



Challenges in Emergency Medical Services in Mega Cities: A Qualitative Study in Iran

Abbas Naboureh^{1,2}, Mehrdad Farrokhi¹, Mohammad Saatchi¹, Shokoufeh Ahmadi¹, Babak Farzinnia¹, Ferydon Layeghi³, Hamidreza Khankeh^{1,4*}

¹Health in Emergency and Disaster Research Center, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran

²Bostan School of Nursing, Ahvaz Jundishapur University of Medical Sciences

³Department of Clinical Sciences, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran

⁴QUEST center for responsible research, BIH, Charite, Berlin, Germany

*Corresponding author: Hamidreza Khankeh

Address: Health in Emergency and Disaster Research Center, Social Health Research Institute, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran. Tel: +98 9123767147; e-mail: hrkhankeh@gmail.com

Received: August 2, 2024

Revised: September 16, 2024

Accepted: September 29, 2024

ABSTRACT

Objective: This qualitative study aimed to identify the key issues within Emergency Medical Services (EMS) in large urban regions.

Methods: This study used qualitative content analysis as its research methodology. The study was conducted in 2023 and involved 21 Iranian EMS stakeholders, selected through purposive sampling with maximum diversity to ensure a broad range of expertise. Data were collected through semi-structured, in-depth interviews, which were conducted until data saturation was reached. The analysis followed the method proposed by Landman and Graneheim, which involved systematic coding and categorization to identify key themes and patterns related to EMS challenges.

Results: The study included 17 men and 4 women. The data analysis identified eight subcategories, which were then divided into three main categories based on their similarities. These main categories addressed challenges in EMS delivery, emerging issues in EMS demand, and resource constraints.

Conclusion: This study highlighted the challenges that Iran's EMS encountered in megacities due to rapid urbanization and an elderly population. Key issues included operational inefficiencies, increasing demand, and limited resources. Addressing these challenges is crucial for enhancing the effectiveness and sustainability of EMS. Further research is required to develop strategies for overcoming these obstacles and strengthening EMS in large urban regions.

Keywords: Emergency medical services, Urban health, Prehospital care, Qualitative research.

Please cite this paper as:

Naboureh A, Farrokhi M, Saatchi M, Ahmadi S, Farzinnia B, Layeghi F, Khankeh HR. Challenges in Emergency Medical Services in Mega Cities: A Qualitative Study in Iran. *Bull Emerg Trauma*. 2024;12(4):2-9. doi: 10.30476/beat.2024.104033.1543.

Introduction

The world is undergoing a rapid shift toward urbanization. Today, more than half of the global population resides in urban areas, a significant increase from about one-third in 1950. Projections indicated that by 2050, over two-thirds of the world's population will live in cities. This growth, as well as the rise of megacities, represents a significant and rapidly evolving 21st-century trend [1]. In these megacities, the fast-paced lifestyle characterized by high levels of stress, sedentary behavior, and increased consumption of processed foods profoundly impacts disease patterns. Urban residents are more susceptible to chronic disorders, such as cardiovascular diseases, diabetes, obesity, and respiratory issues, all of which are exacerbated by pollution and limited access to green spaces [2].

The rapid growth of urban populations has heightened concerns among municipal public managers about the ability to provide effective Emergency Medical Services (EMS) to meet pre-hospital care requirements [3]. Providing EMS is crucial for ensuring timely medical care and improving patient outcomes, as it allows for timely medical intervention, stabilizing patients before hospital arrival, and reducing mortality and morbidity rates [4]. In megacities, the complexity and volume of emergencies necessitate a well-coordinated and well-resourced pre-hospital emergency system to ensure timely and effective care delivery [5].

Iran's emergency medical center was established in 1973. Tehran, Mashhad, Isfahan, Tabriz, and Shiraz are among the country's biggest cities, with a population of approximately 91 million, 73% of whom live in urban areas [6]. Tehran, the capital, has grown from a small village to a metropolis with over 9 million residents and a population density of around 11,800 per Km² in just two centuries [7]. Rapid urbanization in Tehran, fueled by migration from within Iran and neighboring conflict-affected countries, has resulted in the expansion of suburban areas with poor living conditions. These marginalized areas face severe health issues due to inadequate healthcare, clean water, and essential services [8].

