

Smooth Roads Ahead: Lessons From our Sick Neonate Retrieval Service

Zubair Ahmad Bhat, Mohamed Muneer Varikkottil, Femitha Pournami, Ajai Kumar Prithvi, Naveen Jain

Department of Neonatology, KIMS Health, Trivandrum, Kerala, India

ABSTRACT

Strategies for free transfer of sick neonates to hospitals are in place, but reports suggest suboptimal status of the same across the country. Over 7 years, our Sick Neonate Retrieval Service (SNRS) transported 165 neonates, of whom 92.1% survived. Safe, stable transportation mandates the presence of a neonatology-trained doctor and nurse in an equipped ambulance.

Keywords: *Ambulance services, Neonatal transport, Newborn*

Clinical status of sick neonates who need referral for advanced care often warrants upgradation of treatment before or during the process of transport. The increased risks associated with interhospital transport of sick neonates can be minimized when the transport is being performed by trained neonatal retrieval teams. The developed world has established systems in place for the retrieval of sick neonates [1].

Free transport facilities for pregnant women and neonates by the National Ambulance Service (NAS), emergency medical training of drivers and attendants have been introduced in various states across India [2]. Clinical practice guidelines with descriptions of elements required for efficient transport of sick neonates are available in India [3]. Individual hospital-based data have also demonstrated that those infants who are accompanied by trained personnel fare better than those who come by self-arranged or unequipped means [4]. However, the literature pertaining to neonatal transport from various parts of the country reports a dismal picture [5]. This retrospective analysis aimed to systematically describe the experience of our hospital over a period of seven years (2016 to mid-2023) with the Sick Neonate Retrieval Services (SNRS) wherein the presence of a neonatology-trained doctor, nurse and patient care assistant in the equipped ambulance is mandated

We are a Level IIIB accredited (National Neonatology Forum, India) unit in a tertiary care facility of South Kerala, India. A written protocol is in place for the SNRS. A phone call or email or fax or text message from the referring doctor or family, documents the transport request and helps determine the history and clinical status of the infant. The daily duty-roster includes one doctor and a nurse responsible for a possible SNRS during the shift. The necessary equipment, prearranged in a ready-to-grab bag is cross-checked and the onward journey is made with the siren of the ambulance wailing and beacons flashing. When the team arrives at the pick-up destination, we follow the “stand and play method” where the baby receives treatment and stabilization on scene before transportation to the referral centre rather than “scoop and run”. The return journey is pursued at a steady pace to ensure comfort of the team and control over the baby’s requirements enroute. Documentation of vitals and interventions during transport are done systematically. We strive to reverse transport when clinical stability is ensured, based on the family’s preferences and readiness of the referring doctor.

A sample size of 139 was calculated based on pilot data collected from our unit. We presumed that 90% of neonates who were transported by the SNRS would survive, with a precision of 5% and a type I error of 5%. Complete data was available for 7 years (2016 to mid-2023) from the electronic medical records of our unit.

Since this was a retrospective descriptive study, informed consent was not obtained, however, privacy and confidentiality of all patients is ensured. Data of 165 neonates transported by SNRS was analyzed. Demographic details, pre-referral clinical information, and outcomes are described in **Table I**. Of the 165

Correspondence to: Dr. Femitha Pournami,
Senior Consultant,
Department of Neonatology, KIMS Health,
Trivandrum, Kerala, India.
femi_shifas@yahoo.com
Received: Sep 20, 2023; Initial Review: Sep 20, 2023;
Accepted: Jan 12, 2024

Table I Demographic and Pre-Transport Clinical Characteristics of Retrieved Neonates (n = 165)

<i>Characteristic</i>	<i>Value</i>
Gestational age (wk) ^a	37 (33, 38) (Range 25 to 40)
Birth weight (g) ^a	2660 (1880, 3007) (Range 705 to 5100)
Male gender ^b	99 (60)
Postnatal age at transport (d) ^a	2 (0, 9) (Range 0 to 71)
<i>Primary reason for referral^b</i>	
Respiratory distress	90 (54.5)
Preterm care	82 (49.7)
Very preterm	39 (23.6)
Encephalopathy	18 (10.9)
Shock/ heart disease	15 (9.1)
Major congenital malformations and multiorgan dysfunction	34 (20.6)
<i>Pre-referral supports already present^b</i>	
Thermal control and feeds/maintenance fluids alone	66 (40)
Non-invasive respiratory support	66 (40)
Intubation and ventilation	66 (40)
Central venous line	19 (11.6)
Inotrope support	37 (22.4)
Hypoglycemia correction	19 (11.7)
<i>Catchment area^b</i>	
Within the city	40 (24.2)
Within district limits	62 (37.6)
Neighboring districts	31 (18.8)
Neighboring states	21 (12.7)
Maldives (overseas)	11 (6.7)
<i>Therapies commenced at referring hospital by SNRS^b</i>	
No additional supports	115 (69.7)
Oxygen/ Non-invasive ventilation	34 (20.6)
Hypothermia correction	28 (16.9)
Intubation and ventilation	16 (9.7)
Fluid bolus/ inotrope initiation for shock	38 (23)
<i>At our unit</i>	
Outcome: Survival till discharge ^b	152 (92.1)
Reverse transport after stabilization ^b	42 (25.5)
Referred to other units for continuation of care ^b	4 (2.4)
Duration of hospital stay (d) ^a	6 (3, 15) (Range 2 to 97)
Central line insertion ^b	48 (29.5)
Inotrope support ^b	32 (19.4)
Hypoglycemia correction intravenous ^b	17 (6.1)
Non-invasive respiratory support ^b	58 (35.2)
Conventional ventilation ^b	38 (23)
High frequency ventilation ^b	17 (10.3)
Inhaled nitric oxide therapy ^b	10 (6.1)

