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The first national data of Turkish pre-hospital emergency care for children: Epidemiology, clinical characteristics, and outcomes

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Abstract

Background and Objectives: The emergency medical service system is designed to ensure rapid identification and transport of patients from the field to emergency departments. This study aims to examine pediatric patients' clinical characteristics and reasons for ambulance use in Turkey. Life-saving interventions and non-life-saving interventions performed during transport and patients' outcomes following transport were also investigated.

Methods: This is a prospective-multicentric study conducted at four metropolitan cities and nine tertiary pediatric emergency departments. This survey-based study evaluated all children brought by ambulance to emergency departments. Patient demographics, clinical features, triage levels, procedures performed in the ambulance or emergency department, and final outcomes were sought.

Results: A total of 2094 patients were transported during the study period. Only a minority of ambulances were physician staffed (16.5%), and 72% of the patients were delivered to pediatric emergency departments without notification calls. Although notification calls were more likely given for particularly critically ill children, for non-urgent conditions transfer calls were less common (60.8% vs 23.5%, respectively; $p < 0.001$). A majority of transports were performed for trauma patients (20.5%), neurological issues (20%), and toxicological emergencies (13.8%). While parents prefer using the ambulances for medical emergencies, physicians prefer it for mainly traumatic and toxicological emergencies. In total, 65% of the patients received at least one intervention, and 18 patients needed immediate life-saving interventions (intubation, cardiopulmonary resuscitation, etc.) but they did not receive it. Mortality occurred in nine patients. If the

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health care providers were paramedics, they were more likely avoided by performing any intervention in critically ill children ($p < 0.001$). A majority of the procedures performed in children were older than 12 months ($p < 0.001$).
Conclusion: This study presents comprehensive epidemiological and outcome data for pediatric patients transported by the national emergency medical service system in Turkey. Non-urgent calls were more likely made by parents, physicians avoided making NCs, and paramedics also avoided performing any intervention when they were transporting children.

Keywords
Ambulance, children, life-saving interventions, pre-hospital care

Introduction

Emergency medical service (EMS) systems are designed to reduce morbidity and mortality for those experiencing life-threatening medical emergencies in a pre-hospital setting.[1] The primary tasks of the EMS systems are to rapidly identify emergency patients, provide out of hospital medical care, and transport to the most appropriate emergency department (ED) for advanced care.[2,3] In developed countries, equipment and training were primarily aimed at adult patients, and little attention was paid to the requirements of ill children until the Emergency Medical Services for Children (EMSC) legislation in 1985.[4–6] Although the EMSC system is well recognized for decreasing the morbidity and mortality in the United States, in Turkey, even the epidemiology of pediatric patients using ambulances and the appropriateness of this usage remains unknown.

In the years before 2000, the Turkish Ministry of Health (TMH) introduced national EMS systems and they were similarly geared primarily toward adult patients. Ambulances provide free pre-hospital care, including scene to health facility and inter-facility transfers. A free ambulance phone number (112) is used for access by the public. The main care providers are paramedics who have limited short-term pre-hospital/inter-hospital adult–patient-based care training.[7]

Even in developed countries, significant limitations exist in the area of pediatric EMS. So far, in the current literature, there is a lack of information describing the demographic characteristics, utilization rates, and outcomes of pediatric patients using the EMS system. This study aims to examine pediatric patients' clinical characteristics and reasons for ambulance use in Turkey. Life-saving interventions (LSI) and non-LSI performed during transport and patients' outcomes following transport were also investigated.

Materials and methods

Study design

According to the Address Based Population Registration System (ABPRS) released by the Turkish Statistical Institute in 2014, Turkey had a total population of 77.695 million, with 22.838 million children aged 0–18 years. The proportion of children in the four most populous provinces, Istanbul, Ankara, Izmir, and Adana, stood at 27.9%, 26.3%, 23.7%, and 30.7%, respectively.

This prospective study was conducted in four metropolitan cities and nine tertiary pediatric EDs. Patients aged under 18 and presenting to one of the participant EDs (four in training and teaching hospitals and five in university hospitals) between 1 August 2014 and 1 August 2015 were included in the study.

