Original Research Article

DOI: http://dx.doi.org/10.18203/2394-6040.ijcmph20191838

Timely referral and safe transport of neonates admitted to neonatal intensive care unit of tertiary care government hospital of Agra district: a cross sectional study

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Received: 24 February 2019 Accepted: 30 March 2019

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ABSTRACT

Background: Timely referral and safe transport form a crucial link for the survival and safety of sick newborn. Thus the study aimed at assessing referral and transport of sick neonates admitted to NICU of a tertiary care government hospital and the factors associated with direct referral and safe final transport.

Methods: A hospital based cross-sectional study was carried out in among 450 neonates and was based on face to face interview with caregivers. The data was analyzed using proportions and mean values Chi square test of significance and independent t test were appropriately applied and p<0.05 was taken to be statistically significant. Odds ratios were calculated for dichotomous variables.

Results: 72.6% of high risk pregnancies were transferred timely in utero to district hospitals. Around two thirds (65.8%) of neonates were referred by doctors. Treatment during transportation was administered to 29.6% of the neonates. 50.2% of neonates have used the services of an ambulance at some point of time during their travel. Highly significant association of direct referral was observed with earlier age at admission (2.3 days), early development of neonatal symptoms (1.45 days), lesser gestational age (33.1 weeks) and lesser total distance travelled (15.7 km). The odds of final transport of newborns in ambulance was significantly more in males (OR=1.5), rural residents (OR=1.5) and registered pregnancies (OR=4.3).

Conclusions: Wide variations remain in neonatal referral and transport with some glaring gaps which need to be adequately addressed.

Keywords: Neonate, Newborn, Referral, Transport

INTRODUCTION

A newborn infant, or neonate, is a child under 28 days of age during which he or she is at the highest risk of dying. India has witnessed a significant reduction in the number of neonatal deaths from 1.35 million in 1990, to around 0.76 million in 2012. The current neonatal mortality rate of India remains at 24 per 1000 live births³

In low-resource community-based settings, care seeking for neonatal illnesses can be triggered through two paths.

One is through household self-identification of potentially life-threatening illness and subsequent self-referral. The second path is via community-based health workers detecting danger signs during home visits, and referring the newborn for care at an appropriately equipped facility.⁴

Where transfer of a neonate is planned, it is imperative that the receiving health facility is informed and can get prepared to receive the baby. Even with the wide reach of the mobile phone networks, there are gaps in the communication. In low-income countries, there are few standardized protocols for transfer and transport of a sick newborn.⁵

Where transportation is available, lack of emergency care on the way to higher centers put many a lives to death. The poor quality or perceived quality of care at referral facilities may also be a major barrier. The essence of neonatal transport medicine is to keep the infant stable and, preferably, improve the clinical status of the infant or at least, ensure it is not worse off on arrival at the receiving hospital. But the receiving hospital.

With this background the study aimed at assessing referral and transport of sick neonates admitted to NICU of a tertiary care government hospital and the factors associated with direct referral and safe final transport.

METHODS

This cross sectional study was conducted in the Neonatal Intensive Care Unit (NICU) of Sarojini Naidu Medical College (SNMC), Agra, Uttar Pradesh being the only fully functional tertiary care government NICU at the time of study. All neonates fulfilling the eligibility criteria during the study period of one year from May 2017 to April 2018 were included keeping in mind the restrictions of resources.

Inclusion criteria

Neonates admitted to NICU within less than 28 days of birth.

Exclusion criteria

Exclusion criteria were refusal to give written informed written consent; non availability of a reliable respondent at the time of visit.

A semi-structured, pilot tested questionnaire was prepared and data was collected through face to face interviews. Visits to NICU were made twice a week for the purpose and it was attempted to have the primary care giver as the respondent. The respondents were clearly explained the purpose of the study and the type of questions therein in their local language after which written informed consent was obtained.

Since our study questioned the respondents regarding steps taken post initial detection of neonatal illness, including other health facilities visited and various modes of transport in between, so the terms initial and final has been used to delineate it. Of the total of 485 interviews conducted, completed forms were available for 450 study subjects who were subsequently analysed. Data was entered in Microsoft Excel (2010), cleaned and then transferred to SPSS (Ver. 22). Chi square test of significance and Independent t Test were appropriately applied and p<0.05 was taken to be statistically

significant. Odds ratios were calculated for dichotomous variables. Clearance from institutional ethics committee was obtained.

