Original Article

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Characteristics of Paediatric Patients Transported by Emergency Care Personnel in a Government Tertiary Care Centre, Mysuru, India: A Cross-sectional Study

Paediatrics Section

K NAGENDRA[1], GIRISH GOPAL[2], SUDHA RUDRAPPA[3], D KARTHICK[4]

ABSTRACT

Introduction: Emergency Medical Service (EMS) systems have been well established and designed largely to cater to the needs of the cardiac and trauma related emergencies in adult patients. Paediatric emergencies are different; the benefits and outcomes of paediatric EMS have been assumed but without much evidence. With the emergence of paediatric and neonatal Advanced Life Support (ALS); it is imperative to have data that define the problems encountered in the prehospital care setting and also their outcome. This analysis may also provide insights into any modifications that may be required in the EMS system that exists to transport sick children.

Aim: To characterise the paediatric prehospital care with emphasis on demography, presenting symptoms, treatment given, prehospital times, vitals monitoring and interventions done during EMS transport affiliated to Emergency Medical Service Agency.

Materials and Methods: This descriptive cross-sectional study was conducted from July 2018 to June 2019 in Cheluvamba Hospital, a tertiary care referral teaching hospital attached to Mysore Medical College and Research Institute, Mysuru, India. The study included 147 children who were provided EMS by the 108 ambulance affiliated to the state/central government. Data pertaining to demography, presenting symptoms, vital sign monitoring, treatment given, various prehospital times, and interventions done during transport was obtained and analysed. Inpatient diagnosis with the duration of hospital stay and outcome in these childrens were also described.

Results: Among the 147 children included; 3 were brought dead, hence the studied population comprised of 144 children. Amongst them, 42 were neonates and the remaining 102 belonged to the general paediatric population (older children). Overall, 61.8% were males and 57.64% hailed from a rural background. Mean 'on-scene' time was 12.12±2.34 minutes and 5.50±5.01 minutes, and 'transport time' was 33.79±16.78 minutes, and 26.11±14.2 minutes for neonates and older children, respectively. Respiratory distress was the most common presenting symptom. The mean Heart Rate (HR, beats/min), Respiratory Rate (RR, cycles/min) and temperature (°C) in neonates was 129.86±27.91, 59.90±15.40 and 36.14±0.84 whereas in older children it was 112.81±28.39, 34.87±14.86, and 37.40±0.96, respectively. Mean systolic blood pressure (SBP mmHg) in children aged more than 10 years was 116.67±8.61. Of the 39 children aged more than 6 years, 36 (92.30%) had a Glasgow Coma Scale (GCS) between 13-15. The most common intervention done was administering oxygen in 84.02% (121/144) of children; 34.02% (49/144) of children were unstable at admission; 127 (88.2%) were discharged; remaining 17 (11.8%) succumbed to their illness. On-scene time of more than 15 minutes, transport time of more than 30 minutes and factors such as hypoxia, respiratory failure and shock at admission were significantly associated with mortality ($p<0.001$).

Conclusion: Majority of the EMS transports were related to medical conditions. Basic Life Support (BLS) interventions were done albeit mostly in older children. Emergency Medical Technicians (EMT)/paramedics delivering EMS need special training to orient themselves to the special needs of critically ill children and to improve their outcome.

Keywords: Life support, Paediatric emergencies, Prehospital care, Sick children transport

INTRODUCTION

The Emergency Medical Service (EMS) has been one of the cornerstones in improving the outcome of critically ill patients either by providing a quick transport to the nearest point of care or by providing certain BLS or ALS interventions until the definitive treatment is initiated. While the concept of EMS has been well established in the developed countries, it is a relatively new concept in developing countries like India. EMS can be provided by a variety of individuals (trained physicians, paramedics or nurses) using variety of methods and it is largely determined by the country and locale.

The Emergency Management and Research Institute (EMRI) associated with Gunupati Venkata Krishna (GVK) is the largest authorised professional EMS provider in India. Based on the model of Public Private Partnership (PPP) with the government of India, it operates a fleet of 108 ambulances which help to deliver EMS to the needy population [1]. Whilst their services were developed mainly to cater to the emergency needs of the adults, consideration of the special needs of critically ill children becomes even more important. Prehospital phase of paediatric emergency care can be crucial for positive patient outcomes. Available data from the West suggests that paediatric patients comprise a small but critical portion of EMS encounters, with children accounting for approximately 10% of all EMS transports [2-4].