Value expressed as ^amedian (IQR) or ^bn (%)

neonates, 152 (92.1%) survived. It is important to emphasize that SNRS team was required to commence therapies at the referring hospital itself for 50 neonates (30.3%). None of the babies showed clinical deterioration at admission at our unit when compared to the hemodynamic status at the start of travel. Four families requested transport to other centers where they eventually expired. Five of the nine infants who expired in the unit had major congenital malformations; 3 were extreme preterm neonates who were transferred after one week of life in a moribund state; one had an intestinal perforation pre-transport and developed refractory shock. We have conducted four air transports in commercial airlines (Bengaluru and Maldives). The process involved documentation and extensive arrangements including clearance for oxygen cylinders and mechanical suction to be made in advance.

There exist different models for institutions catering to emergency medical services (EMS) out of hospital. The Franco-German model is physician-led while the Anglo-American one is dependent on trained paramedics [6]. India has schemes based on regional circumstances like the NAS, Emergency Management and Research Institute model, Bihar model, Janani Express Scheme etc. [7]. Audits in 2013-2014, however, show that less than 20% of pregnant women use the NAS in six states [2].

In our study group, no neonate showed signs of deterioration at admission. Reports about neonatal

transport from several parts of the country are not reassuring with up to 40% deaths within 24 hours of admission [8,9]. Suboptimal conditions were reported leading to 20% mortality; 76% were hypothermic at admission [10]. Multivariate analyses by Singh et al revealed that the need for immediate cardiorespiratory support on arrival, and absence of medical staff during transfer were significant predictors of mortality [4]. We wish to emphasize by our report that a robust system for retrieval of sick neonates with special emphasis on the mandatory presence of neonatology trained doctors and nurses is not only feasible, but also worthwhile and rational. Number of medical trainee seats for post-graduation in pediatrics and postdoctoral courses in neonatology are increasing across the country. With over 4000 doctors training in these subjects at any point of time, it should be prudent to earmark transport teams with specified duty rotations in every teaching hospital, both government and private. Instead of dealing with unexpected arrival of a crashing neonate to emergency rooms, an appeal needs to go out to all tertiary public and private sectors who have facilities for advanced neonatal care to consider organized retrieval of sick neonates from specific catchment areas. A model for SNRS would depend on closest available tertiary care facility, financial status of the family and distance acceptability, logistics like distance from home, accommodation facilities etc (Fig. 1). The design of a multimedia app (not unlike the food delivery apps) would be recommended so that the

