obtained.

The THP team, which consisted of physicians, neonatal nurse practitioners (NNPs), four clinical social workers and seven trained family resource specialists (FRS), all with their own infants previously cared for in a NICU, has been described previously.⁷ Bilingual and trilingual social workers and FRS were hired. The FRS were paid employees who received training in parent and infant needs and hospital and community resources by the Rhode Island Parent Information Network (www.ripin.org) and our clinical research team. The THP matched each FRS with a mother–infant dyad with common background and primary language to the extent possible. The FRS had a key role by providing education and supportive intervention services under the supervision and guidance of Licensed Independent Clinical Social Workers (LICSWs). It was expected that the FRS providers would became increasingly adept at facilitating the transition home intervention for families over the 3 years.

Methods predischarge

The team made NICU rounds daily, identified eligible subjects and obtained informed consent. All families received the standard NICU multidisciplinary care. The study transition home team communicated closely with the NICU team, the Follow-up Clinic and the primary care provider (PCP). Study providers (social workers or FRS) met regularly with parent(s) during the hospitalization, reviewed a comprehensive education binder with the parents that included safety, nutrition, human milk (HM) benefits, infection control and respiratory syncytial virus prophylaxis, assisted parents as needed to complete study questionnaires, identified family challenges and barriers to care and informed parents of indicated community resources. At enrollment, the LICSW obtained a maternal

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186

Care provided	Early/moderate PT	Late PT	Provider
Postdischarge call within 24 h	Yes	Yes	LICSW or FRS
Neonatal Nurse Practitioner visit within 1 week for assessment, management and support	Yes	No	4 Study NNPs \pm FRS or LICSV
Standard Visiting Nurse visits	Yes	Yes	State program
Discharge summary to PCP	Yes	Yes	Staff
Referral to early intervention	Yes	As needed	Staff
24/7 on call by study physicians for 90 days postdischarge	Yes	No	Physicians and NPs
Real-time alerts to staff of ER visits and hospitalizations from state Current Care secure database	Yes	Yes	Physicians and NPs
Seen in Clinic at 1 and 3 months	Yes	No	Physicians and NNPs
Edinburgh administered at 1 month postdischarge	Yes	Yes	LICSW and FRS
Phone communication at 1 and 3 months To identify concerns and facilitate necessary referrals	Yes	Yes	LICSW and FRS

Abbreviations: ER, emergency room; FRS, family resource specialists; LICSW, Licensed Independent Clinical Social Worker; NNP, neonatal nurse practitioners; NP, nurse practitioners; PCP, primary care provider; PT, preterm.

mental health (MMH) history by maternal report and record review of documented diagnoses of anxiety, depression, bipolar disorder, posttraumatic stress disorder, obsessive compulsive disorder or other Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition diagnosis and information regarding mental health treatment or medication. Additionally, mental health disorders were monitored during the study period. If any criteria were met, a mother was categorized as having an MMH disorder and referrals were made as needed. Attendance at an educational discharge class and cardiopulmonary resuscitation class were encouraged. Staff supported families in accessing community resources, and families considered to have high social, environmental or medical risk received a predischarge home visit to further assess the home environment and address needs. All early and moderate PT infants received a postdischarge home visit provided by a skilled NNP. The entire team made NICU rounds every Friday so that families and providers would get to know each other. The team also met weekly to review specific challenges and barriers encountered by families. One or more of staff presented a family with complex psychosocial and medical needs that was considered a successful outcome of THP or a continuing challenge and in need of the support services. The overarching goal was to provide supportive individualized family-centered care to every family.

Methods postdischarge

All study services were provided in addition to standard visiting nurse and PCP visits. There was continued ongoing communication among the medical team, social workers, FRS, support staff, PCP and Follow-up Clinic. The postdischarge interventions included more in-person contacts for early and moderate PT infants compared with late PT infants based on perceived risk status and are shown in Table 1. Letters were sent to the PCP for each infant eligible for Synagis for respiratory syncytial virus prophylaxis based on American Academy of Pediatrics recommendations¹⁰ to facilitate the process. Directions for all medication doses and formula mixes were reviewed at the time of each encounter. The late PT infants were considered of lower risk and were not seen in the Follow-up Clinic. If, however, problems were identified during phone communications, referrals were made to support both the family and the medical needs of the infant.