Operational definitions

In utero transport: It is the transport of mother prior to delivery and includes the identification and transport of at-risk pregnant women, including those with pregnancies complicated by threatened preterm labor and fetal anomalies with mother being the best incubator. ⁹⁻¹¹

Safe transport- safety of transport can be assessed on the basis of ambulance as a means of final transport, prereferral treatment/stabilization, and ambulance accompanying health personnel and prior communication from referring center.

Timely referral: Timely referral can be assessed by means of the time spent in other facilities, direct referral, time spent in transportation of neonate and in-utero transport.

Direct referral: Neonates came directly to NICU of SNMC either from home or other health facilities. Direct referral was considered timely.

Self-referral: The action of a making an appointment with a medical specialist oneself, rather than being referred by a general practitioner.¹²

Initial transport: From home or place of delivery to the first health facility referred to.

Final transport: Transportation of the neonate to our NICU. In cases of direct referral intial and final modes of transport were the same.

RESULTS

Of the 450 admitted neonates 64% were males. 37% were admitted in our NICU on the very first day. The newborns had a mean gestational age of 33.8±3.8 weeks and average birth weight of 2.08±0.7 kg. In 67.1% newborns symptoms appeared at birth or within the first day suggesting a greater vulnerability of the neonates during the early days of life. Taking into account multiple causes for initial referral, respiratory distress (38.2%) was the most common cause. The other main reasons for referral were low birth weight (31.5%), pre term (26.2%) and delay in cry (25.7%).

The pregnancy was identified as high risk in 70.7% mothers. Of these 318 high risk pregnancies almost three fourths (72.6%) were transferred timely in utero to district hospitals and higher centers where there are adequate facilities to manage obstetric emergency situations.

Table 1: Referral and in –transport characteristics of admitted neonates (n=450).

S.No.	Variables	Admitted neonates N (%)
	Problem first seen By	
	1. Mother	103 (22.9)
	2. Father	24 (5.3)
1.	3. Grandparents	55 (12.2)
	4. Doctor	200 (44.4)
	5. Other health personnel	54 (11.9)
	6. Others	14 (3.1)
	Type of initial referral	
2.	1.verbal	204 (45.3)
	2. Written	246 (54.7)
	Number of referral points	
3.	Direct referral 1	247 (54.9)
3.	Indirect referral 2	149 (33.1)
	>2	54 (12.0)
	Duration of stay at other	
	health facilities/home	
4.	<24 hrs	227 (50.4)
	1-2 days	114 (25.3)
	>2 days	109 (24.4)
	Treatment during transport	
5.	1. Yes	133 (29.6)
	2. No	317 (70.4)
	*Neonate accompanied by (mu	ıltiple options)
6.	1. Mother	105 (23.3)
	2. Father	286 (63.6)
	3. Grand parents	225 (50)
	5. Health personnel	50 (9.3)
	8. Other(relatives/friends/ neighbors) e Response Ouestion (Percentages t	221 (49.1)

^{*} Multiple Response Question (Percentages taken out of 450)

Table 2: Place of referral (n=450).

Place of referral	Initially Number of neonates N (%)	Initially Number of neonates N (%)
1. PHC	12 (2.7)	8 (1.8)
2. CHC	54 (12)	40 (8.9)
3. District hospital	35 (7.8)	56 (12.4)
4.Medical College	48 (10.7)	48 (10.7)
5.Private hospital/ clinics	161 (35.8)	256 (56.9)
6. Home	140 (31.1)	42 (9.3)

Distribution of the initial referral being oral or written was almost equal. More than half (54.9%) of the neonates came directly to NICU of SNMC either from home (38 individuals) or other health facilities (209 newborns), while 12% went through more than two health facilities before reaching here. Those who came directly to NICU

would have a timelier referral. Close to two thirds (65.8%) of neonates were referred by doctors (36.7% and 29.1% by private and government doctors respectively), 28% on their own and 6.2% by other health staff initially. 67.3% of neonates underwent pre-referral treatment at some point during their referral through various centers before reaching NICU of SNMC. The average length of stay at other referral points was 1.37 (SD=0.73) days. Half of the neonates (50.4%) stayed in other health facility or home for less than a day post symptoms appearance. Treatment during transportation administered to 29.6% of the neonates. This in transport treatment enables stabilization and provides for a safer means of transport for the neonate. Usually multiple people accompanied the neonate during transportation. Fathers (63.6%), grandparents (50%) and other relatives (46.2%) were the common members escorting the neonates. Merely 11.1% of transportation was accompanied by a health personal signifying relatively unsafe travel (Table 1).