Few studies from India have shown that, the percentage of neonates being referred to the paediatric Emergency Room (ER) of tertiary care hospitals using National Ambulance Service (NAS) like 108 ranges from as low as 11% to maximum of 58%. Transport Related Adverse Events (TRAE) like hypoxia, Emergency Room (ER)

intubation, pneumothorax, shock/hypotension and hypoglycaemia have been noted in such children. Poorer outcomes in terms of increased mortality and morbidity have been noted in such children who have documented TRAE at the time of arrival in the paediatric ER [5-8]. Data related to the patient characteristics, treatment received and outcome of paediatric patients who utilise the GVK-EMRI services through 108 ambulances are scarce and therefore the data obtained from this study can be used to formulate guidelines for such ambulances that are involved in providing paediatric EMS. In this study, the various attributes of transport and prehospital emergency care received by critically ill children and their outcome have been described. The primary objective was to characterise paediatric prehospital care with emphasis on demography, presenting symptoms, treatment given, prehospital times, vitals monitoring and interventions done during transport. Secondary objective was following-up these children during their hospital stay and assessing their outcome.

MATERIALS AND METHODS

This descriptive cross-sectional study was conducted at Cheluvamba Hospital, a tertiary care referral teaching hospital attached to Mysore Medical College and Research Institute, Mysuru, India from July 2018 to June 2019. This study was permitted by the Institutional Ethics Committee (EC REG: ECR/134/Inst/KA/2013/RR16).

Inclusion criteria: All children aged between 0-18 years transported by the GVK-EMRI affiliated 108 ambulance during the study period between July 2018 to June 2019 for need of emergency care and admitted to the Emergency Department (ED) of Cheluvamba hospital were included in the study.

Exclusion criteria: Children transported by private ambulances which are not recognised by the state/central government for providing EMS and children arriving in the ER through personal mode of transportation were excluded.

Procedure

The BLS ambulance is one which was equipped with an oxygen cylinder, Blood Pressure (BP) apparatus, nebuliser and a stethoscope. An ALS ambulance is one which had defibrillator-monitor, Electrocardiography (ECG) machine, syringe pump, pulse oximeter, resuscitation kit and a suction machine in addition to the equipments of a BLS ambulance [3]. Cheluvamba hospital is a state-run tertiary care referral teaching hospital. A 108 ambulance transports sick children from Mysuru city and surrounding districts. A senior Paediatrician and two postgraduate students are posted round-the-clock in the paediatric ER. Sick children received in the ER are attended immediately and stabilised as per the Neonatal/Paediatric ALS (NALS/PALS) guidelines [9]. After stabilisation, the patients were shifted to either the Neonatal or Paediatric Intensive Care Unit (NICU/PICU).

Definition

- **Response time:** It was defined as the time interval between the receipt of call by the communication/dispatch officer at the call centre and communicating the same to the EMT of the nearest ambulance to the scene of emergency;
- **On-scene time:** The time interval between the receipt of the call by the EMT to the arrival and intervening (if any) at the scene of emergency and to start to the hospital for definitive care;
- **Transport time:** The time interval between the start from the scene of emergency to the arrival at the ER in hospital [10].

After the arrival of the ambulance; on a prestructured and pretested proforma, details of the type of ambulance, number of EMS personnel accompanying the child, response time, on-scene time and transport time was noted. Demographic details of the child, vitals monitored by the EMT and any interventions done at the scene of emergency or during transport were also noted down from the case records maintained by the EMT. Child was categorised to be unstable at ER, if on arrival, child was hypoxic {Oxygen Saturation (SpO_2) <92% in room air}, hypoglycaemic {General Random Blood Sugar (GRBS) <25 mg/dL in the first four hours of life; <35 mg/dL between 4-48 hours of life and <60 mg/dL in neonates aged more than 48 hours and older children}, had respiratory failure (needing immediate endotracheal intubation), or had shock (absent/feeble peripheral pulses). Written informed consent was obtained by the parents/caregivers and the children were followed-up with the hospital diagnosis till their discharge/death.