Statistical analysis

Primary study groups were infants with and without ER visits within 90 days of NICU discharge. Secondary analyses were for ER visits by early, moderate and late PT infants and rates of ER visits at 7, 30 and 90 days after NICU discharge. Study data were prospectively collected. Maternal characteristics and outcomes for infants with and without ER visits were compared with *t*-tests and Wilcoxon tests for continuous variables and Chi Square for categorical variables. *P*-values are two sided. Infant variables and outcomes were analyzed using random effects models (continuous) or generalized estimating equation (categorical) methods to adjust for multiple births within mothers. Logistic regression models were run to predict ER visits by 90 days postdischarge. One-sided 95% confidence intervals were used to test the directional hypothesis of lower odds of ER visits over study years 3 vs 1, 3 vs 2 and 2 vs 1. Independent variables in addition to year of program implementation were those identified as significantly associated with ER visits in bivariate analyses and included early, moderate and late PT, Medicaid, non-English speaking, MMH disorders, multiple birth and HM at discharge. Birth weight, gestation, IVH 3–4 and oxygen at discharge were not included in the model due to collinearity with early PT and/or BPD. The regression model was also run among only those infants with an ER visit using the same independent variables to predict ER visits leading to hospitalization.

RESULTS

Maternal and infant characteristics comparing any ER visit by 90 days vs none are shown in Table 2. Mothers of infants seen in the ER compared with those not seen were significantly more likely to be on Medicaid (63% vs 54%), non-White (53% vs 47%), non-English speaking (27% vs 17%), have less than a high school education (22% vs 14%) and a MMH disorders (44% vs 34%). A total of 181/954 (19%) of infants had ER visits (23.5% of early PT, 9.7% of moderate PT and 18% of late PT). Infants seen in the ER had more neonatal morbidities and longer stays in the NICU. They were less likely to be discharged on HM (58% vs 70%).

Table 3 shows the rates of ER visits for each year of the study during the first week, first 30 days and first 90 days postdischarge for the 3 PT groups. All PT groups had non-significant decreases in rates of ER visits over the 3 years of the study (early; 27, 21 and 23%, moderate 16, 16 and 11%, late PT 19, 18, 17% and total cohort (21, 18, and 18%), respectively. Early PT infants were at increased risk of an ER visit vs moderate and late PT infants.

Table 4 shows the reasons for ER visits separated by total visits and visits resulting in admission to the hospital. The majority of reasons for ER visits for early PT (52%), moderate PT (47%) and late PT (43%) ER visits were for respiratory illness. Of the 181 infants seen in the ER, 83 (46%) had a subsequent admission to the hospital. Overall 51, 45 and 34% of ER visits of early, moderate and late PT resulted in admission to the hospital. Infants presenting to the ER with respiratory problems, gastrointestinal problems, infection/fever, neurological problems and injury/abuse were at high risk of being admitted.

The relationship between number of social–environmental risk factors that were significant in bivariate analyses (non-English speaking, < high school education, mental health disorder and Medicaid) and ER visits was analyzed. Rates for infants with none, 1, 2 and \geq 3 were 12, 17, 26 and 29%, respectively (*P* < 0.001; not shown in table). For the total cohort, rates of ER visits more than

