Importance of awareness in improving performance of emergency medical services (EMS) systems in enhancing traffic safety: A lesson from India

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ABSTRACT

Objective: India has been slow in implementing a central emergency medical services (EMS) system across the country. "108 services" is one of the most popular services that is functional under the public–private partnership model. Limited available literature shows that despite access to services, many traffic crash victims are transported using private vehicles. The objective of this study is to understand the effectiveness of 108 services from a traffic safety perspective.

Method: A questionnaire survey is conducted to understand the awareness of EMS and their function. Using traffic-related fatalities as the dependent variable, a fixed effect panel data model is developed to analyze the effectiveness of the 108 services in improving the traffic safety.

Results: The results from the survey show that, in general, people are not aware of the 108 services. A majority of the population prefers taking victims to the hospital using their personal vehicles or any other vehicles available compared to calling an ambulance. Results from panel data analysis show that despite having an efficient system, these services failed to make significant improvement in the safety of road users in the states in which their services were subscribed.

Discussion: The lack of awareness of an important safety service is alarming. This could be a major reason for lower utilization of 108 services for transporting victims of traffic crashes. This article shows the importance of having efficient awareness campaigns to improve the efficiency of any similar programs that are aimed to enhance the safety of a region.

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Introduction

The World Health Organization (2013) reports that more than 1.24 million people are killed on the world’s roads each year and as many as 50 million people are injured in road crashes annually worldwide. About 70% of these fatalities occur in developing countries. Road crashes pose serious social and economic challenges, especially in developing countries. In most of these fatal traffic crashes, the breadwinner for a family is the victim of the traffic crash because they are exposed to traffic the most. India has been investing heavily on building and improving its road infrastructure over the past decade. Along with improvements in infrastructure, traffic-related fatalities and injuries also showed a sudden increase. Total traffic-related fatalities in India for the year 2014 were 141,526 (National Crime Records Bureau 2006), which account for over 10% of the world’s fatalities. Other than these fatalities, it is estimated that traffic crashes also cause over 9,000,000 road user injuries (Mohan et al. 2009). For the 5-year period between 2006 and 2010, the number of road fatalities in the United States was reduced by 21% (NHTSA 2011) and that of the UK reduced by 41% (Department of Transport 2014). During the same time frame, in India, traffic-related fatalities increased by 29%. This shows the potential for addressing traffic safety efficiently on Indian roads.

Role of EMS in saving lives

The emergency medical service (EMS) system plays a crucial role in reducing the number of fatalities and injury severity resulting from a road crash. Records from developed countries indicate the significance of well-organized EMS in saving lives. A majority of victims die because of lack of treatment during the initial few minutes immediately following the incident (Clark et al. 2012, 2013). An efficient EMS helps victims by providing medical assistance during this critical phase. Like most developing countries, India also was slow in understanding the severity of road crashes and the important role that many components, including an efficient EMS system, play in improving overall safety. The following section discusses a brief history of EMS in India.

History of EMS in India

India still does not have a centralized emergency medical response system. Although various cities have private ambulance services, mainly operated by individual hospitals or by private service providers, they are not coordinated (National Institute of Mental Health and Neuro Sciences [NIMHANS] 2012). Because most of these are designed to support the...
customers of these service providers, they are operated with different intents than that of a traditional emergency medical response systems in a developed country. The main purposes of these vehicles are to transport their patients between homes and hospitals or between 2 hospitals. Although these vehicles are available for emergency services, they are not efficiently utilized due to various reasons, some of which are as follows:

1. Lack of service vision: Ambulances are owned and operated mainly by hospitals or by private service providers who are serving a group of hospitals. They typically entertain only their own customers or would take the victims (patients) only to their hospitals, even though there may be other hospitals closer to the victims.

2. Lack of coordination among service providers.

3. Lack of uniform a number for EMS: Because ambulances are operated by different service providers, each of which maintains its own emergency number, making it difficult for the public.

4. Lack of trained professionals in the EMS vehicles: The EMS vehicles are considered transport vehicles to carry patients rather than as emergency response vehicles. In most cases, these vehicles have only a driver and an attendant, who may not be a trained paramedical staff. This means that even if the EMS vehicle reaches the victim in time, the staff may not be trained to give emergency care.

5. Lack of reliability.

6. Lack of reach: Because most of the ambulances are linked to hospitals, they are usually parked at the hospitals. This makes it difficult to reach remote locations in time, especially in rural areas.