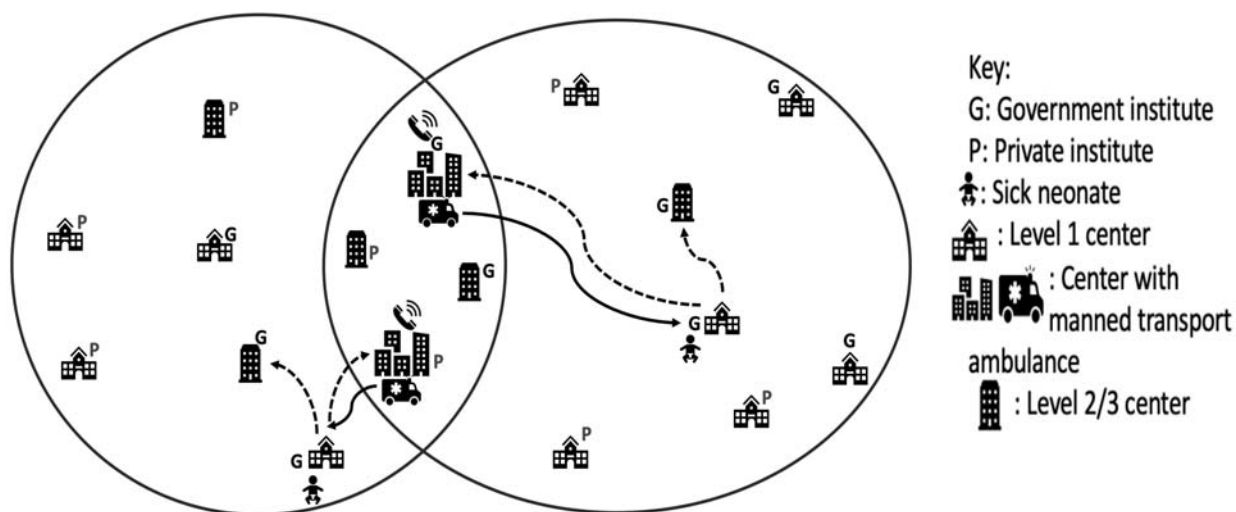


Fig. 1 Suggested Sick Neonate Retrieval Network: Sick neonate in a Level I Government/Private facility. Transport call to the nearest Government/ Private institute with manned transport ambulance. Solid black arrow depicts rushing to retrieve sick neonate. The network can decide based on bed/ facility availability to move baby in equipped and manned ambulance to private/ government Level 2/3 facility as warranted (black dotted arrow). The choice of hospital for further care is based on multiple factors like distance, family choices, bed availability, stability for near/far transport.

referring doctor can rapidly recognize the nearest transport team available, estimated arrival time by realtime satellite maps of traffic and road conditions and closest intensive care bed/ hospital with the requisite facilities. These goals would need immense networking and collaboration amongst units to achieve one step towards equitable distribution of health services, and the target of single digit neonatal mortality rate by 2030s in India.

Private-public partnerships and use of multimedia and networking would go a long way in optimizing support for these sick neonates. There is a beacon of hope for smooth roads ahead with small strides from each of us.

Ethics clearance: KIMS/IHEC/Transport/04/2023 dated April 03, 2023.

Contributors: FP: Conceived the study, collected and analyzed data, drafted manuscript; ZAB, MMV: Collected the data; AKP, NJ: Critical inputs, will act as guarantor. All authors approved the final manuscript and are accountable.

Funding: None; *Competing interests:* None stated.

Acknowledgements: We thank Adib Shifas for designing and constructing infographics, data analysis and conceptualization of the multimedia app toward sick neonatal transport.

REFERENCES

1. Insoft RM, Schwartz HP (Eds). Guidelines for Air and Ground Transport of Neonatal and Pediatric Patients Manual, 4th ed. American Academy of Pediatrics; 2016. Accessed on July 26, 2023. Available from: <https://doi.org/10.1542/9781581109795>
2. Kumutha J, Rao GVR, Sridhar BN, et al. The GVK EMRI maternal and neonatal transport system in India: a mega plan for a mammoth problem. *Semin Fetal Neonatal Med.* 2015; 20:326-34.
3. NNF Clinical Practice Guidelines. Transport of Sick Neonates. Accessed on Aug 20, 2023. Available from: <https://www.ontop-in.org/ontop-pen/Week-12-13/Transport-of-sick-NB.pdf>
4. Singh J, Dalal P, Gathwala G, et al. Transport characteristics and predictors of mortality among neonates referred to a tertiary care centre in North India: a prospective observational study. *BMJ Open.* 2021;11:e044625.
5. M Kumar, Dabas V, Mohta A. Neonatal transport: the long drive has not even begun. *Indian J Community Med.* 2017;42:244-5.
6. Dick WF. Anglo-American vs. Franco-German emergency medical services system. *Prehosp Disaster Med.* 2003;18:29-35
7. National Health System Resource Centre. Emergency medical service (EMS) in India: A concept paper. Accessed on Aug 31, 2023. Available from: https://nhsrcindia.org/sites/default/files/202102/Emergency_Medical_Service_in_India_Concept_Paper.pdf.
8. PHFI, AIIMS, and SC—State of India's Newborns (SOIN) 2014—A Report. Zodpey S, Paul VK (Eds). Public Health Foundation of India, All India Institute of Medical Sciences and Save the Children, New Delhi, India. Accessed on Aug 31, 2023. Available from: https://www.healthynewbornnetwork.org/hnn-content/uploads/SOIN_Report_2014.pdf
9. Roy MP, Gupta R, Sehgal R. Neonatal transport in India: From public health perspective. *Med J DY Patil Univ.* 2016;9:566-9.
10. Rathod D, Adhisivam B, Bhat V. Neonatal transport in resource restricted settings: a simple clinical score at arrival and its role in predicting mortality. *Int J Emerg Med.* 2014;7:P2.