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Car Seat Tolerance Screening in the Neonatal Intensive Care Unit: Failure Rates, Risk Factors, and Adverse Outcomes

Erik A. Jensen, MD, MSCE¹, Elizabeth E. Foglia, MD, MSCE¹, Kevin C. Dysart, MD¹, Zubair H. Aghai, MD², Alison Cook, DO³, Jay S. Greenspan, MD, MBA², and Sara B. DeMauro, MD, MSCE¹

¹Department of Pediatrics, Division of Neonatology, The Children's Hospital of Philadelphia and The University of Pennsylvania Perelman School of Medicine, Philadelphia, Pennsylvania

²Division of Neonatology, Nemours/Sidney Kimmel Medical College at Thomas, Jefferson University, Philadelphia, Pennsylvania

³Optum, Inc., Eden Prairie, MN

Abstract

Objective—To characterize the epidemiology of Car Seat Tolerance Screening (CSTS) failure and the association between test failure and all-cause 30-day post-discharge mortality or hospital readmission in a large, multicenter cohort of preterm infants receiving neonatal intensive care.

Study design—Retrospective cohort study using the prospectively collected Optum Neonatal Database. Study infants were born <37 weeks gestation between 2010 and 2016. We identified independent predictors of CSTS failure and calculated the risk-adjusted odds of all-cause 30-day mortality or hospital readmission associated with test failure.

Results—Of 7,899 infants cared for in 788 hospitals, 334 (4.3%) failed initial CSTS. Greater postmenstrual age at testing and African American race were independently associated with decreased failure risk. Any treatment with an antacid medication, concurrent use of caffeine or supplemental oxygen, and a history of failing a trial off respiratory support were associated with increased failure risk. The mean adjusted post-CSTS length of hospitalization was 3.1 days (95% CI 2.7–3.6) longer among the infants who failed initial screening. Rates of 30-day all cause mortality or readmission were higher among infants who failed the CSTS (2.4% vs 1.0%; $P = .03$), however the difference was not significant after confounder adjustment (odds ratio 0.38, 95% CI 0.11–1.31).

Conclusion—CSTS failure was associated with longer post-test hospitalization but no difference in the risk-adjusted odds for 30-day mortality or hospital readmission. Whether CSTS failure

Corresponding Author: Erik A. Jensen, MD, MSCE; The Children's Hospital of Philadelphia, The Division of Neonatology – 2NW 59, 3401 Civic Center Blvd, Philadelphia, PA, 19104; Phone: 267-648-2720; Fax: 215-590-3051; jensene@email.chop.edu.

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unnecessarily prolongs hospitalization or results in appropriate care that prevents adverse post-discharge outcomes is unknown. Further research is needed to address this knowledge gap.

Keywords

car seat tolerance screening; infant car seat challenge; premature infant

Infant car seats are essential for the safe automobile transportation of neonates and young children. When used correctly, they are effective at preventing fatality and serious injury resulting from a car collision.¹ The American Academy of Pediatrics (AAP) first recommended universal use of car seats for infants in 1974 and formalized this recommendation in a policy statement in 1990.^{2, 3} At that time, all approved car seats were designed for the “average” term newborn. Studies conducted in the late 1980s found that standard car safety seats provided suboptimal postural support for preterm infants weighing ~ 2kg or less.^{4, 5} When physiologic monitoring was conducted, between 30%–60% of preterm infants who were otherwise deemed ready for discharge developed transient hypoxia or bradycardia while positioned in a car seat.^{6, 7} The small numbers of term infants in those studies did not demonstrate physiologic instability.^{6, 7} Largely in response to these findings, the AAP recommended in 1991, and subsequently reaffirmed in 1996, 1999, and 2009 that all infants born less than 37 weeks gestation should be monitored in a car seat prior to discharge to assess for apnea, bradycardia, or oxygen desaturation.^{8, 9} This period of observation is commonly referred to as “Car Seat Tolerance Screening” (CSTS) or the “Infant Car Seat Challenge.”^{10–13}