The initial referral place was a government institution for 33.2% (medical college, district hospital, CHCs, and PHCs), private institutions for 35.8% and home for 31.1% of newborns. In contrast nearly half (50.9%) of neonates had private hospitals as last referral with government institutions contributing only 33.8%% and 8.4% from home. At some instances the initial and final referral points coincided when the referral was direct (Table 2).

50.2% of neonates have used the services of an ambulance at some point of time during their travel while rickshaw was least used (1.3%). For the initial mode of transport ambulance was the preferred (31.1%) followed by auto (22.3%) and 2 wheeler conveyance (17.3%). Ambulance constituted nearly half (48.8%) of final transportation vehicle used suggesting a safer option being used at later stages of transport. Compared to initial mode, the final mode of transportation indicates a decrease in use of walking (14.8 to 12.4%), auto (22.3 to 17.3%) and 2 wheeler (17.3 to 8.4%) as a means of transport while the usage of ambulance has increased (31.5% to 48.8%) (Table 3).

The mean total duration of time spent on transportation was 1.08 hr. However the average duration spent on transportation from last referral to NICU has reduced to 0.73 hours. The total time spent on transportation varied for nearly half (48.8%) of neonates was half to two hours in transportation. 4.2% of the neonates spent more than 2 hours on total transportation. However, when it came to duration spent on last transport a maximum (62.4%) reached the NICU within half an hour indicating faster transport from last referral (Table 4).

Direct referral was considered as timely. Highly significant association of direct referral was observed with earlier age at admission (2.3 days), early development of neonatal symptoms (1.45 days), lesser

gestational age (33.1 weeks), lesser total distance travelled (15.7 km), lesser cost on transportation (Rs 210.7), lesser time spent on travel (0.7 hr.), lower birth

weight (1.9kg) and reduced expenditure in health facility (Rs 4333.5) as compared to indirect referral (Table 5).

Table 3: Distribution of modes of transport (n=450).

Mode of transport	*All vehicles used during transportation	Initial transport used N (%)	Final transport from last centre to NICU N (%)
1. Walking	68 (15.1)	67 (14.8)	56 (12.4)
2. Rickshaw	6 (1.3)	6 (1.3)	5 (1.1)
3. Auto	123 (27.3)	99 (22.3)	78 (17.3)
4. 2 wheeler	84 (18.7)	78 (17.3)	38 (8.4)
5. Car	59 (13.1)	47 (10.4)	45 (10)
6. Ambulance	226 (50.2)	142 (31.5)	219 (48.8)
7. Bus	24 (5.3)	11 (2.4)	9 (2)

^{*} Multiple Response Question (Each percentages taken horizontally out of 450). Initial and final modes of transport were same in direct referral.

Table 4: Time spent on transportation (n=450).

Time spent on transportation (categories)	Total time spent on transportation N (%)	Time spent on last transportation N (%)
1. 0-30 min	169 (37.7)	281 (62.4)
2.31 min -60 min	111 (24.6)	76 (16.9)
3. 61 min- 120 min	109 (24.2)	72 (16)
4 >120 min	61 (13.6)	21 (4.7)

Table 5: Co-relates of referral (n=450).

	Variables	Referral	Mean	SD	Independent t test p value
1.	Age at admission	1. Direct referral	2.3	5.2	0.000
	Age at admission	2. Indirect referral	8.9	10.2	
2.	Development of	1. Direct referral	1.45	4.2	0.000
	symptoms (days)	2. Indirect referral	4.11	6.7	
3.	Gestation period (in	1. Direct referral	`33.1	4.0	0.000
	weeks)	2. Indirect referral	34.6	3.2	
4.	Total distance travelled	1. Direct referral	15.7	20.6	0.000
	(km)	2. Indirect referral	36.6	30.4	
5.	Transport and total (Da)	1. Direct referral	210.7	401.3	0.000
	Transport cost total (Rs)	2. Indirect referral	642.7	774.6	
6.	Total time in transport	1. Direct referral	0.7	0.7	0.000
	(hr)	2. Indirect referral	1.5	1.0	
7.	Dinth waight (Ita)	1. Direct referral	1.9	0.7	0.001
	Birth weight (kg)	2. Indirect referral	2.2	0.6	
8.	Duration of stay at	1. Direct referral	5.7	4.0	0.133
	NICU	2. Indirect referral	6.3	4.4	
9.	Total expenditure in	1. Direct referral	4333.5	2016.4	0.000
	health facilities (Rs)	2. Indirect referral	15896.4	1836.6	