Due to these major flaws in emergency response systems, ambulances are not a popular mode for transporting road crash victims in India. A study in Bengaluru, India, revealed that private vehicles/taxies and auto rickshaws were mainly used to transfer injured victims to hospital (NIMHANS 2012). The Bengaluru Injury Surveillance collaborators group data showed that private vehicles were used for transporting almost half of the injured patients to hospital, and one third of the injured patients were transported using auto rickshaws. Ambulances were used mainly to transfer patients from one hospital to another. Bystanders or relatives transport the victims in their own personal vehicles or in any other vehicle available to them. There are several issues in transporting victims in this way. Some of the key problems include the following:

1. Absence of trained personnel.
2. Lack of first aid kits.
3. Lack of proper transporting facility.
4. Inconspicuous vehicles: Because personal vehicles do not have sirens or flashing lights, other road users are not able to recognize vehicles carrying injured victims.

Legal issues are another major factor that discourages people from transporting victims to hospitals. Prior to recent changes in law, people who transport victims were asked to file a report to the police, which consumed quite some time and they would generally have to serve as a witness (Law Commission of India 2006). In addition, before implementation of these recent changes in law, hospitals run by private parties had the right to deny services to victims, forcing the transporter to take the victim to a government-run hospital (Law Commission of India 2006).

Overview of “108 services”

108 Services is a privately run EMS in India that operates and offers services similar to EMS in developed countries. It was started in the state of Andhra Pradesh on August 15, 2005, by a nonprofit organization, the Emergency Management and Research Institute (EMRI). Because it was first of its kind in India, it was well received by the media and by the public. It was marketed as 108 services because 108 is the toll-free number marketed to call for its service. As of early 2015, this service was operational in 16 states and 2 union territories. The major difference in 108 services from similar services in developed countries, such as the United States, is that this service is a public–private partnership between state governments and the private EMS provider. This is unlike in developed countries, where EMS service is completely owned and operated by local governments. In order to receive 108 services, the state governments have to subscribe to their program. There are 2 options: (1) pay an annual subscription fee that is based on the population and its distribution or (2) pay an initial capital fee plus actual operating cost to the service provider. In return, 108 services promise to provide quality reliable EMS services, which includes a guarantee to reach the victims within a defined time, dependent on the type of contract they have in place with that particular state. The EMS vehicles are required to have a trained paramedical staff on duty. Details about 108 services can be obtained from a report by the National Health System Resource Centre (2009). This report also lists brief case studies from 4 states that subscribed to this service. In states where the 108 services are subscribed, their call-in number also serves as a single number to report any emergency including police and fire emergency. Demographics of the states that have subscribed to the services and the number of ambulance vehicles provided are shown in Table 1. The population is based on 2011 census data.

| Sl. no. | State                | Population (2011) | Area (km²) | No. of 108 ambulances |
|--------|----------------------|-------------------|------------|-----------------------|
| 1      | Andhra Pradesh       | 49,379,944        | 8,249      | 802                   |
| 2      | Assam                | 31,169,272        | 78,438     | 899                   |
| 3      | Chhattisgarh         | 25,540,196        | 135,191    | 540                   |
| 4      | Goa                  | 1,457,723         | 3,702      | 32                    |
| 5      | Gujarat              | 60,383,628        | 196,024    | 671                   |
| 6      | Himachal Pradesh     | 6,856,509         | 55,673     | 174                   |
| 7      | Karnataka            | 61,130,704        | 191,791    | 517                   |
| 8      | Kerala               | 33,387,677        | 38,863     | 43                    |
| 9      | Madhya Pradesh       | 72,597,565        | 308,245    | 604                   |
| 10     | Meghalaya            | 2,964,007         | 22,327     | 47                    |
| 11     | Odisha               | 41,947,358        | 155,707    | 108                   |
| 12     | Rajasthan            | 68,621,012        | 342,239    | 592                   |
| 13     | Tamil Nadu           | 72,138,958        | 130,058    | 638                   |
| 14     | Telangana            | 35286,757         | 114,840    | 108                   |
| 15     | Uttarakhand          | 10,116,752        | 53,483     | 245                   |
| 16     | Uttar Pradesh         | 195,281,477       | 240,928    | 1194                  |
| 17     | Dadra and Nagar Haveli| 585,764           | 603        | 13                    |

*Only in a selected districts.

