

Symposium

Pre Hospital Pediatric Trauma: EMS experience, Improving the Prehospital Care and Road Map for the Future

G.V. Ramana Rao*, Geethanjali Ramachandra**,
Srinivas Puppala***, Aruna Gimkala****, Rani Janumpally****

*Director, Emergency Medicine Learning Centre (EMLC) & Research, GVK EMRI, ** Pediatric Intensivist, Founder member, Pediatric Simulation Training and Research Society India (PediSTARS), ***Regional Transport Officer, Founder Road Safety Club Hyderabad, ****Assistant Partner, Research Department, GVK EMRI

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ABSTRACT

Objectives: To study the Pediatric (age 0-14 years) prehospital trauma pattern for year 2015 in Telangana (TS) and Andhra Pradesh (AP). To highlight the experiences of pre hospital training and injury prevention measures in selected geographies and to recommend road map for the future. **Methods and Materials:** Data collected from Primary sourced computer aided dispatch (CAD) 108 emergency medical response services (EMS) at Gunupati Venkata Krishna Reddy (GVK) Emergency Management and Research Institute (EMRI). Results: Total 9517 children were identified. 5563(58%) stabilised and transported to the hospital. 23% died at the time of EMS arrival. First aid given in 3% and 16% found to be stable and not transported. Medical guidance sought in 30%. Majority were school children 5 to 14years (82%), boys (68%). Evenings 3-7pm, Sundays, month of May saw highest peak. 51% belonged to rural area. Ranga Reddy district had the highest incidence. Government hospitals received 69%. Vehicular trauma calls were higher (75%) than Non-Vehicular (25%). Two wheeler (motorcycle and cyclist) injuries (79%) among vehicular; skid and fall from height in non-vehicular (81%) were top most causes. Conclusion: Two wheeler accidents, skid and fall from height are the most common causes. Such research studies should be an annual feature in all EMS systems. Detailed countrywide study is needed on the use of helmet, speeding, mobile usage, mechanism of fall and place to identify the role of preventive measures. There is an urgent need to improve pre hospital trauma care and implement preventive strategies to stem the tide of trauma deaths.

Keywords: Pediatric trauma, Prehospital Care, Safety Education, Road Map.

Introduction

Pediatric trauma in the context of pre hospital care attention of researchers and policy makers in India. Trimodal distribution of trauma deaths reveals that most of the deaths occur during the first peak, within seconds to minutes. Mode of the trauma differs in children from adults. Understanding the pattern of trauma to identify risk factors and urgent implementation of injury prevention measures are the only answers to stop these preventable deaths. Second peak occurs within minutes to several hours. Timely prehospital care, rapid assessment, resuscitation and transfer during this time critical period is crucial for survival and prevention of secondary injury¹.

Scale of the problem: According to World Health Organisation (WHO), 95% of the child injuries deaths occur in poor and middle income countries and India has one of the highest proportions of childhood injuries in the world². National Crime Records Bureau (NCRB) 2014 reported that there has been remarkable 63% rise in injury deaths in India in the past decade. India lost 451,757 precious lives in 2014 compared to 277,263 in 2004 to injuries³. This is only tip of the iceberg as many cases are underreported. Injuries are the 3rd and 4th leading cause of death in children aged 5-14 and 1-4 years respectively as shown by Medical Certification of Causes of Death- MCCD 2014 data, Ministry of home affairs India⁴.

Correspondence: Dr G.V. Ramana Rao, Director, Emergency Medicine Learning Centre (EMLC) & Research, GVK Emergency Management and Research Institute (EMRI) DevarYamzal, Medchal Road, Telangana 500 014.
Telephone: +91 40 23462388
E-mail: ramanarao_gv@emri.in

Methods and Materials

This was a retrospective observational study. Analysis of records was done for the year 2015 using Microsoft Excel. Source data: Computer Telephonic Integration (CTI) database retrieved from Emergency Management and Research Institute (GVK EMRI)

emergency response centre at Hyderabad for the period of one year (January to December 2015) from the operating states of Andhra Pradesh (AP) and Telangana (TS). Distressed callers for Pediatric ages from 0 to 14 years who complained of Trauma related emergencies caused due to Vehicular and Non-Vehicular injuries and availed GVK EMRI-108 emergency ambulance services were included in the study. Data collected regarding time and place of trauma, age group, causes of trauma, type of hospital transferred and follow from callers at 48 hours.

