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ORIGINAL ARTICLE

Characteristics of neonatal transports in California

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OBJECTIVE: To describe the current scope of neonatal inter-facility transports.
STUDY DESIGN: California databases were used to characterize infants transported in the first week after birth from 2009 to 2012.
RESULTS: Transport of the 22 550 neonates was classified as emergent 9383 (41.6%), urgent 8844 (39.2%), scheduled 2082 (9.2%) and other 85 (0.4%). In addition, 2152 (9.5%) were initiated for delivery attendance. Most transports originated from hospitals without a neonatal intensive care unit (68%), with the majority transferred to regional centers (66%). Compared with those born and cared for at the birth hospital, the odds of being transported were higher if the patient's mother was Hispanic, <20 years old, or had a previous C-section. An Apgar score <3 at 10 min of age, cardiac compressions in the delivery room, or major birth defect were also risk factors for neonatal transport.
CONCLUSION: As many neonates receive transport within the first week after birth, there may be opportunities for quality improvement activities in this area.

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INTRODUCTION

Neonatal transport has become an important element in the regionalization of perinatal care.[1] Following arrival at the referral hospital, neonatal transport teams often need to stabilize critically ill neonates and provide intensive care during transport. The process of acute inter-facility transport of sick neonates is fraught with risk to patients.[2,3] Compared with infants born at and cared for in the same neonatal intensive care unit (NICU), the acute inter-facility transport of a sick neonate has been associated with increased morbidities such as death, intra-ventricular hemorrhage and other adverse outcomes.[2,4–7] One retrospective study based in Japan has also shown an association between duration of transport and increased neonatal mortality.[3] Infants transported for >90 min had more than twice the rate of neonatal death and those transported between 60–89 min had an 80% higher rate of neonatal death.[3] However, Marlow et *al.* showed there to be a risk incurred for babies who are not transferred to higher-level intensive care facilities despite needing more advanced care. They found that early neonatal deaths occurred more often in non-transported babies admitted into level II NICUs, implying that some sick babies are not transferred and may be cared for at a facility that cannot meet their needs.[8]

There exist birthing hospitals that do not have NICUs, and even in those hospitals with a NICU, there are varying levels of capacity for delivering neonatal care. For example, higher-level NICUs may have increased capacity for more advanced ventilatory therapies and the availability of pediatric surgical sub-specialists to perform complex surgery. In the EPICure2 study, infants who were delivered at high-activity level III neonatal units had the greatest chance of survival overall. In addition, antenatal transfer also improved outcomes for mother and baby.[8] Despite the possibility of active transport of high-risk maternal patients to a level III NICU prenatally, delivery of a patient at a facility without neonatal intensive care is not uncommon and at times inevitable. Provision of neonatal intensive care during transport of newborns from community hospital to a tertiary center may be an important determinant of patient outcomes.[9] Indeed, the condition of an infant around the time of transport is linked to mortality.[10] Broughton et *al*. developed a seven-variable score that proved to be a reliable predictor of neonatal mortality risk when used during the first point of contact between referring hospital and regionalized neonatal transport service.[11]

Despite a perceived large number of neonatal transports in California, our awareness of the demographics of transported infants and the factors characterizing these transfers are for the most part anecdotal. Our objective was to better understand the scope and type of acute neonatal inter-facility transports under the current operational system in the state. We also examined whether there were differences in transport patterns by race/ethnicity of the family.

MATERIALS AND METHODS

The California Perinatal Quality Care Collaborative (CPQCC) collects clinical data in a prospective fashion for neonates born at member hospitals by use of an expanded version of the VON (Vermont Oxford Network) data set.[12]

This study was based on data collected on infants born from 1 January 2009 to 31 December 2012. Eligibility criteria for CPQCC data collection include one or more of the following: birth weight from 401 to 1500 g, gestational age 22 0/7 weeks to 29 6/7 weeks, or for infants >1500 g either death, surgery, intubation for >4 h, positive pressure support for more than 4 h, readmitted for total bilirubin $\geqslant 25$ and/or exchange transfusion or early bacterial sepsis. Furthermore, acute transfer alone makes an infant eligible for data collection. Therefore, all infants who were transported for care to one of the 131 CPQCC NICUs in the neonatal period were accounted for in the data set.

The CPeTS (California Perinatal Transport System) collects perinatal and neonatal transport data for regional planning, outreach program development and quality improvement. Over 100 specialized NICUs and 57 transport teams who serve to facilitate the transport of critically ill infants NICUs in California are members of CPeTS.[10] Transport teams complete a neonatal transport data form (Supplementary Figure 1) for each infant

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transported. These databases were linked for all the infants by a unique patient identifier.

