ORIGINAL ARTICLE

Mapping of pathways of care, assessment of delays and gap analysis in provision of care following road traffic injury among patients in selected tertiary hospitals in urban Karnataka, South India

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Abstract

Background: Evidence-based public health advocates decision making based on best available scientific evidence, hence it is important to gather evidence of current scenario of trauma care. **Aim & Objective:** To determine pathways of care and delays among Road Traffic Injury patients and assess gaps in resources. **Settings and Design:** This cross-sectional study was conducted in selected tertiary care hospitals in Mangaluru taluk, Karnataka. **Methods and Material:** Participants were administered validated proformas on prehospital and hospital care. WHO trauma care checklist was used for capacity assessment and gap analysis. **Statistical analysis used:** Time intervals are expressed as measures of central tendency and dispersion. Descriptive analysis is given as percentages and proportions. **Results:** Median pre-hospital time was 30 minutes. Overall, 67.5% of the patients reached within golden hour. Majority (64.1%) were directly transported to current hospital. All patients received first aid, but only 0.8% received it at the RTI site. First aid was mostly administered by doctors (68.7%) or nursing staff (31.1%) and none by bystander. Insurance coverage was 32.8% and 87.9% incurred out of pocket expenditures. Scores were low in GP level hospital. **Conclusions:** Although transport was within the golden hour, pre-hospital care was poor. Out of pocket expenditures were high.

Keywords

Pathways of Care; Road Traffic Injury; Golden Hour

Introduction

Road traffic injuries (RTIs) are currently the ninth leading cause of death globally and are predicted to become the seventh leading cause of death by 2030. (1) India has one of the highest numbers of road deaths globally with a mortality rate of 16.6 per 1,00,000 population compared to 10.6 in the USA and 2.9 in the UK. (2) Road safety is a multisectoral public health issue. (3) The concept that the first 60 minutes following traumatic injury is a critical period for getting patients to a trauma centre is deeply ingrained. (2,4,5) In reality, there is not so much a “golden hour” as a chain of opportunities for intervening across a longer timescale. (2,3,6,7) In other words, the trauma care system encompasses a continuum of care that provides injured persons with the greatest likelihood that they could return to the prior level of function. This includes appropriate triage and referral, ambulance intimation and dispatch as well as prehospital care, in-hospital care and rehabilitative services. (8,9) With this in mind, we attempt to study the pathway while calculating the time between points within it. We also perform capacity assessment and gap analysis at each level, limiting ourselves to RTI care.

Aims & Objectives

1. To determine pathways and assess delays in pathways of care following RTI from the event through the range of post trauma care till the outcome (death or survival and costs) among patients admitted to selected hospitals in Mangaluru.
2. To assess gaps in resources and services for care following RTI among selected hospitals in Mangaluru.

Material & Methods

Study type: This cross-sectional study is part of a larger mixed-methods study

Study duration: This was conducted for 2 years

Study area: It was done in selected tertiary care teaching hospitals in Mangaluru, Dakshina Kannada district, Karnataka.

Study population: This was conducted among the eligible patients admitted in the selected tertiary care teaching hospitals.

Sample size calculation and sampling: As our primary objective was assessment of delays, proportion of cases reaching tertiary care beyond golden hour was used to estimate the sample size. (10) Hence, the minimum sample size was calculated as 338 using OpenEpi, with p as 32.68% (proportion with delay beyond golden hour), absolute precision of 5% and confidence interval of 0.95. (10, 11) To account for non-response of 15%, final sample size was calculated as 390. Since this was a part of larger facility based mixed methods study, the unit of sampling was tertiary level teaching hospitals. Based on the rule of thumb, 50% of total no. of teaching hospitals in Mangalore (total N= 6), 3 institutions were selected for recruiting the participants. We decided to recruit equal number of patients to the extent that was possible, while also taking into account the feasibility/ ease of administrative permissions.

The first institution which was included during the protocol development phase, denied permission during data collection. The second institution had 2 different multi-specialty hospitals: one hospital attached to the medical college and the other corporate specialty hospital within the same campus, both of which were included for recruitment. The third institution ran a multispecialty hospital as well as an outreach centre, both of which cater to trauma care. Thus, form the third institution, we included 3 sites- the medical college hospital, the speciality hospital and the outreach centre. Hence, data collection was ultimately done in 5 sites (Figure 1).