Information on prehospital training, "education and enforcement" was documented by the experiences of the co-authors involved with respective activity. Future road map recommended is the consensus among the researchers of this scientific paper.

Results

9517 children aged 0-14 years were enrolled. 5282 (56%) belonged to AP and 4230(44%) to TS. Out of 9517 total, 5563(58%) were stabilised and transported to the hospital. 1560(16%) were found to be stable and 238(3%) required first aid only by trained emergency medical technicians (EMT) and hence not transported.

Sadly 2156 (23%) children died prior to the arrival of EMS. Medical guidance from emergency response centre physicians (ERCP) at EMRI was sought in 2852(30%). Highest numbers of victims among admitted and first aid given were school aged children 5-10 years (43%), 11-14 years (39%), followed by 1-5 years (16%) and infants (3%). Exact age was not documented in some children who were not alive on arrival at scene; hence not included for age group analysis. Boys were in majority (68%) with male female ratio 2.1:1.

Causes of trauma: Vehicular trauma victim were much higher proportion in this study 7116(75%) than non-vehicular trauma 2401(25%). The details are given in **table1**. Top causes in vehicular category were two wheeler injury 5605 (79%) which included both motor bike and cyclist followed by multiple vehicular collision 607(9%) and auto rickshaw 470(7%). Among non-vehicular injuries skid and fall 1278(53%), fall from height 659(27%), electrocution 230(9.5%), crush injuries 55(2.3%) and near drowning 46(2%) were the top risk factors. Please see **figure 1**.

(Table 1) CAUSES OF TRAUMA IN PEDIATRICS (Age 0 to 14 Years)					
Causes of Trauma		ANDHRA PRADESH		TELANGANA	
Sl. No.	Trauma (Non Vehicular)	No. of cases	%	No. of cases	%
1	Skid and Fall	788	52.9%	490	54%
2	Fall from height	428	28.7%	231	25%
3	Electrocution	133	8.9%	97	11%
4	Others	75	5.0%	42	5%
5	Crush Injuries	32	2.1%	23	3%
6	Near drowning (Suicidal/accidents)	29	1.9%	17	2%
7	Hit by Object	6	0.4%	10	1%
8	<i>Total (sum Sl.No. 1 to 7)</i>	1491	100.0%	910	100%
Sl. No.	Trauma (Vehicular)	No. of cases	%	No. of cases	%
1	2 Wheelers (Bike+Bicycle)	2985	79%	2620	79%
2	Multiple Vehicular Accidents (Two/More Vehicles)	325	9%	282	8%
3	3 Wheelers (Auto)	270	7%	200	6%
4	4 Wheelers	72	2%	67	2%
5	Train Accident	69	2%	73	2%
6	Others	56	1%	47	1%
7	Pedestrian (Run Over/Hit & Run)	19	1%	31	1%
8	Total (sum Sl. No.1 to 7)	3796	100%	3320	100%
9	Sub Total (sum Sl.No. 8 & 9)	5287	56%	4230	44%
Grand Total (Su Sl. No.10)		9517			

Table1. Causes of Trauma in Pediatrics during year 2015

Figure 1) AP and TS Trauma Non-Vehicular distribution (n=2401)