STATISTICAL ANALYSIS

The data obtained were tabulated in Microsoft Excel. Continuous data was presented as mean (standard deviation) whereas categorical data were presented as frequency (percentage). Chi-square test was used to find out the statistical significance and p-value of <0.05 was considered significant.

RESULTS

The data of 147 children who fulfilled the inclusion criteria were analysed which resulted in the following observations. All children were transported in BLS ambulance. Each ambulance had a driver and only one EMT who was responsible to maintain the case record, monitor the child and intervene with any procedure (if required).

Of the 147 children, 3 (2 neonates and 1 adolescent/teenager) were brought dead. Among the remaining 144 children, 42 were neonates (aged between 0-28 days) and 102 belonged to the general paediatric population (29 days to 18 years). The mean age of the neonates and general paediatric population (older children) was 12.17±7.68 days and 5.50±5.01 years, respectively. Males encompassed 61.8% (24-neonates, 65-older children), and 57.64% (22-neonates, 61-older children) hailed from a rural background. Most of the neonates 71.43% (30/42), and only 21.57% (22/102) of the older children were picked from a hospital/healthcare facility; rest were picked up from their respective homes. Mean 'on-scene' time was 12.12±2.34 and 5.50±5.01 minutes and 'transport time' was 33.79±16.78 and 26.11±14.2 minutes for neonates and older children respectively [Table/Fig-1].

Medical cases predominated with respiratory distress being the most common complaint 32.64% (67/144), 12 surgical cases of which 4 neonates with imperforate anus, 3 children with acute appendicitis and 5 children with Road Traffic Accident (RTA) were also admitted [Table/Fig-2]. The neonates had a mean HR/min, RR/min and temperature (in °C) of 129.86±27.91, 59.90±15.40 and 36.14±0.84; while in older children it was 112.81±28.39, 34.87±14.86 and 37.40±0.96 respectively. GCS was monitored only for children aged more than 6 years and most of them (36/39) had a GCS of 13-15. Blood pressure was monitored only for children more than 11 years and most of them were normotensive [Table/Fig-3]. Most of the children 84.02% (121/144) were administered oxygen, and i.v. fluids were administered in 63 (43.75%) children [Table/Fig-4].

Sepsis was the most common 35.71% (15/42) admission diagnosis in neonates; respiratory conditions like Wheeze Associated Lower Respiratory Tract Infection (WALRI), bronchopneumonia, bronchiolitis

Parameters	Neonates (n=42)			Paediatrics (n=102)		
		n (%)	Mean±SD		n (%)	Mean±SD
Age	0-7 days	16 (38.10)	12.17±7.68 days	1 month-1 year	25 (24.51)	5.50±5.01 years
	8-14 days	08 (19.05)		>1-5 years	38 (37.25)	
	15-21 days	12 (28.57)		6-10 years	18 (17.65)	
	22-28 days	6 (14.28)		11-18 years	21 (20.59)	
Gender	Male	24 (57.14)	-	Male	65 (63.73)	-
	Female	18 (42.86)		Female	37 (36.27)	
Area of residence	Urban	20 (47.62)	-	Urban	41 (40.20)	-
	Rural	22 (53.38)		Rural	61 (59.80)	
Patient pick up site	Hospital	30 (71.43)	-	Hospital	22 (21.57)	-
	Home	12 (28.57)		Home	80 (78.43)	
Transit time (in minutes)	On-scene time		12.12±2.34	On-scene time		5.50±5.01
	Transport time		33.79±16.78	Transport time		26.11±14.22

[Table/Fig-1]: Demographic characteristics of the study population (N=144).

Presenting symptoms/Diagnosis of EMS agency		Neonates (n=42) n (%)	Paediatrics (n=102) n (%)
Respiratory distress		18 (42.86)	49 (48.04)
Convulsions		4 (9.52)	16 (15.69)
Febrile illness		-	15 (14.71)
Loose stools		1 (2.39)	5 (4.90)
Poisoning		-	2 (1.96)
Snake bite		-	2 (1.96)
Diabetic ketoacidosis		-	2 (1.96)
Sepsis		3 (7.14)	-
Jaundice		2 (4.76)	3 (2.94)
Birth asphyxia		6 (14.29)	-
Prematurity		2 (4.76)	-
Poor feeding		2(4.76)	-
Paediatric surgery	Surgical cases	4 (9.52)	3 (2.94)
	Road traffic accident/head injury	-	5 (4.90)

[Table/Fig-2]: Distribution of study population based on the presenting symptoms/ diagnosis of the EMS agency.