Study setting, population, and data collection

A data collection google form was sent to all EDs before patient enrollment began. Each data form was completed by the physician who provided medical care for the patient upon arrival. Epidemiological data such as age and gender, clinical features, presentation time (during or out of normal working hours), triage levels, notification calls to the receiving facility, and reasons for transport were recorded. The specialty of the referring physician, emergency care provided either by the EMS crew or the ED staff was also investigated. LSI and non-LSI procedures were classified based on the Emergency Severity Index triage instrument v4.[8] According to this system, five immediate LSI have been defined as follows: airway and breathing (bag-valve-mask ventilation, intubation, surgical airway, continuous positive airway pressure (CPAP), and biphasic positive airway pressure (BIPAP)), chest compression (CC), electrical therapy (defibrillation, emergency cardioversion, external pacing), invasive procedures (chest needle decompression, pericardiocentesis, and open thoracotomy), hemodynamics (significant intravenous (IV) fluid resuscitation, blood administration, and control of major bleeding), and medications (naloxone hydrochloride, dextrose 50%, dopamine, atropine, adenosine, and epinephrine). Critically ill children (CIC) are defined as patients who require immediate LSI or need intensive care admission for any reason.

Ambulance patients were divided into four age groups based on the Pediatric Advanced Life Support (PALS) guideline: 0–28 days (group 1), 28 days–1 year (group 2), 1–10 years (group 3), and 10–18 years (group 4). This study was approved by the local research ethics committee (13–4.1/14).

Statistical analysis

Statistics Package for Social Sciences 22.0 software (SPSS Inc.; Chicago, IL, USA) was used for statistical analysis. Continuous data were represented as mean with standard deviations. Categorical variables were expressed as frequency (%). The chi-square test was used to compare demographics in terms of age groups and time and month of presentation; p values lower than 0.05 were regarded as statistically significant.

Results

Between 2014 and 2015, 380,000 children visited nine EDs in four cities, and only 2094 (0.55%) of these children arrived via EMS. The mean age of the ambulance patients was 7.0 (±5.5) years, and 55% were boys. Most patients arriving via EMS were more likely located in the age groups 3 and 4 at 50% and 31.7%, respectively (Table 1). Ground ambulance was the most commonly used modality for pediatric transports (94%). The physician staffed ambulance ratio was only 16.5%, the main EMS providers were paramedics (Table 1).

Table 1. Characteristics of transported children and EMS crew.

	n (%)
Sex (male)	1309 (54.9)
Age, mean (±SD) (years)	7.0 (±5.5)
0–28 days	62 (2.6)
28 days–1	375 (15.7)
1–10	1192 (50)
10–18	755 (31.7)
Distance (km), mean (min–max)	38.6 (0.2–950)
Notification call	
No	1698 (71.2)
Yes	686 (28.7)
Transport from	
Home	620 (26)
Field	446 (18.7)
Hospital	1028 (55.3)
Referred center	
Primary care hospital	140 (6.7)
Secondary care hospital	779 (37.2)
Tertiary care hospital	172 (8.2)
Others	67 (3.2)
EMS staff	
Physician	346 (16.5)
Paramedic + AEMT	1048 (83.5)

EMS: emergency medical service; SD: standard deviation; min: minimum; max: maximum; AEMT: ambulance and emergency care technician.

Table 1 displays the frequency of dispatched patients' transfer sites. Secondary care hospitals served as the main referral site for 37.2%, while 26.2% of the patients were brought from their homes. Most frequently, the dispatch decision was given by a pediatrician (46.8%). Most receiving facilities did not receive a notification call from most transports (71.2%). Patients transferred from the scene or home were less likely to undergo diagnostic tests and/or interventions, most of them (75%) were more likely to be discharged following primary assessment in the fast track unit (Table 2). Although cases transported from home included slightly more medical emergencies than those transported from hospital (70.8% vs 60.7%, $p < 0.001$), those transported from hospital included more traumatic (14.9% vs 4.9%, $p = 0.00$), and toxicological emergencies (17.1% vs 11.9%, $p = 0.023$; Table 3).

If patients were referred from a secondary care hospital, they had higher rates of hospitalization to intensive care units and they were more likely to receive LSI. Although notification calls were performed particularly for CIC, these calls were frequently not made for non-urgent conditions (60.8% vs 23.5%, respectively). Notification calls were more likely made for transport from hospitals and CIC (both, $p < 0.001$; Table 4).

The majority of transports in the present cohort were performed for trauma (20.5%), neurological issues (20%), or toxicological emergencies (13.8%). Table 5 shows details concerning types of patients' diagnosis. Older children (groups 3 and 4) were usually transferred for trauma or poisoning (42.8%). Our data showed that most physicians (83%) contacted the National Drug and Poison Information Center when they had to manage a child suffering from poisoning. On the contrary, younger children (groups 1 and 2) were more likely brought to the ED for other medical emergencies (80.8%).

