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Facilitators, Causes and Lesson learnt from Two Bus Incident in Tehran-Qom Highway: A Case Study in Iran

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Abstract

Background: There is an increasing trend of traffic accidents in the world in recent years. Road traffic injuries in Iran, caused 17994 deaths in 2012 - 13. Among these accidents, the most terrible one occurred on September 9, 2012 at 22:48 hour GMT, when two approaching buses had a head-on collision on 28-kilometer Tehran-Qom highway, killing 44 passengers on board and leaving 47 injurers.
Objectives: This study aimed to assess factors, causes, and lessons learned from the two bus collision on the Tehran-Qom highway in Iran.
Methods: This case study adopted qualitative approach, to explore the different scenarios of the crash focusing on content analysis. Focus Group Discussion, semi-structured individual interviews and review of documentations and evidence were the data sources. Data and evidence gathered from people's experience and perceptions, such as officials and staffs of rescue teams, were analyzed.
Results: After repeated analysis and comparison of data, three categories were explored (agent/host/environment causes, victims' search and rescue, and psychosocial support). Inadequate bus supervision and driver's behavior, lack of fire extinguishers, and rescue tools such as hammers in buses, and blocked doors contributed to increased casualties. Effective field assessment for incidence and decentralizing stand-by hospitals would help reduce casualties. Lack of effective coordination, lack of psychosocial support services for victims and participation of 'lay people' the scene, were key findings.
Conclusions: Lessons learned: controlling per-second speed, improving vehicle manufacturing quality, re-training courses for drivers and the empowerment of rescuing people should help reduce human casualties during accidents. Lack of fire stations and fire extinguishing agent along the road outside cities are major problems. Common dispatch center with national emergency number is explicitly recommended for faster and more coordinated rescue services to reach the accidents scene. We also suggested instruction of psychosocial support for victims, survivors, and even rescuers during and after rescue process. Finally, persistent merge of existing rescue organizations, leading to the development of a national emergency management organization (NEMO) and national data collection system are highly recommended.

Keywords: Lessons Learned, Bus Crash, Case Study, Content Analysis, Iran

1. Background

Annually, many people lose their lives and many were injured through road traffic injuries (RTIs) in the world (1). Closely, 91% of RTIs related deaths occurred in low and middle-income countries (1). According to the Iranian legal Medicine organization, during 2012 to 2013, in Iran, 17994 people were killed through RTIs. This number has decreased by 5.7% in comparison to the previous year. A total of 64% (64.3%) of deaths occurred on suburban roads and 7.2% on rural highways (2). Recently, RTIs involving two bus crashes have resulted in an increased number of casualties. These fetal bus accidents have consequently gained attention of the mass media as an emerging man-made disaster, apparently observed in China (3).

Worldwide, there is an increasing trend in bus crashes as observed in China and in Bangladesh (4). In Malaysia, 48% of 'pick-up' buses were registered in a bus crashed from 2006 to 2008 (5). Between 1999 and 2005, nearly 63000 accidents occurred, in which buses played role (5). In the United States, 14000 of these accidents involved at least one casualty, and a total of 325 deaths (ref). Annually, it is estimated that about 5 bus accidents and 30 deaths

occur worldwide (6). Over the last decade, 10 bus accidents occurred in Sweden, displaying 30 - 60 injuries (6). One of the most horrible bus accidents occurred in Iran on September 9th, 2012. Two buses involving 44 passengers each collided on a 28-kilometer Tehran-Qom highway. The first bus blasted its front tire and as a result veered off its direction into the highway's middle guardrails, and collided head-on with the second on coming bus. In this incidence, 44 people were burnt to death as a result of fire outbreak from the collision, and 47 passengers were injured from both buses including children, women, and older adults (7). The different aspects of this incident, the victims' involved, and the high number of deceased involved sparked arguments in this context. Results of this study presented some ideas of preventing these kinds of incidents in the future, and also to provide better aid and rescue services for the surviving victims.

2. Methods

2.1. Study Design, Data Collection and Data Analysis

This study is a case study, using qualitative content analysis and triangulation, by integrating several data sources and data gathering methods. The process of data collection lasted from August 2014 to March 2015. Each interview lasted about 25 - 45 minutes. The main questions of the interviews included: "what are the important challenges in your opinion during the scene of this crash?", "what factors helped in the process of providing coordinated services? and explain the various aspects of Psychosocial Support for this accident".