Table 2. Maternal and infa	nt characteristi	ics for ER visit	by 90 days
N (%)	ER visit, yes	ER visit, no	P-value
Mothers	172 (20)	632 (80)	
Medicaid	109 (63)	339 (54)	0.02
Maternal age (years)	28.7 ± 6	29.8 <u>+</u> 6	0.03
Maternal age < 19 years	6/171 (4)	17/622 (3)	0.59
White	80 (47)	360 (57)	0.01
Non-White	92 (53)	272 (43)	
Non-English speaking	46 (27)	109/630 (17)	0.005
Gravida > 1	123 (72)	421 (67)	0.22
Prenatal care	167 (97)	622/630 (99)	0.13
Single	101/171 (59)	324/618 (52)	0.12
Other children in	N=165	N = 596	0.76
house < 5 years			
0	88 (53)	335 (56)	
1	59 (36)	195 (32)	
≥2	18 (11)	66 (12)	
Education	N = 167	N = 597	
Less than high	36 (22)	81 (14)	0.04
school			
HS graduate	45 (27)	171 (29)	
Some college or	86 (51)	345 (58)	
higher education		. ,	
DCYF involvement	18/170 (11)	64/626 (10)	0.89
Domestic violence	16/170 (9)	53/621 (9)	0.72
Substance abuse	19/170 (11)	74/624 (12)	0.81
Mental health disorders	74/170 (44)	215/624 (34)	0.03
Infants	181 (19)	773 (81)	0.00
Early PT	70 (23.5)	. ,	0.02
Moderate PT	30 (9.7)	179 (23)	
			M vs L 0.27
1 · · • • •	01 (10)	267 (02)	E vs M 0.01
Late PT	81 (18)	367 (82)	0.000
Birth weight	1722.6 ± 740	1879.4 ± 629	0.006
Gestation	31.6 ± 4	32.3 ± 3	0.001
SGA	41/174 (24)	166/760 (22)	0.34
Male	100 (55)	411 (53)	0.65
Multiple birth	41 (23)	248 (32)	0.03
IVH 3–4 or PVL	9 (5)	10/772 (1)	0.002
NEC (Bell's stages 2–3)	10 (6)	12/770 (2)	0.02
Sepsis	8 (4)	21/770 (3)	0.48
BPD	36 (20)	61 (8)	< 0.0001
Human milk at	105 (58)	538/771 (70)	0.001
discharge		224/652 (23)	0.1.4
Human milk at 1 month	50/163 (31)	234/659 (36)	0.14
Oxygen at discharge	15 (8)	31 (4)	0.02
Days in NICU	45.8 ± 44	33.9 <u>+</u> 34	< 0.0001
Abbreviations, BDD, brenche	برامي محمد مساريم) an automount of

Abbreviations: BPD, bronchopulmonary dysplasia; DCYF, Department of Children Youth and Families; ER, emergency room; HS, high school; IVH, intraventricular hemorrhage; NEC, necrotizing enterocolitis; NICU, neonatal intensive care unit; PT, preterm; PVL, periventricular leukomalacia; SGA, small for gestational age.

doubled between those infants with none to those with ≥ 3 . The majority of the cohort had ≥ 1 social/environmental risk factors.

Table 5 shows the regression models to predict ER visits by 90 days. Non-English speaking household (odds ratio (OR) = 1.7) and MMH disorders (OR = 1.6) were significant maternal predictors of ER visits, whereas BPD (OR = 3.3) was a significant infant medical predictor. Both HM at discharge from the NICU (OR = 0.66) and year 3 compared with year 1 of the transition home intervention program (OR = 0.67) were associated with 34% and 33%, respectively, decreased risks of an ER visit. In the second regression run to predict ER visits leading to hospitalization, the effect of social/environmental risk factors differed; non-English speaking lost significance, Medicaid insurance was associated
 Table 3.
 Rates of ER visits during week 1, first 30 days and first 90 days postdischarge

	Year 1	Year 2	Year 3	Year effects, P
Early PT, N	92	106	99	
1 week	5 (5)	3 (3)	4 (4)	0.65
30 days	14 (15)	13 (12)	14 (14)	0.83
90 days	25 (27)	22 (21)	23 (23)	0.51
Moderate PT, N	51	79	79	
1 week	2 (4)	4 (5)	1 (1)	0.50
30 days	5 (10)	5 (6)	3 (4)	0.35
90 days	8 (16)	13 (16)	9 (11)	0.45
Late PT, N	135	169	144	
1 week	4 (3)	4 (2)	3 (2)	0.90
30 days	9 (7)	10 (6)	15 (10)	0.33
90 days	26 (19)	30 (18)	25 (17)	0.80
Total PT	278	354	322	
1 week	11 (4)	11 (3)	8 (2)	0.58
30 days	28 (10)	28 (8)	32 (10)	0.55
90 days	59 (21)	65 (18)	57 (18)	0.41
P-values	Early, modera	ite and late PT	group compar	isons with
		year		
1 week	NS	NS	NS	
30 days		Early PT vs		
	late PT 0.04	late PT 0.08		
			PT 0.03	
90 days	NS	NS	Early PT vs	
			moderate	
			PT 0.03	

(OR = 2.4), whereas infants of mothers with mental health disorders (OR = 0.40) were less likely to be admitted. Both BPD (OR = 3.3) and multiple birth (OR = 2.0) were associated with ER visits resulting in rehospitalization. In addition, among the infants seen in the ER HM at discharge was not protective of hospital admission.