Recent studies confirmed that some infants, including full term babies, experience transient cardiorespiratory abnormalities when positioned in a car seat.^{14–18} However, no studies have determined whether CSTS accurately identifies infants who are unsafe for transport in a car safety seat and results in subsequent pre-discharge care that prevents later morbidity or mortality among those who fail screening.^{11, 12, 19} Moreover, there is limited multicenter data describing the basic epidemiological characteristics of CSTS including the incidence of and risk factors for test failure. Citing these evidence gaps, the Canadian Paediatric Society revised its position in 2016 and recommended against routine CSTS.¹¹ This policy change highlights the need for further investigation of the pre-discharge car seat test. We conducted the present study to characterize the incidence and risk factors for CSTS failure and the independent association between CSTS failure and the risk for 30-day post-discharge mortality or hospital readmission in a recent, multicenter cohort of preterm infants receiving neonatal intensive care.

METHODS

We performed a retrospective cohort study using data collected prospectively for the Optum neonatal database (Eden Prairie, Minnesota). The Optum Corporation provides neonatal care management services for multiple private, government, and self-insured employer health plans throughout the United States. The database comprises predefined daily clinical, socio-demographic, and cost-related information that are abstracted 3–4 times per week throughout the hospitalization by trained neonatal nurses. Infants who receive care in a Level

II or higher neonatal intensive care unit (NICU) and whose insurer contracts with the Optum Corporation to provide care management services are captured in the database. Infants admitted to a Level I unit or well-baby nursery are not included. Hospital readmissions and deaths occurring within 30 days of NICU discharge are recorded in the database using insurance claims data, regardless of whether the outcome was measured at the discharge hospital or a different institution. Data on the etiology of these post-discharge outcomes are not collected.

For the present analysis, we evaluated infants with gestational ages < 37 weeks, who were born on or after January 1, 2010, and underwent pre-discharge CSTS in a NICU before November 16, 2016. Infants diagnosed with cyanotic congenital heart disease and/or structural abnormalities of the airway were excluded. We chose this approach to guard against unmeasured confounding from the unique risk factors for cardiorespiratory instability and the study outcomes present in these infants.^{20, 21} The Institutional Review Board at Thomas Jefferson University certified the use of this de-identified dataset as non-human subjects research.

The primary study exposure was failure of initial CSTS. In the Optum database, the date and result of cardiorespiratory monitoring performed in an infant travel restraint device (ie, car safety seat or car bed) are recorded in a data collection field titled “Car Seat Test.” For the current analysis, we assume that the initial CSTS was performed in an infant car safety seat. Subsequent screening may have been performed in a car seat or car bed. For simplicity, we refer to all pre-discharge monitoring conducted in a travel restraint device as CSTS. In addition, the Optum database does not include information on how CSTS was performed and “failure” defined. These test characteristics may vary widely between centers.²²

We evaluated 46 *a priori* defined individual and categorical maternal and infant characteristics as potential independent risk factors for CSTS failure. These fell into 1 of the following 6 categories: infant demographic characteristics, maternal characteristics, infant respiratory characteristics, infant medications, other infant therapies, and infant comorbidities. The primary study outcome was the composite of 30-day all cause post-discharge mortality or hospital readmission compared between the infants who passed versus failed initial CSTS. The secondary outcomes were the individual components of the primary outcome: readmission and death within 30 days of hospital discharge. In addition, the duration of hospitalization following CSTS was assessed among the infants who passed compared with failed initial testing. For the subgroup of infants who failed their initial CSTS, we compared the duration of time between the first and second tests among those who passed versus failed the second CSTS. Finally, the risks for the post-discharge outcomes were compared between the infants who passed a CSTS, regardless of the number of attempts, and those discharged from the NICU without record of a passed CSTS.

Bronchopulmonary dysplasia was defined as the use of supplemental oxygen at 36 weeks postmenstrual age (PMA) among infants with gestational ages < 32 weeks or the use of supplemental oxygen at 56 days postnatal age among more mature infants.^{23, 24} Brain injury was defined as grade 3 or 4 intraventricular hemorrhage or periventricular leukomalacia on cranial ultrasonography.²⁵ The diagnosis of bacterial or fungal sepsis required blood culture

confirmation. Necrotizing enterocolitis (NEC) was defined as modified Bell's stage 2 or higher.²⁶ Neonatal abstinence syndrome (NAS) required pharmacological treatment for symptoms attributed to narcotic withdrawal following in-utero exposure. Persistent pulmonary hypertension of the newborn (PPHN) was defined based on clinician diagnosis documented in the medical record.