In addition to its demographic complexities, Tehran faces over 60 hazards, including natural disasters such as earthquakes and extreme weather, as well as manmade threats, such as industrial incidents [9]. Given these multifaceted challenges, it is crucial to understand the provision of EMS and identify the specific challenges that emergency services encounter in such a dynamic and risk-prone environment [10]. Megacities are highly complex, with diverse cultures, contexts, and vulnerability to a wide range of natural and man-made disasters, necessitating a robust EMS infrastructure [11]. However, the current state of EMS in Tehran is poorly documented. Few studies have been conducted, and the majority are quantitative, lacking insights into the experiences

and perceptions of key stakeholders.

Given the significance of pre-hospital EMS and the challenges inherent in this field within large urban areas, alongside the scarcity of existing research, it is crucial to address this issue comprehensively. To achieve a more accurate and systematic understanding, the present qualitative study was conducted using content analysis to identify the challenges that EMS faces in urban areas, as well as to provide insights and recommendations for future improvements.

Materials and Methods

This study utilized a qualitative content analysis, as recommended by Graneheim and Lundman, to explore the challenges of EMS in Iran's megacities. The decision to employ this method was driven by several factors, including its ability to provide a deeper understanding of complex phenomena, offer precise insights into participants' perspectives, beliefs, and experiences related to the investigated topic, facilitate interpretation, and uncover hidden meanings within textual data. Additionally, this method contributes to the advancement of knowledge in the relevant field and serves as an effective tool for addressing the research questions [12].

Study Design, Participants, and Sampling

The study included 17 men and 4 women ranging in age from 30 to 54. Purposive sampling was first used, followed by maximum diversity sampling, until data saturation was reached after 21 interviews. Participants ranged in education level from BSc to PhD and included emergency medical technicians, dispatchers, managers, and academic members, providing a comprehensive perspective of EMS.

Inclusion and Exclusion Criteria

Eligible participants include experienced professionals with expertise in EMS, strong verbal communication skills, and a willingness to participate. Participants are selected from EMS managers and staff members with at least three years of experience in a variety of job roles within the emergency dispatch center, EMS, and operational personnel. Any participant who expressed unwillingness to continue the study was excluded.

Data Gathering

Individual in-depth semi-structured interviews were conducted over three months from July 22 to October 22, 2023, with each interview lasting between 35 and 65 minutes. Before progressing to more detailed inquiries, the interviews began with open-ended, general questions such as "How do you experience working in EMS in this big city?" and "What challenges have you experienced during these missions?" If additional interviews were deemed necessary, a second session was scheduled with the participant's consent. All

interviews were recorded with explicit consent and transcribed verbatim. Sampling and data collection continued until data saturation was achieved. To ensure accuracy, each interview was meticulously documented on paper, word for word.

Statistical Analysis

This study conducted data analysis alongside data collection using Graneheim and Lundman's content analysis method. This qualitative approach systematically classifies, codes, and identifies themes to better comprehend the textual data. The process involves five key steps: transcribing interviews immediately, reading the material to grasp its overall meaning, identifying meaning units and initial codes, categorizing related codes, and extracting the main themes. Following each interview, the content was transcribed line by line and reviewed several times to ensure a complete understanding. Important words, sentences, or paragraphs were selected as meaning units and coded to convey their essence. The codes were then compared, merged, and reviewed. Reliability was ensured by comparing codes with the original data. Themes were developed through careful consideration and analysis of both explicit (manifest) and implicit (latent) content. After 21 interviews, data collection was discontinued due to saturation. Finally, categories with comparable meanings were merged, and key themes were determined. MAXQDA software (2020) was used to help with the analysis.

Results

Participants Characteristics

The participants included 17 men and 4 women,

with a mean age of 42 years ranging from 30 to over 54 years. The mean duration of work experience was 14.2 ± 3.4 years. All participants had more than three years of work experience in the field of EMS. Additional participant information is presented in Table 1.

Main Results

Interview analysis identified three main categories and eight subcategories. The main extracted categories were "Challenges in EMS Delivery", "Emerging Issues in EMS Demand", and "Challenges in Resource" (Table 2).