Our first analysis concerned differences between those infants in CPQCC who were not transported to those who were transported. Demographic and medical characteristics of infants were compared between those were born at the NICU of care to those transported in the first 7 days after delivery. We also considered the level of care of NICUs based on the system of classification by the California Children's Service (CCS).[13]

We subsequently focused the main analysis on neonates transported in the first 7 days after delivery. Of the neonates transported, demographic and medical characteristics were compared according to transport type: called for delivery attendance, emergent, scheduled, urgent and other. The type of transport is determined by receiving hospital physician after discussing the case with the transferring physician. Among the types of transport, delivery attendance was when transport team was initially requested to attend the delivery, emergent transport is when immediate response was requested, urgent if the response within 6 hours was requested and scheduled transport is when transport was planned and infant whose medical/surgical needs required eventual transfer but current clinical condition was stable. The 'other' category of transport does not conform to these definitions.

Various personnel such as neonatal nurse practitioner, physician, registered nurse or transport specialist lead transports. A transport specialist is typically a registered nurse with further training in transport medicine.

Time intervals between key periods of maternal and neonatal care were calculated from the CPeTS data. Total length of transport coordination was calculated from the time of referral phone call to the time of NICU evaluation following completion of transport. Data about the type of and reason for transport and the composition of the transport team were also collected. Indication for transport was categorized as need for medical services, for a major invasive surgery, bed availability or for insurance purposes.

Although data are not validated routinely, all data abstractors receive training yearly and missing information is tracked. CPQCC data undergo internal logic checks for consistency.

Expedited approval was obtained from the Stanford Institutional Review Board.

Statistical analysis

All statistical analyses were performed using Statistical Analysis System (SAS) version 9.3 (SAS Institute, Cary, NC, USA). Comparisons were performed using analysis of variance (ANOVA) for continuous variables and Fisher's exact test for categorical variables. A stepwise logistic regression analysis was performed for risk of transport including socio-demographic and clinical variables. Gestational age correlated with birth weight and so was excluded. Delivery room resuscitation variables were also excluded.

RESULTS

We identified 58 537 CPQCC patient records from 1 January 2009 to 31 December 2012 (including both transferred and non-transferred infants). Of those patients, 1657 (2.8%) infants died in the delivery room, and 16 records were missing information on birth weight and gestational age. Of the remaining 56 864 patients, 2619 (4.6%) had incomplete data regarding transport and were excluded from the analysis. Among the 2619 infants that were excluded they did not differ substantially from those included from the analysis.

Of the remaining cohort, 31 005 infants remained in the birth hospital for at least the first 7 days of life; another 690 were transferred to the same level of care within the first 7 days of life.

The remaining 22 550 infants were transferred to higher level of care within 7 days after birth.

The average number of infants transported per year for this cohort of 22 550 was 5636 ± 141. The numbers of transport by year were 5818, 5607, 5476 and 5649 starting in year 2009 to 2012. Of the total 22 550, 300 (0.1%) of these infants were transported twice, 18 241 (81%) of these infants were transported on day 1 of life and 4309 (19%) were transported on days 2 to 7.

In Table 1, characteristics of infants who were transported in the first week are compared with those who were born at and stayed in the same hospital eligible for CPQCC data collection. The odds of transport were higher for male infants, and those born to mothers who were of Hispanic ethnicity, <20 years old, or had a previous C-section. Infants were also more likely to have been transported if their Apgar score was <3 at 10 min of age, received cardiac compressions in the delivery room, or had a major birth defect. In a risk-adjusted model, the following factors were associated with higher risk of first week transport for infants admitted to the NICU: higher birth weight, Hispanic ethnicity, maternal bleeding and breech/malpresentation. Major birth defect was the strongest risk for transport (Table 1).

Most transports originated from hospitals without a NICU (68%), with the majority going to regional centers (66%), with 33% going to community level NICUs and 1% to intermediate NICUs.

A total of 6425 infants transported (28.5%) were diagnosed with congenital anomalies, of which 1906 (30%) were diagnosed prenatally and 4519 (70%) after birth. Eighty-seven infants were diagnosed to have an anomaly prenatally but were not diagnosed with an anomaly at the receiving hospital after transport.