DISCUSSION

Our findings in adjusted analyses confirmed the beneficial effects of a THP resulting in a 33 % decrease in the odds of ER utilization over the 3-year period. This is consistent with our prior report on this cohort which showed that THP was associated with a decrease in rehospitalizations.⁷ The most common cause of ER visits for all PT groups was respiratory illness. We note that 20% of the infants with an ER visit by 90 days had BPD. It is well documented that PT infants with BPD are at increased risk of postdischarge respiratory illness, resource utilization, ER visits and rehospitalization, ^{11–15} and that involvement of an interdisciplinary team after discharge is beneficial.¹⁶ However, 49, 55 and 66% of ER visits for early, moderate and late PT did not result in hospitalization, suggesting that they were potentially preventable non-urgent ER visits that could have been managed in a clinic or pediatric office. This is supported by our finding that a higher number of social/environmental risk factors was associated with ER visits for the entire cohort of infants with an ER visit. In a study of full-term infants followed for the first 3 months, Pomerance et al.,¹⁷ reported that 60% of all visits were non-urgent. The finding of potentially unnecessary ER visits and the fact that overall 7.6% of all neonates in the United States are seen in an ER within the first 28 days¹⁸ suggests that more education and support of families are needed.

Transition home program and preterm emergency room visits B Vohr *et al*

Reason	Early PT	Early PT admissions	Moderate PT	Moderate PT admissions	Late PT	Late PT admissions	Total ER visits	Total admission
N ^a	96	49 (51%)	38	17 (45%)	100	34 (34%)		
Respiratory	50 (52)	33 (66)	18 (47)	12 (67)	43 (43)	20 (47)	111	65 (59)
Gastrointestinal	17 (18)	4 (24)	11 (29)	2 (18)	21 (21)	6 (29)	49	12 (24)
Infection/fever	13 (14)	6 (46)	5 (13)	2 (40)	14 (14)	6 (43)	32	14 (44)
Neurological	5 (5)	5 (100)	1 (3)	1 (100)	0 (0)	0 (0)	6	6 (100)
Injury-Abuse	1 (1)	1 (100)	0 (0)	0 (0)	4 (4)	2 (50)	5	3 (60)
Crying	3 (3)	0 (0)	0 (0)	0 (0)	3 (3)	0 (0)	6	0 (0)
Parent concern	1 (1)	0 (0)	0 (0)	0 (0)	2 (2)	0 (0)	3	0 (0)
Accidents	2 (2)	0 (0)	0 (0)	0 (0)	3 (3)	0 (0)	5	0 (0)
Skin/rash	1 (1)	0 (0)	2 (5)	0 (0)	2 (2)	0 (0)	5	0 (0)
Other	2 (2)	0 (0)	1 (3)	0 (0)	7 (7)	0 (0)	10	0 (0)
Surgery	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1	0 (0)
Cardiac issues	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	0 (0)	1	0 (0)

Abbreviations: ER, emergency room; PT, preterm. "Number N (%) of ER visits and ER visits resulting in hospital admissions for the 181 infants with at least 1 ER visit.

Predictor	OR		95% confidence limits	
Dependent variable: ER v	visit by 90 a	lays		
Early vs moderate and late PT	0.8332	0.5322	1.3045	0.42
Medicaid insurance	1.1548	0.7518	1.7738	0.51
Non-White vs other	1.3821	0.8971	2.1291	0.14
Non-English speaking	1.6812	1.0121	2.7926	0.04
Multiple birth	0.7021	0.4421	1.1148	0.13
Education $<$ HS	1.3460	0.8087	2.0401	0.25
Maternal mental health disorders	1.5519	1.0574	2.2778	0.02
BPD	3.2661	1.8745	5.6908	< 0.000
Human milk @ discharge	0.6590	0.4433	0.9795	0.03
Year 2 vs 1 ^a	0.7907	0.5541	1.1285	0.14
Year 3 vs 1 ^a	0.6693	0.4645	0.9643	0.04
Year 3 vs 2 ^a	0.8465	0.5866	1.222	0.23
Dependent variable: ER v	isits by 90	days resulting	in hospital	ization
Early vs moderate and late PT	0.9317	0.4044	2.1465	0.87
Medicaid insurance	2.4223	1.0310	5.6914	0.04
Non-White vs other	0.5929	0.2736	1.2846	0.18
Non-English speaking	1.0325	0.4794	2.2238	0.93
Multiple birth	2.0413	1.0005	4.1648	0.05
Education < HS	0.6553	0.2760	1.5560	0.34
Maternal mental health disorders	0.4006	0.2130	0.7532	0.005
BPD	3.3091	1.2867	8.5100	0.01
Human milk @ discharge	1.1224	0.5426	2.3217	0.76
Year 2 vs 1 ^a	0.5230	0.2457	1.1134	0.09
Year 3 vs 1 ^a	0.4700	0.2218	0.9959	0.05
Year 3 vs 2ª	0.8986	0.4352	1.8556	0.77