Statistical Analyses

Maternal and infant demographic and clinical data were summarized with standard descriptive statistics and compared with t-tests, Wilcoxon rank sum, chi-square, or Fisher exact tests as appropriate. Logistic regression, using a backwards, stepwise elimination process, was used to identify risk factors independently associated with failing initial CSTS. Maternal and infant characteristics associated with CSTS failure at a $p = 0.2$ in bivariable testing were included in the initial regression model. The variables associated with CSTS failure at a $p < 0.05$ in the multivariable modeling were retained in the final regression model. The mean lengths of hospitalization following the initial CSTS, adjusted for the independent risk factors for test failure, were compared between the infants who passed versus failed initial CSTS using negative binomial regression. Finally, we used multivariable logistic regression to compare the odds of the study outcomes between the infants who failed and those who passed CSTS. Odds ratios were adjusted for the clinical and demographic variables associated with the primary study outcome at a $p < 0.05$ in the final multivariable model. A robust variance estimator for cluster-correlated data was used in all multivariable models to relax the assumption of independence among the subjects cared for in the same hospital.^{27, 28} Receiver operating characteristic (ROC) analyses were used to assess model fit. All statistical testing was performed using Stata version 13.1 (StataCorp, College Station, Texas).

RESULTS

A total of 7,899 infants sampled from 778 different hospitals underwent CSTS and were included in the present analysis. Of the evaluated infants, 334 (4.2%) failed initial car seat testing. The characteristics of those who failed compared with those who passed the initial CSTS are shown in Table I. Among the infants who failed the initial test, 201 (60.2%) underwent subsequent testing and the remaining were discharged without record of a passed CSTS (Figure).

Seven of the 46 evaluated clinical characteristics were independent predictors of CSTS failure risk (Table II). Older PMA at testing and African American race were associated with decreased risk-adjusted odds of CSTS failure. Treatment with supplemental oxygen or caffeine at the time of initial CSTS and use of an antacid medication during the hospitalization were the strongest identified factors independently associated with increased risk of test failure (Table 2).

The total duration of hospitalization was longer among the infants who failed compared with those who passed initial CSTS (median length of stay: 25 days, IQR 15–43 vs. 19 days, IQR 11–37; $p < 0.001$). This difference is explained, in part, by the 3.1 day (95% CI 2.7–3.6) longer mean, risk-adjusted post-test length of stay observed among the infants who failed

initial CSTS. Finally, the duration of time between the first and second CSTS, among the subset of infants who failed initial screening, was greater for those who passed versus failed the second CSTS (mean duration between tests: 3.6 ± 4.8 days vs. 2.1 ± 1.5 days; $p = 0.001$).

The frequencies and risk-adjusted odds of the post-discharge outcomes are shown in Table 3. A greater proportion of the infants who failed compared with those who passed initial CSTS died or were readmitted to a hospital within 30 days (2.4% vs. 1.0%; $p=0.03$). However, after adjusting for confounding variables, car seat test failure was not associated with increased or decreased risk for the primary study outcome (adjusted OR 0.38, 95% CI 0.11–1.31). Failure of initial CSTS was associated with lower risk-adjusted odds of 30-day post discharge readmission (0.28, 95% CI 0.08–0.98). There were no differences in the risks for the primary or secondary post-discharge outcomes among the infants with record of passing the CSTS prior to discharged compared with those who were discharged without documentation of a passed test (Table 4; available at www.jpeds.com).