Challenges in EMS Delivery: Participants believed that EMS are critical components of urban healthcare systems since they provide rapid response and life-saving care in emergencies. However, the effectiveness of EMS service is frequently compromised by various challenges, including ambulance access constraints, motorist behaviors, and bystander interference.

Ambulance Access Issues: In large urban areas, EMS teams face challenges due to the uneven distribution of facilities, resulting in unequal access to emergency care. Ambulances frequently encounter parking issues, restricted routes, and a lack of dedicated lanes, all exacerbated by heavy traffic. Additionally, high-rise buildings make it harder to reach patients swiftly.

"The challenges associated with land acquisition, particularly in large cities, hinder our ability to appropriately position and distribute city-level bases. This problem contributes to increased response times." (P. 1)

"As EMS manager, I often hold my breath during

Table 1. Demographic information of the participants

Participant's number	Sex	Age	Degree of education	Service location
1	M	48	PhD	International Medical Emergency Organization
2	M	41	BSc	Shiraz University of Medical Sciences
3	M	51	PhD	Ahvaz University of Medical Sciences
4	F	36	MSc	Tehran University of Medical Sciences
5	M	53	PhD	Tabriz University of Medical Sciences
6	M	34	MSc	Tehran Medical Emergency Organization
7	M	43	PhD	University of Social Welfare and Rehabilitation
8	M	30	BSc	Shiraz Medical Emergency Organization
9	F	41	BSc	Tehran Medical Emergency Organization
10	M	47	MSc	Mashhad Medical Emergency Organization
11	M	54	BSc	Kerman Medical Emergency Organization
12	M	33	PhD	Tehran Medical Emergency Organization
13	M	41	BSc	Mashhad University of Medical Sciences
14	M	38	BSc	Ahvaz Medical Emergency Organization
15	F	40	PhD	International Medical Emergency Organization
16	M	44	MSc	Kermanshah University of Medical Sciences
17	M	36	PhD candidate	Alborz University of Medical Sciences
18	M	41	MSc	Isfahan University of Medical Sciences
19	F	38	BSc	Tabriz Medical Emergency Organization
20	M	35	PhD	Isfahan Medical Emergency Organization
21	M	48	BSc	Ahvaz University of Medical Sciences

M: Male; F: Female

Table 2. Categories and Subcategories of the interviews

Categories	Subcategories	Example of codes
Challenges in EMS Delivery	Ambulance Access Issues	Imbalance in EMS facility distribution
		Parking and Loading Zones
		Limited access routes
		No special lanes for emergency vehicles
		High-rise Buildings
		Traffic congestion
	Motorist behaviors	Lack of Emergency Vehicle Right-of-Way
		Stress and Fatigue
		Tailgating
		Distracted driving
		Aggressive Driving
		Lack of Awareness
Barriers in Dispatching	Uncertainty About When to Call	
	Delays Due to Non-Urgent Calls	
	Language Barriers	
	High Call Volume	
	Shortage of Experienced Dispatch Personnel	
	Bystander Interference	
Emerging Issues in EMS Demand	Increase in Elderly Population	Delays Due to Onlookers
		Crowd Control Issues
		Unsafe interference by witnesses
		Disruptions from Bystanders Filming Incidents
	Urbanization	Higher Incidence of Medical Emergencies
		Longer On-Scene Times
		Social Isolation
		Increased Need for Palliative Care
		Increased Population Density
		Risk of Mass Casualty Incidents
		Socioeconomic Disparities
		Mental Health Crises
Homelessness and Vulnerable Populations		
Challenges in Resource	Financial Constraints	Elevated Crime Rates
		Higher public awareness and usage of EMS
		Funding Issues for EMS Facility Upkeep
		Inadequate Supply of Ambulances
	Human Resource shortages	ambulance wear and tear
		Limited Storage for Medical Supplies
		High Staff Turnover Rates
		Workforce Emigration Trends
Recruitment Challenges		
Wage Inequities		

peak hours. Last week, responding to a heart attack call in a congested, narrow street district became a major challenge, with the city's layout proving to be the biggest obstacle." (p. 20)

Motorist Behaviors: Interviews showed several motorist behaviors that significantly hinder efficient EMS delivery. These behaviors include lack of emergency vehicle right-of-way, stress and fatigue, tailgating, distracted driving, aggressive driving, and lack of awareness. Such behaviors can lead to challenges in EMS delivery by prolonging response times and increasing the risk to both emergency personnel and the public.