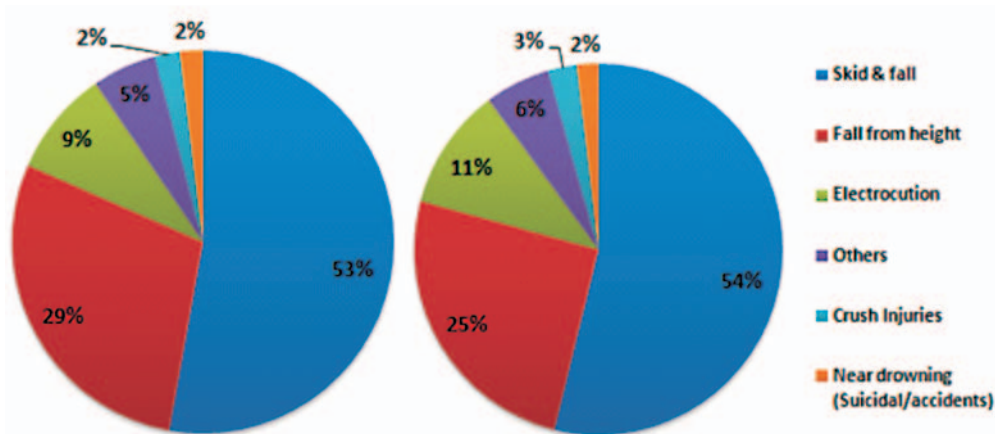


Fig 1. Pediatric trauma Vehicular and Nonvehicular distribution . (AP- Andhra Pradesh. TS- Telangana State)

Timing of Pediatric Trauma: Month of May (1018-11%) and July (998- 10.4%) saw the maximum injuries, November and December being the good months (4.5% each). Highest peak was reported on Sunday 1676(18%) as shown in **figure 2**. Out of 9517, majority of trauma 3376(35%) occurred at evening hours between 3-7 pm which is illustrated in **figure 3**.

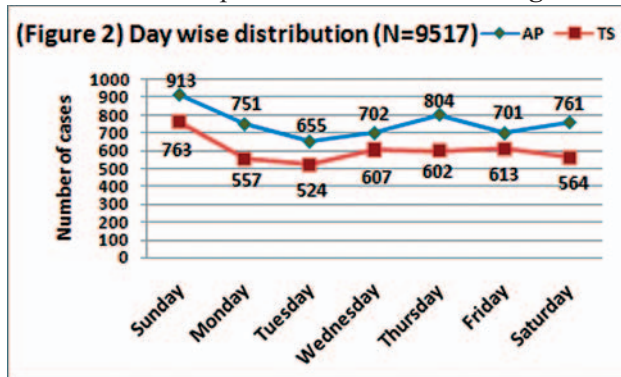


Fig2. Trauma incidences day wise. (AP- Andhra Pradesh. TS- Telangana State)

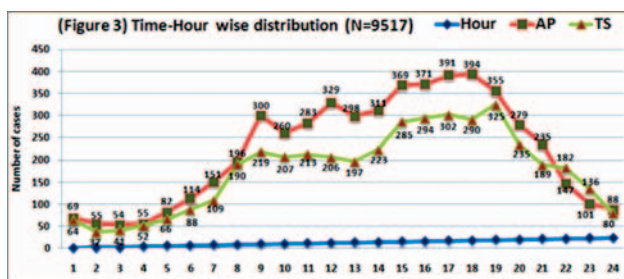


Fig3. Pediatric Trauma hourwise distribution. (AP- Andhra Pradesh. TS- Telangana State)

Geographical distribution: Out of 9517 cases, maximum were reported from Ranga Reddy district (905) in TS followed by Chittoor district (631) in AP as shown in **figure 4**. Rural area saw 4839(51%) of the injuries, Urban 42% and tribal 6% (not known in 1%).

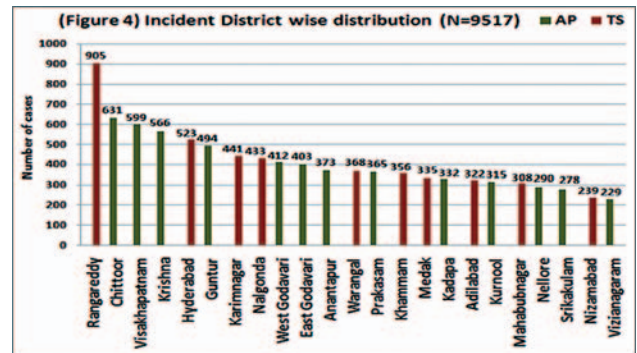


Fig4. Pediatric trauma distribution in districts of Andhra Pradesh (AP) and Telangana State (TS)

Destination Hospital and Follow-up: Out of 9517 injuries, 5401(57%) were admitted to the hospitals. Majority (71%) were transported to the government hospitals, 26% to private hospitals and 3 % to trust hospital. GVK EMRI follows up the callers at 48 hours for feedback information on patient status and quality of services. Unfortunately feedback was very poor; only 6% (321) of the callers could be contacted. Of these, 265(83%) said injured were recovered and discharged from hospital, 11(3%) were still in the hospital but stable and 5 (2%) children died. 40(12%) said they did not know as they were bystanders.