Abbreviations: BP, bronchopulmonary dysplasia; ER, emergency room; HS, high school; OR, odds ratio; PT, preterm. ^aOne-sided 95% confidence intervals to test directional hypothesis of lower odds of ER visit over time.

Social/environmental risk factors, including Medicaid insurance as a marker of poverty, were associated with any ER utilization in bivariate analyses. The report of Paul *et al.*² of infants in the state of Delaware with Medicaid insurance identified that 39% of infants with Medicaid and a birth weight < 1500 g were seen in an ER by 6 months of age. Within our cohort, infants on Medicaid were more likely to go to the ER vs infants with private insurance. In adjusted analyses, however, Medicaid was not significantly associated with all ER visits. Medicaid was, however associated with ER visits that lead to hospitalization. The association of Medicaid with rehospitalization is consistent with our prior findings⁷ and that of others.² A history of MMH disorders, including depression, anxiety and bipolar disorder, was associated with a 55% increase in the odds of ER visits in our cohort. This is similar to the findings of Paul et al.² in which both maternal depression disorders and other mental health diagnoses were associated with increased use of ER. This finding is of particular importance because maternal depression is more common among mothers of infants cared for in a NICU and is known to have a negative impact on parenting and decision making. In a recent report by Hawes et al.¹⁹ of our transition home cohort, one in five mothers of early, moderate and late PT infants had depressive symptoms 4 weeks after discharge. Mothers with depressive symptoms were more likely to feel negative about themselves and their ability to care for her infant, a potential contributing factor to seeking the assistance of an ER for more minor infant medical concerns. This speculation is supported by our finding that infants of mothers with MH disorders whose infants were seen in the ER had a 60% decrease in the odds of being admitted. The other social/environmental risk factor that was independently associated with a 68% increase in the odds of using the ER was non-English speaking. The increase in non-English speaking immigrants to the United States in recent years has been associated with language barriers impacting on ER use, misinterpretation of medication use and rehospitalization rates.²⁰⁻²²In the pediatric population, this impact is even greater for children with special health-care needs.²³In our THP, we were fortunate to have bilingual and trilingual social workers and FRS staff in addition to interpreter services to address family needs. Despite this service, non-English speaking was associated independently with increased ER use. Families confided that when calling their primary care clinic/office, there was often no one who could take their call, which in turn resulted in a visit to the ER. Despite our 24/7 on-call service, non-English speaking families did not always avail them of this resource. The ER, however, has interpreters readily available to assist with the assessment and to answer parent's gueries. This is consistent with our finding that non-English speaking was not independently associated with rehospitalization of infants seen in the ER. It is apparent that more must

term infants. Clin Perinatol 2006; 33(4): 935-945 abstract xi.

term infants. Clin Perinatol 2013; 40(4): 753-775.

of prematurity in Canada. BMC Pediatr 2014; 14: 93.

Study Group. Pediatr Infect Dis J 2000; 19(7): 592-597.

trics 2011; 128(5): e1216-e1225.

illness, J Pediatr 2010: 157(2): 209-214 e201.

2016: 181: 86-92.

(3): 263-272.

748-753.

