

The Impact of Ambulance Disinfection Methodology on 112 Emergency Health Care Parameters, During the COVID-19 Pandemic in İstanbul

Yılmaz Aydın¹, Verda Tunalıgil¹, Şakir Ömür Hıncal¹, İsmail Ödemiş², Gökhan Eyüpoğlu³, Kenan Ahmet Türkdoğan³

¹Republic of TR MoH, Health Directorate of İstanbul, Presidency of Emergency Medical Services, İstanbul, Turkey

²TR MoH Büyükçekmece Mimar Sinan State Hospital, Clinic of Emergency Medicine, İstanbul, Turkey

³TR MoH University of Health Sciences Turkey, Başakşehir Çam and Sakura City Hospital, Clinic of Emergency Medicine, İstanbul, Turkey

Abstract

Objective: This study aims to analyze the effects of the coronavirus disease-2019 (COVID-19) pandemic on the preparation process of the first responder teams in emergency medical services. Ambulance station response times, command and control centers' response times, and case response times are reported and compared with current literature. Research findings elaborate on how the procedures for corrective actions in the disinfection process affected these main parameters in a 24-hour period in prehospital care.

Materials and Methods: The comparison was made for ambulance times, after the transportation of COVID-19 cases, between the March 2020 period when the ambulances were disinfected in five centers in the hospital yards and the April 2020 period when the disinfection devices were placed in all ambulances.

Results: The total number of cases per ambulance per day was 10.1 (8.5-11.6) in the March group and 10.8 (8.8-13.2) in the April group ($p < 0.001$). While the number of COVID-19 cases per ambulance per day was 1.7 (1.3-2.1) in the March group, it was 3.2 (2.4-4.1) in the April group. While the ambulance disinfection time per COVID-19 case was 51.9 (27.7-73.0) minutes in the March group, it was 11.0 (6.0-24.1) minutes in the April period ($p < 0.001$).

Conclusion: During the pandemic process, ambulance disinfection and wearing personal protective clothing-prolonged preparation times. In March 2020, ambulances had to travel to common sites for cleaning and disinfection. Changing this procedure to self-cleaning at the ambulances' own station locations in April 2020, decreased both the ambulance disinfection time and the ambulance response time, in spite of the increase in the number of COVID-19 cases.

Keywords: 112 emergency call center, ambulance response time, prehospital transport, infection control, pandemic, communicable disease, outbreak

Introduction

Urban growth, with the rise in urbanization and population explosion, poses challenges globally. Estimates indicate that, by 2050, 6.29 billion people will populate urban areas, which is approximately 68% of the world population [1,2]. An increasing proportion of people living in large cities. Consistently, increasing numbers of heart attacks, drownings, traffic accidents, and other serious events occurring with firearms are consistently observed ubiquitously. The process of urbanization promotes and infects disaster risks. Higher levels of susceptibility and vulnerability are encountered to the social, economic, environmental

impacts of hazards, such as landslides, floods, earthquakes [3]. Urban development proportionally reflects on health care costs worldwide. Health care spending reached an estimate of 17.6% in 2010, with emergencies constituting 5%-10% of health expenditures [4,5]. Shifting rural populations to urban areas have to inevitably rely on existing reserves and resources are scarce. The demand for transport causes serious congestions, delays, accidents, environmental problems in metropolitan areas around the world [6], which places a significant burden on ambulance services. Ambulance response time (ART) is overall the main indicator. ART defines the period between the



Address for Correspondence: Yılmaz Aydın MD, Republic of Turkey Ministry of Health (TR MoH), Health Directorate of İstanbul, Presidency of Emergency Medical Services (EMS), İstanbul, Turkey

Phone: +90 535 664 82 44 **E-mail:** yilmaz.aydin@saglik.gov.tr **ORCID-ID:** orcid.org/0000-0001-9828-8740

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notification of the event and the arrival of the ambulance at the scene. According to the World Health Organization, ART is ideally under 8 minutes [7]. Regarding the definition of ART, Lawner et al. [8] draw attention to secondary results which include changes in other metrics, such as the average ART range and the overall out-of-service interval. The ART range is the time that passes between the referral of the ambulance to arrival at the scene. The out-of-service interval is the amount of time that an ambulance is not available to respond to other incidents.