Definitions: Road Traffic Injury is defined as:

a) a fatal or non-fatal injury incurred as a result of a collision on a public road involving at least one moving vehicle
b) that require hospitalization with out-patient (casualty) or in-patient care

Inclusion criteria:

a) All patients brought to the selected trauma centres with a history of collision on public road involving at least one moving vehicle
b) Patients belonging to any age group

Exclusion criteria:

a) Fatal cases (brought dead) of RTI will not be included
b) Patients who refuse consent

Data collection: This was done in 3 phases.

In the first phase, training material and data collection tool were developed and validated. The research assistant was recruited and trained. The questionnaire was piloted for feasibility issues and revised.

In the second phase, after necessary administrative permissions, data registries were maintained in the hospitals based on the data collecting tool. Consecutive patients were recruited from each site until the sample size was reached. Details regarding prehospital care including first aid (defined here as immediate stabilization) were collected after obtaining informed consent. In addition, patient outcome details including death and out of pocket expenditure (OOPE) were also collected. The information regarding self-reported disability was collected telephonically after 1 month. Monitoring of data collection and cross-verification of data was done by the principal and co-investigators.

In the last phase, World Health Organization (WHO) “Full Essential Trauma Care Checklist (EsTC)” was used to assess the gaps in the health facility for trauma care. Data was collected through direct facility inventory. Matrix was applied for 14 categories of care. Each item was listed as - Essential (E), Desirable (D), Possibly Required (PR) and Irrelevant resources (I) with rating as NA (Not applicable at that level), 0 (Absent), 1 (Inadequate), 2 (Partially adequate- present, but use not assured; present, but not all the time; present, but not readily available), 3 (Adequate- present and used appropriately). For 3 of our sites, we used the tertiary hospital checklist (2 medical college hospitals and 1 corporate hospital), for the outreach centre we applied the GP level checklist and the specialist hospital checklist was applied to the specialist hospital as per the definitions and criteria given in EsTC guidelines.

Ethical approval: The institutional ethical clearance from the ethical committees of the respective medical college institutions was obtained.

Data analysis: Descriptive analysis was done as percentages and proportions. Direct pathway meant those patients that were directly transported to the current hospital. The indirect pathway consisted of the patients who had been to one or more points of care before they reached the current hospital. Time taken at each point in the pathway was assessed as appropriate measures of central tendency and dispersion under the following heads: (12,13) SPSS was used for the analysis.

In the case of patients being transported by ambulance, the following time intervals are calculated

Notification time: Time from the event of RTI to call for an ambulance

Activation + response interval: Time from the call for an ambulance to the arrival at the site

Transport interval: Time between departure from the site of RTI (irrespective of the vehicle of transport) and arrival at the current hospital in those patients who were brought directly to the hospital. In those patients who had been to other points of care before arriving at the current hospital, transport time 1 (time of departure from the site of RTI to arrival at the first health care facility), 2 (time of departure from the first facility to arrival at the second facility, if referred from the first facility) and 3 (time of departure from the second facility to arrival at the current facility, if referred from the first facility) are calculated between each point of care.

Pre-hospital time is the time from the event of RTI till the arrival of the patient to the hospital. In the case of patients being brought from other points of care, only those who were referred to the current hospital after being treated in the casualty or on an outpatient basis were included. Those patients who had been treated on an in-patient basis in earlier points of care were excluded from this calculation.

Results

Sociodemographic details: A total of 396 patients were included in the study. The majority belonged to the 21 to 30 years age group, were males, of the Hindu religion, currently married. Most of them belonged to class 4 socio-economic status.

Phase 2: Pathway analysis

Prehospital care:

- Pathway, time and points of care: Most of the patients were transported from the site of RTI to the hospital in a private 4-wheeler. 74 patients (18.7%) had been transported to the hospital via ambulance (either public or private) (Table 1). The median pre-hospital time irrespective of the pathway was 30 minutes. Overall, 67.5% of the patients reached within the golden hour irrespective of whether they were directly brought to the hospital or had been to other points of care.
- The majority of the RTI patients (64.1%) were directly transported to the current hospital. The median pre-hospital time and transport interval in this direct pathway was 20 minutes and 14 minutes respectively. The proportion of patients brought within the golden hour in this pathway was 95.7%. (Table 2)
- The rest of the study population (35.6%) had been to one or more points of care before they reached the current hospital. The median pre-hospital time in the indirect pathway was 195 minutes and the proportion brought within the golden hour was only 10.4%. (Table 2) District hospital/ other medical college hospitals were the most common facility at both first and second points of contact in the indirect pathway.
- First aid: All patients received first aid (100%), however only 0.8% received the same at the site of RTI or in the ambulance (0.3%). First aid was mostly given by doctors (68.7%) and nursing staff (31.1%). There were no instances where it was given by bystanders.

