## Original Research Article

# Predictors in profile of referred newborns for their outcome in a tertiary newborn referral facility

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**ABSTRACT**

**Background:** This study was aimed to assess newborn referral and factors contributing to outcome of referred newborns.

**Methods:** This prospective observational study was conducted in a tertiary newborn referral facility for a period of one year. Referred newborns fulfilling inclusion criteria were enrolled in study, and assessed in terms of demographic profile, transport characteristics, physiological variables. Investigations, management of neonatal illness was done as per standard management protocols, they were followed up to their outcome.

**Results:** Out of 2000 enrolled referred newborns, 30.10% were expired. Mean gestational age for survived newborns was $36.54\pm2.92$ (SD) weeks, for expired newborns $35.24\pm3.99$ (SD) weeks. Mean weight for survived newborns 2312.27 gms $\pm555.71$ (SD), for expired newborns 1936.71 gms $\pm665.67$ (SD). Out of total 60.05% newborns transported from periphery, had higher mortality i.e. 35% as compared to newborns transported from urban place i.e. 25%. Mean transport duration for survived newborns 61.94 minutes $\pm55.18$ (SD), for expired newborns 89.51 minutes $\pm88.94$ (SD). Prolonged CRT was observed in 57.45% newborns, grunting 19.70%, Cyanosis 11%, gasping 7.6%, apnea 5%, respiratory distress 39.80%, hypothermia 74.95%, and 25.50% required resuscitation on admission. Unattended delivery, self-arranged mode of transport, prolonged CRT, respiratory distress, apnea , hypothermia on admission, weight on admission(<1500gms), hypoglycaemia and duration of transport more than 1 hour found statistically significant independent variables associated with mortality of referred newborns.

**Conclusions:** A significant number of neonatal deaths can be prevented, if referral system is structured and organized. Improper referral leads to poor physiological profile of referred newborns, which leads to their poor outcome. There are many independent variables which are affecting the outcome of referred newborns. These independent variables can be taken care in holistic way once the referral system is cultured and nurtured in existing health system.

**Keywords:** Newborn referral, Neonatal deaths, Referral System

## INTRODUCTION

India contributes to nearly 20% of total live births while contribution of India to neonatal mortality is 30% which is out of proportion.[1] According to National Family Health Survey-4 (2015-16) Neonatal Mortality Rate of India was 28, Madhya Pradesh has maximum NMR i.e.35.[2] As per the India Newborn Action Plan, it is expected that India will achieve the goals of "Single Digit NMR" by 2030.[3] Emphasis on neonatal care is very much required in today's perspective as majority of neonatal mortality takes place in the first 28 days of life and addressing Sustainable Developmental Goal-3 to decrease the neonatal mortality to 12/1000 live births by 2030, which seems to be a distant dream for India in present scenario of neonatal care.[4] Government of India under National Health Mission with support from UNICEF established Special Newborn Care Units at

district level based on Purulia model (2003) to improve newborn care and newborn survival in April 2005. At present there are total 54 SNCUs in Madhya Pradesh in 50 districts, out of which 49 are providing level II care and 05 providing level III care (Medical College).[5]

Though institutional delivery and in-utero transport of newborn is safest but unfortunately preterm delivery and perinatal illness cannot be always anticipated resulting in continued need of transfer of these babies after delivery.[6,7] These newborns are often critically ill, and outcome is also dependent on effectiveness of transport system.[8] Currently there is limited, or no dedicated neonatal transport service is provided in India.

Prematurity, asphyxia and sepsis are the most common causes of neonatal mortality in developing countries.[9] Many of these are easy to manage and significant decrease in neonatal mortality can be anticipated with regionalization of perinatal care, where many sick newborns can be provided with better care and outcome if they are timely transported in stable condition. At the same time facility of neonatal transport in India are not encouraging.[6] Most of neonatal transports are self-transport without any pre-treatment stabilization or care during transport. Many of these newborns thus transported are cold, blue and hypoglycaemic and 75% of the babies transferred may have serious clinical implications currently there is limited, or no dedicated neonatal transport service is provided in India.[10,11]

The present study was carried out with the objective of finding out the causes of neonatal morbidity that leads to referral in the referral facility and causes of neonatal mortality, and what are the factors that predicts outcome of referred newborns brought directly or referred from smaller hospital in the region (from peripheries). Significant number of higher mortality of extramural referred newborns in the referral facility led the foundation of this study.