Although 65.1% of children received at least one intervention during transport, for 730 patients no single ambulance resource (LSI or non-LSI) was utilized. About a quarter of them had a situation requiring urgent intervention: 93

Table 2. Comparison of transported patients who received life-saving interventions based on referral sites.

Life-saving interventions	Referred center							*p*
	Home	Field	Primary care hospital	Secondary care hospital	Tertiary care hospital	Private hospital	Total	
Yes	24	26	5	130	32	10	227	0.000
No	520	366	135	649	140	57	1867	
Total	544	392	140	779	172	67	2094	

Table 3. Comparison of the transport center and the causes of transport, clinical characteristics, and LSI at the ED.

	Transport from		*p*
	Home, *n* (%)	**Hospital,** *n* (%)	
CIC	24 (4.4)	177 (15.3)	0.000
LSI at the ED	42 (7.7)	111 (9.6)	0.706
AMS	63 (11.6)	158 (13.6)	0.247
Traumatic emergencies	27 (4.9)	173 (14.9)	0.000
Medical emergencies	385 (70.8)	704 (60.7)	0.000
Toxicologic emergencies	65 (11.9)	199 (17.1)	0.023
Discharge	394 (72.4)	445 (38.4)	0.000

CIC: critically ill children; LSI: life-saving interventions; ED: emergency department; AMS: altered mental status.

Table 4. The association between transport site and CIC with notification call.

	Notification call		*p*
	+	−	
Transport from			
Home	15	529	0.000
Field	13	379	0.000
Hospital	548	610	0.000
CIC			
No	438	1429	0.000
Yes	138	89	

CIC: critically ill children.

(12.7%) seizure/status epilepticus, 73 (10%) altered mental status, 5 respiratory failure, and 4 supraventricular tachycardia (SVT; Table 6).

If the health care providers in the ambulance were paramedics, they were more likely to avoid performing any intervention during transport for CIC ($p < 0.001$). The majority of procedures were performed in patient groups 3 and 4 ($p < 0.001$). Twenty-five patients received immediate LSI in the ED upon arrival; however, for seven of them, the transport team avoided performing any intervention. Overall, one fourth of the ambulance patients were discharged after ED assessment at the fast track unit, 32% were admitted to a ward, 10.4% were admitted to an intensive care unit, and nine patients died. Demographic features, clinical characteristics, and interventions on those patients who died are shown in Table 7. The discharge rate of ambulance patients who were brought from home was considerably higher than those who were brought from a hospital (72.4% vs 38.4%, respectively; $p = 0.000$; Table 3).

Discussion

This study describes the characteristics of pre- or inter-hospital pediatric transport in Turkey over a 12-month period.

Table 5. Diagnosis of children who arrived by EMS.

Trauma	428 (20.5)
Major (ISS > 11)	76 (17.8)
Minor	352 (82.2)
Toxicity type	286 (13.8)
Drug	175 (60.7)
Paracetamol	64 (36.6)
NSAI	32 (18.3)
Antidepressant	8 (4.6)
Organophosphates	7 (4)
Rodenticide poisoning	7 (4)
Multidrug	74 (42.3)
Carbon monoxide poisoning	52 (18)
Substance use	18 (6.3)
Thinner	5 (28)
Alcohol	3 (17)
Ecstasy	8 (44)
Synthetic Cannabis	2 (11)
Scorpion bite	12 (4.2)
Others	29 (10.8)
Medical emergencies	1380 (65.7)
Neurological	419 (20)
Afebrile convulsion	215 (10.3)
Febrile convulsion	56 (2.7)
Status epilepticus	16 (0.7)
Respiratory	247 (11.8)
Bronchopneumonia	113
Acute bronchiolitis	40
Asthma attack	15
Tracheostomy patient	24
Foreign body in respiratory tract	14
Cardiac	89 (4.3)
Chest pain	39
SVT	12
Cardiomyopathy/heart failure	28
Syncope	48
Infectious diseases	159 (7.6)
Acute gastroenteritis	62(3)
Sepsis	22
CNS infection (meningitis/encephalitis)	32 (11/21)
Acute tonsillopharyngitis	25
Acute otitis media	18
Gastrointestinal	79 (3.8)
Abdominal pain	36 (1.7)
Bleeding	15 (0.7)
Foreign body in gastrointestinal tract	12 (0.6)
Non-traumatic surgical	85 (4.1)
Acute appendicitis	37
Corrosive substance ingestion	40
VP shunt dysfunction/infection	8
Endocrinological	24 (1.1)
Diabetic ketoacidosis	16
Diabetes mellitus (Type 1)	6
Hypoglycemia	2

NSAI: nonsteroidal anti-inflammatory; SVT: supraventricular tachycardia; CNS: central nervous system; VP: ventriculoperitoneal; ISS: Injury Severity Score.