DISCUSSION

In this contemporary cohort of nearly 8000 preterm infants admitted to a level II or higher NICU, we found a failure rate for initial car seat testing of 4.2%. In apparent contravention of the AAP recommendation, 1.9% of tested infants were discharged without record of passing the CSTS.⁹ Prior studies describing the incidence of CSTS failure among preterm infants reported failure rates ranging from 4.3% to as high as 83%.^{6, 7, 10, 14, 16, 17, 29–33} Consistent with our findings, the two prior largest studies on this topic found CSTS failure rates of 4.3% and 5.5% among infants with gestational ages < 37 weeks.^{10, 14} In contrast to these reports, however, our results only reflect a population receiving intensive care at the time of car seat testing. The two prior studies reported combined failure rates inclusive of infants who underwent CSTS in either the NICU or well baby nursery.^{10, 14}

There are no well-established risk factors for CSTS failure. Initial, small studies suggested that preterm infants at the lowest gestational ages and those with a history of apnea of prematurity or prior supplemental oxygen use were at greater risk for hypoxia or bradycardia while positioned upright in a car seat.^{6, 7, 17, 34} Davis et al found the opposite in a recent, large retrospective study comprising preterm infants admitted to the NICU or well baby nursery.¹⁰ Infants with the highest gestational ages and birth weights and those without prior treatment with caffeine or supplemental oxygen experienced greater failure rates.¹⁰ After adjustment for differences in infant characteristics, only increasing gestational age was associated with higher failure risk.¹⁰ The authors postulated that lower gestational age infants had greater chronological maturity leading to improved cardiorespiratory stability at the time of car seat testing.¹⁰ In the present analysis, higher PMA at the time of CSTS was associated with lower adjusted odds of initial test failure. This finding, and our observation that a longer interval between repeat testing was associated with higher subsequent passing rates, support the hypothesis that greater postnatal maturity reduces CSTS failure risk.

The two strongest independent risk factors for CSTS failure identified in this cohort were treatment with supplemental O₂ or caffeine at the time of testing. A history of receiving

supplemental O₂ via nasal cannula at any time during the hospitalization and failing a wean to room air breathing prior to CSTS were also associated with greater failure risk. Collectively, these results suggest that greater cardiorespiratory immaturity and/or lung disease severity predispose to CSTS failure. Any prior treatment with an antacid medication was also associated with increased failure risk. Our database does not include a reliable measure of the frequency or severity of hypoxemia or bradycardia detected during the neonatal hospitalization. However, it is possible that the higher antacid treatments rates among the infants who failed initial CSTS are indicative of more frequent cardiorespiratory events in those babies. Although there is no clear link between gastroesophageal reflux and transient hypoxemia or bradycardia, antacid medications are frequently used in preterm infants because of a suspected relationship between the two phenomena.^{35–37} Finally, African American race was independently associated with decreased risk of CSTS failure. This finding may be due to a lower frequency and severity of lung disease among black compared with white preterm infants.^{38–41}

The most important unknown factor about CSTS is whether it prevents morbidity or mortality. Specifically, does screening accurately identify infants who are unsafe to be placed in a car safety seat and result in subsequent care (e.g. prolonged hospitalization, use of a car bed) that prevents apnea, bradycardia, or hypoxia during automobile transport? No randomized controlled trial has addressed this knowledge gap.¹² Preterm infants commonly experience cardiorespiratory abnormalities near the time of hospital discharge.^{42, 43} However, the presence of these events does not predict an increased risk of sudden and unexpected death during infancy.⁴² Moreover, most cases of sudden infant death syndrome associated with sitting devices occur among full term infants outside of a moving vehicle.^{44, 45}

In the present cohort, we found a 2-fold increase in the rates of 30-day post-discharge mortality or hospital readmission among the infants who failed compared with those who passed initial CSTS. After adjustment for potential confounding variables, test failure was not associated with increased or decreased risk for this composite outcome. This suggests that the other evaluated risk factors were the key drivers of the observed association. However, whether CSTS failure led to treatment decisions that mitigated the risk for the primary study outcome and potentially prevented an even greater difference in death or readmission rates is unknown. Infants who failed CSTS remained hospitalized after their initial testing on average 3 days longer than those who passed the test, indicating there were some differences in care between the two groups. Notably, CSTS failure was associated with decreased risk-adjusted odds of all cause 30-day readmission, but with a wide confidence interval owing to the small number of infants who experienced this outcome. This finding does not rule out the possibility of a potential benefit of CSTS.