Table 2 compares the baseline characteristics of the infants transported in the first week after delivery by type of transport. Delivery attendance was requested for 839 (39%) for infants weighing <1500 g and 1009 (47%) for infants between 1500 and 2499 g. Delivery attendance was also requested for multiple births 518 (24%). Majority of the infants 6046 (64%) were transported emergently weighed >2500 g. Cesarean delivery was the more common mode of delivery 1567 (73%) when attended by the transport team.

Table 3 compares characteristics of the transport team including indication for transport, based on the type of transport. Among the scheduled transports, 700 (34%) were for insurance. A sub-specialist was the team leader in 1165 (54%) of the transports requested for delivery attendance, whereas a transport specialist was the most common team leader for emergent transports 5300 (56%) and 3783 (43%) for urgent transports. Ground transportation was the most common mode of transport for all four groups. Helicopter was used for 1190 (13%) of emergent transports.

The median duration from the time of maternal admission to the perinatal unit to request for transport for delivery attendance was 16.3 h with an interquartile range of 32 h. The median duration of transport calculated from the time of departure of transport team to referral hospital to NICU evaluation at receiving hospital was 2.2 with an interquartile range of 1.5 h.

The large majority of the infants were transported on the day of birth for all types of transport. Infants born to Asian mothers were more likely to be transported on day 2–7 compared with other races. Emergent transports were more likely to occur on day 1, whereas scheduled transports were more common in days 2–7.

DISCUSSION

In this study, we provide a population-based appraisal of neonatal transports. We found a large proportion of neonates are transported for neonatal intensive care during the first week after delivery and this presents a risk to infants, particularly low birth weight infants. Babies born with a birth weight <1500 g and those that had a prenatal diagnosis of congenital anomaly may have benefitted from antenatal transfer; however, we recognize that circumstances may have prevented such a transfer from occurring, thereby making neonatal transport unavoidable.

Gould et al.[14] analyzed data from California from 1990 to 1997 and found delivery of very low birth weight infants at regional perinatal centers declined from 36.5 to 27.2%, whereas the percentage of birth at community hospitals increased from 11.7 to 37.4%. Our study shows that among the 2909 (12.9 %) very low birth weight infants that were transported, delivery room attendance was requested for 836 (28.7%), highlighting the importance of maternal transport when possible.

It is possible that there has been an overall increase in higher risk births at community hospitals, thus leading to more transports. Economic incentives in obstetric care offer an