Discussion

Up to 80% of the childhood injuries can be prevented by application of simple strategies¹. There has been a move away from use of the term “accident”, because of its implication of inevitability. On the other hand, the term “injury” has been used to indicate that these are events that can be studied, understood and therefore prevented.⁵

Male children are at much higher risk which is similar to other hospital based studies from India⁶. What is striking is the disproportionately high rate of two wheeler accidents. Alarm bells were ringing too in 2014 NCRB report about this rising trend³. Underage motor bike driving is increasingly becoming a social problem. Helmet usage is negligible whilst riding bicycle. In India, head and neck are the common mode of injury and head injury is the highest cause of mortality from pediatric trauma⁶⁻⁸. According to WHO, 718 children die daily from only road injuries, this is much more than a jumbo jet crash!

Skid and fall and fall from height are the second top most causes followed by electrocution and crush injuries (such as television fall). We fear that the magnitude of the problem is much higher as many parents still bring these children (non- vehicular trauma) to hospital by rickshaw or bus. Studies from hospitals in Asian countries have shown that injuries in children occur commonly at home followed by road^{6,7,9}. WHO states that worldwide 47,000 children and teenagers lose their precious lives to falls in per year. Higher proportion of incidents on Sunday, holiday months and after school hours highlights the need for urgent action plan to help vulnerable children. It is indeed tragic that 23% of children died before the EMS arrival. The average time for 108 ambulance arrival is 15 minutes. Training first responders and injury prevention strategies to reduce this first (highest) peak of trimodal death in trauma is the only solution. The present study has the potential to help implementing these strategies as it has captured data on origin of incidents and was able to identify the hotspots.

Medical direction was sought in a significant number of cases. Emergency Response Centre Physicians (ERCP) are available round the clock at EMRI to support the EMTs. Trained Emergency Medical Technicians (EMT) in the ambulance provide evidence based prehospital care under the guidance of

ERCP.

Limitation of the study is that it is retrospective and further prospective studies are required which includes feedback from receiving hospitals regarding the outcome. Majority of the population using 108 ambulances is from lower socioeconomic group. Hence this study may not represent the whole community; however this is a first step towards analysing the prehospital data and calls for all EMS across India to come together for this cause.

How do we improve the Prehospital care?

Haddon Matrix: William Haddon was one of the pioneers in injury prevention and in 1970, described a two dimensional model called Haddon Matrix. It is the most commonly used brain storming tool that combines epidemiology triangle (host, agent, and environment) and levels of prevention before, during and after the event. If we apply this paradigm to pediatric trauma, we can more effectively increase use of proven strategies^{10,11}

- a) **Pre-event:** Factors contributing are small stature, bravado, curiosity, inexperience, poor quality of vehicle, unsafe balcony, terrace, playgrounds and pools, speed limit, pedestrian and cyclist facilities, roadworthiness, underage driving, poverty, caregiver depression, enforcement laws and community training.
- b) **Event:** Helmet, seatbelt use, speed, median barrier, supervision by adult, visibility, child lock in bottles, covering electrical sockets, smoke detector etc.
- c) **Post event:** Bystander training in first aid, EMS response and training, rapid triage and access to appropriate emergency stabilisation centre.

Can this be applied in Indian scenario? The biggest question is how can we make it work in a complex country like India? Lack of acknowledgement of what can be done, lack of ownership, poor regulations & enforcement are some of the challenges we face in India. Here we share a few examples of small steps taken locally in Hyderabad and TS (**Fig 5**).