## METHODS

This prospective observational study was conducted in the tertiary care centre for neonatal treatment for a period of one year. During this period data were collected for referred extramural newborns satisfying following criteria.

### Inclusion criteria

• Newborn referred within 28 days of birth.

### Exclusion criteria

• Newborn having major congenital anomaly.
• Newborn who brought dead.
• Refusal to give informed written consent.

Study was conducted after approval of institutional ethical committee. The extramural referred newborn were assessed in terms of, place of delivery (home, Primary Health Centre, Community Health Centre, District Hospital, Private Hospital), persons conducting delivery (Doctor, Nurse, Female Health Worker, Trained Birth Assistant, or Other) and if any reason for referral (written), down referral after good outcome from referral facility advised or not, pre-referral treatment, indication for referral, mode of transport (ambulance or self-arranged), advise given during transport (like feeding, temperature, airway), health staff accompanying during transport, communication to referral facility before transport done or not. Clinical conditions of baby at arrival in SNCU were assessed and need for immediate resuscitation on admission. After initial stabilization newborns will be assessed for maturity, clinical condition, risk factors, individual morbidity and their outcome will be assessed in term of successfully discharged or expired with duration of stay in Special Newborn Care Unit (SNCU).

Data were analysed using SPSS version 17. All quantitative variables such as gestational age, birth weight were compared using student's t-test, and categorical variables were analysed using Chi-square test or fisher exact test.

Distributions of the data were tested first for normality and association of variable was tested by univariate analysis and if variable found statistically significant, then variables were analysed by regression analysis using binary logistic regression.

Multivariate analysis (logistic regression) was used to adjust confounding factors on mortality. P value<0.05 will be considered statistically significant, all the values were given up to two decimals.

Following definitions were used in the study[7]:

### Hypothermia

Axillary temperature in .F is taken and graded as per standard guidelines of W.H.O [12].

### Hypoglycaemia

Is taken less than 45 mg/dL by reagent strips.

### Prolonged CRT

Considered more than three seconds at mid sternal region.

### Cyanosis

Presence of dusky soles with perioral cyanosis and cyanosis of oral mucosa.

*Respiratory distress*

Respiratory distress was defined as respiratory rate more than 60/minute in a quite baby associated with deep lower chest wall indrawing with or without nasal flaring and/ or expiratory grunting.

*Prematurity*

Newborn born before 37 complete gestational weeks by history and New Ballard Score.

*Low birth weight*

Birth weight less than 2.5 kg irrespective of gestational age.

*Very low birth weight*

Birth weight less than 1.5 kg.

Sepsis, Birth asphyxia, Respiratory distress syndrome (RDS), Meconium aspiration syndrome (MAS) were diagnosed as per standard guidelines provided by National Neonatology Forum.[7]

Referred newborns were investigated, managed and monitored as per the standard management protocols.

Outcomes were assessed in terms of survival and expiry.

## RESULTS

Mean gestational age for survived newborns was 36.54 weeks ±2.92 (SD), for expired newborns 35.24 weeks ±3.99 (SD).

Mean weight on the admission for survived newborns was 2312.27 gms ±555.71 (SD) and for expired newborns 1936.71 weeks ±665.67 (SD).

