

Public health perspective on quality of emergency medical services in Riyadh Province of Saudi Arabia

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median OST for women was 22 minutes (interquartile range [IQR] 15 – 30) and 18 minutes (IQR 11 – 26) for men, $p < 0.001$; for medical cases, median OST was 23 minutes (IQR 16 – 31) for women compared to 20 minutes (IQR 13 – 29) for men, $p < 0.001$; for trauma cases, median OST of both sexes were 16 minutes. In addition, we found the following additional predictors of OST: Factors of emergency type, sex, age category, geographical locations, types of vehicles, and hospital type were all significantly associated with OST in the crude or adjusted analyses. Factors of emergency type, sex, age category, geographical locations, types of vehicles, and hospital type were also significantly associated with the odds of OST of more than 15-minutes in the crude and adjusted regression analyses. We concluded that the median of OST was longer than 15 minutes for more than half of transported cases. For medical cases, women had a longer median OST than men. Additional predictors associated with prolonged OST were the patient's age, location (i.e., urban vs. rural), type of ambulance vehicle, and season.

In chapter 5, we investigated the association between demographic and operational factors and EMS missions ending in non-conveyance (NC) due to patient-initiated refusal (PIR). Using the Riyadh province EMS information system, we conducted a retrospective population-based registry study and analyzed 67,620 EMS missions dispatched to the scene during 2018 in the Riyadh province. Numbers and percentages of conveyances statuses were calculated. Using crude and adjusted linear and logistic regression analysis, we determined what characteristics were predictors of NC due to PIR. We found the following: Of 67,620 missions, 23,991 (34.4%) ended in NC due to PIR, and 5,969 ended in EMS-initiated refusal (8.6%). We found that NC rates due to PIR were higher for women, adults, for missions in Riyadh city, during nighttime, for medical emergencies, and for ALS crews. We found the following additional predictors significantly associated with the odds of NC due to PIR in the crude regression analyses: age category, geographical location, EMS-shift, time of call, emergency type, and response time. We concluded that the NC rate represents half of all missions for patients requesting EMS. Most NC due to PIR occurred for the highest urgency level of medical emergency types in Riyadh city during the nighttime with ALS crews. NC due to PIR involved male more than female patients, adult patients more than elderly and children, and Riyadh city more than other areas. However, relatively (percentagewise), EMS missions for the gender category of female patients, the age category of elderly, and the geography of small cities were predominant to end up with conveyance status. Most NC due to PIR occurred during the daytime shift, and also more occurred during rest time compared to office time. Medical emergencies had the highest NC due to PIR. The rate of NC due to PIR has increased in Riyadh capital city compared to previous studies. Our findings have provided empirical evidence that might indicate that conducting further studies involving EMS providers, patients, and the public to identify precise, detailed reasons is required.

This chapter deals with the social value of our findings and contributes to the political and social discussion on the quality of emergency medical services in Saudi Arabia. Recently, the Saudi government launched a grand vision to be achieved by 2030. The Saudi Red Crescent Authority (SRCA) works towards achieving its part of the government vision. One of the aims declared for health services in the 2030 vision is to improve access to health services through optimal coverage and a comprehensive and equitable geographical distribution, expand the provision of e-health services and digital solutions, and improve the quality of health services.

Emergency medical services (EMS) is an essential component of any health system in the world. The WHO deems a solid EMS system as part of the health system of any nation, and should be able to respond to different kinds of emergencies within a specific target of time. Evidence has shown that early responding to life-threatening emergencies would improve patient's outcomes on average. Although there is a lot of heterogeneity in EMS systems across the world, exemplified above all by the different models of EMS that are implemented, all EMS policymakers agree to provide EMS for patients to match their expectation of obtaining ambulance care within the shortest possible time when they were exposed to life-threatening emergencies. The findings of this dissertation contribute to the additional development of the quality of EMS and could have profound implications for the national Saudi health system and support decisions for the policymakers in Saudi Arabia toward rapid progress in targeting the future governmental and widespread vision of Saudi Arabia. I feel that our findings have implications for patients, call-takers, dispatchers, emergency providers at the scene, policymakers, researchers, and public health and EMS academies.