In the data collection, face to face interviews, and focus group discussion (FGD) were exploited. A content analysis approach was employed to analyze the data collected, which include, but not limited to, FGD, semi-structured individual interviews, and review of documentations and evidences. Regarding trustworthiness, credibility was ensured through constant comparison, triangulation, member check, and peer review. Interviewees chose the interview venues and all interviews were tape recorded and transcribed verbatim. The interviewees deliberately selected the venues for the interviews in their own convenience. All interviews were transcribed verbatim and read several times. Documents regarding other sources included written interviews, media, news extracted from broadcast, websites, basic information or reports regarding the incidence on mass media, and official websites or networks were collected. Accordingly, they were assessed word by word. A code (conceptual label) was assigned to each keyword or sentence. Following this, similar codes were classified in categories such that basic classifications of codes were acquired. Importantly, content analysis with the method of Graneheim approach was used in this research (8). The elicited concepts were assessed in one FGD for further evaluation and validation of their search findings. Ultimately, factors and main categories were delineated.

Table 1. Participants' Information Based on Gender, Profession, Education and Work Experiences

Participants' Information	Male	Female	Total
Education			
Diploma	3	0	3
Technician	4	0	4
Bachelor	7	1	8
Masters	3	2	5
PhD	2	0	2
Profession			
EMS	6	2	8
Police	4	0	4
Red crescent	6	0	6
Road maintenance	2	0	2
Hospital nurse	1	1	2
Work experience, y			
2 - 4	6	2	8
5 - 7	8	1	9
8 - 10	5	0	5
Total	19	3	22

2.2. Participants

Purposive participants involved in this research included stakeholders such as emergency Medical services (EMS) personnel, authorities and other authorized personnel of medical university of Qom, Red Crescent officials, police commanders, officials who were present at the scene, and emergency management experts of ministry of health. In total, 22 officials were engaged in this study. The participants had between 2 to 15 years of work experience with an education level ranged from diploma to PhD (Table 1).

3. Results

Overall, 3 categories and 8 sub categories (explored factors) were derived as key elements leading to the tragic crash as shown below (Table 2).

Table 2. Analysis Process; Overview of Main Categories, Sub Categories, and Meaning Unites

Category	Meaning Unites
Agent/host /environment causes	
Road defects	Inappropriate guardrails
	The steep slope of the high-way
Driver negligence	High speed driving
	Inability to control the bus after puncturing tire
	Manipulation of automatic door opening system, absence of hammers for breaking the windows
	Maintenance of the bus in an unknown service center
Vehicle defects	Low quality of interior combustible materials
	Inappropriate placement of batteries and tank
	Technical defect in the bus structure
Negligence in the periodic control	Insufficient monitoring of driving capabilities
	Lack of periodic monitoring of the quality of buses
	Lack of re-training courses for drivers
	Inability of applying new methods for vehicular speed monitoring
Victims' search and rescue	
Effective treatment of victims	Effective field assessment of the incidence by EMS
	Treatment of victims in a bus ambulance
	Declaring stand-by at Qom medical hospitals
Lake of effective search and rescue	Lack of high-level collaboration
	Absence of firefighting unit in roads
	Untimely (late) arrival of firefighters
	Participation of the 'lay people'
	Multiple emergency numbers and relief organization
	Mismanagement and mistakes in delivering dead bodies
Psychosocial support	
Lake of psychosocial support in incident scene	Lake of psychosocial support for victims
	Lake of psychosocial support for first responders
Psychosocial support for community and families	Psychosocial support only for victims' families in Place of delivery of corpses
	Only expressing condolences by political authorities

3.1. Agent/Host/Environment Causes

Participants, according to their opinions regarding vehicles' surveillance and control, road safety, and bus supervision have suggested different reasons pertaining to a bus crash. Participants mentioned some technical defects in the bus structure such as inappropriate placement of batteries and gas tank, and defect in electric system in these kinds of buses (both of buses assembled in the same factory). Participants also mentioned the driver's inability to control the bus after puncturing a tire due to a high speed and the steep slope of a highway. Inappropriate guardrails were also mentioned as factors associated with bus departure from the main route and colliding with another bus. According to the reports and interviews obtained, manipulation and impairment of automatic door opening system by drivers, absence of hammers for breaking through the windows, and repairing the bus at invalid service centers (that could cause the malfunctioning of doors) were the main reasons for increasing casualties.

Negligence in periodic inspection of bus quality, insufficient monitoring of driving capabilities, absence of re-training courses for drivers, and inability to applying new methods for vehicular speed monitoring were also mentioned in this research.

…The first reason of this accident is technical defect and tire rupture, and because of weak body and defect in power system of buses fire occurred after the crash and intensified the incident…

3.2. Victims' Search and Rescue

According to participants' experiences, some people simultaneously called the EMS as well as police call center shortly after the crash, timed 22:49. Ambulances were dispatched to the scene on time to follow rapid assessment. They then called to their dispatches and told them the severity of the accident. A total of 10 ambulances and one bus ambulance were again released. A few minutes later (2 - 5 minutes), the police and Red Crescent teams also arrived at the scene.