"As an EMS driver, I often lose precious time because drivers don't yield to my ambulance, despite the sirens and lights. It is frustrating knowing that delays can cost lives." (p. 11)

"While responding to a critical call, a driver tailgated our ambulance, attempting to use our path to avoid heavy traffic. This reckless behavior added stress and posed a serious risk to our patients and staff." (p. 19)

Barriers to Dispatching: The EMS dispatch system faces challenges with public uncertainty about when to call, leading to delays and several non-urgent calls. Language barriers and a shortage of experienced dispatchers contribute to slower response times, while high call volumes overwhelm the system.

"We encounter various challenges while conducting proper telephone triage. Some citizens lack the knowledge to provide an accurate medical history, while others may misrepresent symptoms to obtain non-emergency services, such as a blood pressure check. Additionally, there is a lack of experienced

personnel at certain dispatch centers, further complicating the triage process.” (P. 9)

“A few months ago, while responding to a call on the outskirts of Tehran, I encountered a citizen speaking Persian with a very strong accent, which made communication difficult. The stressful conditions further complicated managing the call.” (p. 6)

Bystander Interference: Bystanders frequently interfere during emergencies, causing delays and crowd control issues. Unsafe actions, such as filming incidents, complicate EMS work and can endanger both patients and responders.

“During a cardiac arrest call, a large crowd of bystanders made it difficult to reach the patient and provide care, with some even filming the scene. Such incidents occur frequently and present considerable challenges for us. (P. 6)

“As an emergency technician with years of expertise, I frequently deal with well-meaning but unskilled spectators who, in their haste to assist, aggressively open car doors to remove injured passengers. This may jeopardize the victims’ safety and complicate our response.” (P. 14)

Emerging Issues in EMS Demand: Interview participants indicated that EMS in megacities is encountering various emerging issues driven as a result of demographic changes and urbanization. These challenges are reshaping the demand for and delivery of emergency care, necessitating a sophisticated understanding and strategic response.

Increase in Elderly Population: The rising elderly population in urban areas increases medical emergencies and EMS demand. Longer on-scene times are needed due to complex medical needs and social isolation, which increases the demand for palliative care services.

“Our mission rates and ambulance requests have increased as the elderly population grows, life expectancy increases, and chronic illnesses become more prevalent. Often, elderly individuals call for an ambulance not due to physical issues, but out of loneliness and a need for companionship.” (P.2)

“Missions involving elderly patients often take longer due to non-specific symptoms, lack of companions for hospital visits, and a preference for outpatient services, which may be beyond our technicians’ capabilities. These factors contribute to lengthier on-scene timeframes and longer overall call durations.” (p. 15)

Urbanization: According to interviewees, urbanization has raised the need for EMS due to growing population density, increasing mass casualty risk, and pronounced socioeconomic disparities affecting vulnerable populations. The system is additionally burdened by increased public awareness and usage of EMS, as well as elevated crime rates.

“Urbanization and rising population density in metropolitan cities have led to more traffic accidents and medical emergencies, such as heart attacks and strokes. With increased public awareness of

free EMS services, we have seen a 10-15% annual increase in missions.” (P. 3)

“We have seen a growing number of missions involving homeless individuals and drug addicts in poor health, abandoned on streets or in parks. This condition has become increasingly prevalent in recent years.” (p. 13)

Challenges in Resource: A key point highlighted in the interviews was the issue of resource challenges, which included both financial constraints and human resource shortages. These challenges significantly impact the ability of EMS to operate efficiently.

Financial Constraints: Financial constraints hinder EMS facility maintenance and ambulance availability. Worn-out ambulances and limited storage for medical supplies, combined with budget constraints, lead to inadequate service provision.

“Despite sanctions decommissioning over 50% of our ambulances, we must continue to serve the public with a reduced fleet. We struggle not only to improve but also to maintain our existing quality of service.” (P. 5)

Human Resource Shortages: EMS services struggle with high staff turnover, workforce emigration, and recruitment challenges, leading to a lack of experienced personnel and jeopardizing long-term viability.