**Table 1: Demographic Profile of referred newborns.**

| Characteristics | Total (2000) | Survived 1398/2000 (69.90%) | Expired 602/2000 (30.10%) | $\chi^2$ value, df p value |
|---|---|---|---|---|
| **Gestational age (weeks)** | | | | |
| <28 | 64 | 10 (0.5%) | 54 (2.7%) | 1.35, 4, <0.01 |
| 28-32 | 298 | 168 (8.4%) | 130 (6.5%) | |
| 32-37 | 647 | 479 (23.95%) | 168 (8.4%) | |
| 37-42 | 989 | 740 (37%) | 249 (12.45%) | |
| >42 | 2 | 1 (0.05%) | 1 (0.05%) | |
| Mean gestational age (weeks) | 36.15±3.33 (SD) | 36.54±2.926 (SD) | 35.24±3.995 (SD) | |
| **Age on admission (in days)** | | | | |
| <1 | 904 | 673 (33.65%) | 231 (11.55%) | 16.93, 2, <0.01 |
| 1-2 | 301 | 203 (10.15%) | 98 (4.90%) | |
| 3-4 | 282 | 189 (9.45%) | 93 (4.65%) | |
| >4 | 513 | 333 (16.65%) | 180 (9%) | |
| **Weight on admission (g)** | | | | |
| <999 | 31 | 4 (0.2%) | 27 (1.35%) | 1.87, 3, <0.01 |
| 1000-1499 | 263 | 107 (5.35%) | 156 (7.80%) | |
| 1500-2499 | 902 | 654 (32.70%) | 248 (12.40%) | |
| >2500 | 804 | 633 (31.65%) | 171 (8.55%) | |
| **Mean weight (g)** | 2199.23±615.41 (SD) | 2312.27±555.71 (SD) | 1936.71±665.67 (SD) | |
| Sex | | | | |
| Male | 1234 (61.70%) | 865 (43.25%) | 369 (18.45%) | 0.06, 1, 0.84 |
| Female | 766 (38.30%) | 533 (26.65%) | 233 (11.65%) | |
| Residence | | | | |
| Rural | 1201 (60.05%) | 808 (40.4%) | 393 (19.65%) | 9.83, 1, <0.01 |
| Urban | 799 (39.95%) | 590 (29.5%) | 209 (10.45%) | |
| **Place of Delivery** | | | | |
| Institutional | 1960 (98%) | 1381 (69.05%) | 579 (28.95%) | 15.43, 2, <0.01 |
| Home | 33 (1.65%) | 13 (0.65%) | 20 (1%) | |
| On the way | 7 (0.35%) | 4 (0.2%) | 3 (0.15%) | |
| **Delivery conducted by** | | | | |
| Skilled person | 1479 (73.95%) | 1013 (50.65%) | 466 (23.3%) | 26.51, 3, <0.01 |
| Trained person | 481 (24.05%) | 368 (18.4%) | 113 (5.65%) | |
| Unskilled person | 33 (1.65%) | 13 (0.65%) | 20 (1%) | |
| Unattended | 7 (0.35%) | 4 (0.2%) | 3 (0.15%) | |

**Table 2: Transport characteristics of referred newborns.**

| Characteristics | Total (2000) | Survived 1398/2000, 69.90% | Expired 602/2000, 30.10% | $\chi^2$ value, df p Value |
|---|---|---|---|---|
| **Referral note given** | | | | |
| Yes | 1633(81.65%) | 1106 (55.3%) | 527 (26.35%) | **2.290, 1, <0.01** |
| No | 367(18.35%) | 292 (14.6%) | 75 (3.75%) | |
| **Accompanying health staff** | | | | |
| Yes | 340 (17%) | 302 (15.10%) | 38 (1.9%) | **18.65, 1, <0.01** |
| No | 1660 (83%) | 1045 (52.25%) | 615 (30.75%) | |
| **Prior communication** | | | | |
| Yes | 140 (7%) | 130 (6.5%) | 10 ((0.60%) | **5.789, 1, <0.01** |
| No | 1860 (93%) | 1209 (60.45%) | 651 (32.55%) | |
| **Reason for referral specified** | | | | |
| Yes | 1530 (76.50%) | 1109 (55.45%) | 421 (21.05%) | **19.952, 1, <0.01** |
| No | 470 (23.50%) | 289 (14.45%) | 181 (9.05%) | |
| **Prereferral stabilization** | | | | |
| Yes | 1248 (62.40%) | 722 (36.1%) | 526 (26.3%) | **20.656, 1, <0.01** |
| No | 752 (37.60%) | 676 (33.8%) | 76 (3.8%) | |
| **Advised during transport regarding airway** | | | | |
| Yes | 1126 (56.30%) | 949 (47.45%) | 177 (8.85%) | **3.470, 6, <0.01** |
| No | 874 (43.70%) | 449 (22.45%) | 425 (21.25%) | |
| **Advised during transport regarding temperature** | | | | |
| Yes | 1355 (67.75%) | 1066 (53.3%) | 289 (14.45%) | **3.470, 6, <0.01** |
| No | 645 (32.25%) | 332 (16.6%) | 313 (15.65%) | |
| **Advised during transport regarding feeding** | | | | |
| Yes | 1104 (55.20%) | 958 (47.9%) | 146 (7.3%) | **3.470, 6, <0.01** |
| No | 896 (44.80%) | 440 (22%) | 456 (22.8%) | |
| **Transport duration (hours)** | | | | |
| <1 | 1129 (56.45%) | 849 (42.45%) | 280 (14%) | **60.761, 2, <0.01** |
| 1-2 | 652 (32.60%) | 441 (22.05%) | 211 (10.55%) | |
| >2 | 219 (10.95%) | 108 (5.4%) | 111 (5.55%) | |
| Mean transport duration(min.) | 70.24±68.315 (SD) | 61.9421±55.18 (SD) | 89.5183±88.94 (SD) | |
| **Distance (km)** | | | | |
| ≤50 | 1551 (77.55%) | 1118 (55.9%) | 433 (21.65%) | **19.797, 2, <0.01** |
| 51-100 | 265 (13.25%) | 175 (8.75%) | 90 (4.5%) | |
| >100 | 184 (9.2%) | 105 (5.25%) | 79 (3.95%) | |
| Mean distance (km) | 41.25±50.05 (SD) | 36.8827±43.56 (SD) | 51.3887±61.44 (SD) | |
| **Transport type** | | | | |
| Govt. | 1308 (65.40%) | 897 (44.85%) | 411 (20.65%) | **8.056, 2, 0.02** |
| Self-arranged | 664 (33.20%) | 486 (24.3%) | 178 (8.9%) | |
| Public transport | 28 (1.4%) | 15 (0.75%) | 13 (0.65%) | |
| **Referral type** | | | | |
| Primary | 1190 (59.50%) | 713 (35.65%) | 477 (23.85%) | **1.401, 2, <0.01** |
| Secondary | 802 (40.10%) | 677 (33.85%) | 125 (6.25%) | |
| Tertiary | 8 (0.4%) | 8 (0.4%) | 0 | |