…A 22:55 a report indicating a horrible collision of two buses was sent to Red Crescent emergency call center (112), and considering the emergency nature of the received report, five rescue teams were immediately sent to the scene…

According to the participants' experiences, the absence of fire stations on the highways of Iran, caused firefighters to reach accident scenes very late and could not effectively save lives of victims. Some passengers were locked inside the buses due to a blockage of the automatic doors. Saved patients received medical attention in the bus ambulance and were transferred to Qom hospitals. Due to the fact that Qom medical hospitals were declared standby hospitals, all victims were accepted in emergency departments in a short period.

…The first problem on our roads is that officials and rescue teams do not arrive at the same time; secondly, there is no responsible firefighting station on the roads…

Due to crash severity, participation of lay people in rescue, and lack of high-level collaboration between relief agencies caused some complexity. For instance, the number of dead bodies were not marked properly, whereas a few corpses were mistakenly delivered to the wrong families.

3.3. Psychosocial Supports

With reference to participants' experiences and related written reports, due to the intensified nature of the incidence, mass media and state authorities expressed their sympathies to the deceased families and survivors at early moments after the accident, and emphasized their interest in finding out the causes of the accident, treating the victims, and preventing similar crashes in future. Isfahan and Yazd governors announced a one-day public mourning in these provinces, due to the fact that the passengers on the buses were residents of these provinces.

Eventually, the Qom crisis management organization prepared habitats for the families of the deceased passengers. In addition, a post-disaster team of psychologists, Moheb (the volunteers of national welfare organization) supported the victims and their families in the area of delivery of corpses.

…Basic medical proceedings for victims' care were appropriate but victims were not insured, so it's necessary that ministry of Health and corresponding insurance companies take essential steps to support them and decrease their physical and Psychosocial pains…

…I could not forget the screams 'help', and the burning smell! I could not sleep for three nights without drugs following the crash…

According to the participants' experiences, apart from the innovative action of Qom crisis management unit in sending Moheb volunteer teams, there was no plan for immediate (incident scene and hospitals) and long-term psychological supports for victims, their families, and also for particular emergency teams, police officers, and even for the public.

4. Discussion

The large number of casualties and deaths caused, due to the severity of collision and the burning of buses set this crash, a national tragedy. According to interviews and reports, the successful performance of emergency medical services, particularly, the correct assessment of severity of crash, triage in the scene and the first care in the bus ambulance, declaring stand-by medical hospitals at Qom by Qom crisis management have led to the proper care of all victims within the shortest possible time. However, the lack of fire stations along the highways outside cities of Iran, participation of lay people in rescue, and lack of collaboration between emergency agencies and lay people were major problems. First, lessons learned from this study portrayed that police should control high-speed buses by using new technologies, which will help in reducing the intensity of collisions in dangerous spots. Hong et al., (2011), in South Korea, recommended an application of black box for recording pictures of driver's performance and crash scene to assess crash causes more precisely (9). In furtherance to this proponent, the use of third-generation mobiles and smart phones could be beneficial in transferring online pictures (9). Kaplan and Prato (2012) emphasized that high speed and low speed (less than 20 km/h) can increase bus crash intensity (10).

Another lesson learned from this crash is the severe codification of standards in bus safety. Resistance should be made obligatory for both manufacturers and importers. Solah et al., (2009), showed the necessity of reconsidering

and updating structure and standards of buses' interior accessories in Malaysia (5).

Result of the study regarding victims' rescue methods indicated a lack of victims' ability to rescue themselves and others. According to the participants' experiences in this survey, TVs embedded in buses could be useful in public training to combat unfortunate incidences. For instance, before a bus starts moving, safe exit methods in emergency situations could be shown to the passengers in a short movie. In addition, applying public surveillance competence as well as encouraging and facilitating people's connection with police can help passengers identify and control drivers' violations before they become victimized (providing violation report phone numbers or SMS system). Cafiso et al., (2013), found that drivers' fatigue and carelessness were the key factor in the buses' accidents (11). Findings from a study by Olumide et al., in Nigeria, showed that first aid education significantly improved first aid knowledge and skills of intervening drivers. They recommended that police should be directed toward potential drivers to undergo first aid training (12). In a study by Khorasani-Zavareh et al., poor quality of post-crash management was shown. They concluded that involvement of laypeople; lack of coordination, inadequate pre-hospital services, and shortcomings in infrastructure were barriers to effective post-crash management (13).