- i) **Improving the Prehospital Care:** GVK EMRI Hyderabad is a non- profit, largest pre-hospital

emergency service provider in the country delivering speedy and quality emergency care at free cost. There are 10,783 state of the art ambulances handling 26,618 emergencies per day in 15 states and 2 union territories across India. In collaboration with Stanford University USA, GVK EMRI has been providing world class basic and advanced EMT course since August 2005 which includes both learning at the EMRI centre and hands on experience at the hospitals. Basic course consists of 400 hours training in triaging, basic airway, ventilation, circulation and stabilization skills. In addition, pre hospital trauma focus is given on primary assessment including level of consciousness using AVPU (Alert, Verbal, Pain, Unresponsive) scale. Wound management, fixing moving and lifting, arrest of active bleeding, use of splints, recognition of signs of shock, categorization of trauma victims into critical and non-critical and seeking online medical direction. Trauma protocols are separately given for head injuries, spinal injuries, chest trauma, extremity injuries, abdominal trauma, pelvic trauma and crush injuries. Majority of basic EMTs are also trained 2 day ITLS (International Trauma Life Support) recognized by American College of Emergency Physicians (ACEP). Use of GCS (Glasgow Coma Scale) was found to be limited in precise implementation.

Advanced course duration is for 2 years, making them proficient in Advanced airway management, blind insertion airway device, ventilator support, suctioning, needle decompression, sealing sucking chest wound, cardiopulmonary resuscitation (CPR), electrocardiogram (ECG) interpretation, spinal immobilisation, cannulation-intravenous/intraosseous, medication administration and bleeding control through experiential learning.¹²

ii) Injury Prevention–Community involvement: Road Safety Club (RSC) Hyderabad, a registered non-government organisation has been bringing together school children, parents, teachers, local universities, public officials, transport department, traffic police and other community groups towards changing mind set, regarding road safety. Having signed up for United Nations “Decade of action, Road Safety 2011-2020”, since past 3 years RSC has trained greater than 200 government and private schools. Encouraging students to conduct road shows and flash mobs at

traffic junctions, poster competition, workshops, and formation of junior road safety club in schools have generated significant interest. In addition Road safety club is working with heavy vehicle, auto rickshaw and bus drivers towards road injury prevention¹³

iii) Enforcement with a difference–Helmet study: Helmets are shown to improve the survival by 42%. Every euro spent on Helmet saves 29 euro by preventing injuries and saving lives⁵. Adilabad district in TS which had the lowest helmet usage below 3% saw a unique enforcement technique in 2016. RTO Adilabad and team with support from district collector met with all the petrol and diesel pump dealers and enforced the rule “No Helmet No Petrol.” This was preceded by intense campaign at petrol stations, local newspaper, radio and TV channels. This improved the helmet wearing compliance by 60%



Fig5. From Clockwise- prehospital care training at Emergency Management and Research Institute (EMRI), Road safety campaign and enforcement Telangana

What can be done? - Road map for the future

The need for aggressive efforts to prevent injuries is greatest and is the need of the hour. A rapid decrease in childhood injuries can be achieved with political will, creation of national and regional action plan, maintaining national trauma registry, scientific approach, and commitment from all sectors. Mortality and morbidity from trauma have reduced significantly in many countries by implementing preventive action plan and introducing **integrated trauma care system**^{5, 14-20}. We recommended some simple steps – Education, Enforcement combined with Environmental change; the key stones to enable

India to be put on a better place on global injury map.

1) **Establishing Emergency Stabilisation Centres (ESC):**

- GVK EMRI with its ability to capture on data on origin of incidents of trauma emergencies (vehicular and non-vehicular) is able to identify the hotspots. Road crash and other trauma victims who needed advanced stabilisation; if can be managed closer to the incident location and then transported to a definitive care centre which is most often far off in Indian context. Emergency stabilisation centres close to the road traffic injury hot spots provide to the extension/widening of opportunities of survival chance.
- Advanced airway, SMRD (spinal motion restriction device) application, hemorrhage control, management of shock, and pre-arrival communication are a few interventions which can be carried out. A trained Paramedic and a basic EMT can manage these 1,100 square feet Emergency stabilisation centres. The cost of establishing such centers is 25 lakhs Indian rupees per ESC.
- Two ESCs are already functioning in the outskirts of city of Chennai, TN (Tambaram and Padyanellore). On an average 10-12 critical cases are stabilized every day in each of the centres. This model has the potential to be implemented across India if **integrated** in to the national trauma care system and it is our greatest opportunity to save lives.