Hospital care: Only 2 patients were critical enough to warrant direct ICU care on arrival at the hospital. The most common diagnosis was multi-trauma (51.7%) followed by superficial injuries alone (28%) or in combination with other injuries. The most common outcome was discharge with disability (33.3%), followed by complete recovery at discharge (32.3%). 25.5% of the patients died, the most common cause being craniocerebral or brain injury consequent to head injury. However, the cause of death was unknown due to the lack of access to records in many. Insurance coverage among the population was low at 32.8%. Among these, most had only partial coverage. A huge proportion (87.9%) had incurred out of pocket expenditures. The median amount spent on transport, admission, in-patient care as well as the total OOPE was Indian National Rupees (INR) 750, INR 12,000, INR 12,000 and INR 18,178 respectively.

Post-hospital details: On follow up, 11 could not be contacted and 10 had died. We did not ascertain if the death was due to complications related to RTI. The majority did not have any disability at 1 month follow up after discharge. However, 34.6% said they did have a disability, out of which most were partial (94.9%) and were showing signs of improvement. Only 11% said they could not perform daily activities independently. 23.7% was still on treatment for RTI, out of which the majority were on medications alone (74.5%) or on a combination of medication and physiotherapy (18.1%).

Phase 3: Capacity assessment and gap analysis

a) Proportion of essential items adequately present

At the GP level: The lowest proportion of essential items adequately present was in the rehabilitation component (Nil). The highest proportion of all essential items adequately present was for the abdominal injury component (100%).

Specialist hospital: The lowest proportion of essential items adequately present was in the abdominal injury component (Nil) whereas the highest proportion of all essential items being adequately present was in the safety component (100%).

Tertiary hospitals: All essential items were seen in all the 3 tertiary hospitals in airway knowledge and skills, breathing, circulation equipment and supplies, head, neck, chest, extremity, spinal injuries, burns and wounds, pain control and medicines as well as the safety component. The least proportion of essential items adequately present in tertiary hospital 1 was in abdominal

injury (75%); in tertiary hospital 2 and 3 was in rehabilitation (25% and 75% respectively).

b) Scores: total and sub-scores

The total scores were low across most of the components of the matrix in the GP level hospital except the safety for the health personnel. GP hospital scored least in the components of rehabilitation (nil) whereas it scored maximum in the safety component (80%). The specialist hospital, tertiary teaching hospital 2 and tertiary corporate hospital 3 scored least for the rehabilitation component of the matrix (15%, 54% and 91% respectively). The tertiary teaching hospital 1 received the least score for equipment and supplies for airway management (92%). (Table 3)

Discussion

The median prehospital time in our study is similar to other studies in India (14, 15) and elsewhere. (13) However, a study done among all trauma patients in a tertiary care hospital in Mumbai found the median prehospital time of 1.52 h which was much higher. (16) However, in their study majority (70%) of the patients had been transferred from other hospitals in contrast to ours wherein 64% were directly transported to the hospital. A study in West Bengal found that 67.32% could manage to reach medical college hospital within the golden hour which was very similar to our study. (10)

In the current study, only 18.7% of patients were brought in an ambulance of which only 6.8% were brought in a public ambulance. This is similar to studies done in tertiary setting in urban areas of North India, (17,18) however it is much higher than in a study in rural South India wherein only 7.5% of patients were brought to the hospital in any kind of ambulance. (19) The median activation+ response (9 mins) for the ambulance services and transport interval (14 mins in the direct pathway and 15 mins in indirect pathway) in our study are similar to the analysis of Centralised Accident and Trauma Services (CATS) done by Department of Hospital Administration, AIIMS (15) and a study done in Iran which analysed the time intervals of RTIs for ambulance dispatch sites. (13)

In spite of the fact that the majority of the study population arrived within the golden hour, they were mostly brought on their own, either in a four-wheeler or autorickshaw. Further, it is seen that the majority of patients received first aid after arriving in the current hospital or in the first/ second/ third points of care. The low provision of first aid either at the accident site or in the ambulance as well as underutilization of ambulance for transport of victims is a matter of concern as this might poorly contribute to the patient outcome. This was similar to a study in North India (20) where the majority (85.2%) of subjects received first aid from nearby government hospital followed by nearby private hospital/clinic and only 3% at accident place. Another study in North India found a higher proportion of patients were provided first aid at the accident site at 27%, however similar to our study, the proportion of lay bystanders providing first aid was low (4%). (21)