Table 6. Characteristics of transported patients, EMS distance, and procedures on the route.

Life-threatening event based on clinical findings	Distance (mean, min–max) (km)	Glasgow Coma Scale			Vascular access		Procedures				
		<7	7–14	15	+	−	BMV	ETI	CC	Others	None
Respiratory failure	36.8 (5–124)	36	41	97	145	29	9	11	0	0	5
Cardiac arrest	21.7 (3.6–35.1)	18	0	0	17	1	5	14	3	2	0
Status epilepticus	32.95 (2.8–120)	6	7	3	11	5	1	0	0	7	8
Supraventricular tachycardia	27 (10–104)	0	0	12	8	4	0	0	0	5	7
Status asthmaticus	58.5 (3–310)	0	0	15	11	4	0	0	0	4	11
Diabetic ketoacidosis	75.8 (4–300)	0	2	14	15	1	0	0	0	3	13
Altered mental status	62.6 (1–950)	42	212	0	181	73	5	49	0	30	170
Shock *(septic-hypovolemic, cardiogenic)*	93.6 (5–450)	5	9	1	11	4	2	3	0	7	5

EMS: emergency medical service; BVM: bag valve mask ventilation; ETI: endotracheal intubation; CC: chest compression.

Table 7. Patients who died in the ED after transport.

No	Sex	Age (mo)	Distance by EMS (km)	Referral sites	EMS staff	Procedures in EMS					Transfer call	Diagnosis
						Oxygen by mask	Vascular access	BVM	ETI	CC		
1	F	72	5	Tertiary	Paramedic	Yes	Yes	No	No	IE	No	Respiratory failure[a]
2	F	36	110	Secondary	Physician	Yes	Yes	No	No	IE	Yes	Septic shock[a]
3	F	13	3	Home	Paramedic	No	No	Yes	No	IE	No	Respiratory failure[b]
4	F	84	95	Secondary	Paramedic	No	Yes	Yes	No	IE	No	Trauma[b]
5	F	19	4	Primary	Physician	No	Yes	Yes	Yes	E	No	Congenital cardiac anomaly[b]
6	F	14 d	100	Secondary	Paramedic	No	Yes	Yes	Yes	IE	Yes	Congenital cardiac anomaly[a]
7	F	24	30	Secondary	Paramedic	No	Yes	Yes	Yes	IE	Yes	Septic shock[a]
8	M	3	20	Tertiary	Physician	No	Yes	Yes	Yes	IE	Yes	Trauma[a]
9	M	42	20	Field	Paramedic	No	Yes	Yes	Yes	IE	Yes	Trauma[a]

mo: months; d: day; EMS: emergency medical service; BVM: bag valve mask ventilation; ETI: endotracheal intubation; CC: chest compression; F: female; M: male; E: effective; IE: ineffective; ED: emergency department.
[a]Patients who died during follow-up in the ED.
[b]Patients who died upon arrival at the ED.

It is also the first national study to demonstrate the clinical and epidemiological characteristics of all pediatric transports which were performed by an ambulance in one of four metropolitan cities.

Based on limited previously published data, the rates of pediatric ED admission by ambulance worldwide were 14% for all children and 5.3% for those under 15 years of age.[9] These rates vary based on geographical characteristics: 5.2%, 7%, and 13% in South Korea, New York, and Canada, respectively.[10–12] The rate of patients brought to the ED by ambulance in this study was 0.55%, and it was quite low when compared to the literature. One explanation for this difference may be that Turkish parents or caregivers may prefer to come with their own cars or by commercial taxi, believing that the ambulance would be delayed. Most parents also believe that ambulances provide only transport care rather than medical care since they are staffed only by paramedics. The main reasoning for parents may be to reach the hospital as quickly as possible rather than relying on the medical care, which can be provided in the ambulance. Ambulances without skilled personnel likely fail to provide pediatric pre-hospital care as intended, or in a worst-case scenario, may actually represent a danger. Our findings strongly suggest that improvement in pre-hospital pediatric ALS care is needed as soon as possible. It can be done by performing more emergency medical technician (EMT)–paramedic clinical training courses, simulation-based transport studies, and practice. In developed countries, specially trained critical care transport teams are dedicated to performing transport of all CIC. EMS administrators, policymakers, and ED directors should work together to improve the present EMS system. Since medical care during transport impacts both short- and long-term outcomes for CIC, ongoing training is essential.