Table 1. Factors associated with transport for infants admitted to NICU

Characteristic	*Transported in first week* N *(%) 22 550 (41.6%)*	*Not transported in first week* N *(%) 31 695 (58.4%)*	*Crude OR (95% CI)* (n = 54245)	*Stepwise adjusted OR (95% CI)*	*Missing data*
Birth weight					
Under 1500 g	2909 (15)	16496 (85)	0.10 (0.10–0.11)	0.24 (0.2–0.3)	
1500–2499 g	6023 (46)	7168 (54)	0.50 (0.47–0.52)	0.7 (0.6–0.8)	
2500+ g	13618 (63)	8031 (37)	ref	ref	
Male	12936 (43)	17469 (58)	1.10 (1.06–1.14)		39
Gestational age					
20–23 weeks	168 (21)	627 (79)	0.15 (0.12–0.17)		
24–27 weeks	1322 (19)	5737 (81)	0.13 (0.12–0.13)		
28–31 weeks	1955 (16)	9861 (83)	0.11 (0.10–0.11)		
32–36 weeks	7317 (45)	9019 (55)	0.44 (0.43–0.46)		
37+ weeks	11788 (65)	6451 (35)	ref		
Race					
Black	1152 (30)	2659 (70)	0.61 (0.56–0.66)	1.2 (1.1–1.4)	
Hispanic	11394 (45)	13924 (55)	1.15 (1.10–1.20)	1.2 (1.1–1.3)	
White	5256 (42)	7371 (58)	ref	ref	
Other	4748 (38)	7741 (62)	0.86 (0.82–0.90)	1.14 (1–1.3)	
Delivery mode					*3*
Cesarean	12466 (36)	21935 (64)	0.55 (0.53–0.57)	0.8 (0.8–0.9)	
Vaginal	10083 (51)	9758 (49)	ref	ref	
Apgar score at 5 min					*229*
Score 3 or less	913 (38)	1488 (62)	0.76 (0.70–0.82)	1.4 (1.1–1.6)	
Score 4–7	3994 (32)	8484 (68)	0.58 (0.56–0.61)	0.9 (0.8–1)	
Score 8 or more	17511 (45)	21626 (55)	ref	ref	
Apgar score at 10 Min					
Score 3 or less	378 (42)	520 (58)	1.19 (1.03–1.37)		
Score 4–7	2005 (36)	3624 (64)	0.90 (0.84–0.98)		
Score 8 or more	2121 (38)	3465 (62)	ref		
No antenatal steroids CCS level of hospital stay	17903 (58)	12967 (42)	Ref	1.7 (1.6–1.9)	215
Licensed ICN but no designation by CCS	*100 (5)*	*1852 (95)*	*0.03 (0.03–0.04)*	*0 (0)*	
Intermediate	80 (4)	1711 (96)	0.03 (0.02–0.04)	0 (0)	
Community	7525 (28)	19206 (72)	0.24 (0.23–0.24)	0.07 (0.07–0.08)	
Regional	14845 (63)	8926 (38)	ref	ref	
Received prenatal care	21718 (41)	30939 (59)	ref		183
Multiple birth	2210 (24)	6848 (76)	0.39 (0.38–0.42)	0.8 (0.7–0.9)	33
Fetal distress	3982 (38)	6610 (62)	0.82 (0.78–0.85)	1.6 (1.5–1.7)	92
Fetal IUGR	1082 (23)	3592 (77)	0.40 (0.37–0.42)	0.8 (0.7–0.9)	90
Fetal anomaly	1993 (37)	3468 (64)	0.79 (0.75–0.84)	0.4 (0.3–0.4)	91
Obstetrical bleeding/abruption/ previa	2157 (33)	4369 (67)	0.66 (0.63–0.70)	1.4 (1.3–1.6)	60
Malpresentation or breech	2495 (29)	6155 (71)	0.52 (0.49–0.54)	1.4 (1.3–1.6)	60
Premature rupture of membranes	3175 (30)	7561 (70)	0.52 (0.50–0.55)	1.6 (1.4–1.7)	67
Prolonged rupture of membranes	1512 (26)	4287 (74)	0.46 (0.43–0.49)	0.7 (0.6–0.8)	80
Dr resuscitation					
Bag/mask	7359 (31)	15945 (68)	0.48 (0.46–0.50)		163
Cardiac compressions	1167 (42)	1635 (58)	1.01 (0.93–1.09)		126
Nasal CPAP	4725 (26)	13267 (74)	0.37 (0.36–0.39)		165
Epinephrine	476 (37)	794 (62)	0.84 (0.75–0.94)		119
Tracheal intubation	4049 (27)	10889 (73)	0.42 (0.40–0.44)		115
Oxygen	14362 (36)	25763 (64)	0.41 (0.39–0.43)		176
Surfactant in delivery room	1480 (26)	4260 (74)	0.45 (0.43–0.48)		30
Major birth defect	6425 (49)	6817 (52)	1.45 (1.40–1.51)	3.10 (2.68–3.58)	30

Abbreviations: CCS, California Children's Service; CI, confidence interval; CPAP, continuous positive airway pressure; ICN, intensive care nursery; IUGR, intrauterine growth restriction; NICU, neonatal intensive care unit; OR, odds ratio.