415-420

4 Kuzniewicz MW, Parker SJ, Schnake-Mahl A, Escobar GJ. Hospital readmissions and emergency department visits in moderate preterm, late preterm, and early

5 Jain S, Cheng J. Emergency department visits and rehospitalizations in late pre-

6 Johnston KM, Gooch K, Korol E, Vo P, Eyawo O, Bradt P et al. The economic burden

Vohr B, McGowan E, Keszler L, Alksninis B, O'Donnell M, Hawes K et al. Impact of a transition home program on rehospitalization rates of preterm infants. J Pediatr

8 Blumenshine P, Egerter S, Barclay CJ, Cubbin C, Braveman PA. Socioeconomic

9 Hynan MT, Mounts KO, Vanderbilt DL. Screening parents of high-risk infants for

10 American Academy of Pediatrics Committee on Infectious DiseasesAmerican Academy of Pediatrics Bronchiolitis Guidelines Committee. Updated guidance for

emotional distress: rationale and recommendations. J Perinatol 2013; 33(10):

palivizumab prophylaxis among infants and young children at increased risk of

hospitalization for respiratory syncytial virus infection. Pediatrics 2014; 134(2):

et al. Rehospitalization because of respiratory syncytial virus infection in pre-

mature infants younger than 33 weeks of gestation: a prospective study. IRIS

11 Carbonell-Estrany X, Quero J, Bustos G, Cotero A, Domenech E, Figueras-Aloy J

12 Chien YH, Tsao PN, Chou HC, Tang JR, Tsou KI. Rehospitalization of extremely-low-

birth-weight infants in first 2 years of life. Early Hum Dev 2002; 66(1): 33-40.

13 Ambalavanan N, Carlo WA, McDonald SA, Yao O, Das A, Higgins RD et al. Iden-

14 Gunville CF, Sontag MK, Stratton KA, Ranade DJ, Abman SH, Mourani PM. Scope and impact of early and late preterm infants admitted to the PICU with respiratory

15 Mourani PM, Kinsella JP, Clermont G, Kong L, Perkins AM, Weissfeld L et al.

16 Abman SH, Collaco JM, Shepherd EG, Keszler M, Cuevas-Guaman M, Welty SE et al.

Intensive care unit readmission during childhood after preterm birth with

tification of extremely premature infants at high risk of rehospitalization. Pedia-

disparities in adverse birth outcomes: a systematic review. Am J Prev Med 2010; 39

be carried out to provide instructions and access to care information in the language of choice for the family.

Finally, the provision of HM was associated with a decreased risk of visits to the ER. The benefits of HM extend to decreased neonatal morbidities, decreased postdischarge infection, decreased rehospitalization and decreased costs.^{24–27} Continued efforts must be made to support the beneficial and cost-effective intervention of HM.

The other factor associated with ER visits resulting in hospitalization was multiple birth. The increased risk of hospitalization of multiples is consistent with our prior finding⁷ and that of others.^{28,29}

We believe that the transition home intervention is successful with this high-risk population because it is a multifaceted team approach addressing both the medical needs of the infant and the psychosocial, environmental and mental health needs of the mother. Key components are the inclusion of bilingual clinical social workers and trained cost-effective FRS, the use of Rhode Island Current Care electronic statewide database to receive real-time alerts of ER visits and hospitalizations, the 24/7 on-call service and home visits provided by experienced NNPs, LICSWs and FRS. The model of trained parents who partner with the social workers and physicians has been shown to have a positive impact in other studies.^{30–32} Our findings, however, indicate that more needs to be carried out to address language barriers and MMH needs to prevent unnecessary ER visits.

Strengths of the study are enrollment of 74% of high-risk eligible PT infants cared for in a NICU for > 5 days over a 3-year period, the inclusion of early, moderate and late PT infants, assessment of a comprehensive parent education and support program, collection of social/environmental risk factors, follow-up to 90 days postdischarge and enrollment in a statewide database for real-time alerts of ER visits. Weakness includes the lack of a non-intervention comparison group.

CONCLUSIONS

Socially disadvantaged families of PT infants who spend time in the NICU are faced with many challenges. A THP for NICU PT infants that provided enhanced support and education services significantly reduced the rate of ER visits and ER visits resulting in rehospitalization over a 3-year period. Support services must go beyond the traditional focus on infant medical risk factors and expand to provide comprehensive transition support services to meet the needs of high-risk families and their high-risk PT infants.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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REFERENCES

- 1 Smith VC, Zupancic JA, McCormick MC, Croen LA, Greene J, Escobar GJ *et al.* Rehospitalization in the first year of life among infants with bronchopulmonary dysplasia. *J Pediatr* 2004; **144**(6): 799–803.
- 2 Paul DA, Agiro A, Hoffman M, Denemark C, Brazen A, Pollack M *et al.* Hospital admission and emergency department utilization in an infant medicaid population. *Hosp Pediatr* 2016; **6**(10): 587–594.
- 3 Ananth CV, Friedman AM, Gyamfi-Bannerman C. Epidemiology of moderate preterm, late preterm and early term delivery. *Clin Perinatol* 2013; **40**(4): 601–610.

ss includes the lack of a Interdisciplinary care of children with severe bronchopulmonary dysplasia.