Our study has several limitations. First, these observational data cannot establish a causal relationship, only plausible associations. Second, we do not have data on the CSTS protocol or failure criteria utilized at the study hospitals and therefore cannot assess how failure rates and risk factors may differ according to individual testing procedures. Future studies exploring which failure criteria best characterize the risk for adverse post-discharge outcomes are needed to better understand the diagnostic utility of routine CSTS. Third, the

Optum database does not capture whether physiologic monitoring was performed in an infant car seat or car bed. Although it is likely that initial testing was conducted in a car seat, we cannot assess which device was used for subsequent testing. As such, we are unable to determine the extent to which clinicians followed the AAP recommendation that “infants with documented oxygen desaturation, apnea, or bradycardia in a semiupright position should travel in a supine or prone position in an FMVSS213-approved car bed after an observation period that is free of such events.”⁹ It is possible that complete adherence to this policy, assuming some infants underwent repeat testing in a car seat not a car bed, would produce different study results. However, data from randomized crossover trials suggest that preterm and full infants experience similar rates of cardiorespiratory instability in either device.^{46, 47} Fourth, we do not have data on the etiology for hospital readmission or post-discharge mortality and acknowledge that 30-day follow-up may not fully capture the risk for these outcomes. Lastly, our analyses were limited to infants admitted to a NICU and may not be generalizable to late preterm infants undergoing car seat testing in a well-baby nursery. Importantly, caution should also be used when interpreting data from studies that combine these 2 populations as infants receiving well baby rather than intensive care may have different risk factors for CSTS failure and post-testing adverse outcomes.

Despite the above limitations, our dataset allowed for the largest published description of the epidemiology of CSTS failure. Moreover, our study provides novel data on multiple, previously unevaluated risk factors for CSTS failure as well as one of the first assessments of the association between car seat test failure and adverse post-discharge outcomes.

CONCLUSION

In summary, CSTS failure was uncommon in this recent, multicenter cohort of preterm infants admitted to a level II or higher NICU. Failure of initial CSTS was associated with longer post-test length of stay but not higher or lower risk-adjusted odds for the primary composite outcome of all cause 30-day post-discharge mortality or hospital readmission. However, initial CSTS failure was associated with lower adjusted odds for the individual outcome of 30-day readmission. Whether CSTS failure unnecessarily prolongs hospitalization or results in appropriate post-test care that avoids an adverse outcome is not clear from the available data. Future observational studies that include post-discharge follow-up and developmental testing would provide important data to help assess the diagnostic accuracy of routine CSTS. However, a randomized controlled trial may be needed to definitively determine whether CSTS prevents morbidity and mortality among the approximately 400,000 preterm infants recommended to undergo screening in the US each year.^{9, 48}

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Figure. Study flow diagram
Car Seat Tolerance Screening (CSTS).