Fire caused by a crash is important in the fatalities factor of increasing casualties following a crash. Viklund et al., (2012), in Sweden, believes that automotive industry is the first organization in charge of people's safety, therefore, they should design vehicles engine system in such a way that it would not burn due to a crash (14).

It is important to state that manufacturers should accept the responsibility for people's safety, whereas regulatory organizations, including standard organization, take up and emphasize on products' safety. Equipping road rescue teams (EMS, police, Road Maintenance and Red Crescent) with fire control equipment, training their personnel and using self-rescue ability to train people, are some suggested solutions in controlling and limiting vehicular accident and fires outbreak during accident. In effect, considering obligations for one of the rescue organizations or establishing sub-urban firefighting teams alongside state EMS teams are more fundamental steps toward reducing fatalities caused by fire on roads. One of the possible causes of this bus crash in Iran was a ruptured tire. With reference to Sun et al., (2014), tire failure caused 40% of road traffic accidents in highways. He recommended a system for cars that can not only realize the tire abnormal pressure warning, however, it also signals emergency brake control, and convey some sound messages to the drivers in a manner to give early-warning signs for drivers to apply a brake system and avoid crash (15).

Another lesson learned from this severe crash was the inconsistency of police and rescue workers (Red Crescent, EMS, and Firefighting) in dispatching and collaboration between them at the crash scene. Existence of multiplicity of emergency numbers in Iran, which includes police with 110, Red Crescent with 112, EMS with 115, Firefighters with 125, and Road Maintenance with 141, not only make people confused, but also result to delay in providing immediate rescue services. Alinia et al., (2015), showed some barriers of pre-hospital services in RTI in Tehran, including metropolitan infrastructure, profession, and managerial issues (16).

Experiences of other countries showed existence of a common dispatch center. Most EU countries have one emergency number (112). Although some other numbers exist in some circumstances, the main contact number is 112, which is readily available to just a cellphone, even without a SIM card (17). This unique emergency number is better for individuals to recognize it quickly and call during emergency situations to save lives. Alinia et al., suggested to establish a common emergency call center with a National emergency number that can play a crucial role in saving lives and improving quality of collaboration in accident scenes (16).

Berlin et al., (2011), indicated that police, fire, and ambulance services should develop excellent forms of collaboration at the scene of an accident, however, this intersectorial collaboration is avoided due to the uncertainty, asymmetries, and lack of incentives (18). Codifying Psychosocial support for victims' families, survivors, and even for rescuers should be planed for short and long-time periods after an accident. In Sweden, Doohan et al., (2015), studied individuals who survived in a bus accident by qualitative approach and highlighted that victims are likely to get post-traumatic stress disorders after an accident and may need special psychological support, particularly from their family and friends (19). Lyon et al., (2012), revealed that in a bus collision with a rock in Switzerland, which caused 22 deaths and 24 injured kids, the presence of 15 physicians, 3 psychologists, and full rescue teams decreased the malside effects of post-traumatic stress disorders (20). Khorasani et al., suggested that more education should be given to the public, drivers, and first responders to the scene of an accident, more effective legislation, and more rigorous law enforcement to prevent road traffic injuries in Iran should be adopted. They also recommended that an integrated organization for coordinating and managing all activities for reducing road traffic injuries should be established (21). Hatamabadi et al., showed that none of the sources of information, including police, EMS, and health care facilities had complete information on traffic crashes

in Iran. Therefore, they recommended that national data collection system for meeting the goal of forming an integrated road traffic surveillance should be instituted. Although a lead agency is essential to collect this data, collaboration with the police, the Ministry of Health and Medical Education, forensic medicine, and the Iranian Red Crescent is necessary for this purpose (22).

4.1. Conclusion

In reference to the analysis of the lessons learned from the horrific road traffic accident experienced in Iran, controlling per-second speed, improving manufacturing quality of vehicles, and also improving people's knowledge about self-rescue abilities could reduce human casualties during road traffic accidents. Importantly, it is proposed that for faster and more coordinated rescue services, a common dispatch call center, with a national emergency number instead of multiplicity of emergency numbers, should be developed. We recommended instruction for psychosocial support for victims, survivors, and even rescuers during and after a rescue process should be adopted. Feasibility study grounded by theory for common dispatcher during emergency situations should be explored in accordance with the Iranian context. Finally, long-term merge of existing rescue agencies for developing a national emergency management organization (NEMO) could be considered.

4.2. Limitation

This study, due to the lack of evidence of drivers' physical and mental health, including the possibility of using narcotic drugs or heart attacks, cannot judge its impact on the causes of incident. According to another study, severe injuries may mask the role of an initial disease attack and it is necessary to consider these problems in investigating causes of such crashes (23).

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