Newborns from rural residence had poor survival as compared to newborns from urban residence (29.5% vs. 40.5%). Poor survival was observed in those newborns transported from periphery as compared to newborns transported from urban residence (65% vs.75%).

Poor survival was observed in those newborns delivered at home (60.60% expired) and delivery conducted by unskilled person (60.60% expired) (Table 1). Out of all 17% newborns were accompanied by health staff during transport, had better survival as compared to those newborns didn't accompanied by health staff (89% vs.63%).

Seven percent referrals were priorily communicated to referral facility before transport, had better survival as

compared to those newborns whose referral were not priorily communicated (93% vs. 65%). Out of all 1633(81.65%) newborns were having referral note. Newborns having referral note had better survival (55.30% vs.14.60%) as compared to those newborns did not having referral note.

Newborns stabilized before transport had better survival (57.85% vs. 37.60%) as compared to newborns did not stabilized before transport. Survival was better in newborns, who were advised regarding maintenance of temperature (78.67% vs. 51.47%), maintenance of airway (84.28% vs. 51.34%) and advised regarding feeding (86.77% vs. 49.10%). (Table 2).

Poor survival was observed in referred newborns with prolonged CRT (34.20% vs. 24.55% deaths), grunting (63.70% vs. 21.85%), cyanosis (72.27% vs. 24.88%), apnea (94% vs. 26.73%), respiratory distress ( 43.84% vs. 21.01%), hypothermia (42.53% vs. 24.43%), hypoglycemia (70.13% vs. 21.16%), newborns who required resuscitation on admission (44.90% vs. 25.03%), gasping on admission (86.84% vs. 25.43%).

Mean RBS for survived newborns was 88.03 mg/dL $\pm$28.70(SD), for expired newborns 60.36 mg/dL $\pm$30.08(SD), mean temperature was 96.91 .F$\pm$1.14(SD) for survived newborns and for expired newborns 96.35. F$\pm$1.59(SD).

It was observed that unattended delivery [OR=21.19,p value=0.017, self-arranged mode of transport [OR=4.12,p value=0.000], prolonged CRT [OR=1.76,p value=0.021], respiratory distress [OR=1.94,p value=0.011], apnoea [OR=16.69,p value-0.000] ,hypothermia on admission [OR=1.43,p value=0.000], weight on admission(<1500gms) [OR=8.61,p value=0.000], hypoglycaemia [OR=2.14,p value=0.002] and duration of transport more than 1 hour [OR=2.058,p value=0.031] were found to be statistically highly significant independent variables associated with mortality of referred newborns.