Protecting people and societies in an era where lives are profoundly changed, presents new issues to health care providers, as pandemics continue to threaten lives and economies [9]. It is widely accepted that the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) was first identified in China in December 2019 [10,11]. In Turkey, the first patient with coronavirus disease-2019 (COVID-19) was documented on March 11, 2020. Following the index case, the number of cases increased from 15,679 on April 1st to 120,204 on April 30th [12]. By June 28, 2020, the total number of cases in Turkey reached 198,284, of which 108,749 were documented in İstanbul [13]. Disinfection units were created for the teams in March 2020 and disinfection devices were purchased, in order to avoid delays due to the prehospital disinfection protocols. Disinfection devices distributed for the teams to conduct their own disinfection procedures are among examples of good practice. For ambulances, high pressure washers were provided at the 112 transportation units.

The aim of the study is to analyze and compare with current literature, how the COVID-19 pandemic affected the preparation process of emergency medical services (EMS) responders' in prehospital care. Ambulance station response times, command and control center's (CCC) response times, and ARTs are reported. Researchers share their experiences with the international scientific community, regarding how the disinfection process and the period of preparation for cases affected outcomes and propose solutions from recent practices.

Materials and Methods

In the metropolitan city of İstanbul, incoming calls at the Anatolian and the European 112 Emergency Ambulance Services' call centers were analyzed retrospectively, for the period of March 11-May 1, 2020. CCC response times, ambulance response times, the number of cases per ambulance, and ambulance disinfection times were recorded. In the March 2020 group, ambulances were disinfected in five centers after the transfer and transport of suspected or probable COVID-19 cases. In the April 2020 group, disinfection devices were placed in all ambulances and disinfection procedures were performed

in the hospital yards, immediately following the transfer and transport of COVID-19 cases. The study design is based on a comparison of the two groups.

Ethics Committee Approval

The Clinical Research Ethics Committee of the Republic of Turkey Ministry of Health (TR MoH) University of Health Sciences Turkey, Bağcılar Research and Training Hospital approved the research application, dated May 7, 2020 with document #2020.05.1.23.055. Written informed consents were obtained from the COVID-19 Coordination Center of İstanbul.

Statistical Analysis

Categorical data were recorded and measured as numbers and percents, while continuous measurements were the recorded as average and standard deviation. Normality distribution of the continuous variables was analyzed with Kolmogorov-Smirnov test. For comparing the two groups, Student's t-test was used for normally distributed parameters, while the Mann-Whitney U test was used for parameters which were not normally distributed. Chi-square test was used in the analysis of the categorical variables. A $p < 0.05$ value was considered statistically significant.

Results

At the time of study, a total of 3,432 employees worked at 112 İstanbul Emergency Ambulance Services. There were 286 stations in total in the 39 districts of İstanbul.

Before dispatch for cases evaluated by the CCC as suspected or probable COVID-19 patients, each one of the 3,432 ambulance personnel wore protective overalls, goggles, gloves, N95 masks, in compliance with the algorithms released by the TR MoH Coronavirus Scientific Advisory Board.

Table 1 compares of 112 ambulance times for March and April 2020, shows the distribution median, range values, and significance-level p values. The differences were found to be statistically significant for all values of between the March and April groups. While hospital delivery time increased in the April group, the other parameters were found to decrease. Additionally, CCC response time, station response time, ART, prehospital on-scene intervention time, and hospital delivery time median values were calculated as 7.11 (4.11-14.11), 1.65 (0.93-2.95), 10.23 (7.00-16.26), 12.15 (7.98-18.55) and 15.33 (10.00-25.00) minutes, respectively.

In terms of working times, CCC response and station response times were statistically significantly lower, and hospital delivery and intervention times were higher in women. While 112 Emergency Ambulance Services ambulances were cleaned in five centers in March 2020, three on the European and two on the Anatolian sides (Figures 1A, B). In compliance with the TR MoH Coronavirus Scientific Advisory Board algorithms, each

ambulance performed their own cleaning procedures in April 2020 (Figures 2A, B).

Table 2 shows the number of cases per ambulance per day, disinfection time in minutes per ambulance, a number of

COVID-19 cases per ambulance per day, disinfection time in minutes per COVID-19 case. The number of cases and disinfection times in minutes per ambulance were recorded for March and April 2020 groups, in terms of median, range, and p values.