There were significantly higher chances of timely direct referral when the permanent residence was in Agra (OR=2.5) or complications occurred during pregnancy (OR=1.68). There were significantly lower odds of direct referral in cases home delivery (OR=0.275) and in transport treatment (OR=0.537). Also factors like caste (p=0.012) and initial place of referral were significantly related with referral (Table 6).

Considering final transport in ambulance as a safer means, lesser age of appearance of symptoms (1.8 days), more total distance travelled (32.7 km), longer length of stay at NICU (6.6 days), and higher total health facility expenditure (Rs 13678.08) were factors which were statistically highly significant with safer transport as compared to others (Table 7).

Table 6: Association of referral with various factors.

	Referral (total neonates n=420)			
		Direct N (%)	Indirect N (%)	Chi square test
Sex of neonate	Male	150 (52.1)	138 (47.9)	$\chi^2 = 2.54$, d.f. 1
Sex of ficulate	Female	97 (59.1)	65 (40.1)	p=0.111, OR=0.7
Permanent	Agra district	196 (61.4)	123 (38.6)	$\chi^2 = 19.0$, d.f. 1
residence	Outside Agra district	51 (38.9)	80 (61.1)	p=0.000, OR=2.5
	SC/ST	58 (57.4)	43 (42.6)	$\chi^2 = 8.7$
Caste	OBC	143 (59.3)	98 (40.7)	d.f. 2
	Others	46 (42.6)	62 (57.4)	p=0.012
Residence	Rural	110 (50.2)	109 (49.8)	$\chi^2 = 3.7$, d.f. 1
Residence	Urban	137 (59.3)	94 (40.7)	p=0.053, OR=0.692
Complication	Yes	178 (59.1)	123 (40.9)	$\chi^2 = 6.6$, d.f. 1
during pregnany	No	69 (46.3)	80 (53.7)	p=0.010, OR=1.68
Dlagg of delivery	Home	10 (27.0)	27 (73.0)	$\chi^2 = 12.6$, d.f. 1
Place of delivery	Institutional	237 (57.4)	176 (42.6)	p=0.000, OR=0.275
	Govt Sector	117 (78.5)	32 (21.5)	2 72
Place of initial	Private Sector	90 (55.9)	71 (44.1)	$\chi^2 = 72$ d.f. 2
referral	Home	40 (28.6)	100 (71.4)	p=0.000
	No	188 (57.8)	137 (42.8)	p=0.000
Accompanied by	Yes	26 (52.0)	24 (48.0)	$\chi^2 = 0.19$, d.f. 1
health personnel	No	221 (55.3)	179 (44.8)	p=0.663, OR=0.8
Treatment in	Yes	58 (43.6)	75 (56.4)	$\chi^2 = 9.7$, d.f. 1
vehicle	No	189 (59.6)	128 (40.4)	p=0.002, OR=0.524

Table 7: Safe mode of final transport and its co-relates.

	Variables	Final transport mode	Mean	SD	Independent t test p value
1.	Age at admission	1. Ambulance (Safer)	4.9	8.0	0.343
	Age at admission	2. Others	5.6	9.0	
2.	Gestation period (in weeks)	1. Ambulance	34.1	3.7	0.067
	Gestation period (in weeks)	2. Others	33.5	3.7	
3.	Appearance symptom in	1. Ambulance	1.8	4.8	0.006
	neonates (days)	2. Others	3.7	6.2	
4.	Total distance (Irm)	1. Ambulance	32.7	29.6	0.000
	Total distance (km)	2. Others	18.0	23.3	
5.	Birth weight (kg)	1. Ambulance	2.1	0.7	0.067
	Bitti weight (kg)	2. Others	2.0	0.7	
6.	Langth of stay in NICII (days)	1. Ambulance	6.6	4.7	0.004
	Length of stay in NICU (days)	2. Others	5.4	3.6	
7.	Total haspital aget (Ps)	1. Ambulance	13678.08	27259	0.000
	Total hospital cost (Rs)	2. Others	5635.76	10109	

Table 8: Association of safe final neonatal transport (n=450).