These are 2 separate union territories. However, because they are geographically close to each other, 108 services are provided for these 2 regions together.
Literature review

Not many studies have been conducted to study the performance of 108 services. Only a few studies that are specific to a small region or a city over a short period are available. One such study by Bolla et al. (2011) analyzed utilization of 108 services in Khammam district in the state of Andhra Pradesh. Their study was conducted using data provided by the district coordinator of 108 services for a period of 1 year (June 2008 to May 2009). It was found that road crashes were the second major beneficiary of 108 services. A report by the National Health Systems Resource Centre (2009) summarizes the performance of 108 services from an operations perspective. Their report also discusses the financial commitments and options available to subscribers.

Various interventions and policies are being enforced in many countries with an objective of reducing the number of fatalities. Before-and-after studies have been extensively used to evaluate the safety effects of any improvement. However, because crashes are random in nature and they vary year to year, parameters affecting the crashes also vary. When treatment is applied there is change in safety performance. Treatment effects should be isolated from other effects so that one can find the net improvement due to any facility or policy (Transportation Safety Council 2009). These limitations make before-and-after studies almost impossible when the study is in an area other than a site.

Panel data models are being used by several researchers in different research areas. Bresson et al. (2003) used panel data for 46 countries of England and for 62 urban areas of France over a period of 9 years (1987–1996 for England and 1986–1995 for France). Panel data regression models were used by Deb and Filippini (2013) to study the public bus transport demand elasticity in India. Aggregate panel data for 22 states over the period 1990 to 2001 were used to estimate a number of static and dynamic specifications of a log linear function for public transport. An unbalanced panel data set was used to assess the price and income effect on public bus transport demand. A dynamic structure of demand has been captured using a partial adjustment model. Panel data models can also be used to find the effectiveness of various interventions like emergency vehicle services.

Objective

As discussed in the literature review, only a few studies have been done to analyze the effectiveness of 108 services. Those studies were based on data collected from respective district offices and questionnaire surveys. The objective of the article is to analyze the effectiveness of 108 services in different states in India from a traffic safety perspective.

Methodology

There are several ways to address the objective of the study. In this article, the methodology is divided into two parts: (1) Getting responses on awareness of 108 services through a questionnaire survey and (2) data analysis to check the effectiveness of the 108 services across the country.

In questionnaire surveys, the main objective was to determine the awareness of 108 services or any other emergency services and to understand the public preference on transporting a traffic crash victim. The surveys were conducted in 4 metropolitan cities that had subscribed to 108 services. This was expected to provide insight into the root cause of the problem and awareness of availability. Panel data analysis is commonly used in similar studies due its ability to accommodate large sets of data with temporal variation. In this study, panel data analysis is chosen to evaluate the effectiveness of 108 services across India. Each of these is described in detail in the following sections.

Questionnaire survey

Based on the limited literature available in India, most traffic crash victims are transported in personal vehicles. There could be various reasons for this, including lack of awareness of 108 services and lack of faith in their response time. It can easily be hypothesized that one major reason contributing to the actions of the public is due to lack of awareness of 108 services. It is logical to assume that if people knew about a dedicated service that guarantees response within a specific time, they would call that number when they witnessed a crash. To check this hypothesis, a questionnaire survey was conducted in 4 major Indian cities, namely, New Delhi, Kanpur, Kolkata, and Lucknow, between the months of January and April 2013 to obtain insight on public awareness of 108 services in urban India. No cities from southern or western parts of India were selected for the survey. However, because New Delhi and Kolkata are 2 of the 3 megacities in India, people from other parts of the country are also predominantly present in these cities. All of these cities had subscribed to 108 services at least 2 years before the survey dates. A couple of questions on emergency response were asked as a part of a larger questionnaire. The responders were randomly selected and interviewed in various locations such as bus stations and gas stations. Because the interviews require about 3 min, the responders were given gift cards from one of the leading grocery chains as an incentive for participating in the interview. Each of these cities is a metropolitan city with a population of 4 million or more. It is important to note that the respondents were from urban areas, where exposure to information is higher compared to rural areas where people are predominantly poor and illiterate. Therefore, it is reasonable to assume that for people in rural areas, awareness would be lower than in urban areas. Assuming a binomial distribution for the data, the minimum required number of observations was estimated. For a 95% confidence level and 5% tolerable error, the minimum number of observations was estimated to be 384. A total of 711 surveys were completed. Of the 711 responders, 700 answered the following 2 simple questions on EMS: (1) What would you do if you found someone who had an accident on the road and was in need of urgent medical attention? and (2) Are you aware of any emergency service/number in case of medical emergency?