Table 1. The comparison of 112 ambulance times for March and April 2020 (median, range, p values)

Ambulance times (minutes)	March 2020 group	April 2020 group	p value
	Median (range)	Median (range)	
Command response time	8.56 (5.00-19.83)	6.88 (4.01-13.48)	<0.001
Station response time	1.76 (0.96-3.91)	1.65 (0.91-2.86)	<0.001
Time from call to arrival at the scene	24.68 (17.25-40.00)	18.98 (12.71-30.00)	<0.001
Ambulance response time	13.26 (8.71-20.33)	9.96 (6.81-15.47)	<0.001
On-scene intervention time	14.00 (9.00-21.48)	12.00 (7.76-18.00)	<0.001
Hospital delivery time	13.86 (9.00-20.90)	16.00 (10.00-26.00)	<0.001
Busy time	107.50 (77.00-140.00)	69.20 (51.00-97.68)	<0.001



Figure 1. A, B) Photograph showing collective disinfection at a common spot in March 2020



Figure 2. A, B) Photograph showing the disinfection of each ambulance in the hospital yard after each case is taken to the hospital

Table 2. Number of cases and disinfection times in minutes per ambulance, March and April 2020 (median, range, p values)

	March 2020 group	April 2020 group	p value
	Median (range)	Median (range)	
Number of cases/ambulance/day	10.1 (8.5-11.6)	10.8 (8.8-13.2)	<0.001
Disinfection time in minutes/ambulance	8.6 (4.3-12.3)	3.3 (1.7-7.6)	<0.001
Number of COVID-19 cases/ambulance/day	1.7 (1.3-2.1)	3.2 (2.4-4.1)	<0.001
Disinfection time in minutes/COVID-19 case	51.9 (27.7-73.0)	11.0 (6.0-24.1)	<0.001

COVID-19: Coronavirus disease-2019

Table 3. Ambulance times for March and April 2020, in minutes (median, range, p values)

Ambulance times (minutes)	March 2020 group	April 2020 group	p value
	Median (range)	Median (range)	
Time at the hospital	75.9 (58.3-115.7)	102.3 (71.4-171.4)	<0.001
Disinfection time	81.4 (38.1-117.2)	36.1 (18.8-74.0)	<0.001
Total time with the case	134.9 (118.2-152.7)	115.1 (98.6-132.3)	<0.001
Ambulance maintenance time, for breakdowns, repairs, other needs	271.7 (180.7-348.4)	324.9 (279.3-398.5)	<0.001
Case intervention patient time	245.1 (184.6-331.3)	328.0 (247.4-411.2)	<0.001

Table 3 shows ambulance times in minutes for March and April 2020, in terms of median, range, and p values. Waiting time at the station, time at the hospital, disinfection time, total time with the case, round trip transportation time, ambulance maintenance time for breakdowns, repairs, and other needs, case intervention patient time were recorded.

Discussion

This research, conducted in the metropolitan city of İstanbul, is one of the first studies to analyze a 24 h time period in prehospital care and to share case data from 112 Emergency Ambulance Services at the onset of the COVID-19 pandemic. At times, disasters and local events in the community make it necessary to modify the routines, in order to keep up with changing needs and conditions. In March 2020, ambulances were cleaned at five common locations. In April 2020, with guidance from the TR MoH Coronavirus Scientific Advisory Board and the CCCs of İstanbul, each ambulance was cleaned at their station locations in April 2020. Despite the fact that the total number of cases increased, ambulance disinfection time and ART both decreased in April (Tables 1-3). This positive outcome was attributed to disinfection devices which were purchased for the teams, in order to avoid the delays from the disinfection procedures. Teams conducting their own disinfection operations are hereby shared as good practice in ambulance service communicable disease prevention. Worthy of notice is that high pressure washers were provided for ambulances at the 112 transportation units.

The average ART recorded in Vienna, Austria in 2015 was 15 minutes, this value varied with traffic intensity and weather

events that impacted the roads at different locations. In Belo Horizonte, Brazil, the average ART was approximately 21 minutes in 2010 [14]. In the city of São Paulo, Brazil, ART in EMS was 27 minutes in 2007 [15]. Takeda et al. [16] discussed EMS act in the United States, which determined the standards that 95% of the emergency requests should be served within 10 minutes in urban areas and within 30 minutes in rural areas. There are similar regulations in other parts of the world. The regulation in Montreal, Canada states that 95% of the requests should be answered within 10 minutes in urban areas and within 14 minutes in rural areas. In London, United Kingdom, the standard is set for 70% of the requests to be responded to within 7 minutes, and for 50% in 8 minutes [8,17,18]. The average ART is shorter in Asia (7.3 minutes), followed by Oceania (8.0 minutes), where Australia is the only country to report EMS response times, from the city of Melbourne. Only Ghana in West Africa, where the average ART is 19 minutes in the cities of Kumasi, Accra and Tamale, is the only country to report EMS response times. America has a median response time of 9 minutes; in Europe, this value is 11 minutes [3,19]. The median ART was measured as 10.23 minutes during the timeframe of the current COVID-19 research. There was a significant decrease in ART from 13.26 (8.71-20.33) in March 2020 to 9.96 (6.81-15.47) in April 2020 (Table 1). Improvements, in the practice of the disinfection process, in April shortened ART. Compared to March 2020, ambulances no longer had to travel from their stations to different sites for clean-up. As a result, they were able to reach the cases faster in April 2020. The ART value in April 2020 was close to those recorded before the occurrence of COVID-19. The first responder teams' preparation incorporates wearing personal protective clothing,

such as medical masks, overalls, goggles or face protectors, in addition to preparing for patient transfer with the necessary equipment and supplies. Considering that this preparation is also included in ART, this is remarkable performance.