Table 1

Infant and maternal characteristics

Characteristic	Failed CSTS (n=334)	Passed CSTS (n=7,565)	P
<i>Infant demographic characteristics</i>			
Gestational age, wk – median (IQR)	33.3 (30.9–35)	33.7 (31.6–34.9)	0.13
Birth weight, g – median (IQR)	1886 (1430–2263)	1945 (1505–2325)	0.14
Male, n (%)	196 (58.7)	3,983 (52.7)	0.031
PMA at CSTS, wk – median (IQR)	36.5 (35.7–37.6)	36.4 (35.6–37.3)	0.10
Age at CSTS, d – median (IQR)	20 (11–37)	18 (10–35)	0.27
Apgar 5 min – median (IQR)	9 (8–9)	9 (8–9)	0.29
Cesarean birth	233 (69.8)	4,882 (64.5)	0.05
Race/Ethnicity			0.001
African American	30 (9.0)	1,159 (15.3)	
Caucasian	159 (47.6)	2,995 (39.6)	
Hispanic	47 (14.1)	1,206 (15.9)	
Asian	9 (2.7)	347 (4.6)	
Other/Unknown	89 (26.6)	1,858 (24.6)	
Insurance type			0.18
Commercial	158 (47.3)	3,481 (46.0)	
HMO	65 (19.5)	1,243 (16.4)	
Medicaid	111 (33.2)	2,841 (37.6)	
<i>Maternal characteristics</i>			
Pre/Eclampsia, n (%)	44 (13.2)	957 (12.7)	0.78
Gestational diabetes, n (%)	27 (8.1)	479 (6.3)	0.20
Gestational hypertension, n (%)	36 (10.8)	924 (12.2)	0.43
Multiple gestation pregnancy, n (%)	108 (32.3)	2,204 (29.1)	0.21
Cigarette smoking during pregnancy	9 (2.7)	257 (3.4)	0.49
Chorioamnionitis, n (%)	12 (3.6)	211 (2.8)	0.39
Treated with prenatal corticosteroids, n (%)	128 (38.3)	2,814 (37.2)	0.68
<i>Infant respiratory characteristics</i>			
Supplemental oxygen, n (%)	255 (76.3)	5,058 (66.9)	<0.001
Nasal cannula, n (%)	223 (66.8)	3,938 (52.1)	<0.001
Nasal cannula duration, d – median (IQR)	3 (0–9)	1 (0–5)	<0.001
Nasal CPAP	159 (47.6)	3,343 (44.2)	0.22
Nasal CPAP duration, d – median (IQR)	0 (0–3)	0 (0–3)	0.15
Mechanical ventilation	99 (29.6)	1,874 (24.8)	0.04
Mechanical ventilation duration, d – median (IQR)	0 (0)	0 (0–1)	0.04
Room air breathing status at CSTS, n (%)			<0.001
Always breathing in room air	89 (26.6)	2,691 (35.6)	
Breathing in room air > 48hrs	186 (55.7)	4,403 (58.2)	
Breathing in room air 48hr	39 (11.7)	385 (5.1)	
On supplemental O ₂ during CSTS	20 (6.0)	86 (1.1)	

Characteristic	Failed CSTS (n=334)	Passed CSTS (n=7,565)	P
Failed wean to room air prior to CSTS, n (%)	81 (24.3)	1,118 (14.8)	<0.001
Discharged on supplemental O ₂	47 (14.1)	534 (7.1)	<0.001
<i>Infant medications</i>			
Surfactant, n (%)	81 (24.3)	1,506 (19.9)	0.052
Indomethacin, n (%)	18 (5.4)	300 (4.0)	0.20
Antibiotics DOL 0 to 7, n (%)	215 (64.4)	4,954 (65.5)	0.68
Total antibiotic duration, d – median (IQR)	3 (0–7)	3 (0–5)	0.16
Antacid, n (%)	38 (11.4)	464 (6.1)	<0.001
Systemic corticosteroid, n (%)	9 (2.7)	149 (2.0)	0.35
Caffeine, n (%)			<0.001
Never received caffeine	211 (63.2)	5,361 (70.9)	
Off caffeine 5d prior to CSTS	104 (31.1)	1,992 (26.3)	
Off caffeine < 5d prior to CSTS	3 (0.9)	101 (1.3)	
On caffeine at CSTS	16 (4.8)	111 (1.5)	
<i>Infant therapies</i>			
Breast milk feeds only (no formula), n (%)	61 (18.3)	1,596 (21.1)	0.21
History of enteral tube feeds, n (%)	269 (80.5)	5,809 (76.8)	0.11
Weaned from incubator 48hr prior to CSTS, n (%)	49 (14.7)	1,200 (15.9)	0.56
<i>Infant comorbidities</i>			
Bacterial sepsis DOL 0 to 7, n (%)	6 (1.8)	87 (1.2)	0.29
Bacterial sepsis (any time), n (%)	21 (6.3)	372 (4.9)	0.26
BPD, n (%)	42 (12.6)	649 (8.6)	0.01
Brain injury diagnosed by HUS, n (%)	10 (3.0)	135 (1.8)	0.11
Fungal sepsis, n (%)	5 (1.5)	47 (0.6)	0.07
NAS, n (%)	1 (0.3)	113 (1.5)	0.09
NEC, n (%)	2 (0.6)	73 (1.0)	0.77
PDA ligation, n (%)	8 (2.4)	106 (1.4)	0.15
PPHN, n (%)	2 (0.6)	74 (1.0)	0.77
ROP stage 3 or 4, n (%)	3 (0.90)	89 (1.2)	1.0

BPD bronchopulmonary dysplasia; CPAP, continuous positive airway pressure; CSTS, car seat tolerance screening; DOL, day of life; HMO, health maintenance organization; HUS, head ultrasound; IQR, inter-quartile range; Neonatal abstinence syndrome; NEC, necrotizing enterocolitis; PDA, patent ductus arteriosus; PMA, postmenstrual age; PPHN, persistent pulmonary hypertension of the newborn; ROP, retinopathy of prematurity.