The analysis of outcomes showed the proportion of deaths during the course of treatment and disability to be 25% and 33 % respectively which were higher than that in a study done in North India. (22) Proportion of deaths in the current study is comparable to a review of RTI cases done in India. (23) However, we have not assessed the injury severity or other determinants of mortality or disability in the current study. In the current study, among those who have been to other points of care, private facilities were utilized more which is similar to the study done in North India. (21) The reasons for this have not been explored here, in the previous study reasons cited include lack of facilities or poor satisfaction with respect to treatment in public facilities. The poor coverage of insurance and high OOPE in the current study is corroborated by other studies in India (24, 25) Although 108 public ambulance services are available free of cost in Karnataka, underutilization of the same, and use of private means of transport, might have contributed to out-of-pocket expenditure incurred for transport. We have tried to explore the reasons for poor utilization of ambulances and lack of provision of first aid in the ambulances or in the primary levels of care in another qualitative study using focus group discussions among road transport officers, toll booth operators and traffic police; the results of which are yet to be published.

Our study found poor scores across the matrix in the GP level hospital which is similar to a study done in South India (26) and elsewhere. (27) The tertiary hospitals in our study scored high in most of the components and had a high proportion of all essential items similar to the study done in Pakistan. (27) Lack of resources in the primary and secondary levels may lead to suboptimal utilization of existing facilities and unnecessary referrals which can contribute to delays in the patients receiving definitive care. This may mean that patients spend money to avail essential services or medications, contributing to OOPE in terms of admission and in-patient care.

Conclusion

Although median pre-hospital time was within the golden hour; components of pre-hospital care including transport and first aid was inadequate as the majority were transported in private vehicles and without first aid. There was no instance of first aid provided by a bystander. The most common outcome was discharge with disability. Insurance coverage among the population was low with a huge proportion having incurred out of pocket expenditures. Overall, the capacity assessment showed that gaps exist with respect to several components both in the GP as well as the specialist hospital.

Recommendation

This study points towards the need for improving access to ambulance services as well as strengthening the delivery of first aid within the ambulance and also by providing training for the first responders. Further, the low insurance coverage and high OOPE needs to be addressed for mitigating the economic impacts of RTI. Also, it is important that there is increased emphasis on the up-gradation of existing facilities and correcting these deficiencies in the resources.

Limitation of the study

Seasonal variation is possible as more RTI cases are expected to occur in the monsoon (June to August), however, we have not analysed the effect of this variation in our primary outcome measure (prehospital time and proportion of cases with delay beyond golden hour). Also, since we have not collected the baseline data on the non-responders; it is not possible to analyse whether non-responders were different from the study population and how it would have impacted the outcome measures.

Relevance of the study

This study adds knowledge on the current status of pre-hospital care with respect to the transport times as well as first aid in an urban setting in India. In addition, it has given an idea regarding the preparedness of different levels of trauma care facilities in urban India.

Authors Contribution

SP and AR contributed to concept, design, literature search, data acquisition, data analysis, manuscript editing and review. RK contributed to concept, design, literature search, data analysis, manuscript editing and review. SS contributed to the concept, design, literature search, data acquisition, data analysis, manuscript preparation, editing and review.

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Tables

TABLE 1 DISTRIBUTION OF STUDY POPULATION ACCORDING TO DETAILS OF PRE-HOSPITAL CARE (N=396)

Type of vehicle				Frequency (Percentage)
Public ambulance (108, health emergency dial number)				27 (6.8%)
Private hospital ambulance				47 (11.9%)
Autorickshaw				80 (20.2%)
Two-wheeler				61 (15.4%)
Four-wheeler other than ambulance				174 (43.9%)
Time details regarding pre hospital care				
A. **Time details for ambulance (n=74)**				
	Median (mins)	**IQR= Q3-Q1 (mins)**	**Mean (mins)**	**Sd (mins)**
Notification interval: Time from RTI to call for ambulance (n= 66)	2	4 (1 to 5)	3.4	2.7
Don't know	8			
Activation + response interval for ambulance (n=68)	9	4.75 (5.25 to 10)	9.2	4.8
Don't know	6			
B. **Irrespective of the vehicle of transport (n=396)**				
Time from RTI to the pick-up of the patient from the site (n=377)	3	4 (1 to 5)	4.9	5.1
Don't know or not applicable	19			