		Final transport mode (total neonates)			
Variables	Categories	Ambulance (Safer) N (%)	Others N (%)	Chi Square Test	
Sex of Neonate	Male	151 (52.4)	137 (47.6)	$\chi^2 = 4.5$, d.f. 1	
Sex of Neonate	Female	68 (42.0)	94 (58.0)	p=0.033, OR=1.5	
	Agra district	136 (42.6)	183 (57.4)		
Residence	Districts Adjoining Agra	67 (69.8)	29 (30.2)	$\chi^2 = 23.7$, d.f. 3	
Residence	Other districts of U.P.	12 (54.5)	10 (45.5)	p=0.000	
	Other States	4 (30.8)	9 (69.2)		

	SC/ST	60 (59.4)	41 (40.6)	$\chi^2 = 13.4$
Caste	OBC	98 (40.7)	143 (59.3)	d.f. 1, p=0.001
	Others	61 (56.5)	47 (43.5)	
Residence	Rural	118 (53.9)	101 (46.1)	$\chi^2 = 4.6$, d.f. 1
Residence	Urban	101 (43.7)	130 (56.3)	p=0.031, OR=1.5
Registration of	Yes	217 (49.4)	222 (50.6)	$\chi^2 = 4.1$, d.f. 1
Pregnancy	No	2 (18.2)	9 (81.8)	p=0.041, OR=4.3
	PHC	11 (61.1)	7 (38.9)	
	CHC	52 (60.5)	34 (39.5)	$\chi^2 = 80.3$
Site of Delivery	DH	38 (69.1)	17 (30.9)	d.f. 5
Site of Delivery	Medical College	0 (0.0)	64 (100.0)	p=0.000
	Private Hospital	104 (54.7)	86 (45.3)	
	Home	14 (37.8)	23 (62.2)	
Place of Initial	Govt Sector	83 (55.7)	66 (44.3)	$\chi^2 = 18.5$,
referral	Private Sector	89 (55.3)	72 (44.7)	d.f. 2
Telefrai	Home	47 (33.6)	93 (66.4)	p=0.000
Accompanied	Yes	38 (76.0)	12 (24.0)	$\chi^2 = 16.8$, d.f. 1
by Health Personnel	No	181 (45.3)	219 (54.8)	p=0.000, OR=3.8
In Transport Treatment	Yes	122 (91.7)	11 (8.3)	$\chi^2 = 140.1$, d.f. 1
	No	97 (30.6)	220 (69.4)	p=0.000, OR=25.1
1 I calificili				
Pre-referral	Yes	172 (56.8)	131 (43.2)	$\chi^2 = 24.3$, d.f. 1
treatment	No	47 (32.0)	100 (68.0)	p=0.000, OR=2.7

The odds of final transport of newborns in ambulance was significantly more in males (OR=1.5), rural residents (OR=1.5), registered pregnancies (OR=4.3), health personnel accompaniment (OR=3.8), treatment during transport (OR=25.1) and pre-referral treatment (OR=2.1). Also district of residence (p=0.000), caste (p=0.001), site of delivery (p=0.000) and place of initial referral (p=0.000) are other factors found highly significant (Table 8).

DISCUSSION

This study conducted in the NICU of Agra on 450 neonates concurred a diversity in the modes of transport, and duration spent on travelling by the sick neonates as well as the characters associated with them. Timely referral and safe transport are decisive in affecting the outcome of the neonates.

In the present study at times there was more than one reason in the same neonate for initial referral and included mainly respiratory distress (38.2%), LBW (31.5%), no immediate cry (25.7%) and preterm (26.2%). Research by Sampathkumar et al found causes of referral to be preterm 41%, birth asphyxia 27% and RDS 21%. RDS was at 35.9% in the study by Jajoo et al. Research by Kumar et al found 32.6% referred for birth asphyxia with HIE; and 13.4% for prematurity with LBW. In the study by Shalini et al 50% were referred for LBW/preterm, 22% for meconium aspiration and 15% for birth asphyxia. Rarang et al in their study observed 43% referral due to respiratory distress, 22.3% due to prematurity and 20.0% due to delay in cry. Differences

in percentage of referral causes may be because our study included multiple reasons for referral whereas some studies included a single cause only. Also early morbidity pattern may differ on account of factors like ante natal care, correct recognition of symptoms, regional and temporal variations.