Vital parameters	Temp (°C) Mean±SD Min	Max	HR/PR (beats per minute) Mean±SD Min	Max	RR (breaths per minute) Mean±SD Min	Max
Neonates (n=42)						
0-7 days	36.23±0.84		132.75±30.98		57.87±15.19	
	34.40	37.10	98	185	38	80
8-14 days	36.19±0.83		132.88±29.92		62.75±15.78	
	34.40	36.90	112	185	38	80
15-21 days	36.01±0.89		123.17±28.25		58.83±17.28	
	34.40	36.90	98	185	38	80
22-28 days	36.10±0.96		131.5±18.64		63.67±14.17	
	34.40	36.90	113	166	42	80
Cumulative	36.14±0.84		129.86±27.91		59.90±15.40	
Paediatrics (n=102)						
1 month-1 year	37.41±0.98		126.64±24.38		43.40±10.12	
	36.50	40.0	90	188	28	60
>1-5 years	37.75±1.09		123.32±28.11		43.37±13.51	
	36.50	40.10	85	170	24	72
6-10 years	36.87±0.42		93±14.76		21.67±5.67	
	36.50	37.80	70	116	15	33
11-18 years	37.20±0.78		94.33±23.42		20.67±5.59	
	36.50	39.10	67	154	14	36
Cumulative	37.40±0.96		112.81±28.39		34.87±14.86	

[Table/Fig-3]: Distribution of study population based on vital parameters monitored by EMS personnel.
HR: Heart rate; RR: Respiratory rate; SBP: Systolic blood pressure; GCS: Glasgow coma scale; EMS: Emergency medical service; SBP was measured only in children above 11 yrs, Minimum BP recorded: 94 mm Hg; Maximum BP recorded: 126 mm Hg; Mean BP recorded: 116.67±8.61mm Hg; GCS was recorded for children more than 6 years; In age group 6-10 years; 2 children had GCS of 8-13 while 16 children had GCS of 13-15; In age group 11-18 years; 1 child had GCS of 8-13 while 20 children had GCS of 13-15

Interventions	Neonates (n=42) N (%)	Paediatrics (n=102) N (%)	Total (n=144) N (%)
Oxygen administration	35 (83.33%)	86 (84.32%)	121 (84.02%)
i.v./i.m. drugs	-	8 (7.84%)	8 (5.55%)
i.v. fluid/bolus	8 (19.05%)	55 (53.93%)	63 (43.75%)
i.v. cannulation	-	10 (9.8%)	10 (6.94%)
Nebulisation	-	18 (17.65%)	18 (12.5%)

[Table/Fig-4]: Distribution of study population based on the interventions done by EMS personnel.
i.v.: Intravenous; i.m.: Intramuscular

and lobar pneumonia were the predominant diagnoses 48.03% (49/102) in older children. Overall, 34.02% (49/144) children were found to be clinically unstable at arrival [Table/Fig-5]. Total 88.2% (127/144) of the children were discharged, while the remaining 11.8% (17/144) succumbed to their illness. Mean duration of hospital stay was 12.74±8.05 and 7.56±4.76 days in neonates and older children respectively [Table/Fig-6]. Mortality was significantly higher in patients with "on-scene time" of more than 15 minutes, transport time of more than 30 minutes, hypoxia, shock, and respiratory failure at the time of admission in the ER [Table/Fig-7].

Diagnosis	n	Unstable condition at admission	
	Neonates (n=42)		
Early and late onset sepsis	15	Hypoxia	6
Meconium aspiration syndrome	8	Hypoglycaemia	3
Preterm	9	Respiratory failure	2

Neonatal convulsions	4	Shock	8
Hyperbilrubinemia	2	**Total**	**19 (45.23%)**
Imperforate anus	4		
	Paediatrics (n=102)		
Respiratory (WALRI, bronchopneumonia, Lobar pneumonia	49	Hypoxia	21
Acute diarrhoeal disease	5	Hypoglycaemia	1
Infections (Enteric, dengue, rickettsial)	15	Respiratory failure	3
Infective hepatitis	3	Shock	5
Diabetic ketoacidosis	2	**Total**	**30 (29.41%)**
Acute encephalitis syndrome	16		
Road traffic accident	5		
Appendicitis	3		
Snake bite	2		
OP compound poisoning	2		
Cumulative cases	**144**	**49 (34.02%)**	

[Table/Fig-5]: Distribution of study population based on hospital diagnosis.