“As an EMS manager, I am concerned that a recent recruitment ad for Tehran’s EMS drew only 50 applicants for 200 positions. Low interest is caused by high mission volumes, low benefits, and an increasing desire to emigrate, making staff recruiting and retaining essential staff harder.” (P. 17)

Discussion

This qualitative study investigated the major challenges facing EMS in Iran’s megacities, highlighting the importance of enhanced service delivery and patient outcomes. The findings were divided into three main categories: EMS delivery challenges, emerging demand issues, and resource constraints.

EMS Delivery Challenges

One of the most significant issues identified in this study was the difficulty of ambulance access due to traffic congestion and poor urban infrastructure. These findings were consistent with Brent *et al.*, who demonstrated that urban traffic delays extended ambulance response times by an average of eight minutes, negatively impacting patient outcomes during emergencies such as cardiac arrest [13]. Evidence from other studies found that reducing response times was critical for improving outcomes, particularly for trauma patients and stroke victims [14, 15]. Moreover, the participants of the present study highlighted that the unequal distribution of EMS facilities, exacerbated by high land acquisition costs in large cities, contributed to prolonged

response times. This observation was consistent with findings from Azimi *et al.*, who demonstrated that the strategic placement of EMS sites could significantly enhance service efficiency [14-16].

Driver behavior is another major challenge. Council *et al.*, reported that driver distractions, such as mobile phone use, increase the risk of accidents involving emergency vehicles, with 16% of drivers admitting to nearly colliding with a first responder [17]. The issues raised in this study, including drivers' unfamiliarity with proper yielding protocols, mirror the findings reported by Lidestam *et al.*, in Sweden, where a lack of awareness disrupted emergency response efforts [18]. Additionally, telephone triage inefficiencies contribute to the strain on EMS resources, often leading to unnecessary dispatches. As discussed in the present study, the misuse of EMS resources, due to inaccurate or exaggerated reports during triage, is a critical issue, as noted by previous research in this area [19, 20]. Another significant barrier is bystander interference, which can slow down response efforts and endanger both EMS personnel and patients. As seen in Swedish media reports, the public often prioritizes recording incidents over assisting emergency responders, which was consistent with our findings [21]. Besides, Khorasani-Zavareh *et al.*, emphasized that inappropriate bystander actions during emergencies can impede rescue efforts and delay critical interventions [22].

Emerging Demand Issues

Urbanization and demographic changes are driving an increase in EMS demand, particularly in Iran's megacities. The aging population and the rise in non-emergency ambulance requests significantly strain EMS resources. The findings of the present study were consistent with global trends where elderly patients, who are frequent users of EMS, account for a disproportionate number of emergency calls [23, 24]. The need for prolonged on-scene times for older adults, especially those with complex medical conditions and social isolation, further exacerbates the demand for EMS services. Urbanization also poses issues such as increased population density, mass casualty incidents, and socioeconomic disparities. These issues, as highlighted in our study, are not unique to Iran, but rather part of a broader global trend. Rapid urban growth, elevated crime rates, and heightened public awareness of EMS availability all contribute to an annual rise in emergency calls, as observed by several studies [25]. A study conducted in Finland similarly found that a significant proportion of EMS calls, 16-51%, were non-emergency, hence inflating mission statistics [26]. Our findings also showed the impact of socioeconomic disparities, particularly for vulnerable populations such as homeless people and individuals with mental health issues, which was consistent with research conducted by Crain *et al.*, in London [27].

Challenges in Recourse

Resource constraints, particularly financial limitations, are a prominent issue affecting the efficiency of EMS in Iran. Our findings reflected global trends in which financial constraints impede the maintenance of EMS infrastructure, including ambulance repair and medical supply availability. This was consistent with research from other low- and middle-income countries (LMICs), which emphasized the critical role of funding in maintaining service preparedness [28]. The depreciation of ambulance fleets and inadequate funding for station development are key challenges that align with global patterns of increasing financial pressures on emergency services.