Target groups

For Policymakers

Our findings on response time for high-urgent emergencies involved different types of severe emergencies, including OHCA patients, indicate the necessity of the public people to be involved before the arrival of EMS crews to patients' locations. Evidence showed that the Saudi lay people are rarely involved in providing cardiopulmonary resuscitation (CPR). Saudi Public health agencies and SRCA could coordinate efforts by applying comprehensive national educational programs motivating the public to be the first bystanders and increase their knowledge and skills of CPR and using external defibrillators before EMS arrival at the scene. Also, EMS policymakers may need to pay attention to different aspects related to process measures that might threaten the sustainability of their EMS system if kept without intervention. Responding to non-emergency cases while the alternative means are available can be considered as misusing EMS. The findings of this dissertation

are highly relevant for them, as it demonstrated that a high proportion of EMS missions were dispatched for non-emergency cases while EMS response-time, on-scene-time, and total EMS time for a quarter of the patients who requested EMS are more than Saudi EMS benchmarks of time. For the non-emergency patients, this means they either did not have alternative means of transportation or did not understand the general goals of EMS. Reorganizing Saudi EMS by finding alternative means to transport, or alternative means to receive nonemergency medical treatment might support policymakers to reduce the pressure on the EMS system and make EMS crew more available for real emergencies. Reorganizing would improve the response time and consequent total EMS time.

Evidence showed that the Saudi public is unaware of the goals of the Saudi EMS system. Many persons use private transportation during life-threatening emergencies like OHCA or ACS. Some seem unaware of the EMS telephone number; others believe all-male EMS providers for females is not socially acceptable. This dissertation revealed that patients refuse ambulance transportation even when exposed to severe emergencies, while others have been transported to hospitals EDs when they call EMS for non-emergency reasons. Good information campaigns for the community will help for better education and understanding of the proper use of EMS service. It seems imperative for Saudi EMS policymakers to consider this kind of approach because patients still need to understand that EMS is still the best option to call during severe emergencies.

Similarly, these approaches benefit non-emergency patients because they still need to understand that calling EMS while available general practices is still easily accessible would make call-takers busy. Other actual emergency patients might be affected by not getting access to prehospital EMS. This dissertation would support policymakers for conducting different campaigns on a community-based approach before organizing responses for non-emergencies. They could use findings in this dissertation as evidence for seeking other health sectors to cooperate with them in finding alternative means for accessing health services for non-emergency patients. The findings of this dissertation showed that EMS providers are still reluctant to refuse to transport non-emergency patients and are still within the lower range compared to other developed EMS agencies globally. Policymakers could use it as proof that training EMS providers on using non-conveyance protocols will increase their compliance and empower their confidence. Increasing ALS coverage could also improve this norm and reduce the burden on hospitals EDs. Training call-takers and dispatchers on applying a scientific triage system would make them confident to determine real emergencies appropriately.

Findings of this dissertation showed that response time for trauma emergencies in rural areas needs to improve considerably as current findings indicate that patients could have consequences of mortality and morbidity when response time remains without

improvements. EMS policymakers could induce EMS managers in rural areas to provide community education and motivate patients to call emergency numbers. They also should give people in rural areas insight into possible consequences of visiting the EMS ambulance-ground stations instead of calling the emergency number. EMS stations should then be reformed so that visiting the station will not interfere with responding to urgent calls. The personnel should be available for that purpose always.

For EMS academy

EMS academies in Saudi Arabia could focus more on problem-based learning through extensive training for EMS students on efficiently utilizing the allowable time for treating patients at the scene. Findings of this dissertation revealed that on-scene time for females was longer than for males. It also can draw the attention of females' patients and guardians to cooperate further to ease access to females' patients as this measure would reduce the time consumed and reflected by reducing total EMS time. Findings could support Saudi families to encourage their young daughters to study EMS. EMS academies should set universal programs to involve female students in providing EMS to improve conveyance rate among women. Involve of females' paramedics in providing EMS will improve the domain of females' patients-centeredness and increase privacy and confidentiality exchange between female providers and female patients.

Research relevance and contribution to science

The studies of this dissertation have been published in open-access journals, making them accessible by any researcher. In addition, all findings of the four studies have been presented at international conferences in Europe. We still have a plan for future presentation of the findings, especially in Saudi Arabia. Findings of this dissertation also indicate that more studies of sufficient quality about all six quality domains in EMS are needed. Future studies examining EMS performance in rural areas are still needed to yield evidence on how to improve response time for trauma emergencies. Future studies involving patients and the public to determine causes of non-conveyance due to patients' refusals could be key. Limitations of this dissertation are related to random missed data and lacking other important demographic attributes in the EMS registry could encourage policymakers to impose registry reforms and continuously evaluate data entry and add several variables, so that continuous quality assessment and improvement may be possible. Furthermore, determining outcomes for patients after their EMS mission was not possible because of the fact that the EMS registry was not linked to hospital's EDs. Hence, our finding may draw their attention for future linkage to improve the continuous