Outcome	Neonates (n=42)		Paediatrics (n=102)	
	n	%	n	%
Discharge	36	85.71	91	89.21
Death	6	14.29	11	10.79
Mean duration of hospital stay (in days)	12.74±8.05		7.56±4.76	

[Table/Fig-6]: Distribution of study population based on outcome.

Factors	Death (n=17)		p-value
	Number	Percentage	
On-scene time >15 mins (n=72)	14	19.44	**0.042**
Transport time of >30 mins (n=77)	15	19.48	**0.026**
Hypoxia (n=27)	17	62.96	**<0.001**
Respiratory failure (n=5)	4	80	**<0.001**
Shock (n=13)	12	92.30	**<0.001**

[Table/Fig-7]: Factors associated with outcome of sick children.
p-value <0.05 considered significant

DISCUSSION

Research related to EMS agencies in India is scarce and therefore the prehospital phase of critically ill children who utilised the available EMS was studied. GVK-EMRI owned 108 ambulances have been the backbone of providing EMS to both adults and children in most of the states and union territories of India.

During the course of this study, the data of 147 children who utilised EMS was analysed and this accounted for less than 5% of all Emergency Department (ED) admissions. Other children who sought emergency care, either used their personal transport or private ambulances which were not equipped to provide EMS. Studies across India have shown that the percentage of paediatric patients using EMS to reach the paediatric ER varies from as low as 0.63% to as high as 58% [5,8,11-13]. Fiefield GC et al., also observed that among the 6190 critically ill children who were studied only 5% of them used EMS, while the remaining used their personal transport [11]. In the present study, around 71.43% (30/42) of neonates and 21.57% (22/102) of the older children had used the EMS for interfacility transfers (i.e., from another hospital/ healthcare facility like primary health centre, community health centre to Cheluvamba hospital). Similar data was found by Singhi S et al., who found that out of the 656 patients who were referred to paediatric ER of Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh nearly 90% of them used EMS for interfacility transfers [8]. These figures were considerably higher compared to those found by Suruda A et al., and Brady W et al., who found that only 10% and 12%, respectively [10,14] of their study population had utilised EMS for interfacility transfers [15,16]. Higher figures from India are probably because of the lack of trained paediatricians in the facilities from which cases are consistently referred to tertiary care paediatric hospitals.

It was observed that the mean 'on-scene' time for neonates (12.12±2.34 minutes) and older children (5.50±5.01 minutes) was lower as compared to those found by Suruda A et al., [10], (20.1±19.0 minutes) and Tsai A and Kallsen G, (18.4±11.18 minutes) probably because none of the cases included in this study received any intervention at the scene of emergency [17]. Sankar J et al., had analysed the data of 319 children who were transported to the paediatric ER of All India Institute of Medical Sciences (AIIMS), New Delhi and found that the median transport time was 22 minutes and this was almost similar to the transport time for both neonates (33.79±16.78 minutes) and older children (26.11±14.2 minutes) in this study [6]. The transport time in India seems to be significantly higher compared to those found by Suruda A et al., (16.9±12.0 minutes) probably because of the lack of green corridor/dedicated lanes meant to be used exclusively by these EMS agencies [10]. Provision of such exclusive lanes for EMS ambulances may decrease the transport time considerably and help to improve the outcome.

While most of the EMS transports was related to respiratory distress (67/144), less than 5% (5/144) of the transports were related to trauma. Tsai A and Kallsen G, in their study which included 3184 children found that 53.07% of their EMS transports were trauma related [17]. Similarly, Suruda A et al.. in their analysis found that 76% of their EMS transports were trauma related [10]. The cohort of children included in this study were predominantly below the age of 5 years (101/144) in whom medical problems predominate; whereas the age group of the cohort studied by Suruda A et al., and also Tsai A and Kallsen G, was predominantly skewed towards the adolescent/teenage age group where children tend to be more independent, adventurous and accident prone [10,17]. This probably explains the contrasting observation related to trauma.