Table 2

Independent risk factors for car seat tolerance screening (CSTS) failure

Risk factor	Adjusted OR for CSTS failure (95% CI)^a	Adjusted P-value
PMA at CSTS, week	0.86 (0.80–0.92)	<0.0001
Race/ethnicity		
Caucasian	Reference	--
African American	0.49 (0.31–0.76)	0.002
Hispanic	0.74 (0.51–1.07)	0.11
Asian	0.52 (0.26–1.03)	0.06
Biracial/other/unspecified	0.93 (0.67–1.29)	0.67
Antacid therapy	2.08 (1.31–3.30)	0.002
Caffeine treatment status at CSTS		
Never treated	Reference	--
Off > 5 days	1.19 (0.86–1.64)	0.29
Off ≤ 5 days	0.54 (0.17–1.68)	0.29
On caffeine at CSTS	2.24 (1.17–4.28)	0.01
Nasal cannula O ₂	1.82 (1.22–2.70)	0.003
Room air status at CSTS		
Always breathing in room air	Reference	--
Breathing in room air > 48hr	0.74 (0.49–1.11)	0.15
Breathing in room air ≤ 48hr	1.76 (1.04–2.97)	0.04
On supplemental O ₂ at CSTS	2.98 (1.36–6.12)	0.006
Failed wean to room air prior to CSTS	1.36 (1.02–1.82)	0.04

^aOdds ratios (OR) adjusted for all covariates in the table. Regression model c-statistic: 0.68

Table 3

Post-discharge study outcomes

Outcome	Failed initial CSTS (n=334) N (%)	Passed initial CSTS (n=7565) N (%)	Unadjusted P-value	Adjusted OR (95% CI) ^a for CSTS failure
All cause 30-day mortality or hospital readmission	8 (2.4)	78 (1.0)	0.03	0.38 (0.11–1.31)
All cause 30-day mortality	1 (0.3)	2 (0.03)	0.12	10.5 (0.80–139)
All cause 30-day readmission	7 (2.1)	76 (1.0)	0.09	0.28 (0.08–0.98)

^aOdds ratios (OR) adjusted for multiple gestation pregnancy, treatment with antenatal corticosteroids, postmenstrual age at car seat tolerance screening (CSTS), fungal sepsis during the NICU hospitalization, treatment with an antacid during the NICU hospitalization, room air breathing status at initial CSTS, and use of supplemental oxygen at discharge.

Regression model c-statistics: All cause 30-day mortality or hospital readmission: 0.91; all cause 30-day mortality: 0.94; all cause 30-day readmission: 0.93.

Table 4

Post-discharge study outcomes among infants with compared to without record of a passed car seat tolerance screening (CSTS)

Outcome	Never passed CSTS (n=150) N (%)	Passed CSTS (n=7749) N (%)	Unadjusted P-value	Adjusted OR (95% CI) ^a for CSTS failure
All cause 30-day mortality or hospital readmission	3 (2.0)	83 (1.1)	0.22	1.25 (0.16–9.82)
All cause 30-day mortality	0 (0)	3 (0.04)	1.0	-- ^b
All cause 30-day readmission	3 (2.0)	80 (1.0)	0.21	1.20 (0.14–10.2)

^aOdds ratios (OR) adjusted for multiple gestation pregnancy, treatment with antenatal corticosteroids, postmenstrual age at car seat tolerance screening (CSTS), fungal sepsis during the NICU hospitalization, treatment with an antacid during the NICU hospitalization, room air breathing status at initial CSTS, and use of supplemental oxygen at discharge.

^bOdds ratio not calculated because of the zero outcome rate among infants who did not pass the CSTS.

Regression model c-statistics: All cause 30-day mortality or hospital readmission: 0.92; all cause 30-day readmission: 0.93.