Table 2. Baseline characteristics of infants transported

Characteristics	Delivery attendance 2152 (9.5%) N (%)	Emergent 9383 (41.6%) N (%)	Scheduled 2082 (9%) N (%)	Urgent 8844 (39%) N (%)	Other 85 (0.4%) N (%)	P-value
Birth weight (g)						< 0.01
< 1500	836 (29)	1136 (39)	235 (8)	696 (24)	6 (0)	
1500–2499	1009 (17)	2201 (37)	689 (11)	2094 (35)	27 (0)	
>2500	307 (2)	6046 (44)	1158 (9)	6054 (45)	52 (0)	
Male sex	1131 (9)	5460 (42)	1130 (9)	5165 (40)	50 (0)	
Gestational age (weeks)						
20–23	54 (32)	85 (51)	5 (3)	23 (14)	1 (1)	
24–27	372 (28)	557 (42)	93 (7)	297 (23)	3 (0)	
28–31	582 (30)	665 (34)	202 (10)	502 (26)	4 (0)	
32–36	954 (13)	2809 (38)	759 (10)	2757 (38)	35 (1)	
>37	190 (2)	5267 (45)	1023 (9)	5265 (45)	42 (0)	
Prenatal care	2068 (10)	9073 (42)	2000 (9)	8494 (39)	79 (0)	
Multiple births	518 (23)	694 (31)	279 (13)	709 (32)	10 (1)	
Race						
Black	75 (6)	489 (42)	157 (14)	425 (37)	5 (0)	
Hispanic	1166 (10)	4630 (41)	1117 (10)	4445 (39)	35 (0)	
White	482 (9)	2381 (45)	394 (7)	1968 (37)	31(1)	
Asian/Pacific Islander	76 (7)	480 (42)	119 (10)	459 (40)	7 (0)	
Native American	1 (2)	22 (46)	6 (12)	19 (40)	0	
Other/unknown	352 (10)	1381 (39)	289 (8)	1528 (43)	7 (0)	
Delivery mode[a]						
Cesarean	1567 (13)	5114 (41)	1076 (9)	4669 (38)	39 (0)	
Normal/spontaneous vaginal	570 (6)	3907 (42)	949 (10)	3856 (41)	45 (1)	
Operative vaginal	15 (2)	362 (48)	56 (7)	319 (42)	1 (0)	
Ventilator at referral[b]						
None	0	3111 (38)	1254 (15)	3741 (46)	56 (1)	
Hood/nasal cannula	0	2436 (42)	390 (7)	2929 (51)	13 (0)	
Nasal CPAP	0	1036 (57)	172 (9)	618 (34)	3 (0)	
ETT	0	2785 (61)	252 (6)	1523 (33)	12 (0)	
Ventilator at initial evaluation[c]						
None	747 (9)	3027 (34)	1276 (15)	3724 (42)	56 (1)	
Hood/nasal cannula	286 (5)	2242 (39)	392 (7)	2786 (49)	13 (0)	
Nasal CPAP	533 (24)	887 (40)	155 (7)	621 (28)	5 (0)	
ETT	586 (10)	3223 (56)	256 (4)	1705 (30)	11 (0)	
Ventilator at NICU admit[d]						
None	676 (8)	3190 (35)	1279 (14)	3802 (42)	55 (1)	
Hood/nasal cannula	232 (5)	1728 (36)	388 (8)	2477 (51)	13 (0)	
Nasal CPAP	410 (20)	830 (41)	147 (7)	657 (32)	6 (0)	
ETT	834 (13)	3627 (55)	264 (4)	1885 (29)	11 (0)	

Abbreviations: CPAP, continuous positive airway pressure; NICU, neonatal intensive care unit. [a]Missing = 1 . [b] = 2215 . [c] = 15 . [d] = 35.

explanation for delivery of infants at hospitals without NICUs. Hospitals and practitioners may be under financial pressure to deliver infants despite not having the facilities to care for all of them. This may lead to a mismatch between infants' needs and level of neonatal care available in community hospitals, and may result in neonatal transports to a higher level of care.[15,16] On the other hand, some referral centers may refuse equivocal maternal transports if there is a perception that transports could lead to long antepartum hospitalization.

Several studies have demonstrated that high-risk infants such as those with very low birth weight have better outcomes when born at a higher level of care.[2,5–8,17] We acknowledge that it is not always possible for these at-risk neonates to be delivered in Level III or Level IV NICUs and recognize the often unpredictable nature of preterm birth and obstetrical complications. Even optimizing maternal transports cannot eliminate all appropriate neonatal transports. With that being said, in our study of a large population-based cohort, the median duration from maternal admission to the referral for neonatal transport was 16.3 with an interquartile range of 32 h. In addition, neonatal transport took a median of 2.5 h, potentially putting the infant at increased risk for adverse events during transport. These findings highlight an opportunity to assess the timing of transports and explore the barriers to antenatal transfer in situations where this was a feasible option. A recent systemic review of web-based, publically available information by Okoroh et *al*. shows that less than two-thirds of US states have developed policies for maternal transport and only 10 states specify a reimbursement policy for maternal transfers. In states with transport policies, reimbursement focuses on neonatal transport.[18] Quality improvement initiatives aimed at helping mothers deliver at facilities with NICUs that are equipped to handle sick infants may also reduce neonatal transports. Duchovny et *al*.[19] developed a prediction model for antenatal maternal transport, finding that maternal race, gestational age, fetal sex and administration of antenatal corticosteroids all could be used to predict a moderately premature infant's need for level