Panel data analysis

In this study, a one-way fixed effect model was selected as a suitable model after analyzing the data and comparing the performance of fixed effect and random effect models. The performance of various models was compared using Hausman tests.
In the fixed effect model, individual specific effects are assumed to be fixed. Dummy variables are typically included to incorporate the effects of omitted variables. Panel data models were used to determine the effectiveness of various interventions using dummy variable (Hsiao 2003). A simple structure for variance was followed in this model because the fatalities are independent events.

A dummy variable was added for 108 services that has a value equal to 1 for the years the intervention was in use and a value of 0 otherwise. Of the 18 states and union territories listed in Table 1, only 9 were subscribed to the 108 program during the analysis period 2001 to 2010 and data from only these states were used to develop the model. Table 2 shows the months in which 108 services were launched in these 9 states. A dummy variable was assigned a value of 0 for years of launch for all 9 states except for the state of Meghalaya. In Meghalaya, the service was launched in February 2009. For the 10-year period, there were 21 state-years coded as 1 for this dummy variable, with the remaining 69 coded as 0. Data for 10 years were taken for this study (2001 to 2010). The source of fatality data was the National Crimes Records Bureau for various years (National Crime Records Bureau 2011). Population (Census of India 2011), number of vehicles registered (Ministry of Road Transport and Highways 2011), and dummy variable (108 services) were taken as explanatory variables and number of fatalities as dependent variable. Road length, which could have been another explanatory variable to show exposure, was not used as an explanatory variable due to unavailability of reliable data for the analysis period.

### Results

Responders from the questionnaire surveys were predominantly (over 80%) aged 18 to 50 years, which is understandable because this is the major group of working class. The monthly income of responders was well distributed among major income groups (of monthly income in INR, <5,000 to 50,000). Fewer responders were present in higher income groups, similar to the general income distribution in most of Indian cities. Results of the questionnaire surveys are summarized in Tables 3 and 4. As shown in Table 3, fewer than 33% respondents mentioned that they would call for ambulance after witnessing a road accident. One significant observation from this survey is that only about 9% of respondents were worried about police interference. This is positive feedback and could be attributed to the recent changes in law.

Table 4 summarizes the responses to the second question, “Are you aware of any emergency service/number in case of medical emergency?” The responses to this question showed that the majority of respondents were unaware of any emergency medical services. Overall, only about 38% of the total surveyed population in all 4 cities knew about any EMS system (not just 108 services). Of these, 31 responders gave numbers such as 100 and 101, which were emergency numbers for police and fire forces, respectively, who were not equipped to handle medical emergency. These data showed a trend supporting the initial hypothesis that awareness of 108 services was low even among the urban public who had more opportunities than those in rural areas to access information related to the available services. This table also shows that except for Lucknow, the responses exhibit similar trends. A chi-square test for association was employed to analyze the survey data with a null hypothesis that surveyed cities and responses were independent of each other. A chi-square test for association showed that the null hypothesis had to be rejected ($P$ value < .001), indicating that surveyed cities and responses were not independent of each other. The chi-square test was again employed after removing data for the city of Lucknow. The new results showed that the null hypothesis could not be rejected ($P$ value = .97).

The responses of different age groups and income groups are shown in Figures A1 and A2 (see online supplement), respectively. Figure A1 shows that the trend of response remains very similar across all age groups. Over 40% of the responders in the age groups less than 18 years and over 50 years responded that they would call an ambulance if they witnessed a road accident. Though these values were slightly better than those of the other age groups, they were still less than 50%. Figure A2 shows very similar trends across all income groups with about equal proportions of responders choosing between calling an ambulance and taking victims in any available vehicle. The only exception

| Sl. no. | State         | Month of launch |
|---------|---------------|-----------------|
| 1       | Andhra Pradesh| August 2005     |
| 2       | Assam         | November 2008   |
| 3       | Goa           | September 2008  |
| 4       | Gujarat       | August 2007     |
| 5       | Karnataka     | November 2008   |
| 6       | Madhya Pradesh| July 2009       |
| 7       | Meghalaya     | February 2009   |
| 8       | Tamil Nadu    | September 2008  |
| 9       | Uttarakhand   | May 2008        |

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| 5       | Karnataka     | November 2008   |
| 6       | Madhya Pradesh| July 2009       |
| 7       | Meghalaya     | February 2009   |
| 8       | Tamil Nadu    | September 2008  |
| 9       | Uttarakhand   | May 2008        |
patients to hospital (NIMHANS, 2012). The questionnaire survey pointed out previously, studies revealed that mainly private vehicles could be due to several reasons, lack of awareness could be the major contributing factor for this experience. This indirectly means that the public is not utilizing the benefits of 108 services effectively.