In this study problem was identified by the health staff (doctors and other personnel) in 56.3% neonates while the rest were identified by parents and relatives and directs to an almost equally crucial role played by health personnel and the family in recognizing early symptoms. Early role in problem identification by health staff was probably due to increased institutional deliveries.

In the current study 54.9% of the neonates were referred directly (i.e. no intermediate referral points), either from the health facility or their homes and represent timely referral. Research by Jajoo et al found 36% of neonates came directly from home. In 54.7% neonates of the present study the initial referral was written. ¹⁴ Studies by Shalini B et al (2017), Narang et al, Buch et al, Akhani et al (2016) and Parekh et al, found appropriate referral document or note in 82%, 33.4%, 41.9%, 90% and 63%, neonates. ¹⁶⁻²⁰ These variations in written referral note may be due to differences in referral mechanism and practices adopted in the health facilities. In the current study there was no prior communication from the referring facility to the NICU in any neonate.

In our study pre referral treatment at any point was given to 67.3% neonates contributing to safer transport. Similarly pre transport stabilization was seen in studies by Shalini et al, Parekh et al and at 66% and 57.2% respectively. 16,20 Study by Buch et al found pre-referral treatment in 23.5% neonates and this low figure may be because the study is relatively older. 18

The present study had 70.7% pregnancies as high risk while study by Mishra et al had 32% pregnancies with complicated delivery.²¹ Study by Mishra et al included only complicated deliveries and so may account for a lesser percentage.²¹ in study by Dalal et al maternal risk was in 54.4% cases.²²

The current study demonstrated that on comparing the initial to final place of referral for NICU there is an increased contribution of private institutions (35.8% at first to 56.9% at last referral) with simultaneous decrease from home (31.1% for initial to 8.4% for final referral point) suggesting that neonates from home reaching the NICU through private institutions. It also indicates increased usage of private institutions in last referral. This also suggests the inability of the private to provide adequate and quality care since these neonates were ultimately referred from private institutions (56.9%) to our governmental setup. Similarly research by Parekh et al (2018) had 64% private institutions for referral. 20 Study by Thenmozhi et al had 9% referrals from private hospitals, 16% from government hospitals and 21% from homes.²³ Differences may be because our study includes both initial and final referral points whereas such distinction was not made in other studies.

In the present study for 50.4% neonate's duration of stay in other health facilities or home was less than a day implying perhaps a more timely referral for the sick newborns. However in the rest (49.6%) neonates there was a stay of one day or more in other health facilities extending to even more than five days in 10.2% neonates indicating a serious gap in timely referral from these health facilities to the NICU.

In this study the total average distance travelled was 25.2 km while the mean distance from last referral was 17.9 km. Research by Kumar et al found an average distance travelled for in city referral as 12.6 km and out of city referrals as 132.4 km.²⁴ In our study there was a greater proportion of neonates travelling less than 6 km from last referral point (45.7%) as compared to those travelling a total distance of less than 6 km indicating that the last referral points were located closer to the NICU. In our study as far as distance from last referral to NICU is concerned 45.7% travelled <6 km, 27.3% 6-25 km, 17.7% 26-50 km and 9.3% > 50 km. Study by Jajoo et al (2017) had majority (74.09%) travelling a distance between 3-30 km. ¹⁴ Research by Dalal et al had 45% travelling <50 km. ²² Differences in distances travelled may be due to variations in the distance categories demarcation and the catchment area of the NICU.

In the present research for final transport 48.8% used ambulances, 17% autos, 12.4% walking, 10% car, 8.4%

two-wheeler and 2% buses. Similarly high usage of ambulances was seen in the research by Shalini et al (2017), Parekh et al, Dalal et al, Thenmozhi et al (2017), Rathod et al (2015), Punitha P et al (2016) and at 70%, 72.9%, 47%, 60%, 47.3% and 75%. 16,20,22,25-27 Similarly autos contributed 10.6% and 16% towards transportation in studies by Thenmozhi et al and Rao et al. 23,28 Also in our study there was an increase in ambulances contributing 31.5% to initial transport to them constituting 48.8% of final transport. Still a lack of use of ambulance as a means of transport in 68.5% neonates initially and 51.2% neonates finally represents a gap in safe neonatal transport.