Table 3. Transport characteristics based on transport indication

Characteristics	Requested delivery attendance (N = 2152) N (%)	Emergent (N = 9383) N (%)	Scheduled (N = 2082) N (%)	Urgent (N = 8844) N (%)	Other (N = 85) N (%)	P-value
Indication for transport[a]						< 0.01
Medical service	2118 (11)	8781 (44)	943 (5)	7883 (40)	50 (0)	
Surgery	32 (2)	526 (35)	206 (14)	732 (49)	2 (0)	
Insurance	1 (0)	29 (4)	700 (84)	91 (11)	13 (2)	
Bed availability	1 (0)	47 (11)	233 (53)	138 (31)	20 (5)	
Team base[b]						
Receiving hospital	2141 (10)	8991 (43)	1892 (9)	7996 (38)	64 (0)	
Referring hospital	11 (1)	391 (27)	189 (13)	845 (58)	21 (1)	
Contract team	0	0	1 (25)	3 (75)	0	
Team leader[c]						
Sub-specialist	1165 (26)	1240 (28)	287 (7)	1737 (39)	18 (0)	
Pediatrician	22 (3)	454 (53)	72 (8)	308 (36)	9 (1)	
Other MD	49 (3)	846 (43)	266 (14)	783 (40)	6 (0)	
Neonatal nurse practitioner	61 (6)	701 (67)	31 (3)	246 (24)	1 (0)	
Transport specialist	811 (8)	5300 (50)	740 (7)	3783 (36)	25 (0)	
Registered nurse	44 (1)	838 (23)	684 (19)	1984 (56)	26 (1)	
Mode of transport[d]						
Ground	1992 (10)	7848 (39)	2019 (10)	8205 (41)	84 (0)	
Helicopter	143 (8)	1190 (65)	40 (2)	457 (25)	1 (0)	
Fixed wing	17 (3)	343 (61)	22 (4)	181 (32)	0	

Abbreviation: MD, Dr of Medicine. [a]Missing = 1 . [b] = 1 . [c] = 9 . [d] = 4.

III NICU care within the first 24 h of life. Wider implementation of such tools could improve matching infant need with NICU capability.

We found that 28.5 % of infants who were transported had congenital anomalies. Many of these infants ultimately require subspecialty and surgical care at a regional center. Given the advances in prenatal diagnosis, this group presents an opportunity for quality improvement or policy intervention, as some of these infants are transferred after birth despite the condition being known prenatally. Proper alignment of incentives is critical to optimizing care and outcomes for patients and families.

The association of factors such as low Apgar score and birth defects reflect higher acuity of illness and need for specialty services, and it is to be expected that these factors would be associated with higher likelihood of transport. However, we uncovered several novel non-medical risk factors for neonatal transport, including Hispanic ethnicity (maternal) and young maternal age.

The strength of our study is its size and scope. We have analyzed a large population-based database representing 131 hospitals and 57 transport teams that care for over 90% of newborns born in California hospitals. Several limitations of our study should be noted. Some data were missing, including 4.6% of transports with incomplete information regarding the transport. In addition, we do not specify whether transports were avoidable or not. Further research exploring specifically transports that are avoidable could lead to quality improvement and public health initiatives. We also did not analyze regional differences and cannot make any inferences about how neonatal transports in California compared with those throughout the rest of the nation. There is a potential bias in the data collection process as we do not have data on infants > 1500 g who remained at their birth hospital and were not admitted to the NICU. The cost data for transport and details of the transport such as planned referral are not available for this analysis.

Although California is a large state, births and practice patterns here may not necessarily represent the overall state of perinatal medicine. However, one of eight US births occurs in California, which is significant even if the data are not generalizable. Our study provides information for policy makers to assess the current landscape of early neonatal transport.

CONCLUSION

We found that a large number of infants are transported during the first week of age in California and represent a significant portion of NICU admissions. Of concern, many very low birth weight infants and infants with congenital anomalies are transported, and yet the average time between maternal admission and neonatal transport referral is over 24 h.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHOR CONTRIBUTIONS

Vishnu Priya Akula: Dr Akula designed the study, analyzed the data and drafted the initial manuscript. Jeffrey Gould: Dr Gould contributed to the study design, reviewed the manuscript and approved the final manuscript. Jochen Profit: Dr Profit contributed to the study design and critically reviewed the manuscript. Peiyi Kan: Miss Kan wrote the Statistical Analysis System (SAS) program for the data analysis and critically reviewed the manuscript. Lisa Bollman: Miss Bollman conceptualized the study design, developed the data collection infrastructure, reviewed the manuscript and approved the final manuscript. Henry Lee: Dr Lee coordinated and supervised the study, analyzed the data, critically reviewed the manuscript and approved the final manuscript.

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