Discussion

Lack of awareness of 108 services could be preventing the public from full utilization of the services. Survey data showed that people in India generally did not wait for ambulances in case of road accidents and prefer the locally available mode of transportation. The survey data showed that the awareness of 108 services was very poor among the respondents and was almost the same across different age groups and income groups. Although questions were specifically asked about responses in case of traffic crashes in the survey, the same can be assumed in case of other medical emergencies as well. This study indicates that 108 services have not been utilized efficiently by public due to lack of awareness.

Several of the respondents mentioned 100 and 101 as the call-in number for medical emergencies. In fact, these aeromedical emergency numbers for police and fire station, respectively. This shows the importance of having a single number for all emergencies similar to 911 in the United States.

The fixed effect panel model applied to evaluate the effectiveness of 108 services showed that the presence of emergency vehicle services had no significant impact on traffic safety. In this study, due to a lack of reliable data, number of fatalities was taken as the variable to describe traffic safety. Although number of traffic injuries could have been another useful variable to evaluate the effectiveness of such an EMS system, it was not considered due to lack of reliability. Various studies have shown that injury data in India are incomplete because most injury crashes are settled directly by the parties involved, without reporting to the police. Hence, a majority of injury crashes would be absent in the crash database. As reported in a study conducted by Mohan et al. (2009), the actual number of injuries was 5 to 6 times the number officially reported. Therefore, in this study, number of injuries was not used. Due to lack of availability of reliable data, only 2 variables, population and number of registered vehicles, were used as explanatory variables. If other data that better describe exposure to traffic accidents were available, the model could be improved by including them to this model.

This article shows that establishing a service system alone will not benefit society. It is important to study their effectiveness in improving safety. Unless it is properly marketed, its benefits will not be reached to all sections of the public. This means that awareness campaigns targeting various groups need to be planned and conducted. This experience from India shows the importance of marketing any safety improvements to the public to allow users to receive maximum benefits. This learning will help other countries to improve their systems. Almost all countries are implementing several systems to improve traffic safety. This study clearly shows that irrespective of the quality of the program, unless they are marketed properly, they may not achieve their full potential.

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Table 5. Summary of fixed effect model to evaluate effectiveness of 108 services.

|                      | Estimate  | SE     | t Value | Pr(>|t|) |
|----------------------|-----------|--------|---------|---------|
| Population           | 3.45e+02  | 6.47e+01 | 5.331   | 9.21e-07 |
| Registered vehicles  | 3.49e-01  | 8.44e-02 | 4.144   | 8.61e-05 |
| 108 Services         | 2.00e+02  | 1.99e+02 | 1.007   | 0.307038 |
| Andhra Pradesh       | -1.79e+04 | 4.78e+03 | -3.747  | 0.000341 |
| Assam                | -8.71e+03 | 1.78e+03 | -4.874  | 5.64e-06 |
| Goa                  | -4.45e+02 | 2.07e+02 | -2.150  | 0.034650 |
| Gujarath             | -1.61e+04 | 3.02e+03 | -5.337  | 9.01e-07 |
| Karnataka            | -1.36e+04 | 3.29e+03 | -4.136  | 8.85e-05 |
| Madhya Pradesh       | -1.84e+04 | 3.97e+03 | -4.629  | 1.44e-05 |
| Meghalaya            | -7.92e+02 | 2.46e+02 | -3.177  | 0.002336 |
| Tamil Nadu           | -1.40e+04 | 3.62e+03 | -3.889  | 0.000210 |
| Uttarakhand          | -2.52e+03 | 5.81e+02 | -4.346  | 4.14e-05 |

Residual standard error: 622.1 on 78 degrees of freedom; multiple $R^2$: 0.9929; adjusted $R^2$: 0.9918; F-statistic: 907.8 on 12 and 78 degrees of freedom; P value: < 2.2e-16.
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