2) **Training of Bystanders:**

- Bystanders (first responders) have a key role to play in trauma management with particular role in triggering emergency response services activation, CPR if needed, arrest of active bleeding, reassuring the victims and enable scene safety (cordoning).
- With the advent of Good Samaritan Law In March 2016; bystanders will not only be free from the harassment of police but will be getting

appreciated for providing first aid. An untrained bystander is likely to harm a crash victim.

- We recommend half a day first responder course to the, police, Asha workers, school and college students, motivated volunteers, teachers, drivers, village heads, and shop keepers. If commenced in selected areas as a pilot project and later stage wise implementation across the country; could prove to be one of the most promising interventions to mitigate the consequences of injury. This will also help capacity building at community and national level to handle mass casualties¹⁴

3) **Mandatory safety education and first aid training in Schools:**

- Children are our most precious assets and training them at the budding age towards building injury free country should be considered as not as an option, but compulsory.
- Road safety education must include experiential learning in road crossing, helmet use (motorcycle and bicycle), speeding, drunken driving, mobile phone use, seat belt usage in all seats, underage driving, triple riding and emergency evacuation drill from school bus. Safety training regarding injury prevention at playgrounds and home, basic first aid training including choking must be integrated in to the curriculum at the primary and secondary school levels.

4) **Enforcement:**

- Since the majority of deaths occur at the scene of injury within minutes of collision, Indian policy makers must come forward to make safety enforcement as a priority.
- Victorian state of Australia showed reduction in fatality of road accidents from 30.8 to 8.4 per 100,000 population by primary prevention including world's first mandatory seat belt legislation, compulsory bicycle helmets, speed cameras, random alcohol testing and mandatory blood tests for admitted victims¹⁵. It is time India learnt lessons from other countries to stop

ongoing carnage on the roads.

- Stringent rules must be enforced for obtaining driving licence. Enforcement of strict regulations for domestic buildings (balcony, terrace, window safety and smoke alarms), play areas, road design, pedestrian and bicycle passages.
- Enforcement is more effective when simultaneous public awareness campaign is undertaken through media. Using Information Technology Services (ITS) in detecting offenders is feasible and is a simple solution to overcome the shortage of manpower for enforcement.

5) **Responsibility of Hospital and Health care Professionals:**

- Health care providers are in a unique position to be an advocate to reduce these preventable deaths. In addition to conducting trauma resuscitation courses to hospital staff (such as ATLS); improving the ambulance services for rapid inter-hospital transfer, training paramedic (ITLS), data registry and educating parents regarding injury prevention are a few steps towards demystifying the intricacies of prehospital trauma care.
- It is crucial to recognise that effective interventions during the first and second peak of trimodal distribution will ultimately alleviate the magnitude of the problem during the third peak; which is the intensive care phase of the injured^{1,21}. The primary responsibility of 108 ambulances is towards care at the scene of injury than inter-hospital transport. There are several other ambulance services used for inter-hospital transport; some of which do not have trained EMT or paramedic. There is a pressing need to strengthen the quality of these ambulance services and effective linkage between all EMS providers and hospitals across the country.
- Forming a local network with all the hospitals, teachers, voluntary bodies and liaison with police to launch injury prevention campaign will effectively utilise the power of community in preventing injuries. Encouraging parents to use ambulance rather than bringing seriously injured children by public transport can make a huge impact.
- Information leaflets to parents (containing safety

measures for home, play area, supervision of toddlers); displaying messages at the waiting area, integrating injury prevention counselling during routine health checks and vaccination sessions should become part of patient care in every hospital.

Conclusion

Pre hospital Pediatric trauma care is one of the most neglected areas in Indian Health care system. Studying the pattern of trauma in detail should be an annual feature in all EMS providers. There is an urgent need to introduce National integrated trauma care system in India to improve trauma care and implement preventive strategies to stem the tide of trauma deaths. If all of us make concerted efforts, we can make significant difference in saving lives of thousands of children and even bigger impact on avoiding distressing disability.

What this study adds?

Two wheeler injuries followed by skid and fall from height are the common causes of pediatric trauma. It is possible to plan strategies by studying the patterns and hot spots for injury which is one of the major barrier to improving prehospital trauma care in India.

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