Human resource shortages, including high staff turnover and difficulties recruiting skilled personnel, represent another significant challenge. In 2006, Dussault and Franceschini noted that high turnover rates and the emigration of skilled professionals from LMICs to higher-income countries contributed to a significant shortage of healthcare workers [29]. This trend was evident in our findings, where wage inequities and challenging working conditions led to dissatisfaction among EMS staff, resulting in retention difficulties. Similarly, in 2015, Lopes *et al.*, observed that wage disparities exacerbated workforce dissatisfaction, leading to attrition and placing additional strain on remaining staff, which increased burnout and contributed to a cycle of attrition prevalent in strained healthcare systems [30].

By addressing these challenges, future studies can contribute to developing more effective and efficient EMS systems in Iran's megacities, ultimately leading to better patient outcomes and enhanced public health.

The study faced several limitations. Coordinating interviews with EMS personnel was one of the most difficult tasks, due to their unpredictable and demanding work schedules. Additionally, fatigue following long shifts resulted in delayed or canceled interviews. Since this research was qualitative, the findings might have limited generalizability.

This study highlighted the critical challenges facing EMS systems in Iran's megacities, particularly the impact of traffic congestion, uneven distribution of facilities, and resource shortages, all of which contributed to delayed response times and reduced service quality.

Rapid urbanization, demographic shifts, and socioeconomic disparities exacerbated these issues, increasing the strain on EMS. Thus, strategic interventions are required to improve service delivery and patient outcomes, such as optimizing infrastructure, enhancing triage methods, and focusing on recruitment and retention. Addressing these issues will contribute to a more resilient and responsive EMS for the growing urban population.

Declaration

Ethics approval and consent to participate:

This research, involved human participants, and was reviewed and approved by the University of Social Welfare and Rehabilitation Sciences (IR. USWR. REC.1402.043). Before their involvement, participants provided written informed consent indicating their informed agreement to participate in the study.

Consent for Publication: All authors have expressed their consent to the publication of this study.

Conflict of Interest: None declared.

Funding: No funding.

Authors' Contribution: AN and HKH conducted the research, with AN leading the interviews. AN and SHA analyzed the data, secured ethical approval, and drafted the manuscript. BF coordinated and transcribed interviews, assisting with participant feedback. MS contributed to the study design, data collection, and analysis. FL also supported the study design and data analysis. HKH and MF edited the final draft. All authors approved the final manuscript.

Acknowledgment: We sincerely thank the participants who participated in this study and generously shared their insights and experiences.