Total mean duration spent on transport was 1.08hr in our study in comparison to 1.45 hr in the study by Mehta et al.²⁹ 37.7% spent 30 minutes in total transportation in the present study which is similar to 39.09% spending <30 minutes in study by Jajoo et al.¹⁴ In congruence to our study where 13.6% spent >2 hours on total transportation; research by Rao et al puts this percentage at 16%.²⁸ In studies by Akhani et al and Shalini et al transportation duration of less than one hour is in 76.6% and 58% respectively.^{19,16} Similarly our study puts this percentage as 62.3% for total time spent on transportation up to an hour. Longer duration of time spent on sick neonatal transport represents a gap in timely referral and needs to be reduced to a minimum possible.

In our study 11.1% neonates were accompanied by health personnel during transport. This small percentage in suggestive of the existing gap in safer neonatal transport. Likewise, in the study by Buch et al there were 11.4% skilled attendants; 10% paramedics/doctors in the study by Shalini et al and 15.6% health personnel in research by Narang et al who accompanied the sick newborn. 16-18 In contrast study by Jajoo et al had 40% medical personnel, Dalal et al 44.3% trained paramedics, Parekh et al 28% doctors/paramedics accompanying the newborn in transport. 14,22,20 These disparities may be on account of the differences in robustness of referral system in these diverse study areas. In the current study 23.3% mothers, 63.6% fathers, 50% grandparents and 46.2% other relatives accompanied the newborn. Study by Buch et al (2012) had 73.2% relatives and research by Rathod et al 75.9% parents/attendees escorting newborn. 18,26 Our study observed that the newborns at most of the times were accompanied by many attendees and included multiple response options for it and this may account for the variations from other studies.

In the current study direct referral was significantly associated with lesser age of admission, earlier development of symptoms, lower birth weight, lesser gestational age, lesser distance travelled, lesser time in transportation, lesser hospital expenditure and lesser total transport cost as compared to indirect referral. Thus, in situations of greater neonatal vulnerability like lesser gestational age, lower birth weight and early symptoms; the care providers prefer to directly reach the highest

center of care possible, the NICU of medical college in this case. Also in this approach there is saving on distance, time and expenditure. There were significantly higher chances of direct referral in case of permanent residence within Agra district and complications during pregnancy.

In our study considering ambulance use in final transport as a safer option; early appearance of symptoms in neonates, more travelled distance, longer duration of stay at NICU and more total hospital cost were factors associated with ambulance use as compared to other means of transport and were significant. There were significantly higher chances of ambulance use in male neonates, registered pregnancies, accompanying by health personnel, rural areas, and pre-referral treatment/ stabilization. Thus there seems a predisposition of ambulance use associated with increased expenditure and male preference. Also neonates arriving from rural areas, thereby perhaps travelling a greater distance, may suggest a deeper penetration of government schemes such as Janani Suraksha Yojna and Janani Shishu Suraksha Karyakaram.

CONCLUSION

Referral and transport system has seemingly improved with use of written referral notes, direct referral to higher centre according to perceived illness, decreased delay in en route stay in health facilities, wide use of ambulance and in utero transport. However bottlenecks like no prior communication to referred facility, number of in between referrals and stay, use of ambulance travel not universal and increased duration spent on transport remain despite continued emphasis on schemes for maternal and neonatal health. Widening the range and scope of services while reducing the gaps is a way forward to better neonatal survival.

ACKNOWLEDGEMENTS

We would like to acknowledge study participants for their active voluntary participation and Department of Paediatrics, for their support and assistance.

Funding: No funding sources Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee, S.N. Medical College, Agra (Ref No IEC/2017/35)

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Cite this article as: Negi R, Agrawal R, Kaushal SK, Misra SK. Timely referral and safe transport of neonates admitted to neonatal intensive care unit of tertiary care government hospital of Agra district: a cross sectional study. Int J Community Med Public Health 2019:6:2163-71.