Administration of oxygen was the most common prehospital intervention noted. Other interventions such as administration of i.m. midazolam (for children with active convulsions) and i.v. fluids, insertion of i.v. cannula and administering nebulisation for children with audible wheeze was also done. While oxygen administration, nebulisation and giving i.v. fluids was done across all age groups, its noteworthy that insertion of i.v. cannula and administering i.v./i.m. drugs was attempted only in children aged more than 10 years. This emphasises the fact that the training and skills required for assessment and resuscitation of sick children especially those aged under 5 years are quite unique as compared to adolescents/adults.

Similarly, Tsai A and Kallsen G, observed that 45% of their study population received oxygen, 9.4% received parenteral drugs and i.v. cannula was inserted in 19.5% of children [17]. ALS interventions like endotracheal intubation and cervical spine (c-spine) immobilisation were also done in 5% of children. Data provided by Suruda A et al., showed that i.v. cannulation was done in 12%, parenteral medication was given in 13% and endotracheal intubation was done in 2.5% of their study population [10]. Lerner EB et al., analysed the data provided by nearly 14 EMS agencies in the United States and found that

i.v./intraosseous access was obtained in 13.8%, c-spine immobilisation was done in 6.3%, nebulisation was administered in 2.7%, parenteral medication was given in 0.5%, assisted ventilation was provided in 0.6%, advanced airway was inserted in 0.1% and Cardiopulmonary Resuscitation (CPR) was done in 0.2% of the children transported through these EMS agencies [2]. In this study, 3 children (2 neonates and 1 adolescent) were brought dead to the ER and none of them had received any ALS like endotracheal intubation or CPR.

Children with fever at admission had not received antipyretics during their transport. Nearly 34% (49/144) of children were clinically unstable at admission which required aggressive resuscitation. Total 11.8% (17/144) succumbed to their illness. Prabhudesai S et al., also found that nearly 69.6% of the patients were clinically unstable at admission of which 17.1% succumbed [5]. These findings are dissimilar to those of found by Lerner EB et al., whose data showed that majority of children who used EMS were vitally stable [2]. This re-emphasises the fact that availability of EMS with EMTs who are trained/equipped to provide paediatric emergency care during transport can significantly impact the outcome.

Limitation(s)

The descriptive findings of this study are limited by a relatively small sample size, and also that the population was representative of only one district which may have resulted in regional bias. Secondly, an attempt to find out the training received and the technical abilities of the EMTs to assess and manage basic neonatal and paediatric complaints and also the reason behind not initiating ALS in children who were brought dead was not done. Thirdly, data related to the 'response time' was missing in the case records and the data related to the infection control measures adopted by the EMTs during their interventions were not retrieved. Fourthly, seasonal, weekday vs weekend and diurnal variation of the EMS transports were not analysed. Fifth, statistics related to the total number of EMS transports and the proportion of these transports utilised by the paediatric population during the study period was not computed. Finally, blood pressure was monitored only for children more than 11 years.

CONCLUSION(S)

The data of the present study provides reasonable information regarding the prehospital phase of critically ill children utilising the available EMS. Identifying exclusive EMS ambulances with EMTs who are specifically trained to address the basic necessities of common paediatric and neonatal emergencies; employing and training paramedics to acquire certain skills of paediatric and neonatal ALS might favourably influence outcomes in this subset of critically ill children. This domain warrants further research especially in developing countries like India with special emphasis to the life-saving interventions done during the critical prehospital phase of emergency care.

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PARTICULARS OF CONTRIBUTORS:
1. Associate Professor, Department of Paediatrics, Mysore Medical College and Research Institute, Mysore, Karnataka, India.
2. Assistant Professor, Department of Paediatrics, Mysore Medical College and Research Institute, Mysore, Karnataka, India.
3. Professor and Head, Department of Paediatrics, Mysore Medical College and Research Institute, Mysore, Karnataka, India.
4. Postgraduate Student, Department of Paediatrics, Mysore Medical College and Research Institute, Mysore, Karnataka, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Girish Gopal,
Assistant Professor, Department of Paediatrics, Cheluvamba Hospital, Mysore Medical College and Research Institute, Irwin Road, Mysore, Karnataka, India.
E-mail: girishgpl@gmail.com

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