In March 2020, five ambulance disinfection sites were established, in the hospital yards close to CCCs. With guidance from TR MoH Coronavirus Scientific Advisory Board and the CCCs of İstanbul in April 2020, the method of cleaning was changed to cleaning and disinfection procedures to be carried out with devices, for ambulances to use at their own station locations. Although the median number of cases per ambulance increased to 10.8 (8.8-13.2) from 10.1 (8.5-11.6) and the number of COVID-19 cases per ambulance increased to 3.2 (2.4-4.1) from 1.7 (1.3-2.1) from March to April, both disinfection time per ambulance and disinfection time per COVID-19 case decreased significantly (Table 2). This was reflected in the measurements as a reduction in ART. The mileage, time spent, and fuel used in liters spent by the ambulances while going to and coming back from the cleaning centers in March were found to decrease in April.

Going to cases outside of the routine, especially going to cases that require preparation before patient transfer, such as the COVID-19 cases, leads to prolonged intervention time in the assessment of the case. Factors associated with a probable or a suspected COVID-19 case, including comorbidities, prolong intervention time and require choosing an adequate hospital for the patient. However, with the implementation of TR MoH Coronavirus Scientific Advisory Board algorithms and with the guidance of the CCCs of İstanbul, starting from the first day of the pandemic, even though the number of cases increased, patient intervention time decreased significantly from 14.00 (9.00-21.48) in March 2020 to 12.00 (7.76-18.00) in April 2020. The increase in delivery time from 13.86 (9.00-20.90) in March 2020 to 16.00 (10.00-26.00) in April 2020 results from the fact that the patients were not admitted to emergency rooms at hospital arrival, but to the inpatient services directly (Table 1).

In the intensity of the pandemic, an incoming call regarding a new case while the ambulance is at a case or is delivering a case to the hospital, is a factor that contributes to the increase in ART measurement. Contrariwise, a factor that contributes to the decrease in ART in April was the fact that the CCCs of İstanbul determined the hospitals locally according to the features of the COVID-19 cases. As a result, the time spent in cases decreased significantly from 134.9 (118.2-152.7) minutes in March 2020 to 115.1 (98.6-132.3) minutes in April 2020 (Table 3). At 112 İstanbul Emergency Ambulance Services, this shortened the time spent with the cases. Ambulances were ready for new cases earlier than before, resulting in a decrease in ART.

Conclusion

In EMS health care provision, challenges occur every day due to local and environmental factors. In regular times, heavy traffic in urban areas and land conditions in rural areas cause problems. During the pandemic period, preparations, which including wearing personal protective clothing, cleaning up and disinfecting the ambulances, and preparing for patient transfer with the necessary equipment and supplies, prolong response times. A change from common cleaning sites in March 2020 to cleaning and disinfecting the ambulances at their own station locations in April 2020 led to noticeable decreases in both ambulance disinfection time and ART, in spite of the fact that the number of cases increased in the same time period. Both CCCs of İstanbul guiding 112 Emergency Ambulance Services based on both cases and hospitals and the Science Board guiding this center caused a decrease in ART despite an increase in cases. This performance was accomplished through guidance from TR MoH Coronavirus Scientific Advisory Board, supervision and case-based evaluations from the CCCs of İstanbul, including the selecting adequate hospitals for patient transfer.

The COVID-19 pandemic presents global issues for 112 İstanbul Emergency Ambulance Services personnel and their colleagues that creating adaptive strategies in a complex, changing world is critical for health care provision.

Ethics

Ethics Committee Approval: The Clinical Research Ethics Committee at the Republic of Turkey Ministry of Health (TR MoH) University of Health Sciences Turkey, Bağcılar Research and Training Hospital approved the research application (approval number: #2020.05.1.23.055., date: 07.05.2020).

Informed Consent: Written informed consents were obtained from the COVID-19 Coordination Center of İstanbul.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: Y.A., V.T., Ş.Ö.H., İ.Ö., G.E., Design: Y.A., G.E., V.T., Data Collection or Processing: Y.A., Ş.Ö.H., Analysis or Interpretation: Y.A., İ.Ö., G.E., Literature Search: Y.A., G.E., Writing: Y.A., G.E.

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