TABLE 2 DETAILS OF TIME AND DISTANCE IN THE DIRECT AND INDIRECT PATHWAY

A. **OVERALL TIME DETAILS IRRESPECTIVE OF THE PATHWAY**				
	Median	**IQR**	**Mean**	**SD**
Overall pre hospital time (n=379)	30	97 (16- 113)	112.7	197.3
Don't know (6 in indirect and 1 in direct) = 7 **Not applicable (patient admitted in a previous point of care in case of indirect pathway) = 10**	17			
B. **DETAILS REGARDING THE DIRECT PATHWAY (N=255)**				
Overall pre hospital time (n=254)	20	15 (15-30)	29.1	57.1
Don't know	1			
Transport interval: Time between pick up and arrival at the current hospital (mins) (n=254)	14	10.25 (9.75 to 20)	18.5	19.3
Don't know	1			
Distance travelled from RTI site to current hospital (kms) (n=254)	3.5	3.8 (2.2 to 6)	5.5	6.6
Don't know	1			
C. **DETAILS REGARDING THE INDIRECT PATHWAY (N=141)**				
Overall pre hospital time (n=125)	195	259 (102 to 361)	282.7	261.5
Don't know = 6 **Not applicable (patient admitted in a previous point of care) = 10**	16			
1. **Pick up to first point of care/ health facility (n=141)**				
Transport interval 1 (n=135)	15	15 (9 to 24)	18.7	15.3
Don't know	6			
Distance travelled between pick up and first point of care (kms) (n=131)	3.9	5 (2.4 to 7.4)	7.6	11.1
Don't know	10			
2. **First to second point of care (n=14)**				
Transport interval 2 (n=7)	205	200 (90 to 290)	187.5	117.1
Don't know	7			
Distance travelled between first and second points of care (kms) (n=13)	82.90	108 (35 to 143)	84.4	57.2
Don't know	1			
3. **Second to third points of care (n=3)**				
Transport interval 3: Don't know	3			
Distance travelled between second and third points of care (kms) (n=3)	148.2	NA	167.5	171.7

TABLE 3 DISTRIBUTION OF THE TOTAL SCORES ACCORDING TO WHO ESTC CHECKLIST

	General practitioner	Specialist	Tertiary 1	Tertiary 2	Tertiary 3
TOTAL SCORES					
Airway management					
Knowledge and skills	12/ 21	14/ 21	21/ 21	21/ 21	21/ 21
Equipment & supplies	19/ 39	27/ 39	36/ 39	32/ 39	38/ 39
Breathing- management of respiratory distress					
Knowledge and skills	9/15	6/ 15	15/ 15	15/ 15	15/ 15
Equipment & supplies	17/ 27	20/ 30	29/ 30	30/ 30	30/ 30
Circulation and shock					
Knowledge and skills	40/ 63	55/ 66	65/ 66	63/ 66	65/ 66
Equipment & supplies	45/ 69	53/ 72	71/ 72	71/ 72	72/ 72
Head injury	9/ 21	9/ 33	33/ 33	32/ 33	32/ 33
Neck injury	3/ 12	5/ 18	18/ 18	18/ 18	18/ 18
Chest injury	3/ 12	6/ 21	21/ 21	21/ 21	21/ 21
Abdominal injury	3/ 12	14/ 18	17/ 18	18/ 18	18/ 18
Extremity injury	21/ 54	50/ 60	60/ 60	60/ 60	60/ 60
Spinal injury	9/ 21	19/ 36	36/ 36	36/ 36	36/ 36
Burns and wounds	21/ 36	31/ 42	42/ 42	42/ 42	42/ 42
Rehabilitation	0/ 12	5/ 33	33/ 33	18/ 33	30/ 33
Pain control and medicines	95/ 183	150/ 183	183/ 183	183/ 183	183/ 183
Diagnosis and monitoring	39/ 69	57/ 93	91/ 93	81/ 93	90/ 93
Safety for health care personnel	17/ 21	18/ 21	21/ 21	21/ 21	21/ 21

Figures

FIGURE 1 FLOW DIAGRAM DEPICTING THE STUDY TECHNIQUE OF RTI MAPPING STUDY