J Pediatr 2016; 181: 12–28 e1.
 17 Pomerantz WJ, Schubert CJ, Atherton HD, Kotagal UR. Characteristics of non-urgent emergency department use in the first 3 months of life. Pediatr Emerg Care

respiratory failure. J Pediatr 2014; 164(4): 749-755 e743.

- 2002; 18(6): 403–408.
 18 Lee HC, Bardach NS, Maselli JH, Gonzales R. Emergency department visits in the neonatal period in the United States. *Pediatr Emerg Care* 2014; 30(5): 315–318.
- 19 Hawes K, McGowan E, O'Donnell M, Tucker R, Vohr B. Social emotional factors increase risk of postpartum depression in mothers of preterm infants. J Pediatr 2016; 179: 61–67.
- 20 Ginde AA, Clark S, Camargo CA Jr. Language barriers among patients in Boston emergency departments: use of medical interpreters after passage of interpreter legislation. J Immigr Minor Health 2009; 11(6): 527–530.
- 21 Karliner LS, Auerbach A, Napoles A, Schillinger D, Nickleach D, Perez-Stable EJ. Language barriers and understanding of hospital discharge instructions. *Med Care* 2012; **50**(4): 283–289.
- 22 Levas MN, Dayan PS, Mittal MK, Stevenson MD, Bachur RG, Dudley NC et al. Effect of Hispanic ethnicity and language barriers on appendiceal perforation rates and imaging in children. J Pediatr 2014; 164(6): 1286–1291 e1282.
- 23 Mosquera RA, Samuels C, Flores G. Family language barriers and special-needs children. *Pediatrics* 2016; **138**: 4.
- 24 Patel AL, Johnson TJ, Engstrom JL, Fogg LF, Jegier BJ, Bigger HR et al. Impact of early human milk on sepsis and health-care costs in very low birth weight infants. J Perinatol 2013; 33(7): 514–519.
- 25 Cristofalo EA, Schanler RJ, Blanco CL, Sullivan S, Trawoeger R, Kiechl-Kohlendorfer U et al. Randomized trial of exclusive human milk versus preterm formula diets in extremely premature infants. J Pediatr 2013; 163(6): 1592–1595 e1591.
- 26 Schanler RJ, Fraley JK, Lau C, Hurst NM, Horvath L, Rossmann SN. Breastmilk cultures and infection in extremely premature infants. *J Perinatol* 2011; **31**(5): 335–338.
- 27 Vohr BR, Poindexter BB, Dusick AM, McKinley LT, Higgins RD, Langer JC *et al.* Persistent beneficial effects of breast milk ingested in the neonatal intensive care unit on outcomes of extremely low birth weight infants at 30 months of age. *Pediatrics* 2007; **120**(4): e953–e959.
- 28 Petrou S, Mehta Z, Hockley C, Cook-Mozaffari P, Henderson J, Goldacre M. The impact of preterm birth on hospital inpatient admissions and costs during the first 5 years of life. *Pediatrics* 2003; **112**(6 Pt 1): 1290–1297.

- 190
- 29 Henderson J, Hockley C, Petrou S, Goldacre M, Davidson L. Economic implications of multiple births: inpatient hospital costs in the first 5 years of life. *Arch Dis Child Fetal Neonatal Ed* 2004; 89(6): F542–F545.
- 30 Foster BA, Aquino C, Gil M, Flores G, Hale D. A randomized clinical trial of the effects of parent mentors on early childhood obesity: study design and baseline data. *Contemp Clin Trials* 2015; **45**(Pt B): 164–169.
- 31 Flores G, Walker C, Lin H, Lee M, Fierro M, Henry M *et al.* A successful program for training parent mentors to provide assistance with obtaining health insurance for uninsured children. *Acad Pediatr* 2015; **15**(3): 275–281.
- 32 Vohr BR, Yatchmink YE, Burke RT, Stephens BE, Cavanaugh EC, Alksninis B *et al*. Factors associated with rehospitalizations of very low birthweight infants: impact of a transition home support and education program. *Early Hum Dev* 2012; **88**(7): 455–460.