## DISCUSSION

A significant number of neonatal deaths among referred newborns can be prevented. The development of an effective neonatal transport system is needed for proper implementation of regionalization of perinatal care and better neonatal outcome, as observed by Buch Pankaj M et al in their study.[1] It was observed that out of 2000 newborns, 1633 (81.65%) newborns were having referral note. It was found highly significant that newborns with referral note had better survival as compared to newborns without referral note (55.30% vs.14.60%). It was found highly significant that newborns referred with reason specified for referral had better survival as compared to newborns referred without reason specified (72.48% vs. 61.48%). It was found highly significant in the present study that newborns referred with pre-referral

stabilization had better survival as compared to newborns referred without pre-referral stabilization (57.85% vs. 37.60%). Survival was better in newborns, who were advised regarding maintenance of temperature (78.67% vs. 51.47%), maintenance of airway (84.28% vs. 51.34%) and advised regarding feeding (86.77% vs. 49.10%).

This could be because all these factors are required for better physiological care of referred newborns during admission. Similar results also found by Narang et al with sample size of 300, done in tertiary care hospital in Delhi and Pankaj et al with sample size of 149, done in P.D.U. Government Medical College, Rajkot, Gujarat, India, while in study of Sachan et al pre-referral stabilization made no significant difference for outcome of referred newborns with p value of 0.13.[13,14]

So in the present study, it was found that statistically significant difference exist for expired newborns and survived newborns in terms of reason for referral specified or not, pre referral stabilization done or not, referral note mentioned or not, health staff accompanying during transport or not, down referral advised or not, prior communication with referral facility done or not, advised during transport or not i.e. regarding airway ,temperature maintenance and feeding ,transport duration and distance covered to reach the referral facility. In the present study, mode of transport was found to be a statistically significant variable (p value 0.02) between survived and expired newborns. Government transport vehicle like JSY vehicle/ 108 ambulance was found associated with survival of referred newborns as compared to private transporting vehicle (72.08% vs. 68.57%). However, Sachan et al found no significant difference in various modes of transport on survival of referred newborns (p value of 0.07).[14]

Transport duration was found to be associated with the survival of referred newborns. Transport duration within one hour was associated with better outcome of referred newborns as compared to transport duration more than two hours (75.19% vs. 49.31%). Also, it was observed that transport duration > 1 hour proved as an independent variable for mortality of referred newborns with odd ratio 2.05 (p value 0.031) by using multi variate analysis/binary logistic regression. This could be due to referred newborns who reached referral facility within 1 hour had better physiological profile on admission and better outcome as compare to those newborns who faced referral delay. Mean duration of transport for survived group of referred newborns was found 61.94 minutes and for expired group of referred newborns it was found 89.51 minutes. Similar results were also found by Sehgal et al ,Pankaj et al, Narang et al and Sachan et al.[6,1,13,14]

Newborns who required transport distance less than 50 kms were having better survival as compared to newborns requiring transport of more than 100 kms (72.08% vs 57.06%). This could be due to reason that those referred newborns came to referral facility after

travelling more distance were found hypothermic, hypoglycemic, with poor physiological variables on admission, which leds to poor outcome of that referred newborns. Similar results were also found by Sehgal et al, Pankaj et al, Narang et al and Sachan et al.[6,1,13,14]

Present study recommends that though there are referral guidelines available, but there is a need to strengthen the existing referral system. There are many independent variables which are affecting the outcome of referred newborns. These independent variables can be taken care in holistic way once the referral system is cultured and nurtured in existing health system. Communication is one of the key factors for improving outcome. The feedback system to referring facility is must for improving the referral system.

## CONCLUSION

Outcome of referred newborns is poor as compared to intramural newborns and referral system is not structured. Need to strengthen the referral system and transportation as per the guidelines. Referral system should be like a closed loop circle where the continuous feedback to be given to referring facility for the improvement of referral system, as well as once referred newborns stabilised and evaluated, then further ongoing management to be done at referring facility via down referral.

## ACKNOWLEDGEMENTS

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