References

- Jain R. The urban transformation: issues and challenges. *Urban Growth and Environmental Issues in India*. 2021;17-34.
- Doyle YG, Mills AJ, Korkodilos M. Addressing London's modern urban health challenges: learning from other global cities. *J Public Health (Oxf)*. 2017;**39**(4):685-90.
- Cabral E, Castro WRS, Florentino DRM, Viana DA, Costa Junior JFD, Souza RP, et al. Response time in the emergency services. Systematic review. *Acta Cir Bras*. 2018;**33**(12):1110-21.
- Miri K, Sabbaghi M, Mazlum SR, Namazinia M. The trend of change in the role of pre-hospital emergency medical services in Iran's healthcare system: a situational analysis. *BMC Emerg Med*. 2023;**23**(1):99.
- Sagan A, Richardson E. The challenge of providing emergency medical care. *Eurohealth*. 2015;**21**(4):3-5.
- Bank W. Country and lending groups. *World Bank*. 2015.
- Karbaschi GH. The role of decision making processes in urban management systems:(case study of Tehran): Newcastle University; 2013.
- Sshetaban S PS, Ghaiyoomi A. The effect of immigration on marginalization in Tehran. International Conference on the New Horizons in the Civil Engineering, Architecture and urbanization and Cites Cultural Management; IRAN: New Horizon Science and Technology Association; 2017.
- Fatemi F, Ardalan A, Mansouri N, Aguirre B, Mohammdfam I. Industrial chemical accidents: a growing health hazard in the Islamic Republic of Iran. *East Mediterr Health J*. 2019;**25**(1):5-11.
- Aringhieri R, Bruni ME, Khodaparasti S, van Essen JT. Emergency medical services and beyond: Addressing new challenges through a wide literature review. *Computers & Operations Research*. 2017;**78**:349-68.
- Moon SJ, Cho SK, Jung M-S, Park S-H. How to Respond to Complex Disasters on Future Megacities at the Government Level. *The Journal of the Convergence on Culture Technology*. 2021;**7**(1):211-5.
- Graneheim UH, Lindgren BM, Lundman B. Methodological challenges in qualitative content analysis: A discussion paper. *Nurse Educ Today*. 2017;**56**:29-34.
- Brent D, Beland L-P. Traffic congestion, transportation policies, and the performance of first responders. *Journal of Environmental Economics and Management*. 2020;**103**:102339.
- Azimi A, Bagheri N, Mostafavi SM, Furst MA, Hashtarkhani S, Amin FH, et al. Spatial-time analysis of cardiovascular emergency medical requests: enlightening policy and practice. *BMC Public Health*. 2021;**21**(1):7.
- Ono Y, Hayakawa M, Iijima H, Maekawa K, Kodate A, Sadamoto Y, et al. The response time threshold for predicting favourable neurological outcomes in patients with bystander-witnessed out-of-hospital cardiac arrest. *Resuscitation*. 2016;**107**:65-70.
- Xia T, Song X, Zhang H, Song X, Kanasugi H, Shibasaki R. Measuring spatio-temporal accessibility to emergency medical services through big GPS data. *Health Place*. 2019;**56**:53-62.
- Council NS. Drivers More Distracted Around Emergency Vehicles. National Safety Council. 2019.
- Lidestam B, Thorslund B, Selander H, Näsman D, Dahlman J. In-Car Warnings of Emergency Vehicles Approaching: Effects on Car Drivers' Propensity to Give Way. *Frontiers in Sustainable Cities*. 2020;**2**:19.
- Wheeler S. Telephone Triage: Protocols for Adult Populations: McGraw Hill Professional; 2009.
- Palma E, Antonaci D, Coli A, Cicolini G. Analysis of emergency medical services triage and dispatch errors by registered nurses in Italy. *J Emerg Nurs*. 2014;**40**(5):476-83.
- Andersson L, Sundin E. Mobile bystanders and rubbernecks, disaster tourists, and helpers. Towards a theoretical framework for critically studying action possibilities at accident sites. *Mobile Media & Communication*. 2021;**9**(3):531-45.
- Khorasani-Zavareh D, Khankeh HR, Mohammadi R, Laflamme L, Bikmoradi A, Haglund BJ. Post-crash management of road traffic injury victims in Iran. Stakeholders' views on current barriers and potential facilitators. *BMC Emerg Med*. 2009;**9**:8.
- Duong HV, Herrera LN, Moore JX, Donnelly J, Jacobson KE, Carlson JN, et al. National Characteristics of Emergency Medical Services Responses for Older Adults in the United States. *Prehosp Emerg Care*. 2018;**22**(1):7-14.
- Raymond A, Bazeer N, Barclay C, Krelle H, Idriss O, Tallack C, et al. Our ageing population: how ageing affects health and care need in England. 2021.
- Hjälte L, Suserud BO, Herlitz J, Karlberg I. Why are people without medical needs transported by ambulance? A study of indications for pre-hospital care. *Eur J Emerg*

- Med.* 2007;**14**(3):151-6.
26. Hoikka M, Silfvast T, Alakokko TI. A high proportion of prehospital emergency patients are not transported by ambulance: a retrospective cohort study in Northern Finland. *Acta Anaesthesiol Scand.* 2017;**61**(5):549-56.
27. Crane M, Cetrano G, Joly L, Coward S, Daly B, Ford C, et al. Mapping of specialist primary health care services in England for people who are homeless. *Social care workforce research unit London: King's College London.* 2018.
28. Åsa W. Exploring collaboration between the fire and rescue service and new actors: cost-efficiency and adaptation: Linköping University Electronic Press; 2015.
29. Dussault G, Franceschini MC. Not enough there, too many here: understanding geographical imbalances in the distribution of the health workforce. *Hum Resour Health.* 2006;**4**:12.
30. Lopes MA, Almeida Á S, Almada-Lobo B. Handling healthcare workforce planning with care: where do we stand? *Hum Resour Health.* 2015;**13**:38.

Open Access License

All articles published by Bulletin of Emergency And Trauma are fully open access: immediately freely available to read, download and share. Bulletin of Emergency And Trauma articles are published under a Creative Commons license (CC-BY-NC).