We strongly believe that there are interesting issues in the present Turkish pediatric EMS system and they should be improved as soon as possible. The biggest issue was the lack of interventions performed on patients by paramedics,

and this can be solved by performing focused pediatric ALS and simulation-based CIC transport courses. Another beneficial way is to create a dedicated transport team particularly for CIC as in developed countries.[13] The lack of calling ahead for notification to the receiving facility is another factor which may affect the final outcome, especially for children who needed LSI. If the tertiary ED providers get notification calls concerning CIC while they are still on the road, then the team can prepare the resuscitation room in order to achieve the best outcome.[14] We believe that all EMS crews should make a notification call to the receiving facility when transferring a critically ill patient.

The referral system in our country plays a major role in managing the flow of patients from the primary care physician's office to secondary and tertiary institutions (as the health care system structure is based on these three levels). Since our findings demonstrate that CIC were referred from secondary or tertiary care facilities, this condition may be explained by a higher pediatric population despite the limited intensive care bed capacities. In 2006, it was estimated that approximately 60,000 children needed intensive care per year. However, at that time, the total number of available intensive care beds did not even reach 20% of this estimate.[13] A Turkish Society of Pediatric Emergency and Intensive Care Medicine survey illustrated that Pediatric Intensive Care Unit (PICU) facilities were available in only 18 out of 81 (22.2%) Turkish cities.[13] The best description for inter-hospital (mainly from one tertiary to another tertiary care hospital) transport of CIC is the low availability of PICU in some tertiary care hospitals throughout the country. We believe that when intensive care beds for children reach a homogeneous distribution throughout the country, then these transfers will no longer be necessary. The referral system for non-urgent cases should also be modified, since most patients can be managed at the primary care physician's office or secondary care hospitals and they do not need to be transferred to tertiary care facilities. Strict regulations are needed in the national referral system.

It has been recommended that EMS providers should contact the receiving ED in order to reduce the risk of communication failures and to improve the care provided.[14] Transfer calls should be made not only for critically ill patients, as in this study, but also for all patients transported by ambulance.

The most common pre-hospital administered interventions have been revealed as cervical spine immobilization, vascular line, and basic and advanced airway management.[15,16] Although the TMH authorizes paramedics to perform all these aforementioned interventions (life-saving or non-life-saving), this study showed that even some CIC did not receive any procedures. Previously published data emphasized that establishing vascular access can be difficult in a pre-hospital setting, especially in younger, less cooperative children.[17] Similarly, a minority of this study patients who needed a vascular line (due to SVT, status epilepticus, altered mental status, or respiratory failure) were brought to the ED without stabilization. This is thought to be because paramedics receive very limited training compared to physicians and nurses, and most rarely have to manage critically ill or injured children.[18]

The paramedics in this study avoided performing any intervention on CIC similar to previously published works.[19,20] Non-physician EMS staff possess insufficient knowledge and experience to carry out these procedures, and they prefer to transport patients to the final ED without stabilization, even in cases of respiratory or cardiac arrest. This is the most likely explanation for those patients who are clearly dead, or subjects who have been pronounced dead, being transported via ambulance. In such cases, mortality cannot be prevented (since it has already occurred), and transporting such cases places the public and the EMS team at risk of traffic accident in the process. In addition, there can be no benefit to the patient in transporting a dead body. Unnecessary transport of decreased patients negatively impacts upon EMS resources for other patients who may truly benefit from them.

Limitations

This study has several limitations, including a lack of physiological data for patients at the time of pick-up (blood pressure, pulse, Glasgow coma scale, fever, respiratory rate, oxygen saturation, general condition, etc.), and a lack of detailed information concerning physical examination, accurate reasons for referral, some transport times, costs, and patient characteristics in the referral hospital. Our data collection form did not include the attempt or failure rate of LSI. This is an important limitation of this study. We also did not analyze and compare patients (and their outcomes) who received LSI in the ED and were not transported by ambulance.

Conclusion

This study presents comprehensive epidemiological and outcome data for pediatric patients transported by the national EMS system in Turkey. Non-urgent patient transport was overestimated, most patients were brought without notification calls, and paramedics preferred to transfer CIC directly to the ED rather than to perform interventions. The mortality rate was higher in CIC who did not receive LSI during transport.

The most interesting conclusions in the present survey are relevant to modern emergency medical practice, including the lack of calling ahead to notify receiving facilities and the lack of performing interventions on patients by paramedics. These issues should be addressed and solved as soon as possible.

This study highlights key aspects of pediatric emergencies that should be of assistance to EMS administrators,

policymakers, and ED directors in planning for the care of acutely ill and injured children.

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